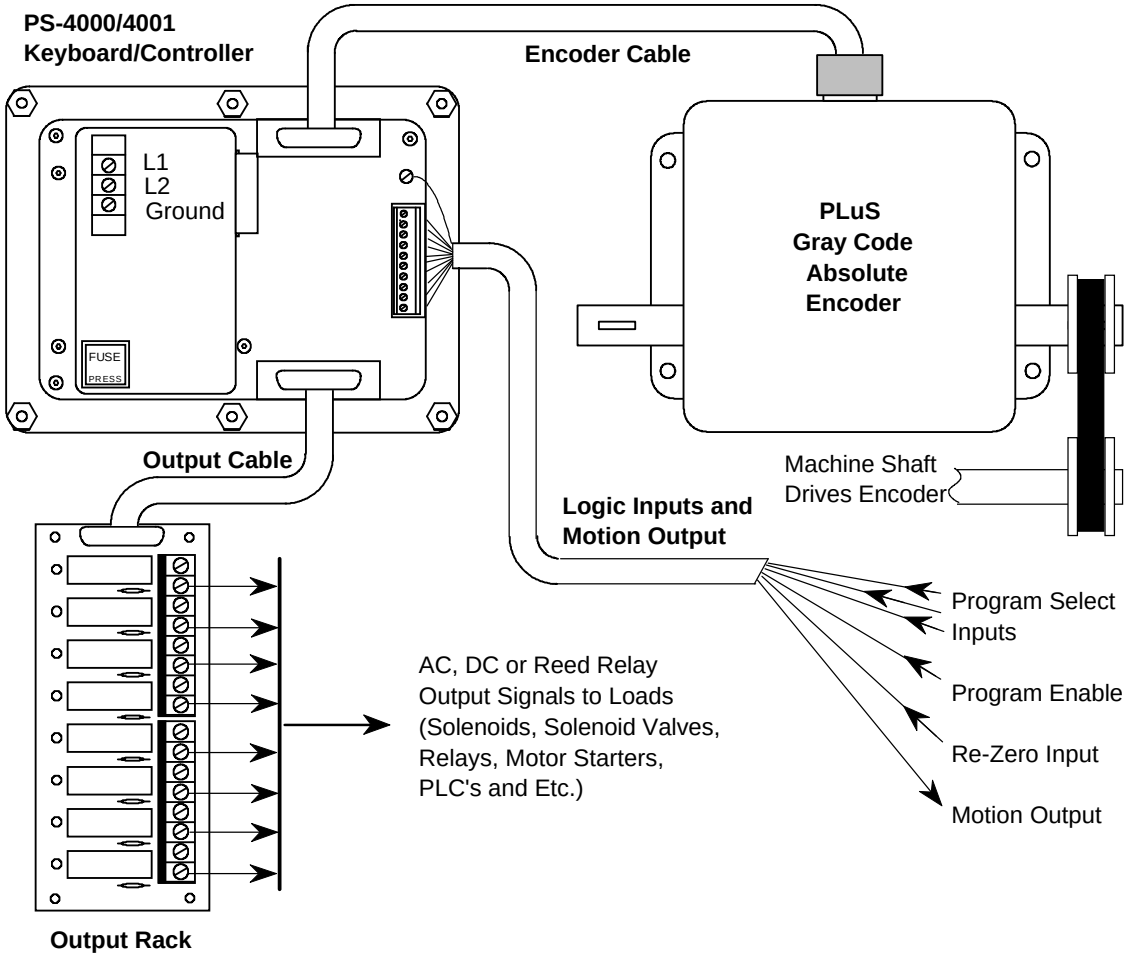
PS-4000/4001 System



PS-4011 System

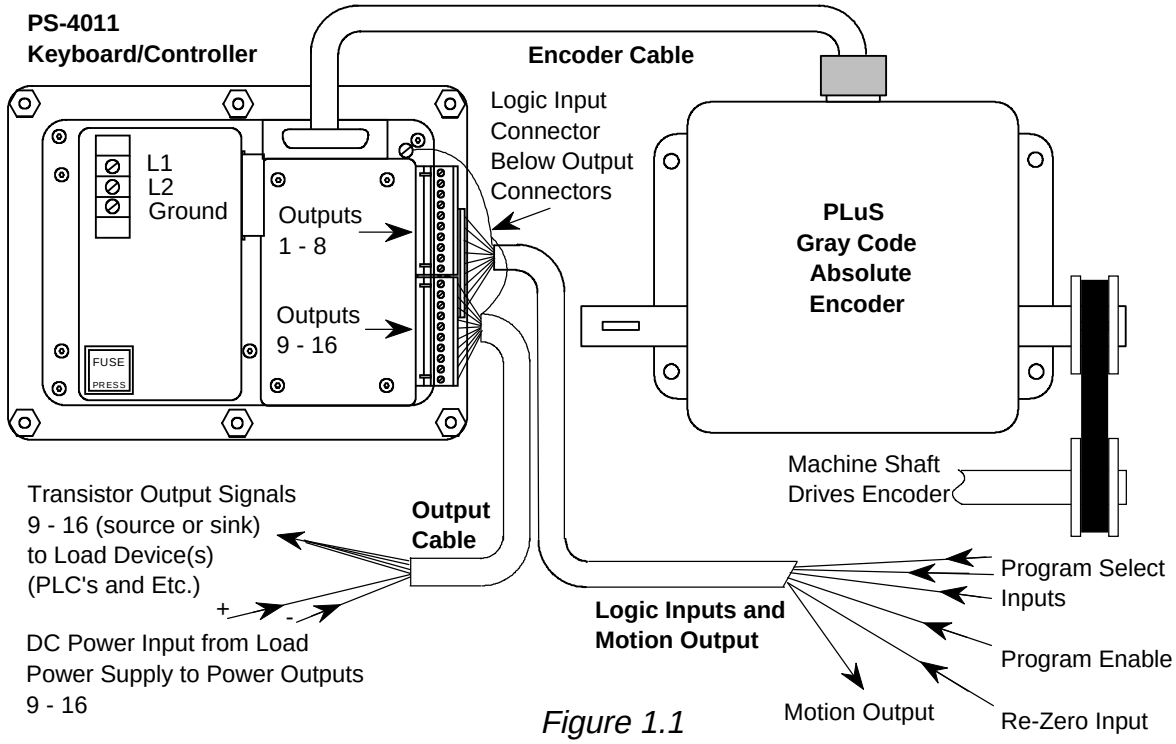


Figure 1.1

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Product Description

Machine control functions must often be synchronized to a rotating shaft. This has been traditionally done by positioning mechanical switches on brackets that surround cams which ride on the shaft. Rotary Cam Limit Switches are a significant improvement; they provide the same function with a simple connection to the input shaft (and at a reduced cost). Programmable Limit Switches (PLS's) provide this same function while allowing remote programming of "ON" and "OFF" setpoints. PLS's also provide users with other advanced features, such as adjustment in motion, programmable offset, RPM and position monitoring, and motion detection.

STANDARD FEATURES

The PLuS controllers are enhanced, multiple program, multiple channel Programmable Limit Switches which accept shaft position input from an absolute Gray code encoder and turn channel outputs on and off according to the position of the encoder shaft. On/off setpoints are programmed through the PLuS Keyboard/Controller, based on 0 to 359 degree shaft rotation. Each output channel has 256 on/off setpoints per revolution of the encoder shaft. The PS-4000/4001 controllers are available with 8, 16, 24 or 48 outputs and the PS-4011 is available with 8 or 16 outputs. The 8, 16 and 24 channel versions have 8 programs, and the 48 channel versions have 5 programs.

NOTE:
All on/off setpoint references in this manual are in **degrees**.

Each separate program contains a complete set of on/off setpoint data for each channel and is stored in non-volatile EEPROM memory. The "active program" (program currently controlling the outputs) is selected through inputs on the back of the PLuS Keyboard/Controller (and/or through the keyboard on PS-4001/4011 model controllers). A new active program may be selected while the unit is in motion. The on/off channel setpoint data for the active program is transferred to the outputs when the encoder input changes.

DEFINITION: ACTIVE PROGRAM

The active program is the program whose channel on/off setpoints are currently being used to update the outputs. When displaying position or RPM, the active program number appears in the LED display above the PGM key. There are up to 8 programs on the PLuS; only one program may be active at a time. When a new program is selected to be active, the on/off setpoint data for all channels is updated to correspond to the data in the newly selected program. Programs which are "not active" may be viewed or changed while the machine is operating. The outputs will continue to be controlled by the "Active" Program.

The output modules used in the PS-4000/4001 systems are optically isolated, and can drive loads (up to 3 Amps) directly. They can also be used to interface with programmable logic controllers or other logic devices. The output transistors used in the PS-4011 are also optically isolated and can drive loads up to 30 VDC, 50 mA. The primary purpose of the model PS-4011 is to interface directly to logic devices (PLC's, etc.) without the use of output racks and modules.

Output channels are programmed through the PLuS Keyboard/Controller and each may have up to 256 on/off setpoints per revolution of the encoder shaft. Pulses are initially programmed while the unit is stopped (RPM = 0) and may extend through 0 (example: “on” at 270 degrees and “off” at 90 degrees). While in motion, the end points of pulses may be moved incrementally by pressing the “INC”(increment) and “DEC” (decrement) keys on the PLuS Keyboard/Controller.

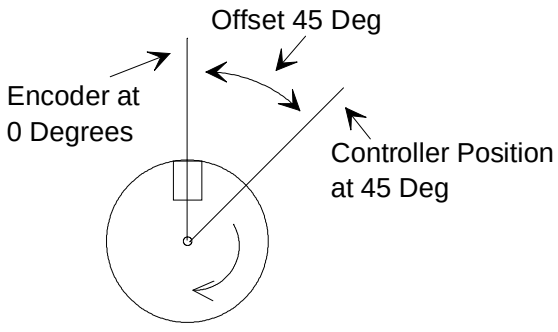
DEFINITION: PULSE

A pulse is the duration of the ON period between an “on” and an “off” setpoint pair. A pulse is programmed by using the “ON” and “OFF” keys in conjunction with numeric entry. A pulse is not entered until both the “on” and “off” setpoints defining it have been entered. Each channel may contain up to 128 pulses (256 on/off setpoints).

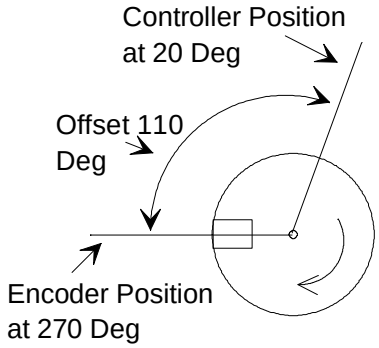
The PLuS controllers incorporate an “offset” which allows “Machine Zero” to be established quickly and easily (Fig 1.2). The amount of offset may be set through the numeric keypad on the PLuS Keyboard/Controllers while the unit is stopped (RPM = 0), and may be incrementally changed while in motion through the “INC” and “DEC” keys. In addition, a “Re-Zero” input on the back of the Keyboard/Controller allows you to **temporarily** set “Machine Zero” at any time. Offset values created by the Re-zero input are not stored in the controller's permanent memory and will be lost when power is removed.

DEFINITION: OFFSET

Offset is the angular difference (in degrees) between the Encoder's actual position and the controller’s position value. This allows the controller’s position value to lead or lag the encoder's actual position by a specified number of degrees. (See figure 1.2). When the offset is 0, the indicated controller position will correspond exactly with the encoder shaft position (when the encoder keyway is straight up the PLuS controller will read a position of 0).



Example 1



Example 2

Figure 1.2 Offset Examples

OFFSET ADJUSTMENT: OFFSET ABSOLUTE (FCN #3)

The “Offset Absolute” function monitors and adjusts the amount of offset in degrees. A different Offset value can be entered numerically when the encoder is not turning or the existing value can be incremented or decremented any time that programming is enabled. The Absolute Offset value should be recorded after the machine is set up and running properly so that it can quickly be re-enter if the offset value is inadvertently changed.

OFFSET ADJUSTMENT: OFFSET RELATIVE (FCN #4)

The “Offset Relative” function monitors and adjusts the current controller position in relation to the Encoder position. A different controller position value (Relative Offset) can be entered numerically when the encoder is not turning or the existing value can be incremented or decremented any time that programming is enabled. This allows the desired controller position to be changed to correspond to the current machine position. Stop the machine in a “known position” and adjust FCN #4 to set the controller position to correspond to that known machine position.

Motion detection is provided through an optically isolated “sourcing” output (5 VDC, 50 mA maximum) on the back of the Keyboard/Controller and through an LED on the keyboard face. High and Low RPM setpoints are provided to establish a “range” of RPM in which the motion detection output (and the LED) will be on.

A “Program Enable” input on the back of the Keyboard/Controller must be energized before programming changes can be made. This input can be used to prevent unauthorized program changes.

The large, easy to read LED display on the face of the Keyboard/Controller may display either RPM (cycles per minute) or controller position in degrees (includes offset).

PS-4001 AND 4011 MODEL ENHANCEMENTS

The PS-4001/4011 model controllers have the same features and physical dimensions as the PS-4000 controllers plus two additional features: 1) Selection of the “Active Program” from the keyboard (Function #5), and 2) Automatic speed compensation on selected output channels (The number of compensated channels and the amount of compensation is selected through functions #6 and #7).

DESCRIPTION OF SYSTEM COMPONENTS

System components, and their relationship to each other, are illustrated on page 1.1, Figure 1.1.

A complete PLuS PS-4000/4001 system consists of:

1) PS-4256 series Encoder (NEMA 12 or NEMA 4X housing and 0 to 1000 or 0 to 2000 RPM must be specified)
2) PS-400X series Keyboard/Controller (8, 16, 24, or 48 outputs)
3) 8, 16 or 24 point Output Rack (2- 24 output racks needed for 48 output system)
4) Encoder Cable (connects the Controller to the encoder)
5) Output Rack Cable (connects the Controller to the output rack - 2 cables needed for 48 output system)
6) Plug-in AC, DC, or Reed Relay Output Modules

All six components must be specified and ordered to have a complete, operating PS-4000/4001 system (ref. Fig. 1.1).

Controller / Output Rack Compatibility:

8 Output Controller: An 8 output rack is best suited to an 8 output controller. A 16 output rack can be used, but only the first 8 output positions will operate.

16 Output Controller: A 16 output rack is best suited to a 16 output controller. An 8 output rack can be used, but only 8 of the controllers 16 outputs can be utilized. Two 8 output racks can NOT be connected to a single controller.

24 Output Controller: A 24 output rack must be used. 8 and 16 output racks will NOT function with a 24 output controller.

48 Output Controller: Two 24 output racks must be used if more that 24 outputs are required. A single 24 output rack can be used if 24 or less outputs are needed (the outputs used can be addressed as 1-24 or 25-48). A second 24 output rack can be added at any time without affecting the wiring of the first output rack.

A complete PLuS PS-4011 system consists of:

1) PS-4256 series Encoder (NEMA 12 or NEMA 4X housing and 0 to 1000 or 0 to 2000 RPM must be specified)
2) PS-4011 series Keyboard/Controller (8 or 16 outputs)
3) Encoder Cable (connects the Controller to the encoder)
4) Output Cable (connects transistor outputs directly to load inputs - Electro Cam PS-4300-04-XXX shielded cable is recommended, 2 cables needed for 16 output system)

KEYBOARD/CONTROLLER

The PLuS Keyboard/Controller is microprocessor based and interrupt driven. Changes in the encoder shaft position generate a hardware interrupt which causes the CPU to suspend its current task (monitoring the keyboard and updating position or RPM display) and immediately update the on/off status of the channel outputs.

A terminal block on the back of the Keyboard/Controller provides logic inputs and motion detection output. Logic inputs are used to select the active program, enable programming, re-zero the indicated shaft position, and determine which direction of encoder shaft rotation causes the indicated position display to increase in value. The re-zero input generates a hardware interrupt for immediate response.

Polarized, screw down DB25 connectors are provided on the back of the PLuS Keyboard/ Controllers to connect the encoder cable. On the PS-4000/4001 controllers, another DB25 connector is used to connect the output rack cable. Encoder and output rack connectors are of different gender so that it is not possible to incorrectly attach cables.

The face of the Keyboard/Controller is constructed of UV hard coated mylar, and is impervious to most environments. Keys provide tactile feedback for keypress verification, and large, easy to read seven segment LED's provide a clear indication of position, RPM, or programming status. Keyboard/Controller units are stud mounted and seal to the mounting surface with the gasket supplied with each unit.

GRAY CODE ENCODER

The PLuS system is designed to use PLuS Encoders which are rugged, sealed, absolute eight bit Gray code encoders. They feature 3/4" double ended shafts supported at both ends by sealed ball bearings. They are available with either Nema 12 or Nema 4X (stainless steel) enclosures and come in two speed ranges. The PS-4256/4456 units are rated at 0 to 1000 RPM. The PS-4257/4457 units are rated at 0 to 2000 RPM. The encoder discs are made of stainless steel. Gray code is output to the Keyboard/Controller via noise immune RS422 differential drivers for reliable operation in harsh industrial environments.

OUTPUT RACKS

8, 16 and 24 point output racks are available for use with the PLuS Keyboard/Controller. The 24 point output racks are "addressable", and two are daisy chained together in 48 output systems.

All output racks provide for individually fused, socketed, optically isolated output modules. The racks are constructed of rugged, .090" thick circuit board material. Connections to the output modules are made through screw down terminal blocks. Bright LED indicators are provided for each module to indicate on/off status (Modules must be in place for Led's to operate).

OUTPUT MODULES (PS-4000/4001)

Output modules must be ordered separately from output racks and are available in AC, DC and reed relay configurations. Both “zero crossing” and “random turn on” AC output modules are available. DC output modules may be wired in either “sinking” or “sourcing” mode, and are available with either 0 to 60 VDC or 0 to 200 VDC ratings.

Output modules can drive loads directly, and may interface directly to programmable logic controllers or other control devices. They can be intermixed in any combination and placed in any position on output racks: up to 8 modules on an 8 Output Rack; up to 16 modules on a 16 Output Rack; and up to 24 modules on a 24 Output Rack.

OUTPUT TRANSISTORS (PS-4011 only)

Sinking or Sourcing transistor outputs must be specified on PS-4011 controllers. The outputs are capable of switching up to 30 VDC, 50 mA maximum. The 18 pin transistor array chips used for each group of 8 outputs are socketed and can be replaced in the field should the need arise. A 1 Amp plug-in fuse is provided for each group of 8 outputs and is also field replaceable. Connection to the transistor outputs is made through keyed, pluggable 10 terminal connectors on the back of the controller.

CABLES

Encoder and Output Rack cables used with the PLuS controllers are pre-assembled at the factory in a variety of standard lengths and shipped ready to install (custom lengths are available). These cables are shielded and are provided with DB25 screw down connectors installed. PS-4011 output cables are cut, stripped and tinned with a spade connector attached to the shield drain wire at the controller end. Program Select and Program Enable cables are shielded, and all wires are cut, stripped, and tinned, and ready to install. All connectors are polarized to insure proper installation, and all discrete wires are clearly labeled. All cables must be ordered separately to customer specified length requirements.

GRAY CODE OUTPUT OPTION

The Models PS-4001/4011 are available with a Gray Code Output option (G Option). The last 8 outputs (16 outputs required minimum) will output an 8 bit Gray Code pattern which is identical to that of the Encoders. The bit pattern output will be the one which corresponds to the controller position, not the encoder position. In other words, the Gray Code output takes into account the Offset. This Gray Code signal can be connected to a PLC or other logic device to provide it with position information.

NOTE: Output Channel 9 is the least significant bit (LSB) and Output Channel 16 is the most significant bit (MSB) of the Gray Code Output.