

PC50 Series Pattern Controllers

PC54 and PC55

Part 107 126B



NORDSON CORPORATION • AMHERST, OHIO • USA

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Section 1

Safety

Section 1

Safety

1. Operate Safely

Section 1 of Nordson's applicator product manuals provides safety guidelines for use of Nordson equipment. The applicator safety guidelines apply to all operators and service personnel working with PC50 Series controllers.

Safety instructions contained in this section and throughout this document apply to tasks that may be performed with or on the applicator unit and with or on associated adhesive application equipment, including the PC50 Series controller. Warnings related to specific safety concerns are included within the text as appropriate. It is very important that these safety instructions are always followed. Failure to do so could result in personal injury and/or damage to the PC50 Series controller, the applicator or other equipment.

With this in mind, here are some basic safety recommendations:

- Read and become familiar with this *Safety* section prior to installing, operating, maintaining, or repairing the unit.
- Read and follow the warnings which appear within the text and are related to specific tasks.
- Store this document within easy reach of personnel operating or maintaining the unit.
- Wear personal protective equipment and clothing such as safety goggles and gloves.
- Familiarize yourself with and follow all safety instructions prescribed by your company, general accident-prevention regulations, and government safety regulations.

2. Safety Symbols

The following symbols are used to warn against dangers or possible sources of danger. Become familiar with them! Failure to heed a warning could lead to personal injury and/or damage to the unit or other equipment.



WARNING: Failure to observe may result in personal injury, death, or equipment damage.



WARNING: Risk of electrical shock. Failure to observe may result in personal injury, death, or equipment damage.



WARNING: Disconnect equipment from the line voltage.



WARNING: Hot! Risk of burns. Wear heat-protective clothing, safety goggles, and/or heat-protective gloves depending on the symbols shown.



WARNING: Risk of explosion or fire. Fire, open flames, and smoking prohibited.



WARNING: System or material pressurized. Relieve pressure. Failure to observe may result in serious burns.



CAUTION: Failure to observe may result in equipment damage.



CAUTION: Hot surface. Failure to observe may result in burns.

3. Qualified Personnel

“Qualified personnel” is defined here as individuals who thoroughly understand the equipment and its safe operation, maintenance, and repair. Qualified personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations, and have been trained to safely install, operate, maintain, and/or repair the equipment. It is the responsibility of the company operating the equipment to see that its personnel meet these requirements.

4. Intended Use

The unit is designed and intended to be used only for the purpose described in the *Description* section. Uses not in accordance with that section or as described in this document are considered unintended uses and not in accordance with governing regulations.



WARNING: Use of this equipment in ways other than described in this document may result in personal injury, death, or equipment damage.

The following actions of the owner or operator of the unit are some, but not all, examples of unintended use which would permit Nordson to claim it is not responsible for personal injury or property damage arising from such unintended use:

- Unapproved modifications or changes to the unit
- Failure to comply with the safety instructions
- Failure to comply with instructions concerning installation, use, operation, maintenance, or repair, or when these tasks are carried out by unqualified personnel
- Use of inappropriate or incompatible foreign materials or auxiliary equipment
- Failure to observe workplace safety rules or regulations issued by government authorities or safety councils

5. Installation and Electrical Connections



WARNING: Failure to follow the safety procedures can result in injury or death.

- All electrical, pneumatic, gas, and hydraulic connections and installations of hot melt equipment may only be carried out by qualified personnel. Be sure to observe installation instructions for components and accessories.
- Equipment must be properly grounded and fused according to its rated current consumption (see ID plate).
- Cables which run outside the unit must regularly be checked for wear or damage.
- Power supply wire gauge and insulation must be sufficient to handle rated current consumption.
- Cables must never be squeezed or pinched. Do not locate cables or hoses in high traffic areas.

6. Operation

The unit should be operated by qualified personnel in accordance with the instructions presented in this document.



WARNING: Failure to follow the safety procedures can result in injury or death.

- Never allow the unit to be operated by personnel under the influence of substances which reduce their reaction times, or who are not able to operate the equipment for physical reasons.
- Prior to each start-up of the unit, check protection and warning devices and make sure they are fully functional. Do not operate the unit if these devices are not functioning properly.
- When the removal of safety equipment is required for installation, maintenance, or repair of the unit, it must be re-connected immediately upon completion of the work.
- Prior to start-up of the unit, check to make sure all safety guards and safety equipment are in place and functioning properly.

6. Operation (contd.)

- In a humid environment, only equipment featuring a corresponding class of protection may be operated.
- Do not operate the unit in an explosive environment.
- Keep parts of the body or clothing away from rotating parts. Do not wear loose articles of clothing when operating or servicing units with rotating parts. Take off wrist watches, rings, necklaces, or similar pieces of jewelry and pin up or cover long hair before performing any work on or with the unit.
- To carry out measurements on work pieces, switch off the unit and wait until it comes to a standstill.
- Never point hand guns or applicator nozzles at yourself or other persons.

Less-obvious Dangers



WARNING: An operator or service technician working with the unit should be aware of less-obvious dangers that often cannot be completely minimized at production sites:

- Exposed surfaces of the unit which cannot be practically safeguarded. They may be hot and take time to cool after the unit has been operating.
- The possibility that electrical potentials may remain in the unit after the unit was de-energized
- Hot melt material and vapors
- Hydraulically or pneumatically operated parts of the unit
- Parts winding something up or down which are not covered

Action in the Event of Unit Malfunction

If the unit malfunctions, switch it off immediately.

- Turn the circuit breaker or main power switch OFF.
- Have the unit repaired by qualified personnel only.

Danger of Burns

Contact with hot melt materials or hot areas of the unit may produce a severe skin burn.



WARNING: Hot! Risk of burns. Wear heat-protective clothing, safety goggles, and/or heat-protective gloves depending on the symbols shown.



- Be extremely careful when using hot melt material. Even solidified material may still be very hot.
- Always wear protective clothing which safely covers all exposed parts of the body.

In case of burns:

- Immediately cool affected skin areas using cold, clean water.
- Do not forcefully remove hot melt material from the skin.
- Immediately seek medical attention.

7. Maintenance/Repair

Allow only qualified personnel to perform the procedures described in this document. When performing such tasks, wear protective clothing, and equipment.



WARNING: Even when the circuit breaker or main power switch is OFF, the unit is still electrically energized. Complete the following steps prior to maintenance or repair:

- Disconnect, lock out, and tag external power supply.
- To ensure the external power supply is disconnected, attempt to operate the unit. If the unit does not energize, proceed with maintenance or repair work.
- If the unit energizes, repeat the disconnect, lock out, and tag procedure. Re-test the unit.

7. Maintenance/Repair

(contd.)

- Follow the specific instructions provided in this manual to relieve the system pressure in the entire unit.
- Secure pneumatically- or hydraulically-operated equipment against uncontrolled movement.
- Only use parts which do not compromise the safety of the unit. Only use genuine Nordson parts.
- Always use tools with insulated handles when removing or installing components.

8. Cleaning

NOTE: Always refer to the material manufacturer's Material Safety Data Sheet (MSDS) or material information sheet before working with any material.



WARNING: Never clean any aluminum part or flush any system using halogenated hydrocarbon fluids. Examples of common halogenated hydrocarbons are: dichloromethylene, 1,1,1-trichloroethylene, and perchloroethylene. Halogenated hydrocarbons may react violently with aluminum parts.



WARNING: Fire, open flame, and smoking are prohibited when cleaning fluids are used. Observe all explosion prevention regulations. Cleaning fluids may only be heated using temperature-controlled and explosion-protected heaters.

- Never use an open flame to clean the unit or components of the unit.
- Use only cleaning fluids designed or intended to be used with the hot melt material being used in the unit. Never use paint fluids under any circumstances.
- Note the flash point of the cleaning fluid used. Only use a controlled heating method to heat fluids.
- Ensure sufficient room ventilation to draw off generated vapors. Avoid prolonged breathing of vapors.

9. Thermoplastic Hot Melt Material

NOTE: Always refer to the material manufacturer's Material Safety Data Sheet (MSDS) or material information sheet before working with any hot melt material.

- Ensure the work area is adequately ventilated.
- Do not exceed recommended processing temperatures. Doing so creates a danger to personnel due to decomposition of the material.

10. Equipment and Material Disposal

Dispose of equipment and materials used in operation and cleaning according to local regulations.

Section 2

Description

Section 2 Description

1. Introduction

This section contains a description of controller capabilities that must be understood before programming.

NOTE: Output Groups and Operating Modes, Offset, and Gun Compensation are discussed in this section to allow operators to determine controller set up and programming that is best suited for their application. These topics should be thoroughly read and completely understood prior to any programming attempts.

PC50 controllers use a resolver (Figure 2-1) to indicate machine position. Resolvers use fixed and rotating wire coils to generate an electronic signal that represents shaft position. The resolver is usually coupled to a machine shaft at a 1:1 ratio so that one resolver shaft rotation corresponds to one machine cycle. Resolvers have no brushes, contacts, or any frictional moving parts to wear out.

Based on the resolver signal, PC50 Series Pattern Controllers turn electrical circuits, or "outputs," on and off.

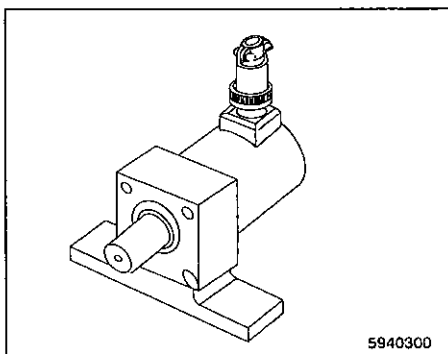


Fig. 2-1 Resolver

Because the combination PC50 Series Pattern Controllers/resolver system is completely electronic and has no frictional parts, it offers several advantages:

- Long service life with no parts to wear out
- "On" and "off" points can be adjusted instantly from the keypad
- Adjustment is possible with the machine running or stopped
- Programmable logic allows complex switching functions that are impossible with typical pattern controllers
- Operation at speeds up to 3000 RPM

2. PC50 Series Pattern Controller Components

Controller and Keypad

PC50 Series controllers consist of two main components, the controller and the keypad/display, both housed within a cabinet. The controller contains the microprocessor, associated circuitry, and all of the I/O circuits.

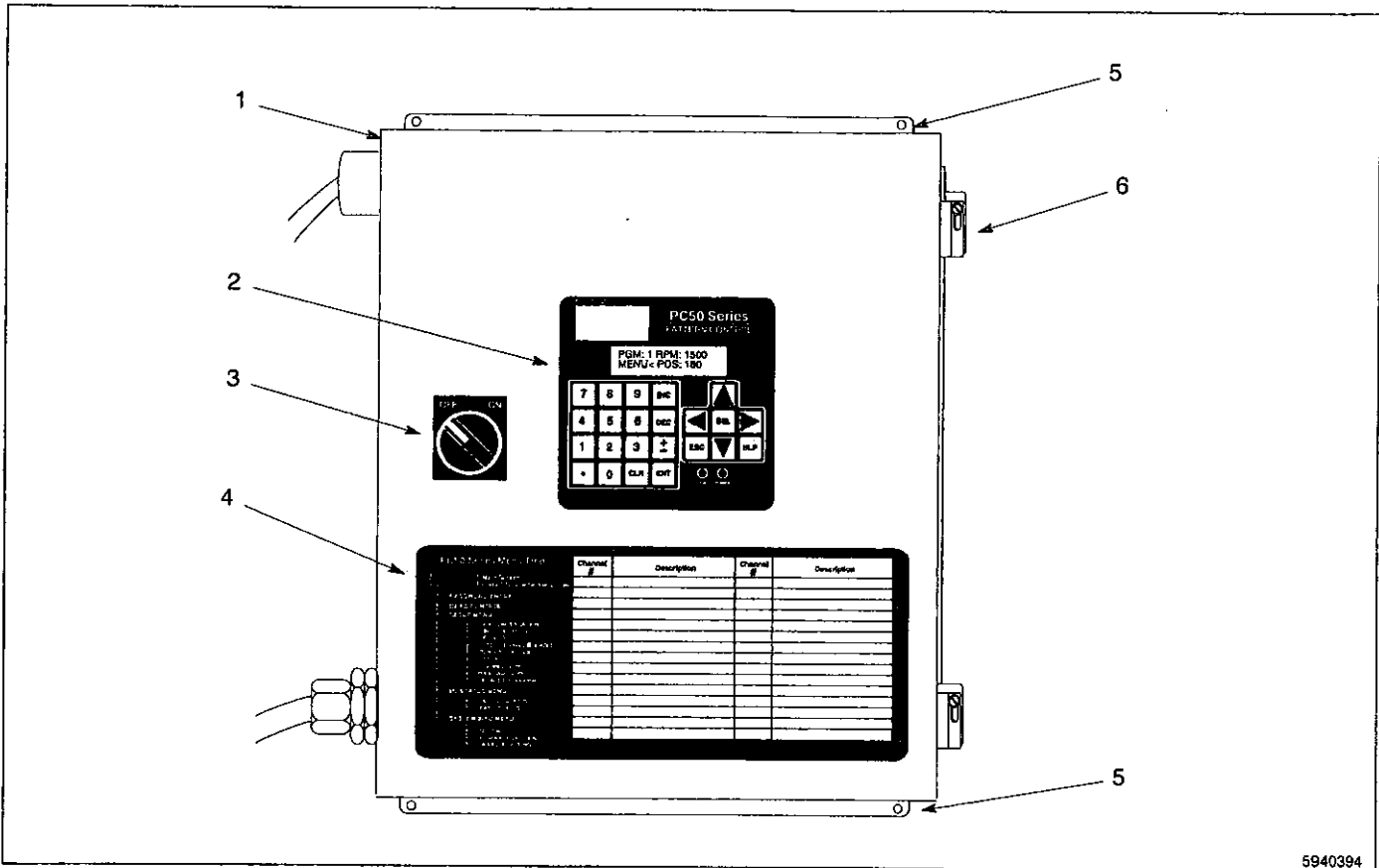


Fig. 2-2 PC50 Series Controller

1. Cabinet

2. Keypad/Display

3. On/Off Switch

4. Stick-On Program Menu and Program List

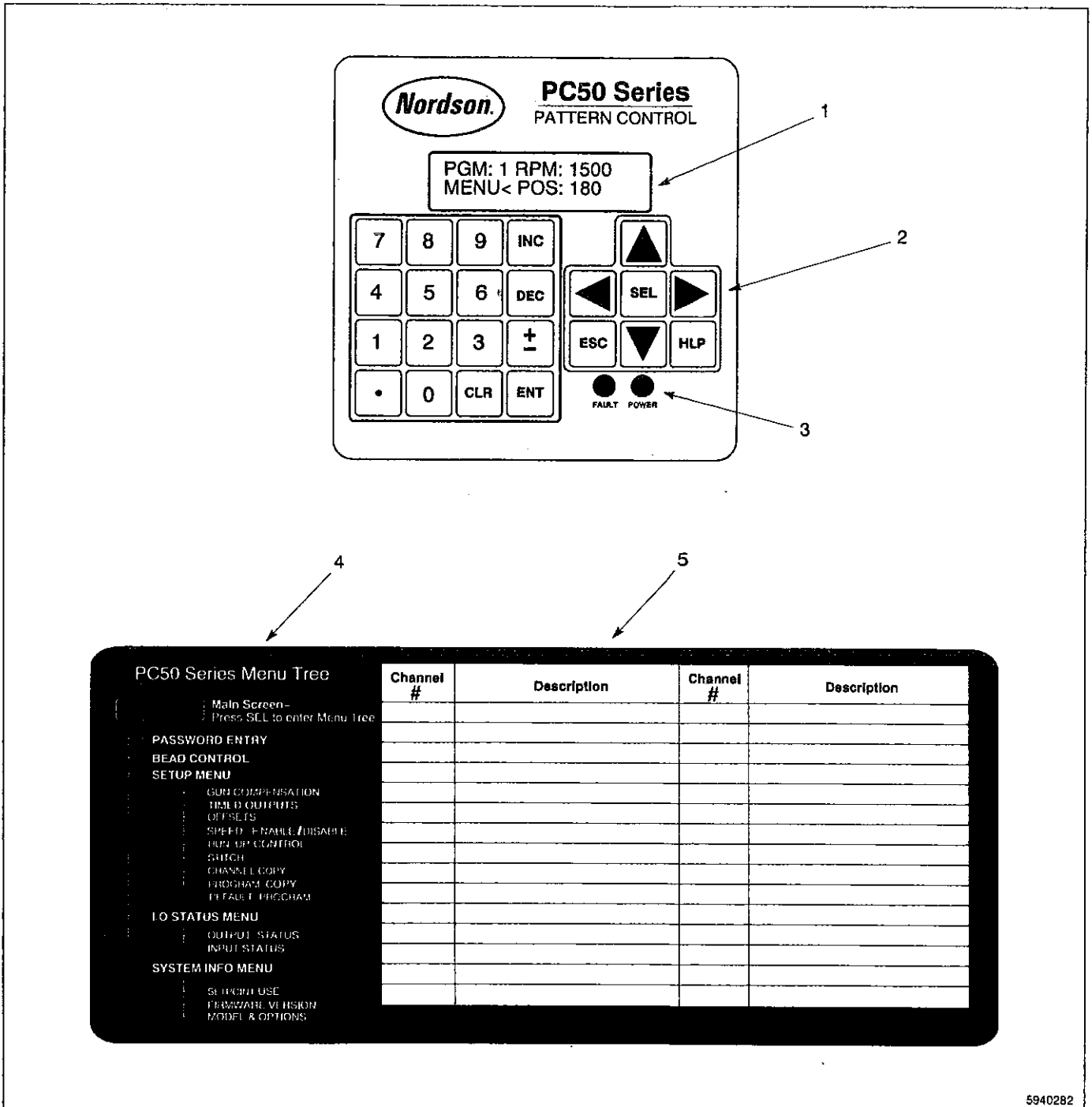
5. Mounting Flange (Top and Bottom)

6. Access to Cabinet Interior

The keypad/display provides a complete user interface from which every aspect of the controller's operation can be monitored and programmed. On PC55 controllers, an additional optional keypad, remotely mounted from the main controller cabinet, can be attached to the system. A clear silicon rubber boot assembly is available to provide protection for installations where caustic washdown chemicals are used.

When interfaced to a PLC or IBM compatible computer, through Nordson's optional communication package, controller programming can be stored on disk. If programming in a controller is lost, the controller can be completely reprogrammed from the computer without using the keypad/display. See *Nordson Communication Software* in Section 8, *Options*.

PC50 Series controllers are available in two models, the PC54 and the PC55. See Section 7, *Specifications* for a listing of each controller's capabilities.



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Fig. 2-3 Controller Keypad and Display and Program Menu Tree and Program Listing

- 1. Display
- 2. Keypad
- 3. Power ON/OFF and FAULT indicators
- 4. Program Menu Tree
- 5. Operator Created Program Listing

3. Keypad Description

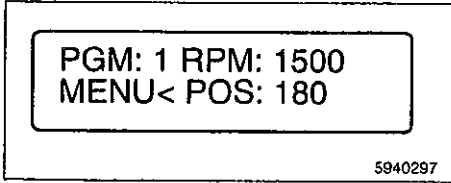


Fig. 2-4 Display Screen

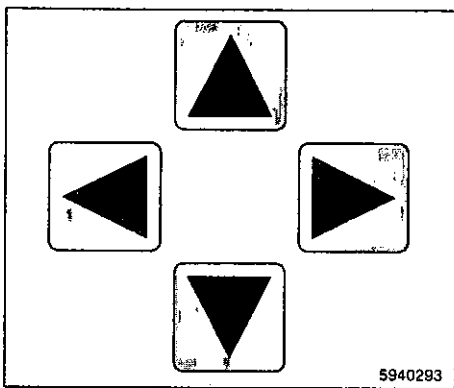


Fig. 2-5 Cursor Keys

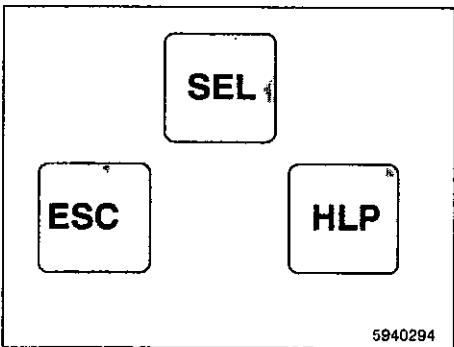


Fig. 2-6 ESC, SEL and HLP Keys

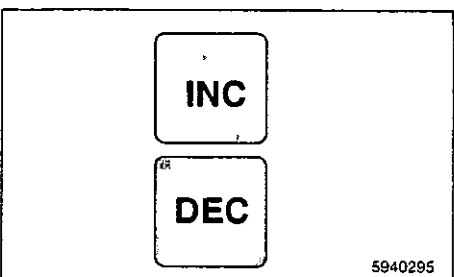


Fig. 2-7 INC and DEC Keys

Display Screen

- Shows Active Program, RPM, Position, and Group number, if applicable.
- See *Main Screen* in this section for a description of screen readouts.
- Press SEL key when cursor is on "MENU" to enter Menu Tree and initiate programming. See Figure 4-1.

Cursor Keys

Use to:

- Scroll through Menu Tree. (See Figure 4-1)
- Move around within a screen
- Scroll through setpoints

ESC, SEL, HLP Keys

- **ESC** exits from current menu level to previous menu, or aborts numeric entry.
- **SEL** enters a new menu level; toggles a value; and selects an output group if multiple groups with different offsets are used.
- **HLP** shows help regarding menu selection and what keys to press. *Use this key if unsure what to do.*

INC, DEC Keys

- **Increment** or **Decrement** (increase or decrease) a value *within a field*.
- Hold for rapid scrolling of value.

3. Keypad Description (contd.)

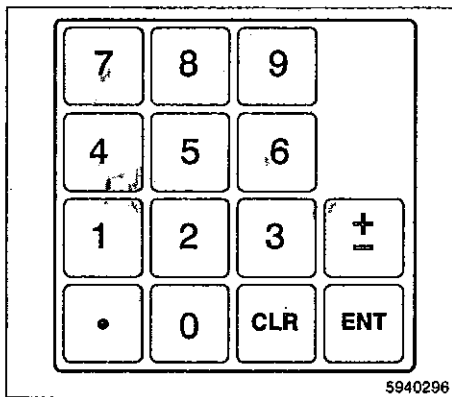


Fig. 2-8 Numeric Keys

Numeric Keys

- Input numeric values within a field.
- **ENT** must be pressed to enter the value; entry will flash until ENT is pressed.
- **CLR** will backspace within an entry prior to pressing ENT.
- \pm converts a positive number to a negative number, or vice versa.

4. Basic Terminology

Channels

The following terms, used throughout this manual, are defined to provide understanding of PC50 Series controller installation, programming and operation:

Each Channel (CHN) in a PC50 Series controller contains "on" and "off" setpoints for one 360° revolution of the resolver shaft. There are two types of channels:

Output Channels - Output module(s) are used to turn an external circuit on or off. The number of output channels depends on the number of output modules provided in the controller. One or two Run Up modules, depending on the controller type, may be used to generate a control signal proportional to parent machine rpm.

NOTE: PC54 controllers can have 1 optional Run Up module. PC55 controllers can provide up to 2 optional Run Up modules.

Group Channels - control the interaction between groups of outputs and an input received from a sensor or other controlling device. See *Output Groups and Operating Modes* in this section for details on Group Channels.

Setpoints

"Setpoints" are the points within one rotation of the resolver at which a channel turns on or off. Setpoints are programmed into a channel through the keypad/display. PC50 Series controllers can turn any given channel on and off multiple times within one rotation.

NOTE: With the optional communication package, setpoints can be downloaded from a computer or PLC through serial communications.

Duration

A "duration" is the "on" period between the time a channel is turned on and off. The "on" setpoint is the leading edge of the duration, and the "off" setpoint is the trailing edge. Adhesive is applied to the substrate during the duration. When multiple pairs of setpoints are programmed into one channel, the channel is said to have multiple durations.

4. Basic Terminology (contd.)

Stitch

Stitch is a type of adhesive application with a duration consisting of a repeating pattern of short adhesive beads (stitch lengths) with uniform spaces (stitch gaps) between them.

Programs

A program is combination of channels (output and group) with defined setpoints that perform a specific operation. The settings are stored as a program. For example:

- Output channels on the controller are programmed with setpoints to apply a specific adhesive pattern to the leading and trailing flap of a certain size carton. These settings are stored as a "program."
- The output channels can then be reprogrammed with different setpoints for a different size carton. This second set of setpoints is then stored as a program.
- An operator activates the program corresponding to the carton size being run and the program of setpoints takes effect.

The active program is selected through the keypad/display or the optional communication package.

- PC54 controllers can store 16 programs.
- PC55 controllers can store 64 programs.

Inputs

In addition to accepting a signal from the resolver, PC50 Series controllers can accept input signals from mechanical switches, relay contacts, DC two- or three-wire sensors, solid state DC output modules, or PLC DC outputs.

PC50 Series controller hardware inputs are dedicated to specific functions involving program selection, and controlling output channels based on sensor signals.

NOTE: The PC54 can have up to 8 inputs; the PC55 can have up to 16 inputs.

Output Groups and Operating Modes

Output channels can be combined into "Output Groups", and each Output Group can be associated with an input terminal in different "Operating Modes".

- PC54 controllers have three different Operating Modes.
- PC55 controllers have six different Operating Modes.

See Output Groups and Operating Modes in this section.

5. Standard Features

Scale Factor

Users can program the number of increments per revolution, or "Scale Factor".

- PC54 controllers have a resolution of 2-1024 increments per revolution.
- PC55 controllers have a resolution of 2-4096 increments per revolution.

Examples of possible linear distance applications include:

- the scale factor may be set to define increments in terms of linear distance, such as one increment equals 0.1" of travel
- for an application (with the PC55 controller only) in which one revolution of the resolver equals 24" of linear travel, a scale factor of 2400 results in increments equal to 0.01" of travel

Examples of having the controller display position in degrees include:

- the scale factor may be set at 360 (for both the PC54 and the PC55) allowing programming in 1 degree increments
- the scale factor may be set at 3600 (PC55 only) allowing programming in 0.1 degree increments

Programming Access

Two levels of programming access are provided: Operator and Master. Each level is assigned a password which must be entered, to allow programming at that level. Careful use of programming access levels provides key personnel with required flexibility in controller programming, while protecting settings against accidental/unauthorized changes. The Operator and Master levels can be activated on an individual keypad through hardware terminals on the back.

Speed Enable/Disable

Minimum/maximum speed ranges can be programmed into the controller. Each power output module can be linked, (through ANDing, see CHN ANDing Menu) with the minimum or maximum speed range.

Min Speed ANDing

The Min Speed ANDing selection is used to link (AND) programmed outputs to either of two speed ranges programmed into the controller. Typically, outputs are ANDed with either speed range such that the output is disabled unless the machine speed is within the range.

Timed Outputs

Timed outputs, like standard outputs, are programmed to turn on and off at specific points during resolver rotation. Once a timed output is on, it remains on for a specified time period regardless of RPM. However, if the programmed off position is reached before the time period passes, the output turns off. Timed outputs can be used to provide a constant volume of adhesive over a wide range of machine speed.

5. Standard Features

(contd.)

Gun Compensation

Gun Compensation advances the setpoints for gun output as machine speed increases, providing greater accuracy, higher production speeds, and reduced downtime for machine adjustment.

Pull In/Drop Out

The PC50 Series controller's pull-in/drop-out gun compensation programming factors in the response time for gun actuators. This feature is used for devices whose "on" and "off" response times may be different. See Gun Compensation later in this section.

Run Up

Optional Run Up output modules produce output signals linearly proportional to parent machine rpm. The Run Up signal levels at zero rpm, as well as the rpm that corresponds to maximum signal (maximum line speed), can be programmed. Measuring equipment and calibration is not required for set up and operation.

Typical use for this Run Up output is to control adhesive output by varying applicator motor speed and pressure control (by signaling the applicator) as parent machine speeds change.

- PC54 controllers - one (1) optional output module
- PC55 controllers - two (2) optional output modules

6. Optional Features

See Section 8, *Options* for a description of options available on PC50 Series controllers. Insert instruction sheets for any purchased options in the Options section of this manual for future reference.

7. System Configuration and Preprogramming Considerations

NOTE: Output Groups, Operating Modes, Offset, and Gun Compensation are discussed in this section to provide operators with PC50 Series controller set up and programming considerations. These topics should be thoroughly read and completely understood prior to any programming attempts.

Output Groups and Operating Modes

Controller Input Signals

In many industrial applications, the action of a machine component such as an adhesive gun pneumatic solenoid, electric adhesive gun driver or parent machine pneumatic cylinder is related to an input signal from a limit switch, sensor, or controller such as a PLC. Typically, input signals are used in two ways:

Conditional Operation

- The device being controlled is allowed to function only if an input signal occurs. In adhesive application, photoeyes are used to sense the presence of a product immediately before adhesive application occurs. If the product is not present, the gun is not enabled to turn on at its programmed setpoints.

Phase Adjustment

- The device being controlled must maintain a certain relationship to other devices on the machine. For example, web converting lines such as disposable diaper machines usually have several machine sections, each performing a different operation on a continuous web of material. As line speed increases, the phase relationships between different machine sections adjust, compensating for stretching of the web material. To keep a device synchronized within its machine section, a sensor is used to detect a registration mark on a component such as shaft or disk. The sensor signal "resets" the position of the device each revolution, ensuring that the device operates at the correct position on the web of moving material.

PC50 Series controller programming links input signals from sensors or other devices to the controller's output channels. The controller's output channels can remain separate or they can be combined together into groups. Each Output Group can then be assigned to an Operating Mode. The Operating Mode controls the interaction between the output group channel, its input terminal and its output channel(s).

NOTE: PC54 controllers have two inputs which can be associated with two Output Groups. PC55 controllers have six inputs, allowing output channels to be divided into as many as six group channels.

NOTE: PC54 controllers have Operating Modes 2, 3, and 5 available. PC55 controllers have Operating Modes 0-5 available.

Output Groups and Operating Modes *(contd.)*

Output Group Programming

PC50 Series controller output channels can be combined into Output Groups through OUTPUT GROUP programming. The number of available Output Groups depends on the controller type.

NOTE: On PC54 controllers, each Output Group is automatically associated with one of the input terminals on TB 1, (See Figure 3-11) as well as a special "Group Channel" ranging from Channel 91 to 92.

NOTE: On PC55 controllers, each Output Group is automatically associated with one of the input terminals on TB 1, (See Figure 3-12) as well as a special "Group Channel" ranging from Channel 91 to 96.

The relationship between Output Groups, input terminals, and group channels is summarized in Table 2-1 and Table 2-2.

Table 2-1 **PC54 Controller**
Output Groups, Input Terminals, and Group Channels

Output Group	Group Input Terminal TB 1, (Figure 3-13)	Group Channel
1	1	91
2	2	92

Table 2-2 **PC55 Controller**
Output Groups, Input Terminals, and Group Channels

Output Group	Group Input Terminal TB1, (Figure 3-14)	Group Channel
1	9	91
2	10	92
3	11	93
4	12	94
5	13	95
6	14	96

Output Group Programming (contd.)

When combining output channels into Output Groups, specific rules must be followed:

- Output channels are assigned to Output Groups sequentially. Output Group 1 begins with output channel 1 and includes the specified number of output channels; Output Group 2 begins with the next output channel and continues sequentially for its specified number of output channels; and so on. The last Output Group automatically includes all remaining output channels.
- With the PC55, six Output Groups or as few as one Output Group, can be established.
- With the PC54, two Output Groups or as few as one Output Group, can be established.
- More than one Output Group can be assigned to the same Operating Mode.

Table 2-3 Output Group Example 1 (PC54)

All Outputs in One Group				
Output Group	Includes Output Channels	Group Input Terminal TB 1, Figure 3-13	Group Channel	*Mode
1	1 thru 8	1	91	2, 3, or 5
All Outputs in Two Groups				
Output Group	Includes Output Channels	Group Input Terminal TB 1, Figure 3-13	Group Channel	*Mode
1	1 thru 4	1	91	2, 3, or 5
2	5 thru 8	2	92	2, 3, or 5

***NOTE:** PC54 controllers have Operating Modes 2, 3, and 5 available. PC55 controllers have Operating Modes 0-5 available.

Output Group Programming (contd.)

Table 2-4 Output Group Example 2 (PC55)

All Outputs in One Output Group				
Output Group	Includes Output Channels	Group Input Terminal TB 1 (Figure 3-14)	Group Channel	*Mode
1	1 thru 25	9	91	0,1, 2, 3, 4 or 5
All Outputs in Two Output Groups				
Output Group	Includes Output Channels	Group Input Terminal TB 1 (Figure 3-14)	Group Channel	*Mode
1	1 thru 4	9	91	0,1, 2, 3, 4 or 5
2	5 thru 25	10	92	0,1, 2, 3, 4 or 5
All Outputs in Three Output Groups				
Output Group	Includes Output Channels	Group Input Terminal TB 1 (Figure 3-14)	Group Channel	*Mode
1	1 & 2	9	91	0,1, 2, 3, 4 or 5
2	3 & 4	10	92	0,1, 2, 3, 4 or 5
3	5 thru 25	11	93	0,1, 2, 3, 4 or 5

Output Group Assignment to Operating Modes

During OUTPUT GROUP programming, each Output Group is assigned an Operating Mode that controls the interaction between the Output Group, its input terminal, and its group channel.

***NOTE:** PC54 controllers have Operating Modes 2, 3, and 5 available. PC55 controllers have Operating Modes 0-5 available.

Output Groups and Operating Modes (contd.)

Operating Modes

Operating Mode 0

NOTE: Mode 0 is available only on the PC55 controller.

NOTE: Mode 0 can be simulated on a PC54 controller by using Mode 3, and hardwiring the group's input permanently "on".

Output channels in a group assigned to Operating Mode 0 energize at programmed setpoints and are not affected by the corresponding input terminal or group channel. For example, adhesive guns fire at the programmed setpoints regardless of trigger input. (A trigger has no effect on any output group operating in Mode 0.)

- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in an Operating Mode 0 group.
- The machine position for an Operating Mode 0 group can be set through OFFSET programming. See Section 4, *Programming*.

Programming

During OUTPUT GROUP programming, group together output channels that should remain unaffected by Operating Modes, and assign them to Operating Mode 0.

Operating Mode 1

NOTE: Mode 1 is available only on the PC55.

Output Groups assigned to Operating Mode 1 are always enabled to turn on at their programmed setpoints. However, when the corresponding input terminal is energized, the machine position for the group immediately resets to the "Preset" value programmed through the OFFSET function, (See Section 4, *Programming*.)

Once the position is reset, the input terminal has no effect until it is turned off and the resolver reaches the leading edge of a duration programmed into the corresponding group channel. See Table 2-1 and Table 2-2 for input terminal and group channel assignments.

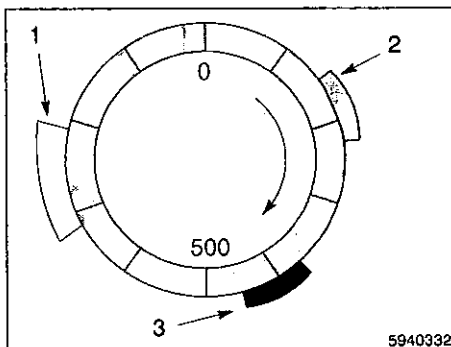


Fig. 2-9 Operating Mode 1 - Typical Setup

1. Group Channel Duration
2. Input Signal
3. Output Channel Duration

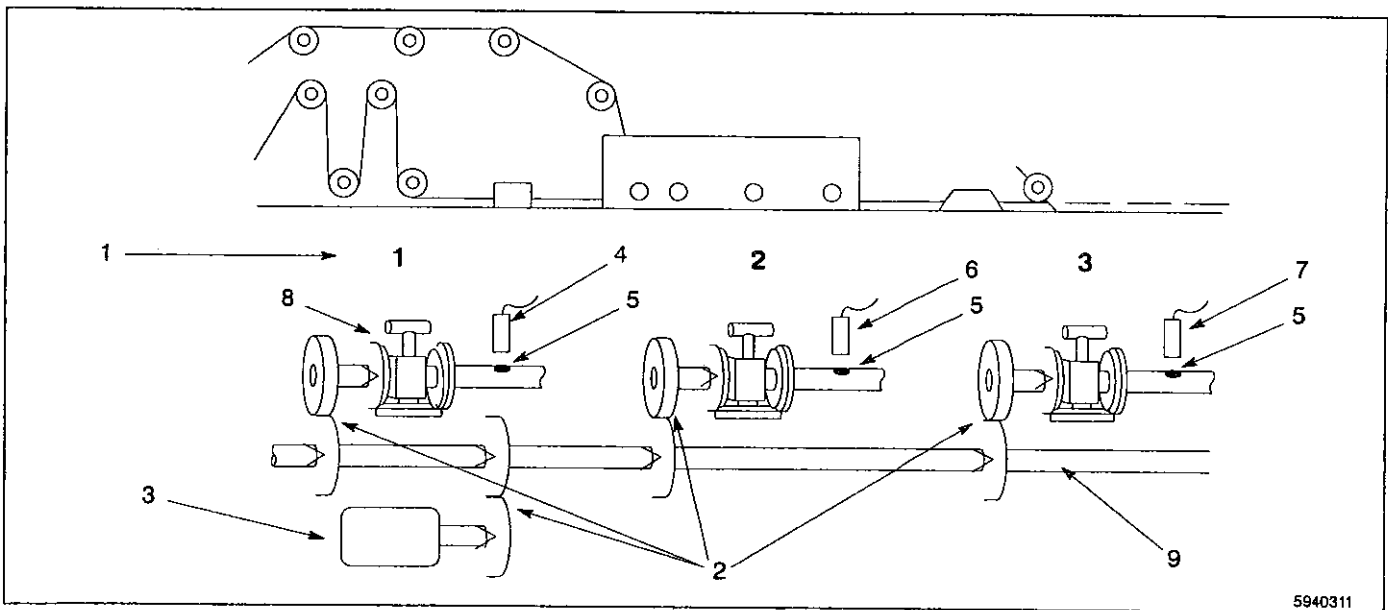
NOTE: Operating Mode 1 can be used to automatically adjust phase relationships between machine sections. Another use is in applications where some machine sections run multiple cycles per resolver revolution.

- The group position resets at the leading edge of the input terminal signal, regardless of how long the terminal is on (item 2, Figure 2-9).
- Output channel setpoints are always enabled (item 3, Figure 2-9).
- Duration (item 1, Figure 2-9) in Group Channel re-arms the terminal .

Operating Mode 1 (contd.)

Possible Applications:

- Machines with Multiple Cycle Ratios - Some machines have different sections that run at different cycle ratios per overall machine cycle. For example, one portion of a machine may complete several cycles while another section makes only one cycle. By using Mode 1 or 2, it is possible for some output groups to cycle multiple times while others cycle once.
- Web Converting Machines - Disposable diapers, medical pads, office folders, and similar products. Mode 1 can automatically change the timing of individual machine sections to compensate for changes in phase relationships between sections.



5940311

Fig. 2-10 Operating Mode 1 Example Application

- | | | |
|---------------------------------|-----------------------|----------------------------|
| 1. Machine Sections 1, 2, and 3 | 4. Sensor Group 1 | 7. Sensor Group 3 |
| 2. Ratio 1:1 | 5. Registration Marks | 8. Adjustable Differential |
| 3. Resolver | 6. Sensor Group 2 | 9. Machine Shaft |

Three sections of an adjustable phase converting machine are controlled by a single controller and resolver. Groups 1, 2 and 3 all operate in Mode 1. The position of each group is reset to the "preset" value when the group's sensor detects the registration mark on the shaft for the corresponding machine section. This keeps the electrical control signals properly synchronized to the mechanical devices in each section when phase adjustments are made.

One resolver provides the position information needed for all sections of the machine, regardless of their phase relationship.

Operating Mode 1 (contd.)

Application Specifics

- The group position resets at the leading edge of the input terminal signal, regardless of how long the terminal is on.
- Once a reset occurs, the input terminal has no effect until it is de-energized and the leading edge of a duration in the corresponding group channel re-arms the terminal.
- When the position of a group resets, the position of the corresponding group channel also resets.
- On start-up, the input terminal is armed and the group position is the same as the value programmed in SHAFT POSITION, Section 4, *Programming*. When powered down, the group's current position setting is lost.
- Either edge of a duration in the group channel can re-arm the input terminal. If the resolver shaft is rotating in the forward direction (position is increasing as shaft rotates) the "on" edge of the duration re-arms the terminal. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the "off" edge of the duration re-arms the terminal.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in an Operating Mode 1 group.

Programming

See Tables 2-1 and 2-2 for input terminal and group channel assignments while reviewing programming steps.

1. Follow the programming steps in OUTPUT GROUPS, in Section 4, *Programming* to establish Output Groups and Operating Modes.
2. Program the "Preset" value for each Operating Mode 1 group following the steps in OFFSET, in Section 4. *Programming*.
3. Jog the machine to the point where the group input terminal energizes. Using this point as a reference, program setpoints into the output channels in the group.
4. Program a duration in the group channel to disable the output channels and re-arm the input terminal. This duration must be after all of the output channels have completed their functions, but before the input terminal is energized.

Operating Mode 2

NOTE: Mode 2 is available on both the PC54 and PC55 controllers.

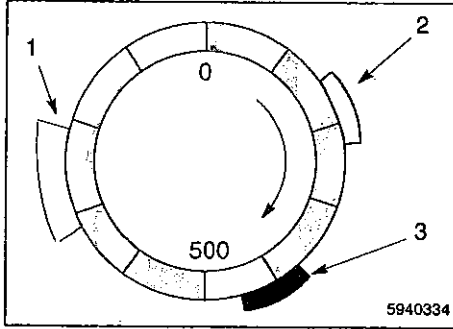


Fig. 2-11 Operating Mode 2 - Typical Set-Up

- 1. Group Channel Duration
- 2. Input Signal
- 3. Output Channel Duration

Operating Mode 2 Output Groups are disabled until the corresponding input terminal is energized. The input terminal resets the group position and enables the output channel. Once the input terminal energizes, outputs then turn on at their programmed setpoints, and the group position immediately resets to the value programmed through the OFFSET function. (See Section 4, *Programming*.)

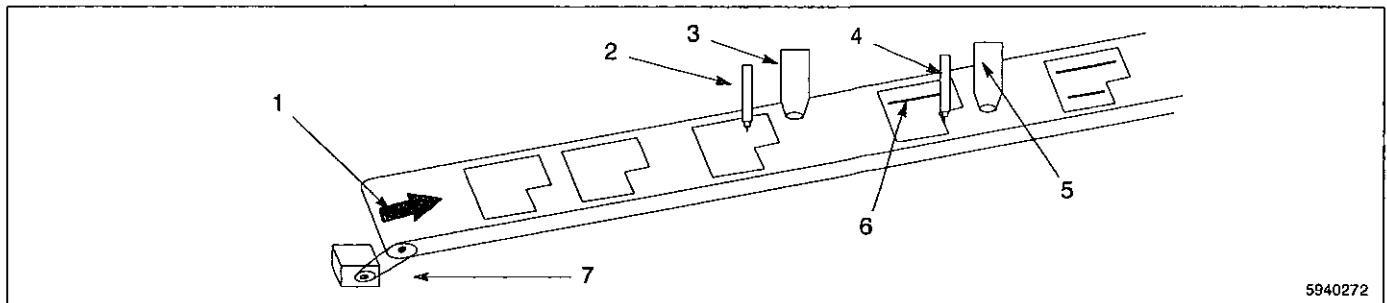
The leading edge of a duration in the corresponding group channel disables the group's outputs and re-arms the input terminal.

NOTE: Operating Mode 2 is used where products may not be evenly spaced *and* when the Output Groups should cycle *only* if product has been sensed.

Application Specifics

- Outputs are enabled and the group position resets at the leading edge of the input terminal signal, regardless of how long the terminal is on.
- Once a reset occurs, the input terminal has no effect until it de-energizes and the leading edge of a duration in the corresponding group channel re-arms the terminal.
- When the position of a group resets, the position of the corresponding group channel also resets.
- On power up, outputs are disabled, the input terminal is armed, and the group position is the same as the value programmed in SHAFT POSITION, Section 4, *Programming*.
- Either edge of a duration in the group channel can re-arm the input terminal. If the resolver shaft is rotating in the forward direction (position is increasing as shaft rotates) the "on" edge of the duration re-arms the terminal. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the "off" edge of the duration re-arms the terminal.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in a Operating Mode 2 group.

Operating Mode 2 (contd.)



5940272

Fig. 2-12 Operating Mode 2 Example Application

- | | | |
|-----------------------|-------------------------|---|
| 1. Conveyor Direction | 3. Group 1 Adhesive Gun | 5. Group 2 Adhesive Gun |
| 2. Group 1 Sensor | 4. Group 2 Sensor | 6. Adhesive Pattern |
| | | 7. One Resolver Provides Info for Both Guns |

Application Example

Refer to Figure 2-12 while reviewing the application example.

- Two adhesive guns at different locations on the conveyor are controlled independently by a single controller and resolver. Product spacing is random.
- The sensors are connected to the input terminals for the corresponding groups. When a sensor detects a product, it resets the corresponding group position to the "preset" values and enables the group outputs to turn on the guns at the correct setpoints.
- When parts are not present, the outputs are inactive.

Programming

See Tables 2-1 and 2-2 for input terminal and group channel assignments while reviewing programming steps.

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the "Preset" value for any Operating Mode 2 Output Groups.
3. Jog the machine to the point where the group input terminal will energize. Using this point as a reference, program setpoints into the output channels in the group.
4. Program a duration in the group channel to disable the output channels and re-arm the input terminal. This duration must be after all of the output channels have completed their functions, but before the input terminal is energized.

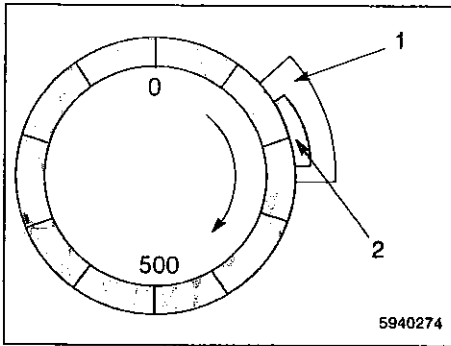


Fig. 2-13 Operating Mode 3 - Typical Set-Up

1. Input Signal
2. Output Channel Duration

Operating Mode 3

NOTE: Mode 3 is available on both the PC54 and PC55 controllers.

Description

Output Groups assigned to Operating Mode 3 are on only while their programmed setpoints are on *and* while the corresponding input terminal is energized. If the input terminal is off, all outputs are off, regardless of setpoint programming.

NOTE: Use Operating Mode 3 where outputs should be *active only* while a sensor or limit switch is on.

Application Specifics

- The group channel for a group operating in Mode 3 has no effect.
- Each program in the controller can have different setpoints for output channels in the group.
- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in a Mode 3 group.
- The machine position for a Mode 3 group can be set through OFFSET programming.

Programming

See Tables 2-1 and 2-2 for input terminal assignments.

1. Program OUTPUT GROUPS to establish Output Groups and Operating Modes.
2. Use OFFSET to program the absolute offset value for any Operating Mode 3 groups.
3. Program setpoints into the output channels in the group.

NOTE: Output channels in Operating Mode 3 are enabled only while a signal is applied to the group terminal.

Operating Mode 3 (contd.)

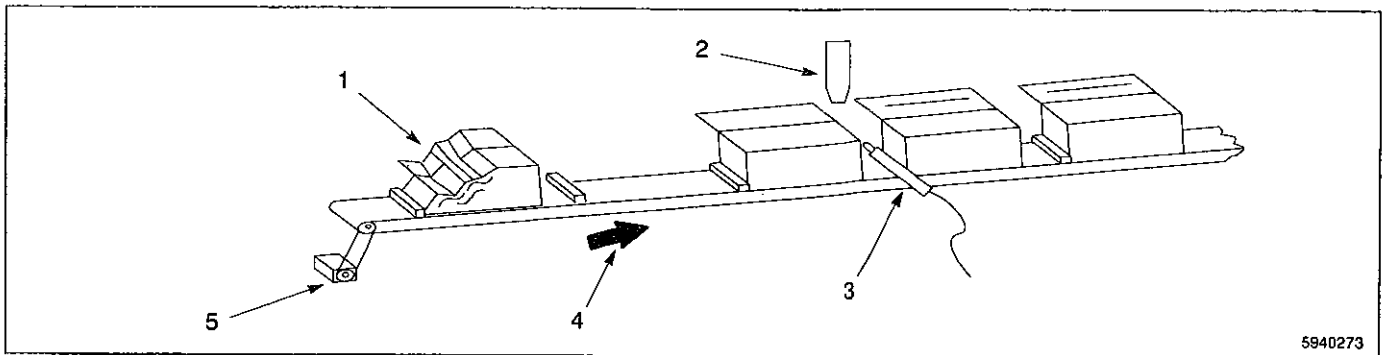


Fig. 2-14 Operating Mode 3 Application Example

- | | | |
|--|-----------------|--------------------------------|
| 1. Adhesive Application Stops When Sensor Turns Off Due to Carton Crushing | 2. Adhesive Gun | 4. Conveyor Direction |
| | 3. Sensor | 5. Resolver Linked to Conveyor |

Application Example

Refer to Figure 2-14 while reviewing the application example.

Adhesive application occurs only while the photo-eye sees the top edge of a carton. Adhesive application stops when crushed or improperly erected cartons cause the photoeye to lose sight of the carton's top edge.

Operating Mode 3 eliminates the need to hardwire photoeyes and other sensors in series with the corresponding controller outputs. Instead, the sensor is "ANDed" with the output through Operating Mode 3 programming.

Operating Mode 4

NOTE: Mode 4 is only available on the PC55 controller.

Refer to Figure 2-15 while reading the Operating Mode 4 description.

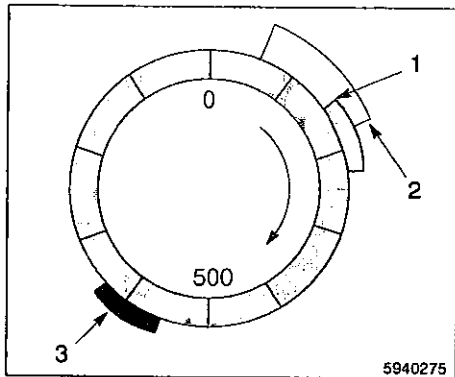


Fig. 2-15 Operating Mode 4 - Typical Setup

1. Input Signal
2. Group Channel Duration
3. Output Channel Duration

Output Groups in Operating Mode 4, are enabled to turn on at their programmed setpoints for one machine cycle if the corresponding input terminal (item 1), turns on within a duration programmed into the group channel (item 2). The output channel (item 3) is disabled at the start of the next duration in the group channel.

NOTE: Use Operating Mode 4 to check the presence and correct positioning of a product before enabling the outputs for this machine cycle. Operating Mode 4 operation is appropriate for flight bar conveyors, rotary index tables, and similar types of machinery where product position is consistent from cycle to cycle.

Application Specifics

- The leading edge of the signal from the input terminal must occur during the duration in the group channel. If the leading edge occurs before the duration, the outputs are not enabled.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- Either edge of a duration in the group channel can disable the outputs. If the resolver shaft is rotating in the forward direction (position is increasing as shaft rotates) the "on" edge of the duration disables the outputs. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the "off" edge of the duration disables the outputs.
- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in an Operating Mode 4 group.
- Machine position for an Operating Mode 4 group can be set through OFFSET programming.

Operating Mode 4 (contd.)

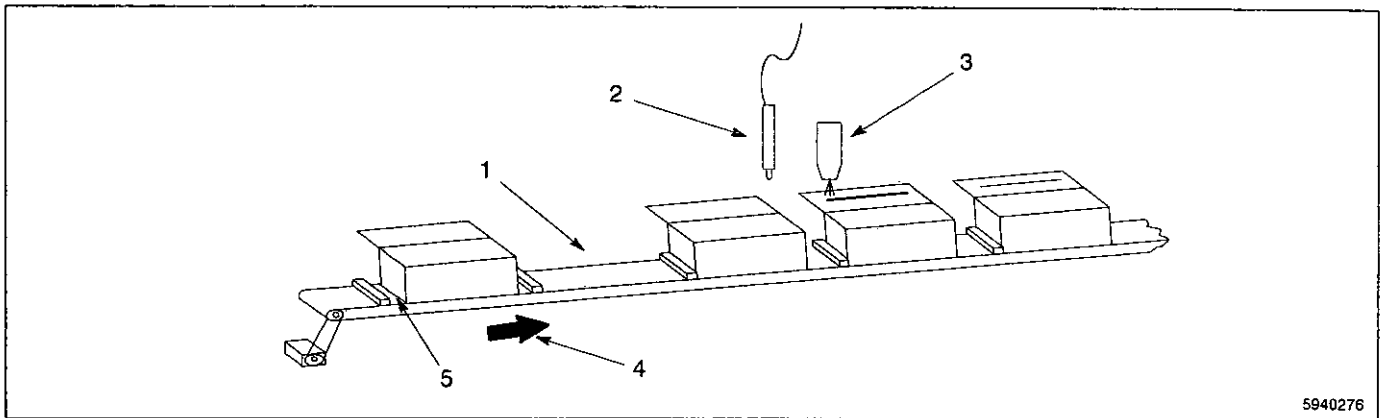
Programming

See Tables 2-1 and 2-2 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS to establish Output Groups and Operating Modes.
2. Use OFFSET to program the absolute offset value for any Operating Mode 4 Output Groups.
3. Jog the machine to the point where the group input terminal energizes. Program a duration in the group channel that turns on a little earlier than this point, and off a little later. The shorter the duration, the narrower the portion of the machine cycle in which the input signal enables the outputs.
4. Program setpoints into the output channels in the group.

NOTE: The leading edge of the duration in the group channel disables the output channels in the group.

Application Example



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Fig. 2-16 Operating Mode 4 - Application Example

1. Empty Flight Bar
2. Sensor

3. Adhesive Gun
4. Conveyor Direction

5. Carton Positioned Ahead of Flight Bar is Skipped

Refer to Figure 2-16 while reviewing the application example.

The adhesive gun is enabled for one machine cycle only if the sensor detects the leading edge of a carton during the duration programmed in the group channel. If a carton is missing (item 1) or incorrectly positioned, (item 5) the gun does not activate.

Operating Mode 5

NOTE: Mode 5 is available on both the PC54 and PC55 controllers.

Mode 5 operation is similar to Mode 4 operation, with the following differences:

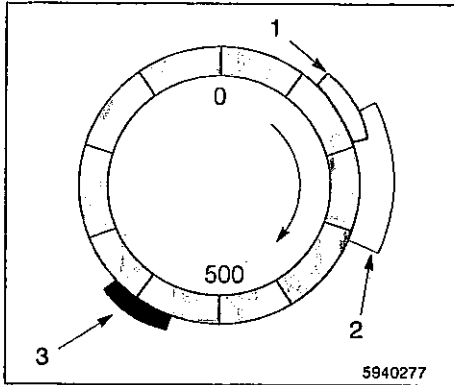


Fig. 2-17 Operating Mode 5 - Typical Set-Up

1. Input Terminal Within Duration Enables Outputs
2. Duration of Group Channel
3. Output Channel Duration

- In Mode 5, the Group Outputs are *enabled if any portion of the input signal* occurs within the duration programmed into the group channel. (In Mode 4, the input terminal signal leading edge must occur *within* the duration.)
- If the machine stops, the group outputs are disabled immediately. This prevents adhesive application from continuing if the machine stops.
- If the machine is stopped and the group's input terminal is "on", energizing the First Cycle Enable (terminal #7 on TB 1 for the PC54; terminal #15 on TB 1 for the PC 55) re-enables the outputs. The discontinued operation can be completed on the product in process when the machine stopped.

Application Specifics

- Regardless of its programmed "off" point, the duration in the group channel ends as soon as any of the outputs in the group turn on.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MIN SPEED ANDing and REM ENAB ANDing can be used with outputs in an Operating Mode 5 group. Use MIN SPEED ANDing to prevent the First Cycle Enable terminal from re-activating the outputs while the machine is stopped.
- The machine position for an Operating Mode 5 group can be set through OFFSET programming.

Operating Mode 5 (contd.)

Programming

See Tables 2-1 and 2-2 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS to establish Output Groups and Operating Modes.
2. Use OFFSET to program the absolute offset value for any Operating Mode 5 Output Groups.
3. Jog the machine to the point where the group input terminal energizes. Program a duration in the group channel that will be on during any portion of the input terminal signal. The smaller the overlap between the input signal and the group channel duration, the narrower the portion of the machine cycle in which the input signal enables the outputs.
4. Using the start of the overlap from Step 3 as a reference point, program setpoints into the group output channels.

NOTE: Do not overlap setpoints programmed in Step 4 with the group channel duration programmed in Step 3.

Application Example

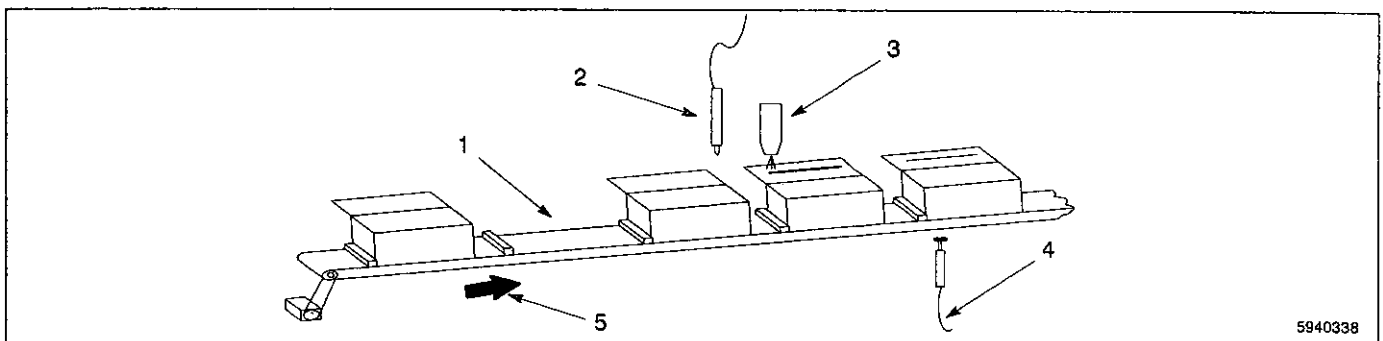


Fig. 2-18 Operating Mode 5 - Application Example

1. Empty Flight Bar is Skipped
2. Sensor

3. Adhesive Gun
4. Pushbutton to Finish Cycle

5. Conveyor Direction

The adhesive gun (item 3) is enabled for one machine cycle if the sensor (item 2) detects a carton during the duration programmed in the group channel. If a carton is missing (item 1) the gun does not activate.

If the line stops, the gun is disabled immediately. The gun is re-enabled on the same machine cycle by depressing the pushbutton (item 4) while the product sensor is 'on'.

NOTE: On the PC54, the pushbutton is wired to Terminal 7 of TB 1; on the PC55, Terminal 15 of TB 1.

Offset

Menu Path

At the MAIN SCREEN:

- Press SEL
- Scroll down to SETUP MENU. Press SEL.
- Scroll down to OFFSET. Press SEL.

Since PC50 Series Controllers are programmable, they can be set to display a "zero" position at any point in the machine cycle. Usually, a machine is jogged to the beginning of a cycle, and the SHAFT POSITION function is set to zero at this point.

Each Output Group operating in Mode 0, 3, 4, or 5 (where applicable, depending on controller model) can be individually "offset" from this SHAFT POSITION through OFFSET programming. This allows the output channels in a group to be set to "zero" at a different machine position than the one that corresponds to "zero" in SHAFT POSITION.

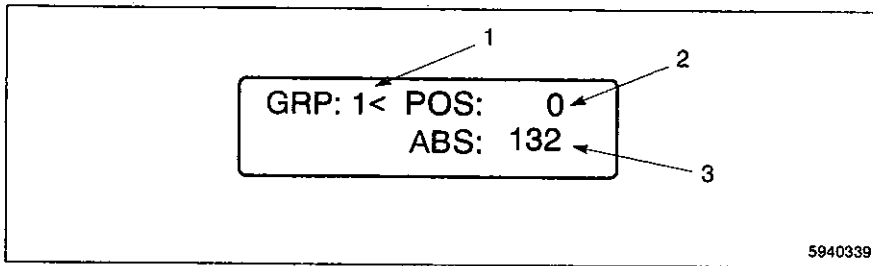


Fig. 2-19 Offset Screen - Group Mode 0, 3, 4 or 5

Setting an Output Group to its own zero position simplifies setpoint programming for output channels by clarifying the relationship between the setpoints and the machine component controlled by the group.

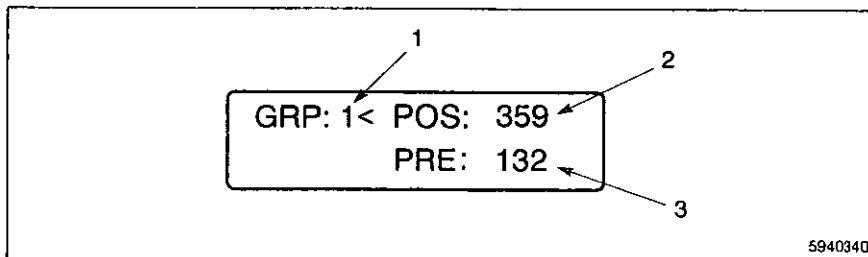
Offset (contd.)**EXAMPLE:**

Assume that an Output Group controls a gun on a cartoning machine and that the scale factor is 360° (1 increment equals 1 degree). When jogging the machine and viewing POS on the controller display, it is evident that the gun opens at 347° and closes at 22° when using the position set through SHAFT POSITION.

Since other output channels correlate well with SHAFT POSITION, it is not desirable to change the SHAFT POSITION setting.

By using the OFFSET function for this group, and adding 13° to the shaft position, the gun opens at a group position of 0° and closes at 35° . Although the group position has been "offset" by 13° , the gun still opens at 347° and closes at 22° , in terms of shaft position.

For Output Groups operating in Mode 1 or 2, (where applicable, depending on controller model) the group position is reset to a "preset" value whenever the group's input terminal is energized. This preset is defined through OFFSET programming. Because the reset can occur at any resolver position, the relationship between the position of a group operating in Mode 1 or 2 and the SHAFT POSITION varies.



1. Output Group
2. Group Position = PRE + Change Since Last Reset
3. Group Preset Value (If Group is Mode 1 or 2)

Fig. 2-20 Offset Screen -Group Mode 1 or 2

8. Gun Compensation and Operating Modes

“Gun compensation” is the controller’s ability to automatically advance or retard setpoints in any output channel depending on the speed of the machine. Gun compensation allows devices with fixed response times, such as solenoids or electric gun drivers, to perform accurately over a wide range of machine speeds. Without gun compensation, the adhesive pattern “drifts” out of position as parent machine speed increases. Programming gun compensation for the gun output channel, maintains the adhesive pattern position precisely throughout the complete range of machine speeds.

Gun compensation affects individual channels in an Output Group as programmed through GUN COMP. However, gun compensation will not affect the group channels, 91 through 96.

Gun Compensation Guidelines

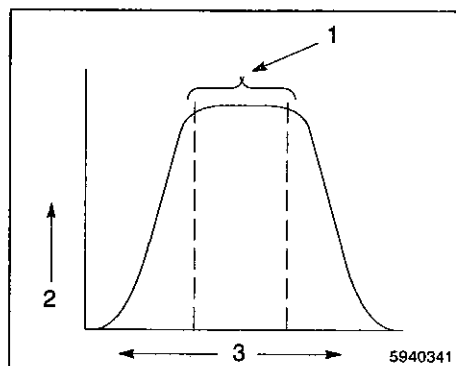


Fig. 2-21 Constant Product Speed Past Gun

1. Gun Placement at Line Steady Speed Location
2. Product Speed
3. One Machine Cycle

Device Placement

For gun compensation to work most effectively, the device being controlled by the output channel should be located on the machine in a position where the product moves past the device at a constant speed. (Figure 2-21) In the case of a gun, if the gun is ON when the speed is changing, adhesive distribution may be inconsistent from carton to carton at varying machine speeds.

Gun Compensation and Operating Modes

When using Operating Modes, be aware that gun compensation affects the relationship between the setpoints, the Group Input signal, and the duration programmed into the Group Channel.

When using gun compensation and Operating Modes together:

- Gun compensation may shift an output channel’s setpoints into a duration programmed in the group channel
- Gun compensation may shift an output channel’s setpoints into the position in which an input signal occurs

NOTE: Depending on the Operating Mode selection and the setpoint arrangement, gun compensation may produce unexpected results.

Pull In/Drop Out Gun Compensation

Gun pull in/drop out allows assigning different adhesive gun compensation values for the leading and trailing edges of the adhesive application duration. Consequently, machine operators can precisely define, within a targeted area, how close to the front and back edges (leading/trailing edges) adhesive is applied.

Setting Pull In/Drop Out Gun Compensation

1. If the gun's ON and OFF response times are known, jog the parent machine line to determine ON and OFF setpoints at zero line speed.
2. Enter the gun compensation values through GUN COMP programming.

NOTE: When setting gun compensation on a system where zero speed setpoints are established, always adjust the gun compensation value. Do not adjust the individual output setpoints!

Compensation setting where system response time is not known:

1. Jog the line to determine ON and OFF setpoints at zero speed.
2. Estimate gun response times for ON and OFF and enter them through the GUN COMP function. The ON timing value controls Pull In, while the the OFF timing value controls Drop Out.
3. Start the parent machine and run product through the adhesive station at a fixed speed. Adjust each gun compensation value as required for proper application. This can be done while the line is in motion.
4. Once the ON and OFF setpoints are programmed, vary the line speed to confirm proper operation at all speeds. Fine tune the GUN COMP values if necessary.

Compensation setting where parent machine can't be jogged:

NOTE: GUN COMP must be set to zero, for both Pull In and Drop Out, while establishing the setpoints.

1. Run the line at a fixed speed, setting the gun ON and OFF operating setpoints as required. Write down the programmed ON and OFF setpoints.
2. Increase the line speed, adjusting the gun ON and OFF operating setpoints to restore proper application.

NOTE: Do not adjust gun compensation values when adjusting ON and OFF setpoints. The first setpoints were adjusted at fixed speed with zero compensation. Changing the GUN COMP value now will upset the first pair of setpoints.

Pull In/Drop Out Gun Compensation (contd.)

3. Establish the second pair of setpoints.
4. Establish separate Pull In and Drop Out GUN COMP values as calculated in the example in Table 2-5.

Table 2-5 Example for Calculating Pull In and Drop Out

	RPM	Pull In (Glue On)	Drop Out (Glue Off)	Difference
1 st Line Speed:	200	73°	156°	83°
2 nd Line Speed:	680	49°	144°	95°

NOTE: The length of the duration is 83° at 200 RPM, and 95° at 680 RPM. This means that the leading and trailing edges require different speed compensation values.

Leading Edge (Pull In)

Difference in Position: $73^\circ - 49^\circ = 24^\circ$
 Difference in Speed: $680 \text{ RPM} - 200 \text{ RPM} = 480 \text{ RPM}$
 Speed Compensation Value: Divide difference in position by difference in speed:
 $24^\circ / 480 \text{ RPM} = 0.05^\circ \text{ per } 1 \text{ RPM}$

Since a shaft at 1 RPM rotates $0.006^\circ/\text{ms}$, this shaft requires $(0.05/0.006)$, or 8.3 ms to rotate 0.05° . This speed compensation value is 8.3.

Trailing Edge (Drop Out)

Difference in Position: $156^\circ - 144^\circ = 12^\circ$
 Difference in Speed: $680 \text{ RPM} - 200 \text{ RPM} = 480 \text{ RPM}$
 Speed Compensation Value: Divide difference in position by difference in speed:
 $12^\circ / 480 \text{ RPM} = 0.025^\circ / 1 \text{ RPM}$

Since a shaft at 1 RPM rotates $0.006^\circ/\text{ms}$, this shaft requires $(0.025/0.006)$, or 4.2 ms to rotate 0.05° . This speed compensation value is 4.2.

5. Gun compensation settings programmed in Step 4 affect the ON and OFF setpoints programmed in Step 1. Restart the parent machine line, running it at a constant speed, adjusting the ON and OFF setpoints, as required, for proper adhesive application.
6. Once new ON and OFF setpoints are programmed for the line running at constant speed, vary the line speed, confirming proper adhesive application at all speed ranges.

Negative Gun Compensation

Normal gun compensation advances an output channel's setpoints, compensating for a fixed response time in the device being controlled. Some applications require negative gun compensation to retard the setpoints in an output channel.

Negative gun compensation is usually found in two situations:

Wrap Up - As some machines increase in speed, the drive train at some point between the resolver and the product "wraps-up," or shifts with respect to the resolver. If the wrap-up is proportional to machine speed, negative gun compensation can be used to retard an output channel's setpoints from the true resolver position, thus maintaining output accuracy.

Sensor Lag - While output channels are usually used to switch devices on and off, another use is to "gate" a sensor into the controller or other computer.

Figure 2-22 illustrates a basic sensor gating scheme, in which the signal from the sensor reaches the controller only when the output channel from the controller is turned on.

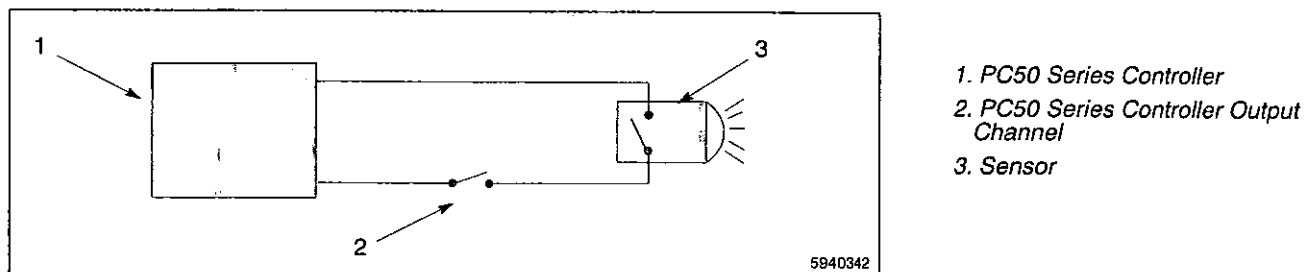


Fig. 2-22 Simple Sensor Gating Scheme

Most sensing devices have very fast response times. However, if a sensor's response time is slow, its signal appears later and later in the machine cycle as the machine speeds up. Eventually, sensor to resolver lag is so great that the sensor signal fails to appear during the window programmed into the controller's output channel.

Negative gun compensation corrects this problem by causing the output channel to lag its programmed machine position by a specified number of milliseconds. Negative gun compensation is calculated using the same method as standard gun compensation. See GUN COMP in Section 4, *Programming* for details on programming negative gun compensation.

9. Controller Initial Programming

While performing initial programming refer to Figure 4-1, Program Menu Tree. The tree shows the path to each major program grouping and selections available within each group.

Practice scrolling through the menu selections to become familiar with the screens prior to attempting initial programming.