

Introduction to Groups & Modes

Input Signals

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

- **Conditional Operation**

The device being controlled is allowed to function only if an input signal occurs. A typical example is gluing, where a photoeye senses the presence of a product immediately before gluing should occur. If the product is not present, the glue 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 are adjusted to compensate 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.

Groups & Modes

The PS-6144 controller includes powerful programming capabilities that allow output channels to be linked to input signals from sensors or other devices. Output channels can be divided into as many as six groups, each of which is associated with one of the input terminals on TB 1, Figure 7. Each group can then be assigned to operate in one of six modes which determines the relationship between the channels in the group and the input signals.

Benefits

Proper programming of output groups and modes can provide substantial benefits:

- **Reduced Waste & Cleanup**—By enabling devices such as glue guns to operate only when a product is present, operating modes conserve glue and reduce mess and cleanup.
- **Increased Productivity**—When used to compensate for phase adjustments between machine sections, operating modes can improve the high speed accuracy of machine functions, allowing higher machine speeds, better product quality, and reduced scrap.

Typical Applications

Details on each of the six PS-6144 operating modes are included later in this section. Following are a few types of industrial machinery which frequently benefit from the use of operating modes.

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.

Cartoners & Case Packers—Vacuum, material handling, loading and other functions are usually controlled in Mode 0. Gluing functions are typically controlled in Modes 4 or 5 to prevent glue from being dispensed when containers are not present.

Vertical Form/Fill/Seal Machines—Package handling functions are controlled in Mode 0, while pump or fill functions are handled in Mode 1 to automatically correct for mechanical phase adjustments made between these two sections of the machine. This allows one resolver to do a job that would otherwise require two.

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.

Introduction to Groups & Modes (cont'd)

Group Programming

PS-6144 output channels are divided into groups through OUTPUT GROUP programming. Each group is automatically associated with one of the input terminals on TB 1, Figure 7, as well as a special “Group Channel” ranging from Channel 91 to 96. The relationship between groups, input terminals, and group channels is summarized in Fig. 28.

Figure 28—Groups, Input Terminals, & Group Channels

<u>Output Group</u>	<u>Group Input Terminal TB 1, Fig. 7</u>	<u>Group Channel</u>
1	9	91
2	10	92
3	11	93
4	12	94
5	13	95
6	14	96

When dividing outputs into groups, keep these rules in mind:

- Output channels are assigned to groups sequentially. Group 1 will begin with Output Channel 1 and include the specified number of channels; Group 2 will begin with the next output channel and continue sequentially for its specified number of channels; and so on. The last group will automatically include all of the remaining output channels.
- You can establish as many as six groups or as few as one.
- More than one group can be assigned to the same mode.

Grouping Example 1—All Outputs in One Group

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input Terminal TB 1, Fig. 7</u>	<u>Group Channel</u>	<u>Mode</u>
1	1 thru 25	9	91	0

Grouping Example 2—Two Groups

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input Terminal TB 1, Fig. 7</u>	<u>Group Channel</u>	<u>Mode</u>
1	1 thru 4	9	91	2
2	5 thru 25	10	92	0

Grouping Example 3—Three Groups

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input Terminal TB 1, Fig. 7</u>	<u>Group Channel</u>	<u>Mode</u>
1	1 & 2	9	91	0
2	3 & 4	10	92	4
3	5 thru 25	11	93	0

Mode Assignments

During OUTPUT GROUP programming, each group is assigned any one of six modes of operation that control the interaction between the group, its input terminal, and its group channel. Detailed discussions of each operating mode follow.

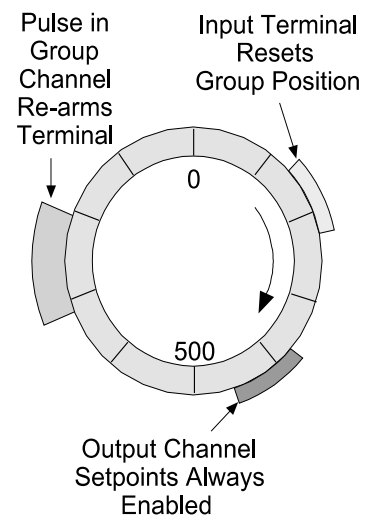
Mode 0 Operation

Description	Output channels in a group assigned to Mode 0 function normally and are not affected by the corresponding input terminal or group channel.
Details	<ul style="list-style-type: none">• MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 0 group.• The machine position for a Mode 0 group can be set through OFFSET programming, Section 3.
Mode 0 Programming	During OUTPUT GROUP programming, group together output channels that should remain unaffected by Modes, and assign them Mode 0.

Mode 1 Operation

Description	Outputs in a group assigned to 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, Section 3. Once the position is reset, the input terminal will have no effect until it is turned off and the resolver reaches the leading edge of a pulse programmed into the corresponding group channel. See Figure 28 for input terminal and group channel assignments.
Applications	This mode can be used to automatically adjust phase relationships between machine sections. It can also be used in applications where some machine sections run multiple cycles per resolver revolution.
Details	<ul style="list-style-type: none">• 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 pulse 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 3. On power-down, the group’s current position setting will be lost.• Either edge of a pulse 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 pulse will re-arm the terminal. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the “off” edge of the pulse will re-arm the terminal.• Each program in the controller can have different setpoints for output channels and the corresponding group channel.• MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 1 group.

Mode 1 Typical Setup

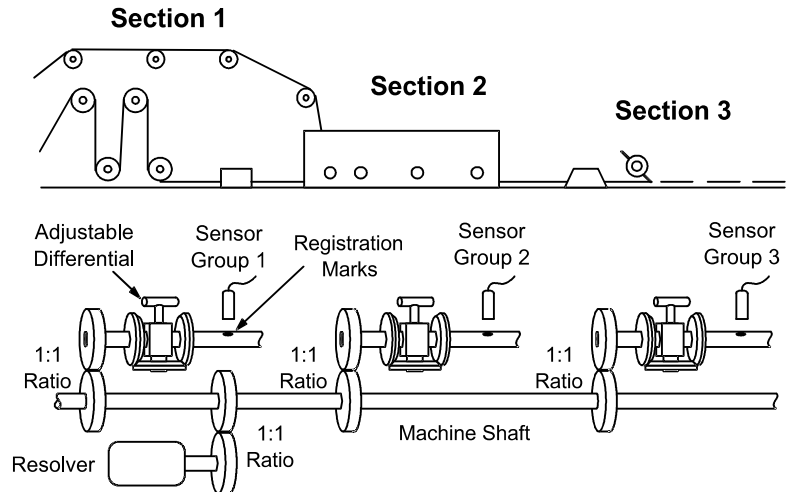


(continued)

Mode 1 Operation (Cont'd)

Figure 29—Mode 1 Example Application

Three sections of an adjustable phase converting machine are controlled by a single PLS 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.



Mode 1 Programming

See Figure 28 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS, Sect. 3, to establish groups and modes.
2. Program the “Preset” value for each Mode 1 group using OFFSET, Section 3.
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 pulse in the group channel to re-arm the input terminal.

Mode 2 Operation

Description

Outputs in a Mode 2 group are disabled until the corresponding input terminal is energized. The outputs are then enabled to turn on at their programmed setpoints, and the group position immediately resets to the value programmed through the OFFSET function, Section 3. The leading edge of a pulse in the corresponding group channel disables the group’s outputs and re-arms the input terminal.

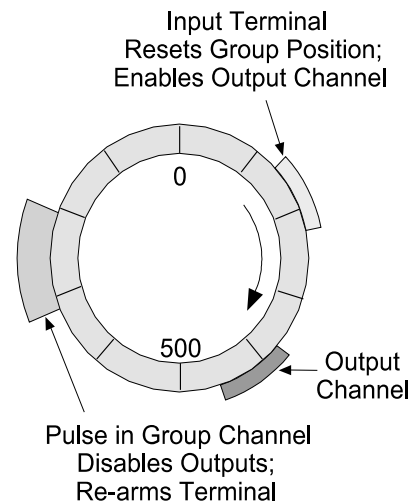
Applications

This mode is used where products may not be evenly spaced and the group outputs should cycle only when a product has been sensed.

Details

- 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 is de-energized and the leading edge of a pulse 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 3.

Mode 2 Typical Setup



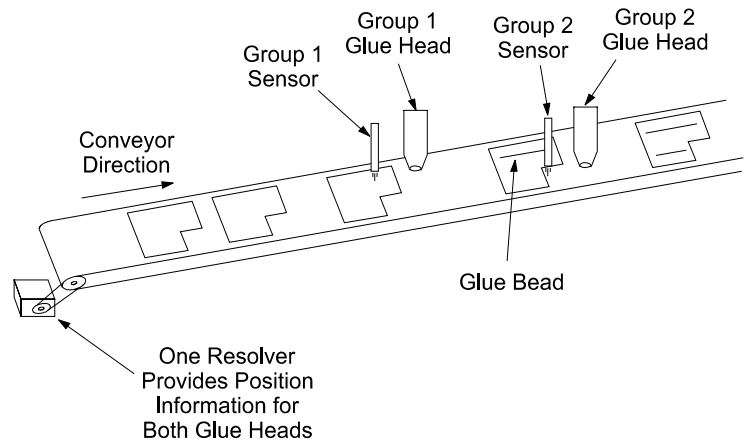
Mode 2 Operation (Cont'd)

- Either edge of a pulse 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 pulse will re-arm the terminal. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the “off” edge of the pulse will re-arm the terminal.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 2 group.

Figure 30—Mode 2 Example Application

Two glue heads at different locations on the conveyor are controlled independently by a single PLS controller and resolver. The spacing between parts being glued 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 glue guns at the correct setpoints.

When parts are not present, the outputs will be inactive.



Mode 2 Programming

See Figure 28 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the “Preset” value for any Mode 2 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 pulse in the group channel to disable the output channels and re-arm the input terminal. This pulse must be after all of the output channels have completed their functions, but before the input terminal will be energized.

Mode 3 Operation

Description

Outputs in a group assigned to Mode 3 are on only while their programmed setpoints are on AND the corresponding input terminal is energized. If the input is off, all of the outputs in the group will be off, regardless of setpoint programming. See Figure 28 for input terminal channel assignments.

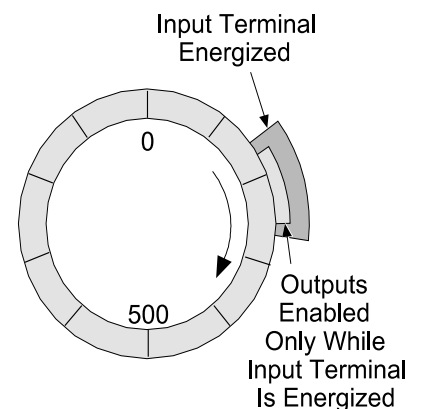
Applications

Use this mode where outputs should be active only while a sensor or limit switch is on.

Details

- 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.
- MOTION ANDING and OUTPUT ENABLE 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.

Mode 3 Typical Setup



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Mode 3 Operation (Cont'd)

Mode 3 Programming

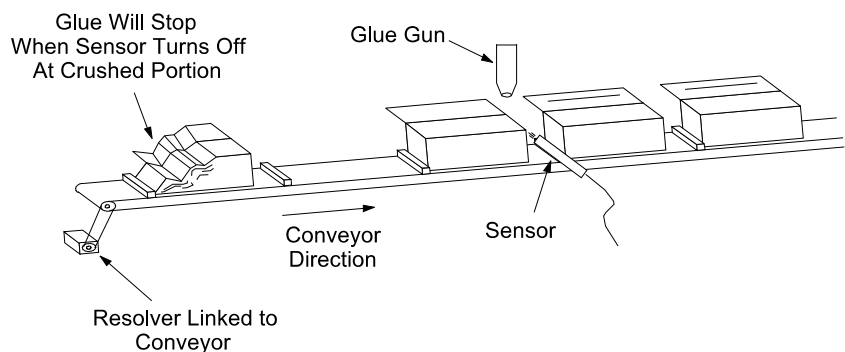
See Figure 28 for input terminal assignments.

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the absolute offset value for any Mode 3 groups.
3. Program setpoints into the output channels in the group. Remember that the output channels in Mode 3 will be enabled only while a signal is applied to the group terminal.

Figure 31—Mode 3 Example Application

In this illustration the glue head will operate only while the photo eye sees the top edge of a carton. Gluing will stop on crushed or improperly erected cartons when the eye loses sight of the top edge.

Mode 3 operation eliminates the need to hard-wire photoeyes and other sensors in series with the corresponding controller outputs. Instead, the sensor is “ANDed” with the output through Mode 3 programming.



Mode 4 Operation

Description

For a group in Mode 4, outputs will be enabled to turn on at their programmed setpoints for one machine cycle if the corresponding input terminal turns on within a pulse programmed into the group channel. Outputs will be disabled at the start of the next pulse in the group channel. See Figure 28 for input terminal and group channel assignments.

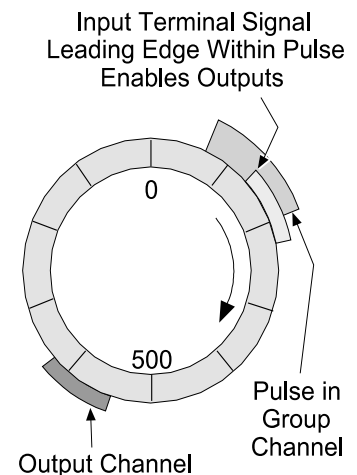
Applications

Use this mode to check the presence and correct positioning of a product before enabling the outputs for this machine cycle.

Details

- The leading edge of the signal from the input terminal must occur during the pulse in the group channel. If the leading edge occurs before the pulse, the outputs will not be enabled.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- Either edge of a pulse 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 pulse will disable the outputs. If the shaft is rotating in the reverse direction (position decreasing as shaft rotates), the “off” edge of the pulse will disable the outputs.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 4 group.
- The machine position for a Mode 4 group can be set through OFFSET programming.

Mode 4 Typical Setup



Mode 4 Operation (Cont'd)

Mode 4 Programming

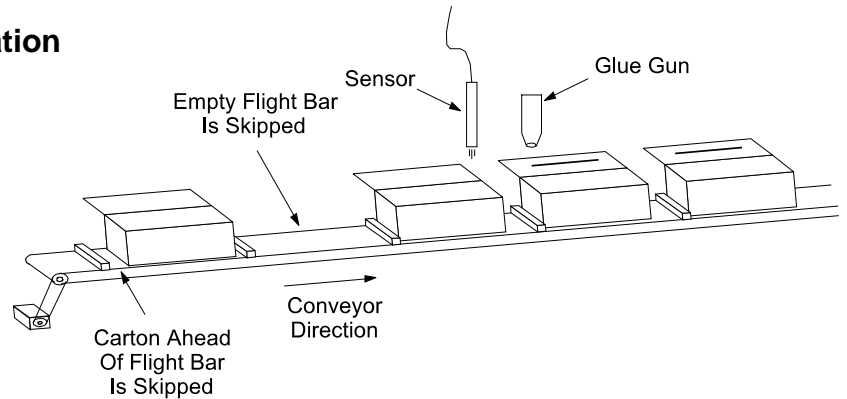
See Figure 28 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the absolute offset value for any Mode 4 groups.
3. Jog the machine to the point where the group input terminal will energize. Program a pulse in the group channel that will turn on a little earlier than this point, and off a little later. The shorter the pulse, the narrower the portion of the machine cycle in which the input signal will enable the outputs.
4. Program setpoints into the output channels in the group. Remember that the leading edge of the pulse in the group channel will disable the output channels in the group.

Figure 32—Mode 4 Example Application

The glue gun will be enabled for one machine cycle only if the sensor detects the leading edge of a carton during the pulse programmed in the group channel. If a carton is missing or incorrectly positioned, the glue gun will not activate.

Mode 4 operation is appropriate for flight bar conveyors, rotary index tables, and similar types of machinery.



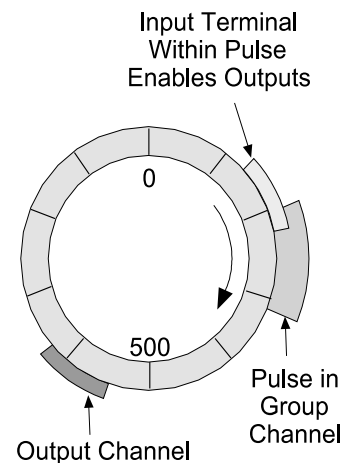
Mode 5 Operation

Description

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

- In Mode 4, the **leading edge** of the input terminal signal must occur within the pulse programmed into the group channel.
In Mode 5, the group outputs will be enabled if **any portion** of the input signal occurs within the pulse.
- If the machine stops, the group outputs will be disabled immediately. This prevents an operation such as gluing from continuing if the machine stops while the glue gun is on.
- If the machine is stopped and the group's input terminal is "on," energizing the First Cycle Enable terminal #15 on TB 1, Fig. 7, will re-enable the outputs. This allows the operation to be completed on a product that was in process when the machine stopped.

Mode 5 Typical Setup



Details

See Figure 28 for input terminal and group channel assignments.

- Regardless of its programmed "off" point, the pulse in the group channel will end 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.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 5 group. Use MOTION ANDING to prevent the First Cycle Enable terminal from re-activating the outputs while the machine is stopped.
- The machine position for a Mode 5 group can be set through OFFSET programming.

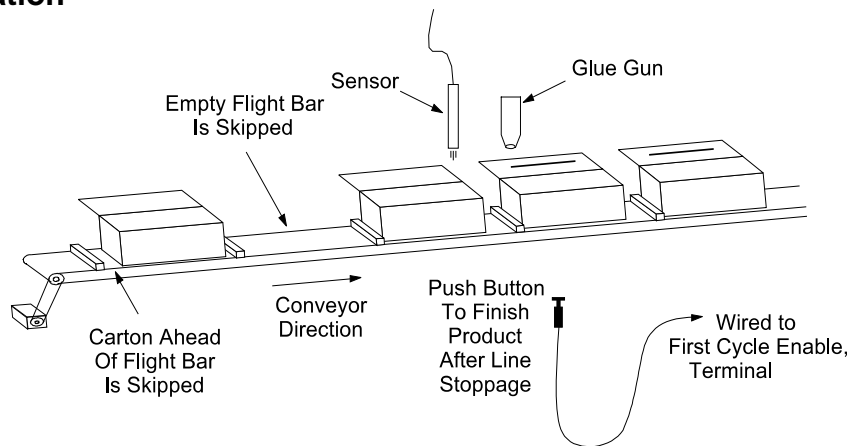
Mode 5 Operation (cont'd)

Figure 33—Mode 5 Example Application

The glue gun will be enabled for one machine cycle if the sensor sees a carton during the pulse programmed into the group channel. If a carton is missing, the glue gun will not activate.

If the line stops, the glue gun will be disabled immediately. To re-enable the glue gun on the same machine cycle, depress the push-button while the product sensor is "on."

Note: Sensor must be active after stopping.



Mode 5 Programming

See Figure 28 for input terminal and group channel assignments.

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the absolute offset value for any Mode 5 groups.
3. Jog the machine to the point where the group input terminal will energize. Program a pulse 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 pulse, the narrower the portion of the machine cycle in which the input signal will enable the outputs.
4. Using the start of the overlap from Step 3 as a reference point, program setpoints into the group output channels. Don't overlap the setpoints with the group channel pulse programmed in Step 3.

Speed Compensation & Modes

Speed Compensation

Speed compensation will affect individual channels in an output group as programmed through SPEED COMP. **However, speed compensation will not affect the group channels, 91 through 96.**

When using speed compensation and modes together, be aware that speed compensation may shift an output channel's setpoints into a pulse programmed in the group channel, or into the position in which an input signal will occur. Depending on the Mode and the arrangement of setpoints, speed compensation may produce unexpected results.