

Introduction to Groups & Modes - Using External Inputs to Condition PLS Outputs

Background

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:

- **Product Present**

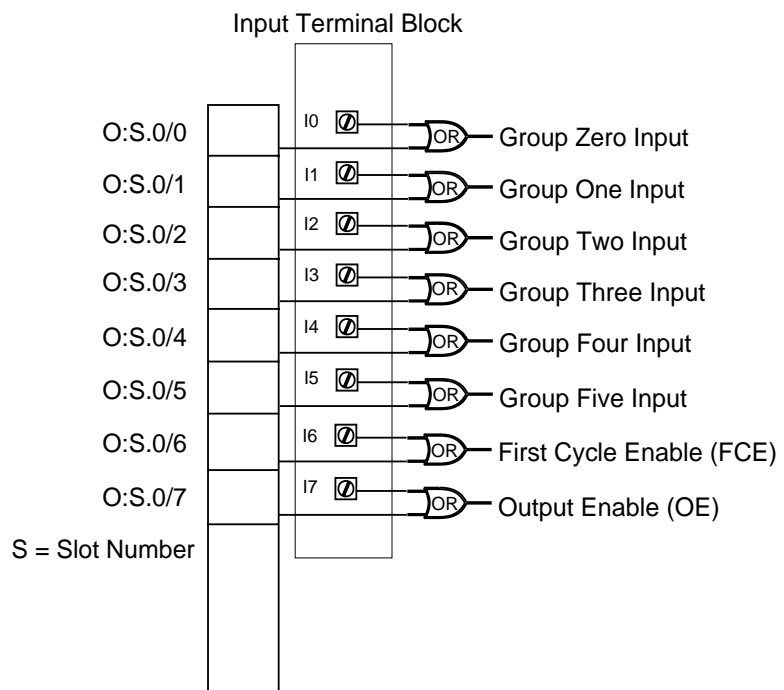
The device being controlled is allowed to function only if an input signal occurs. A typical example is gluing, where a photoeye senses the presence of a product immediately before gluing should occur. If the product is not present, the glue gun is not enabled to turn on at its programmed setpoints.

- **Register Marks**

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.

Input Signals

When the Output File word 0 (O:S.0) is not mapped, its low byte, containing group inputs, the First Cycle Enable input, and the Output Enable input, is or'ed with the input status terminals, which may be located on a PS-4108 rack (for C01 model) or on the front panel (C02 & C03 models). When the first word of the SLC output file is mapped, the group inputs, FCE and output enable inputs are driven directly strictly by the input terminals.



Groups & Modes

The PL-1746 PLuS Module 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 a group input. 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.

Introduction to Groups & Modes (cont'd)

Each group also has an associated Group Channel that is used to signal when group logic should be reset. Group channels are numbered 90 through 95. Pulses are programmed into group channels just as they are programmed into output channels.

Group Programming

Output channels are divided into groups through OUTPUT GROUP programming. When dividing outputs into groups, keep these rules in mind:

- Output channels are assigned to groups sequentially. Group 0 will begin with Output Channel 0 and include the specified number of channels; Group 1 will begin with the next output channel and continue sequentially for its specified number of channels; etc. The last group will automatically include all of the remaining output channels.

Grouping Example 1—All Outputs in One Group

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input</u>	<u>Group Channel</u>
0	0 thru 31	0	90

Grouping Example 2—Two Groups

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input</u>	<u>Group Channel</u>
0	0 thru 3	0	90
1	4 thru 31	1	91

Grouping Example 3—Three Groups

<u>Output Group</u>	<u>Includes Output Channels</u>	<u>Group Input</u>	<u>Group Channel</u>
0	0 & 1	0	90
1	2 & 3	1	91
2	4 thru 31	2	92

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 group input, and its group channel. Detailed discussions of each operating mode follow.

Mode 0 - Straight Cam Logic

Description

Output channels in a group assigned to Mode 0 are not affected by the corresponding input terminal or group channel.

Details

- 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 GROUP OFFSET programming, Chapter 4.

Mode 0 Programming

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

Mode 1 - Reset to Preset Position

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 GROUP OFFSET function. 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.

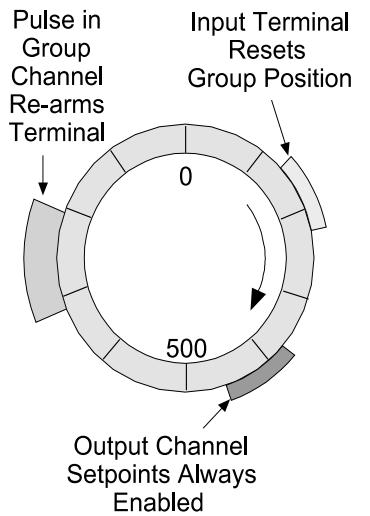
Applications

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

- 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 group channel is affected in the same manner as the output channels.
- On start-up, the input terminal is armed and the group position is the same as the value programmed in MACHINE OFFSET. On power-down, the group's current position setting will be lost.
- If position is increasing as shaft rotates, the "on" edge of the pulse will re-arm the terminal. If position is decreasing as shaft rotates, the "off" edge of the pulse will re-arm the terminal.
- Each program in the controller can have different pulses in its output channels and corresponding group channels.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a group operating in mode 1.

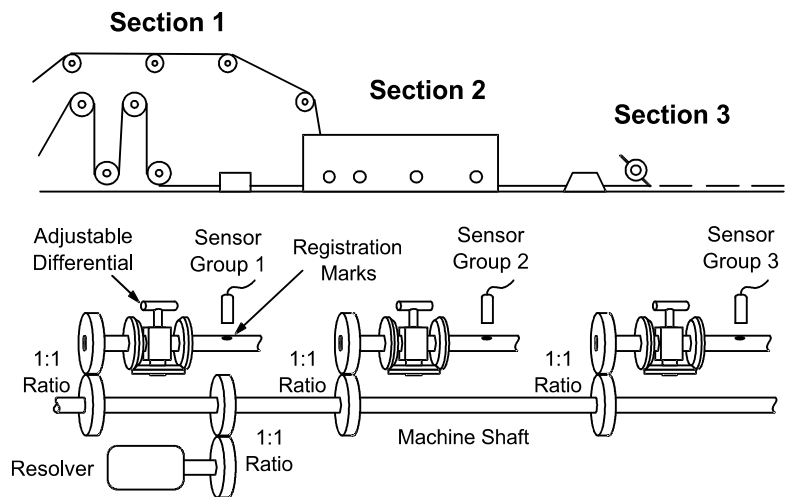
Mode 1 Typical Setup



Mode 1 Example Application

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

1. Program OUTPUT GROUPS to establish groups and modes.
2. Program the preset value for the group using GROUP OFFSET.
3. Jog the machine to the point where the group input terminal will energize. Using this point as a reference, program pulses into the group's output channels.
4. Program a pulse in the group channel.

Mode 2 - Reset to Preset Position with One Cycle Enable

Description

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

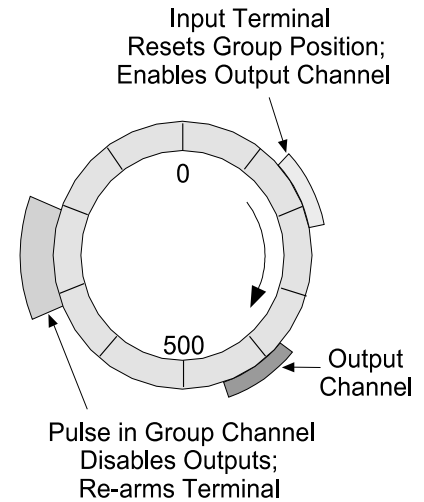
Applications

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, group channel is affected in the same manner as the output channels.
- On power-up, outputs are disabled, the input terminal is armed, and the group position is the same as the value programmed in MACHINE OFFSET.
- If position is increasing as shaft rotates, the "on" edge of the pulse will re-arm the terminal. If position is decreasing as shaft rotates, the "off" edge of the pulse will re-arm the terminal.
- Each program in the controller can have different pulses for output channels and group channels.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a group operating in mode 2.

Mode 2 Typical Setup

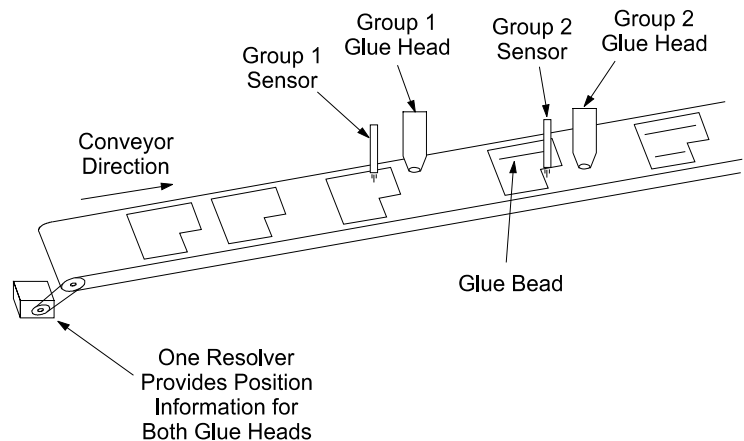


Mode 2 Example Application

Two glue heads at different locations on the conveyor are controlled independently by a single PLuS 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's position to the preset values and enables the group's outputs to turn on the glue guns at the correct pulse edges.

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



Mode 2 Programming

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use GROUP OFFSET to program the preset value for any groups operating in mode 2.
3. Jog the machine to the point where the group input terminal will energize. Using this point as a reference, program pulses 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 - Outputs Gated by Group Inputs

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.

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 group operating in mode 3.
- The machine position for a group operating in mode 3 can be set through GROUP OFFSET programming.

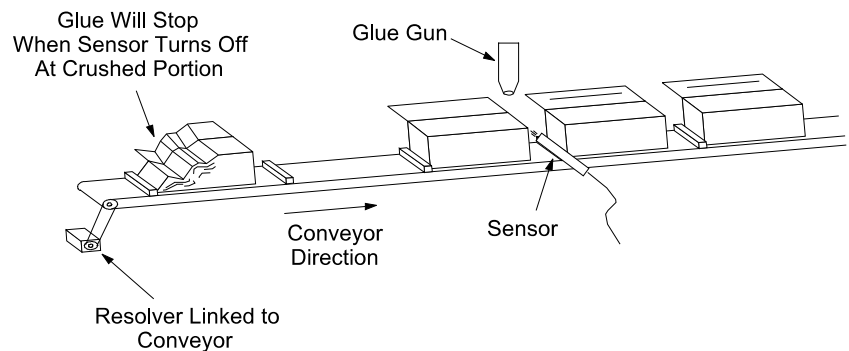
Mode 3 Programming

1. Program OUTPUT GROUPS to establish groups and modes.
2. Use GROUP OFFSET to program the absolute offset value for the group.
3. Program pulses into the output channels in the group.

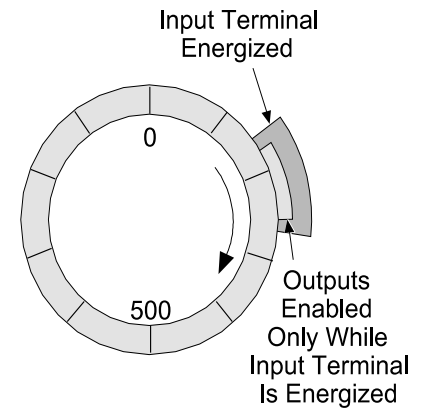
Mode 3 Example Application

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 3 Typical Setup



Mode 4 - One Cycle Enable with Edge-Triggered Input

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.

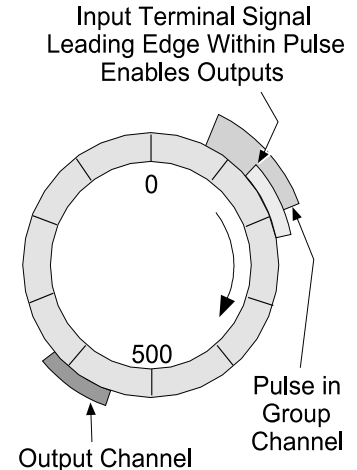
Applications

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 or after the pulse, the outputs will not be enabled.
- Each program in the controller can have different pulses for output channels and group channels.
- If the resolver position is increasing as shaft rotates, the ON edge of the pulse will disable the outputs. If the resolver position is 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 group operating in mode 4.
- The machine position for a group operating in mode 4 can be set through GROUP OFFSET programming.

Mode 4 Typical Setup



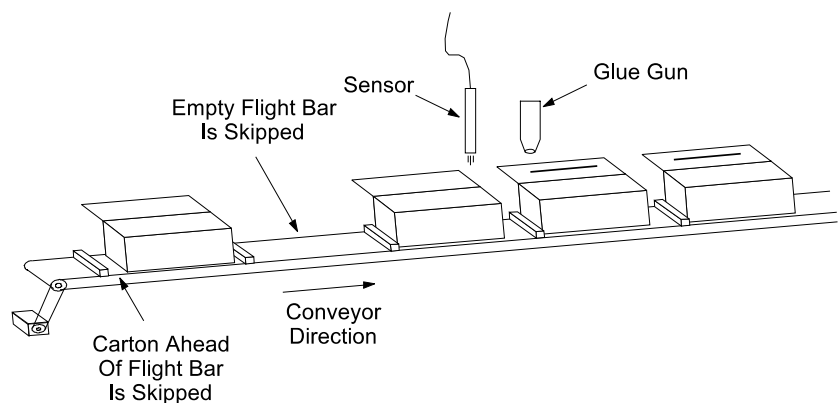
Mode 4 Programming

1. Use OUTPUT GROUPS to establish groups and modes.
2. Use GROUP OFFSET to establish the absolute offset value for any groups operating in mode 4.
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 pulses into the group's output channels. Remember that the leading edge of the pulse in the group channel will disable the output channels in the group.

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.



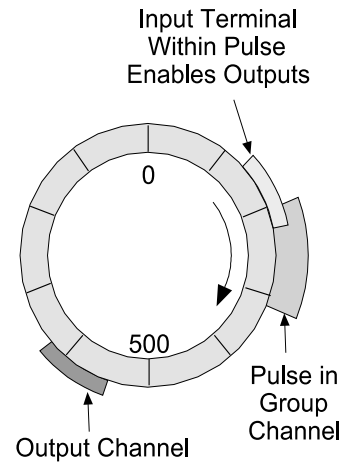
Mode 5 - One Cycle Enable with Level-Triggered Input and First Cycle Enable

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 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



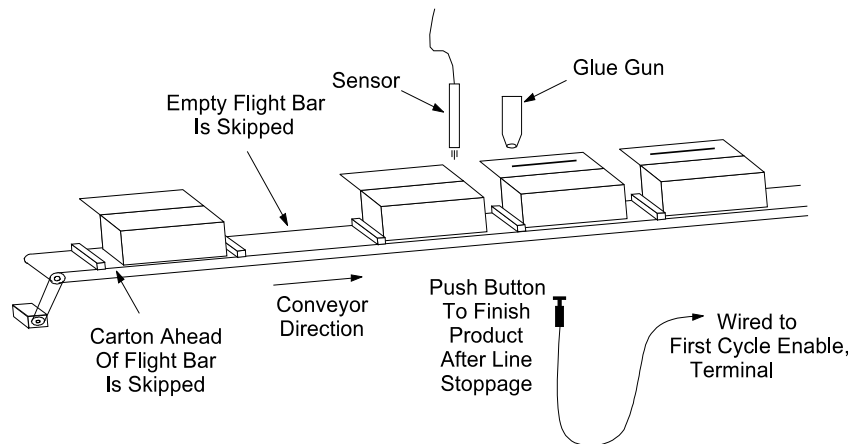
Details

- 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 group channels.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs operating in mode 5. 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 group operating in mode 5 can be set through GROUP OFFSET programming.

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.



(continued)

Mode 5 - One Cycle Enable with Level-Triggered Input and First Cycle Enable

Mode 5 Programming

1. Use OUTPUT GROUPS to establish groups and modes.
2. Use GROUP OFFSET to program the absolute offset value for any groups operating in mode 5.
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 pulses into the group's output channels. Don't overlap the pulses with the group channel pulse programmed in Step 3.