

Mechanical Cam Switches

Mechanical Cams

The PS-6144 Programmable Limit Switch electronically simulates mechanical cam switches. A cam switch consists of a roller limit switch whose arm rides on a cam as shown in Figure 1. The cam shaft is driven by a machine at a 1:1 ratio, so that the cam switch turns on and off at specific positions in the machine cycle. Cam limit switches have the following disadvantages:

- The roller, the cam, and the limit switch wear out.
- The machine must be stopped during adjustment.
- On/off patterns are limited, and changing the pattern may require replacement of one cam with another. For example, a cam that switches on and off twice in one revolution would need to be replaced with a different cam if three on/off pulses per revolution were required.
- They cannot run at high speeds because of contact bounce and excessive mechanical wear.

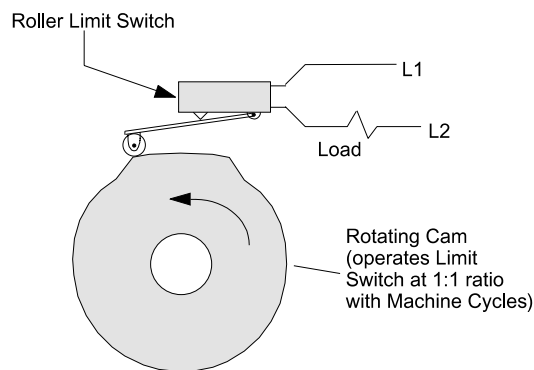


Figure 1—Basic Cam Switch

Programmable Limit Switches

PS-6144's & Resolvers

The PS-6144 Programmable Limit Switch uses a resolver (see Figure 2 on page 2) instead of a cam to indicate machine position. A resolver uses fixed and rotating coils of wire 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, the PS-6144 Programmable Limit Switch turns electrical circuits, or "Outputs," on and off, simulating the mechanical roller limit switch. Because the combination PS-6144/resolver system is completely electronic and has no frictional parts, it offers several advantages over mechanical cam switches:

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

Programmable Limit Switches



Figure 2—PS-6144 Programmable Limit Switch and Resolver

PS-6144 Description

Controller & Keypad

PS-6144 Series Programmable Limit Switches consist of two main components, the controller and the keypad/display. The controller houses the microprocessor, associated circuitry, and all of the I/O circuits. This eliminates the need for external I/O racks.

A separate 1/4 DIN keypad/display provides a complete user interface from which every aspect of the controller's operation can be monitored and programmed. Multiple keypads can be connected to a single controller. In addition, when interfaced to a PLC or other computer, the controller can be used without a keypad/display. When properly mounted with the gasket provided, the keypad/display meets NEMA 4 standards. A clear silicon rubber boot assembly is available to provide NEMA 4X protection for installations where harsh washdown chemicals are used.

The PS-6144 Series is available in two models, the PS-6144-24-X16-M09 and the PS-6144-24M17. Both are described in Figure 3.

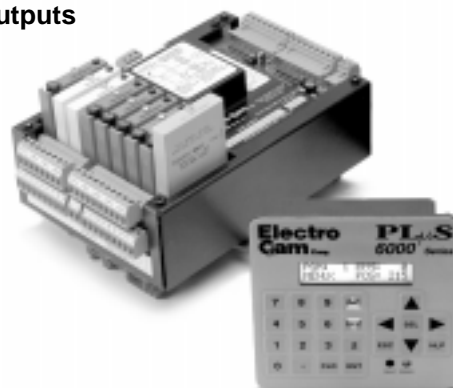
PS-6144-24M17 Controller—Up to 17 Outputs



The PS-6144-24M17 has 17 total outputs:

- Outputs 1 through 17 can accept AC or DC output modules for driving “real world” devices such as solenoids, valves, or glue guns.
- Outputs 16 & 17 will also accept an analog module that generates a control signal proportional to RPM.

PS-6144-24-X16-M09 Controller—Up to 25 Outputs



The PS-6144-24-X16-M09 has 25 total outputs:

- 16 transistor outputs are built into the controller.
- Outputs 17 through 25 can accept AC or DC output modules for driving “real world” devices such as solenoids, valves, or glue guns.
- Outputs 24 & 25 will also accept an analog module that generates a control signal proportional to RPM.

Figure 3—PS-6144 Models

Basic Terminology

The following terms will be used throughout this manual to explain PS-6144 installation, programming and operation:

Channels

Each Channel (CHN) in the PS-6144 controller contains “on” and “off” setpoints for one 360° revolution of the resolver shaft. Channels are one of two types:

Output Channels—These channels use a switching transistor or an output module to turn an external circuit on or off. One or two output channels in a controller may also use an analog output module to generate a control signal that is proportional to RPM.

Group Channels—These channels control the interaction between groups of outputs and an input received from a sensor or other controlling device. See Section 5 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 can be programmed into a channel through the keypad/display, or they can be downloaded from a computer or PLC through serial communications. The PS-6144 can turn any given channel on and off multiple times within one rotation.

Pulses

A “pulse” is the “on” period between the time a channel is turned on and off. The “on” setpoint is the **leading edge** of the pulse, and the “off” setpoint is the **trailing edge**. When multiple pairs of setpoints are programmed into one channel, the channel is said to have multiple pulses.

Programs

Suppose that 15 output channels on a cartoner are programmed with setpoints to fold and glue a certain size carton. These settings could be stored as a “program.” The 15 output channels could then be re-programmed with different setpoints for a different size carton. This second set of setpoints could also be stored as a program. To change carton sizes, an operator could simply activate the correct program, and the corresponding setpoints would take effect.

Standard PS-6144’s can store up to 48 programs. The active program can be selected through the keypad/display, mechanical switches, direct PLC interface, or serial communication messages.

Inputs (hardware inputs)

In addition to accepting a signal from the resolver, the PS-6144 can accept up to 16 input signals from mechanical switches, relay contacts, DC two- or three-wire sensors, solid state DC output modules, or PLC DC outputs. The PS-6144 hardware inputs are dedicated to specific functions involving program selection and controlling output channels based on sensor signals.

Groups and Modes

Output channels can be combined into “groups”, and each group can be associated with an input terminal in any of six different “modes” of operation. For example, some modes activate the group only when the corresponding input has signaled that product is present. Glue control is a typical application where outputs are disabled until product is sensed. See Section 5 for details.

PS-6144 Standard Features

Scale Factor

The user can program the number of increments per revolution, or “Scale Factor.” For example, to make the controller display position in degrees, a Scale Factor of 360 is used. For some applications, Scale Factor may be set to define increments in terms of linear distance, such as one increment equals 0.1” of travel. Standard controls have a maximum of 1024 increments per revolution, while “-H” option (high resolution) controls have a maximum of 4096 increments per revolution.

Programming Access

Three levels of programming access are provided: Operator, Setup, and Master. Each level can be assigned a password that must be entered to allow programming at that level. In addition, the Operator and Master levels can be activated on an individual keypad through hardware terminals on the back. Careful use of programming access levels can provide key personnel the flexibility they need in programming the controller, while protecting settings against accidental or unauthorized changes.

PS-6144 Standard Features (Cont'd)

Speed Compensation	Speed compensation advances the setpoints for an output as machine speed increases. This eliminates the need to manually adjust the setpoints for fixed-response devices when machine speeds are changed. Speed compensation provides greater accuracy, higher production speeds, and reduced downtime for machine adjustment.
Motion ANDing	Two speed ranges can be programmed into the controller, and outputs can be ANDed with either speed range so that they will be disabled unless the machine speed is within the range. A common use for this feature is disabling outputs to glue valves to turn off glue flow if the machine stops.
Timed Outputs	Timed outputs are programmed like standard outputs to turn on and off at specific points of resolver rotation. However, once a timed output is on, it will remain on for a specified time period, regardless of RPM. If the programmed "off" position is reached before the time period passes, the output will turn off. Timed outputs are used to drive devices such as pneumatic cylinders which require a fixed time to perform a task, regardless of machine speed.
Analog Outputs	PS-6144 controllers can drive two analog output modules whose output signals will be linearly proportional to RPM. The analog signal level at zero RPM can be programmed, as well as the RPM that corresponds to maximum signal. No measuring equipment is required for initial setup, and calibration is not needed. Typical uses for the analog output are to control glue pressure as machine speeds change, or to match speeds of other equipment to the machine being controlled by the PS-6144.
Serial Communication	Using Electro Cam Corp.'s PLSNET software for IBM-PC compatible computers, the controller's entire program can be saved to a disk file or loaded from a disk file to the controller. The program can be printed or edited using the computer. Individual commands may also be sent to the controller to change settings while running.

PS-6144 Optional Features

(-F) Large Program Memory	Depending on the number of outputs used, standard controls can store 48 programs consisting of not more than 1258 total output pulses. Controls with the "-F" option can store up to 256 programs consisting of not more than 4589 output pulses.
(-G) Gray Code Output	This option provides eight bits of position information on outputs one through eight. This "gray code" output can provide position information to a PLC or other electronic control device without the use of expensive PLC accessory cards. The PLC can then make control decisions that do not demand a fast response, while other PLS outputs directly control devices that must operate accurately at high machine speeds.
(-G10) Gray Code Output	This option provides ten bits of position information on outputs one through ten.
(-H) High Resolution	Controls with this option can divide one resolver revolution into as many as 4096 increments. Standard controls use 1024 increments maximum. The "-H" Option allows higher Scale Factors to be used. For example, a Scale Factor of 3600 would allow programming in 0.1 degree increments. Or, for an application in which one revolution equals 24" of linear travel, a Scale Factor of 2400 would result in increments equal to .01" of travel.
(-L) Leading/Trailing Edge Speed Comp	The "-L" option allows the "on" and "off" edges of output pulses to be speed compensated by different amounts. This option is used for devices whose "on" and "off" response times are significantly different. High speed gluing is a common application requiring separate leading/trailing edge speed compensation. See Section 4 for details.
(-MSV) Master/Slave	Master/Slave resolver mode for multiple controllers used with one resolver.
(-MB) Modbus™	Modbus™ ASCII protocol for serial communications.
(-V) Vibration Coating	Vibration protective coating for extra protection against shock and vibration.
(-W) Washdown Boot	Keypads with the "-W" option are rated NEMA 4X and are shipped with a clear silicon rubber boot fitted over and around the keyboard area. In addition to preventing contamination from harsh chemicals, the boot also protects the keyboard from grease, oil, dirt and normal wear that could otherwise shorten the life of the keyboard.