PLμS® PS-6144 Series

Programmable Limit Switch

Programming & Installation Manual

Electro Cam Corp.
13647 Metric Rd • Roscoe, IL 61073 USA • 815/389-2620 • FAX 815/389-3304 • 800-228-5487 (U.S.A. and Canada)

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Electro Cam PS-6144 Quick Start Guide

Basic program settings required for operation of the PS-6144 controller.

1) **Scale Factor**
Determines the number of counts per revolution of the resolver. The factory default is 360. *To change Scale factor*: In the Scale factor menu, numerically enter the new scale factor and press ENT. Press the ESC key to return main screen.
Menu Path: Main Screen, press SEL, press ▼ key to CONFIG Menu, SEL, SEL to HARDWARE MENU, SEL, ▼ to Scale Factor, SEL.

2) **Direction of Increasing Rotation**
Turn the resolver and verify that the position counts in an increasing direction. If not, change the direction of rotation: In the INCREASING DIR menu, press SEL to change between clockwise (CW) or counter clockwise (CCW) and then press ENT.
Menu Path: Main Screen, press SEL, ▼ to CONFIG Menu, SEL, SEL to HARDWARE MENU, ▼ to INCREACING Dir, SEL.

3) **Set the Displayed Position to Match the Actual Machine Position**
With your machine stopped at zero or a known position, make sure the PS-6144 display matches the position. If not, you must change the Shaft Position setting. In the shaft position menu, numerically enter the position and press ENT key.
Menu Path: Main Screen, press SEL, ▼ to CONFIG Menu, SEL, SEL to HARDWARE MENU, SEL, ▼ to SHAFT POSITION, SEL.

4) **Set the ON/OFF Setpoints for Each Output Channel**
To set the ON/OFF durations for outputs. In the SETPOINTS menu: Press ▼ to place the blinking cursor to the bottom ON/OFF menu line. Press the SEL key, numerically enter your ON setpoint and press ENT. Enter the OFF setpoint and press ENT.
Menu Path: Main Screen, SEL, ▼, SETPOINTS, SEL, choose program number, SEL to setpoint screen.

Note: Repeat step 4 to add additional ON/OFF settings.
You can enter multiple ON/OFF setpoints in a channel, but they can not overlap.
To view all setpoint in a channel, press the ► key to scroll through all ON/OFF points.
To clear a channel of all setpoints, set both the ON and OFF setpoints to "0".

The PS-6144 is now set up to turn outputs ON and OFF at the specified positions.

If you wish to apply additional features to your outputs such as Speed Compensation, Timed Outputs, Motion Anding or product sensing, refer to the appropriate section of this manual for details.

2/28/06

Table of Contents

Section 1—Introduction
- Mechanical Cam Switches 1-1
- Programmable Limit Switches 1-1
- PS-6144 Description 1-2
- Basic Terminology 1-3
- PS-6144 Standard Features 1-3
- PS-6144 Optional Features 1-4

Section 2—Installation & Wiring
- General Mounting & Wiring 2-1
- Mounting Dimensions 2-2
- Terminals & Components
  - PS-6144-24M17 2-3
  - PS-6144-24-X16-M09 2-4
- Controller Input Wiring 2-5
- Output Wiring 2-8
- Keypad Wiring 2-12
- DIP Switch Configurations 2-13
- Communications Wiring 2-15
- Resolver Installation 2-16
- Resolver Dimensions 2-17
- Resolver Cables 2-18
- Fuse Tester & Fuse Replacement ... 2-19
- Output Transistor Replacement 2-20

Section 3—Programming
- Keypad Overview 3-1
- Menu Tree 3-2
- Initial Programming 3-3
- **Functions (Alphabetically)**
  - Analog Output 3-4
  - Analog Quantity 3-5
  - Channel Copy 3-6
  - Communications 3-6
  - Default Program 3-7
  - Enable Codes 3-8
  - Enable Options 3-10
  - Group Position Display 3-10
  - Increasing Direction 3-11
  - Input Status 3-12
  - Keyboard Quantity 3-12
  - Main Screen 3-13
  - Memory Tests 3-14
  - Motion ANDing 3-14
  - Motion Detection 3-15
  - Offset 3-16
  - Output Enable ANDing 3-18
  - Output Groups 3-18
  - Output Status 3-19
  - Password 3-20
  - Per Channel Enable 3-21
  - Program Copy 3-21
  - Program Select Mode 3-22
  - Pulse Copy 3-22
  - Rate Setup 3-24
  - Resolver Type 3-25
  - RPM Update Rate 3-25
  - Scale Factor 3-25
  - Setpoint Use 3-26
  - Setpoints 3-26
  - Shaft Position 3-28
  - Software Version 3-28
  - Speed Compensation 3-28
  - Speed Comp Mode 3-29
  - Timed Outputs 3-30
  - Toggle RPM 3-30

Section 4—Speed Compensation
- Introduction 4-1
- Examples 4-2
- Leading/Trailing Speed Comp. 4-4
- Negative Speed Comp. 4-6
- Programming Guidelines 4-6

Section 5—Output Grouping & Modes
- Introduction 5-1
- Mode 0 5-3
- Mode 1 5-3
- Mode 2 5-4
- Mode 3 5-5
- Mode 4 5-6
- Mode 5 5-7
- Speed Comp & Modes 5-8

Section 6—Communications
- PLuSNET II Program 6-1
- Serial Communications Using
- Electro Cam Corp. Protocol 6-3
- Error Codes 6-12
- Checksum Calculations 6-12
- Serial Communications Using
- Modbus ASCII Protocol 6-13

Section 7—Troubleshooting
- Controller Diagnostics 7-1
- Keypad Diagnostics 7-2
- Resolver Troubleshooting 7-3
- General Troubleshooting 7-4
- Fuse Part Numbers 7-6

Appendix
- Controller Specifications A-1
- Slimline Module Specifications A-2
- Transistor Output Specifications A-3
- Resolver Specifications A-3
- Factory Defaults A-3
- PS-6144 Setpoint Record A-4

Index

WARRANTY

1. Electro Cam Corp. warrants that for a period of twelve (12) months from the date of shipment to the original purchaser, its new product to be free from defects in material and workmanship and that the product conforms to applicable drawings and specifications approved by the Manufacturer. This warranty period will be extended on Distributor or OEM orders to a maximum of eighteen months to take into consideration Distributor or OEM shelf time.

2. The remedy obligations of Electro Cam Corp. under this warranty are exclusive and are limited to the repair, or at its option, the replacement or refund of the original purchase price of any new apparatus which proves defective or not in conformity with the drawings and specifications. Shipment of the claimed defective product to Electro Cam Corp. shall be at the cost of the consumer. Shipment of the repaired or replacement product to the consumer shall be at the cost of Electro Cam Corp. All claims must be made in writing to Electro Cam Corp., 13647 Metric Road, Roscoe, IL 61073 USA.

3. In no event, and under no circumstances, shall Electro Cam Corp. be liable for:

   a. Any product damaged or lost in shipment. Inspection for damage should be made before acceptance or signing any delivery documents releasing responsibility of the delivering carrier.

   b. Product failure or damages due to misuse abuse, improper installation or abnormal conditions of temperature, dirt or other contaminants as determined at the sole discretion of Electro Cam Corp.

   c. Product failures due to operation, intentional or otherwise, above rated capacities as determined at the sole discretion of Electro Cam Corp.

   d. Non-authorized expenses for removal, inspection, transportation, repair or rework. <u>Nor shall the manufacturer ever be liable for consequential and incidental damages, or in any amount greater than the purchase price of the equipment.</u>

4. There are no warranties which extend beyond the description on the face hereof. This warranty is in LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED INCLUDING (BUT NOT LIMITED TO) ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH ARE EXPRESSLY DISCLAIMED. Any legal proceeding arising out of the sale or use of this apparatus must be commenced within (18) months of the date of shipment from the manufacturer.

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.

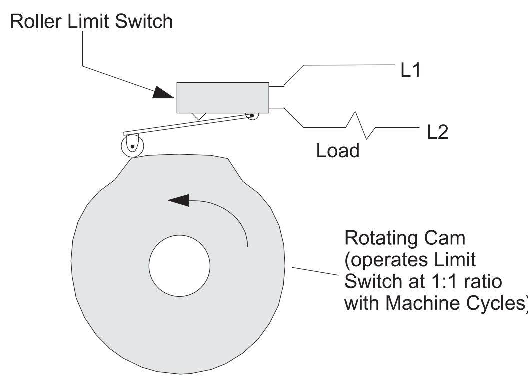


Figure 1—Basic Cam Switch

Programmable Limit Switches

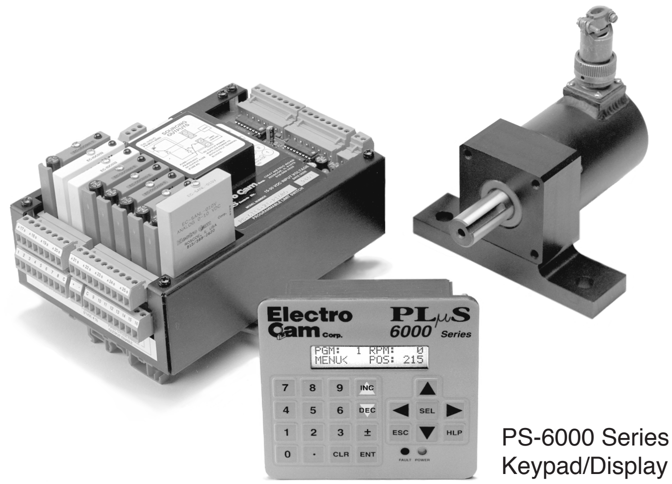
PS-6144's & Resolvers

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.

PS-6144
Controller



Electro Cam Corp.
Foot Mount Resolver
With Side/Top Connection

PS-6000 Series
Keypad/Display

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.

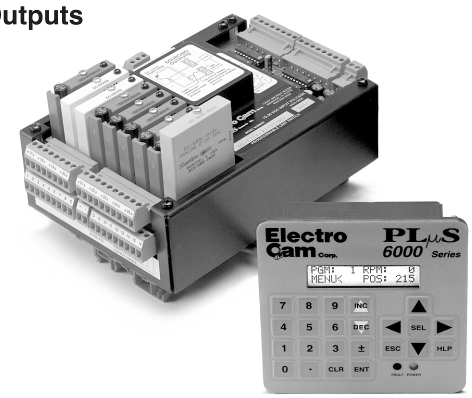
The PS-6144 Series is available in two models, the PS-6144-24-X16-M09 and the PS-6144-24M17. Both are described in Figure 3.

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 PLuSNET 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 PLuS 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.

General Mounting & Wiring

Controller

The controller body mounts on a DIN rail as shown in Figure 4.

Keypad/Display

Mount the keypad/display to a panel using the four studs on the back of the keyboard. Enclosures are available from Electro Cam if an appropriate mounting location does not exist.

DIP Switches

For convenience, set the DIP switches on the side of the controller and keypad to their proper positions before mounting the units in a panel. See page 2-13 for DIP switch information.

Environment

1. Allow space at both sides and the top of controller for terminal blocks to be unplugged.
2. Ambient temperature range is 0° to 55°C (32° to 130°F).
3. Locate the controller and keypad away from devices that generate electrical noise, such as contactors and drives.
4. Use the keypad/display gasket provided to prevent contaminants from getting into the cabinet.

Terminal Blocks

All terminal blocks can be unplugged from the controller. Each block is keyed so it cannot be plugged into the wrong socket. All terminals are labelled on each block.

Wiring Guidelines

Follow normal wiring practices associated with the installation of electronic controls. Some guidelines are:

CAUTION

1. Route input and output wiring away from high voltage, motor drive, and other high level control signals.
2. Use shielded cables for resolver, input, transistor output, and communication circuits. Also shield module output circuits that are driving low current electronic input circuits.
3. Ground shielded cables at the PS-6144 end **only** (except for resolver cable). Use any of the screws on the controller back for grounding.
4. Use appropriate suppression devices where module outputs are directly driving inductive loads.

Power Supply Wiring

Connect a 20 to 30 VDC power supply to TB 8 (Fig. 5 or 6). Reversing the polarity will blow the 1-1/4 amp power fuse. The controller will not be damaged, but you must correct the polarity and replace the fuse before the controller will operate.

To insure electrical noise immunity, connect a good electrical ground to the ground terminal on the power supply terminal block.

Module Mounting

A phillips head screw holds each module in place. Individual modules can be removed and installed without affecting the other modules on the unit.

WARNING

Disconnect power to the controller before changing modules.

Figure 4—Mounting Dimensions

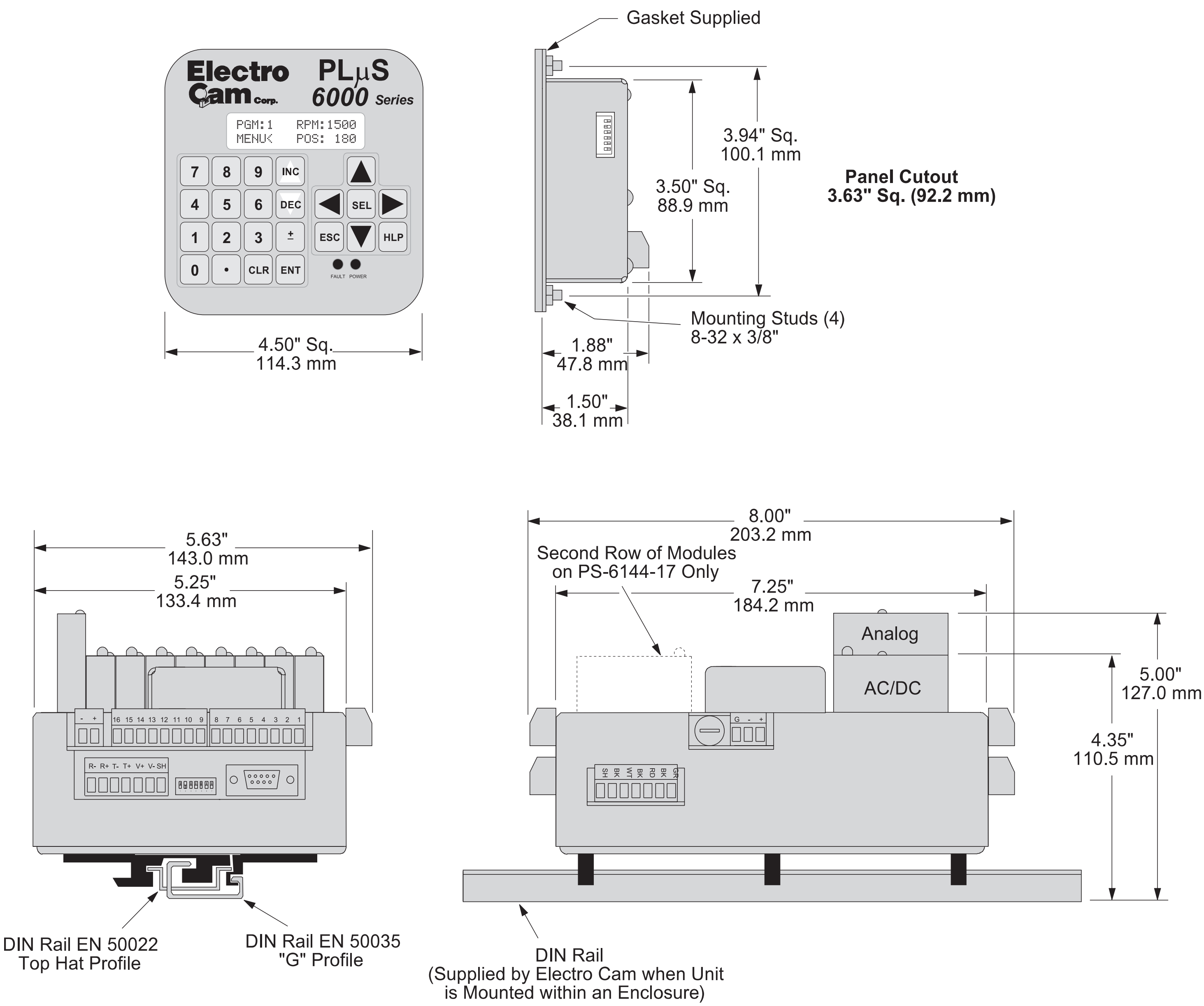
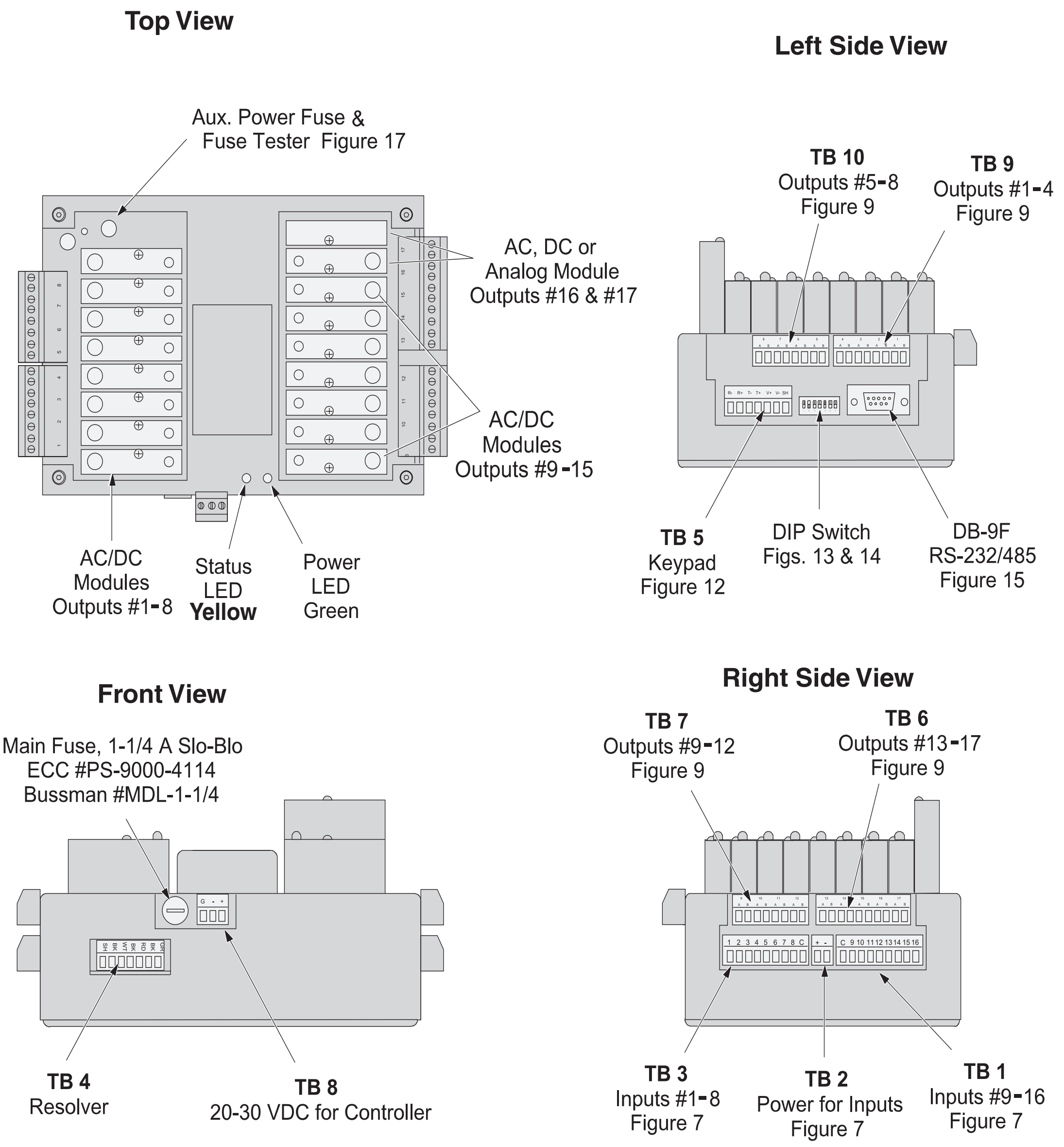


Figure 5—PS-6144-24M17 Terminals & Components



Terminal Block Details

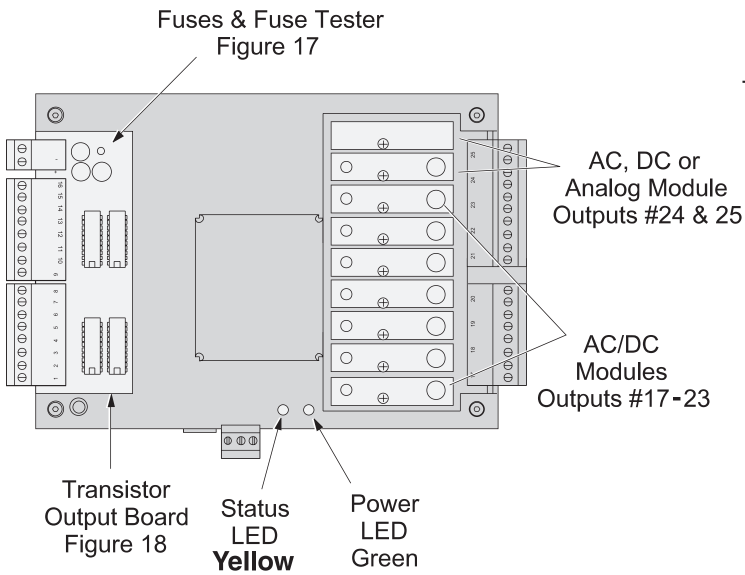
Terminal Block	Function	ECC Part #[1]
TB 1	Inputs #9–16	PS-9006-0024
TB 2	Auxiliary power output	PS-9006-0018
TB 3	Inputs #1–8	PS-9006-0023
TB 4	Resolver connector	PS-5300-01-TER
TB 5	Keypad port connector	PS-9006-0029
TB 6	Module outputs #13-17	PS-9006-0031
TB 7	Module outputs #9-12	PS-9006-0030
TB 8	Power for controller	PS-9006-0026
TB 9	Module outputs #1-4	PS-9006-0033
TB 10	Module outputs #5-8	PS-9006-0034

[1] Keyed to prevent accidental insertion into wrong sockets.

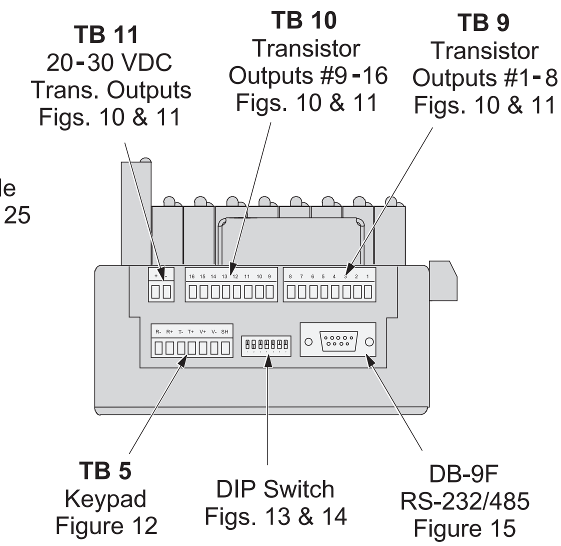
Terminals/Components PS-6144-24-X16-M09

Figure 6—PS-6144-24-X16-M09 Terminals & Components

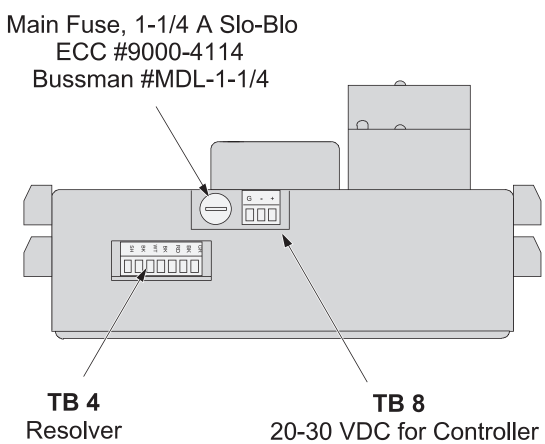
Top View



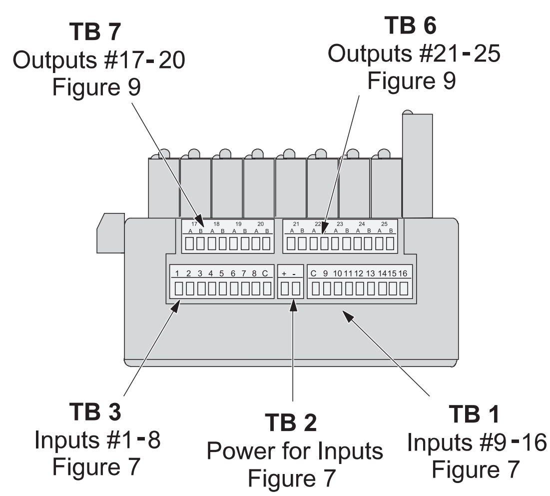
Left Side View



Front View



Right Side View



Terminal Block Details

Terminal Block	Function	ECC Part #[1]
TB 1	Inputs #9–16	PS-9006-0024
TB 2	Auxiliary power output	PS-9006-0018
TB 3	Inputs #1–8	PS-9006-0023
TB 4	Resolver connector	PS-5300-01-TER
TB 5	Keypad connector	PS-9006-0029
TB 6	Module outputs #21–25	PS-9006-0028
TB 7	Module outputs #17–20	PS-9006-0027
TB 8	Power for controller	PS-9006-0026
TB 9	Transistor outputs #1–8, sinking	PS-9006-0019
	Transistor outputs #1–8, sourcing	PS-9006-0021
TB 10	Transistor outputs #9–16, sinking	PS-9006-0020
	Transistor outputs #9–16, sourcing	PS-9006-0022
TB 11	Power for transistor outputs	PS-9006-0017

[1] Keyed to prevent accidental insertion into wrong sockets.

Controller Input Wiring

Input Terminals

Hardware inputs can be used to select a program of setpoints or activate groups of outputs based on sensor signals according to mode logic as described in Section 5.

The 16 inputs on the PS-6144 are arranged on two terminal strips, TB 1 and TB 3, as shown in Figure 7. Each input is optically isolated and can be powered from an external DC power source or the Auxiliary Power terminals located on TB 2.

Sinking or Sourcing

Each terminal strip TB 1 and TB 3 can be wired to accept sinking or sourcing input signals, but all eight inputs on that strip will require the same type of signal. Many types of hardware can drive these inputs, including mechanical switches, relay contacts, DC 3-wire sensors, solid state DC output modules, and PLC DC outputs. 2-wire DC sensors can also be used, but may require a load resistor in parallel with the input. Typical wiring diagrams are shown in Figure 7.

Input Functions

The following are the input terminals and their corresponding functions:

Program Select (1–8)
The on/off status of these terminals selects which program of setpoints is controlling the outputs. Binary, BCD, or Gray Code formats can drive these terminals as shown in Figure 8.

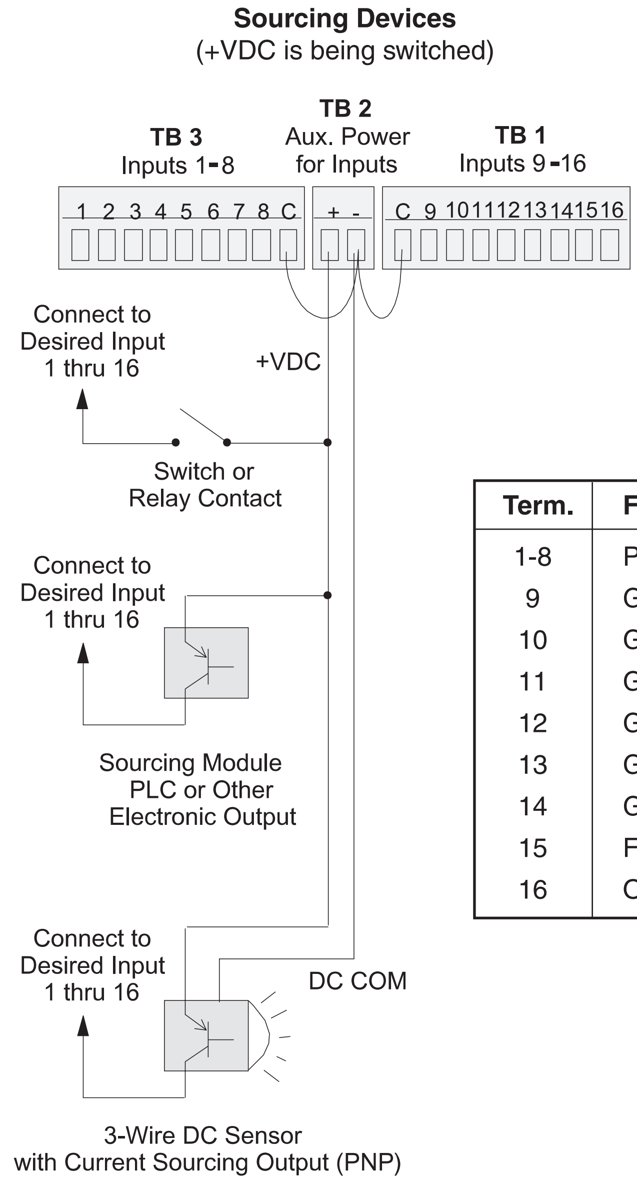
When all program select inputs are off, the "Default" program will become active as programmed through DEFAULT PROGRAM function.

Group Inputs (9–14)
These inputs work in conjunction with groups of outputs according to mode logic as discussed in Section 5. Typically, photo eyes and other sensors will operate these inputs.

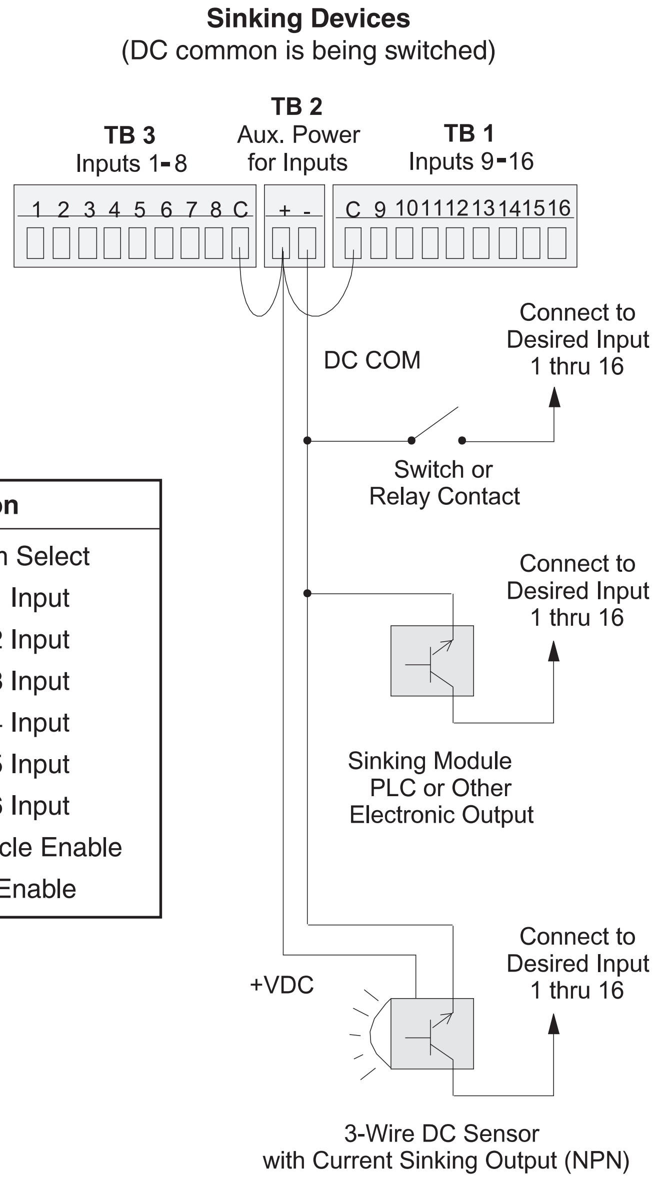
First Cycle Enable (15)
Mode 5 uses this input to allow the first machine cycle to operate the corresponding outputs. See Section 5 for details.

Output Enable (16)
Any of the outputs (except analog) can be ANDed with this input through OUTPUT ENABLE ANDING. Outputs that are ANDed will operate only when this input is on. This can be used in conjunction with Motion ANDing and output modes.

Figure 7—Controller Input Wiring (See Figures 5 & 6 for Terminal Block Locations)



Term.	Function
1-8	Program Select
9	Group 1 Input
10	Group 2 Input
11	Group 3 Input
12	Group 4 Input
13	Group 5 Input
14	Group 6 Input
15	First Cycle Enable
16	Output Enable



Input Wiring Guidelines

- Voltage from TB 2 will be the same as the voltage supplied to the controller.
- Each input powered from TB 2 will draw 11 mA at 24 VDC. TB 2 is fused at 1/4 amp.
- Inputs will operate with voltages from 10 to 30 VDC.
- An external power supply can be used instead of TB 2 to power inputs.
- A combination of mechanical and solid state devices can be used.
- TB 1 can be wired for sourcing while TB 3 is wired for sinking, and vice versa.

Figure 8—Program Select Terminals for Various Formats

BCD Format

	10's			Units			
Input Terminal:	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Value:	40	20	10	8	4	2	1
Program: Default	0	0	0	0	0	0	0
⑨ **1**	0	0	0	0	0	0	1
2	0	0	0	0	0	1	0
3	0	0	0	0	0	1	1
4	0	0	0	0	1	0	0
5	0	0	0	0	1	0	1
6	0	0	0	0	1	1	0
7	0	0	0	0	1	1	1
8	0	0	0	1	0	0	0
9	0	0	0	1	0	0	1
10	0	0	1	0	0	0	0
11	0	0	1	0	0	0	1
12	0	0	1	0	0	1	0
13	0	0	1	0	0	1	1
14	0	0	1	0	1	0	0
15	0	0	1	0	1	0	1
16	0	0	1	0	1	1	0
17	0	0	1	0	1	1	1
18	0	0	1	1	0	0	0
19	0	0	1	1	0	0	1
20	0	1	0	0	0	0	0
21	0	1	0	0	0	0	1
22	0	1	0	0	0	1	0
23	0	1	0	0	0	1	1
24	0	1	0	0	1	0	0
25	0	1	0	0	1	0	1
26	0	1	0	0	1	1	0
27	0	1	0	0	1	1	1
28	0	1	0	1	0	0	0
29	0	1	0	1	0	0	1
30	0	1	1	0	0	0	0
31	0	1	1	0	0	0	1
32	0	1	1	0	0	1	0
33	0	1	1	0	0	1	1
34	0	1	1	0	1	0	0
35	0	1	1	0	1	0	1
36	0	1	1	0	1	1	0
37	0	1	1	0	1	1	1
38	0	1	1	1	0	0	0
39	0	1	1	1	0	0	1
40	1	0	0	0	0	0	0
41	1	0	0	0	0	0	1
42	1	0	0	0	0	1	0
43	1	0	0	0	0	1	1
44	1	0	0	0	1	0	0
45	1	0	0	0	1	0	1
46	1	0	0	0	1	1	0
47	1	0	0	0	1	1	1
48	1	0	0	1	0	0	0

For BCD, calculate the program selected by adding up the values for each of the inputs that are on. For example, if Inputs 5, 3, and 1 are on, Program #15 is active (10 + 4 + 1).

- Only three of the normal four BCD digits for 10's are used.
- **9 is the largest valid value for the units digit.** A units digit combination larger than 9 will set the units digit to 9.

Binary Format

Input Terminal:	**6**	**5**	**4**	**3**	**2**	**1**	
Value:	32	16	8	4	2	1	
Program: Default	0	0	0	0	0	0	
⑨ **1**	0	0	0	0	0	1	
2		0	0	0	0	1	0
3	0	0	0	0	1	1	
4	0	0	0	1	0	0	
5		0	0	0	1	0	1
6	0	0	0	1	1	0	
7	0	0	0	1	1	1	
8		0	0	1	0	0	0
9	0	0	1	0	0	1	
10	0	0	1	0	1	0	
11		0	0	1	0	1	1
12		0	0	1	1	0	0
13	0	0	1	1	0	1	
14	0	0	1	1	1	0	
15	0	0	1	1	1	1	
16	0	1	0	0	0	0	
17		0	1	0	0	0	1
18		0	1	0	0	1	0
19	0	1	0	0	1	1	
20	0	1	0	1	0	0	
21		0	1	0	1	0	1
22	0	1	0	1	1	0	
23	0	1	0	1	1	1	
24		0	1	1	0	0	0
25	0	1	1	0	0	1	
26	0	1	1	0	1	0	
27		0	1	1	0	1	1
28		0	1	1	1	0	0
29	0	1	1	1	0	1	
30	0	1	1	1	1	0	
31	0	1	1	1	1	1	
32	1	0	0	0	0	0	
33		1	0	0	0	0	1
34		1	0	0	0	1	0
35	1	0	0	0	1	1	
36	1	0	0	1	0	0	
37		1	0	0	1	0	1
38	1	0	0	1	1	0	
39	1	0	0	1	1	1	
40		1	0	1	0	0	0
41	1	0	1	0	0	1	
42	1	0	1	0	1	0	
43		1	0	1	0	1	1
44		1	0	1	1	0	0
45	1	0	1	1	0	1	
46	1	0	1	1	1	0	
47	1	0	1	1	1	1	
48	1	1	0	0	0	0	

For Binary, calculate the program selected by adding up the values for each of the inputs that are on. For example, if Inputs 5, 3 and 1 are on, Program #21 is active (16 + 4 + 1).

Gray Code Format

Input Terminal:	**6**	**5**	**4**	**3**	**2**	**1**
Value:	MSB					LSB
Program: Default	0	0	0	0	0	0
⑨ **1**	0	0	0	0	0	1
2	0	0	0	0	1	1
3	0	0	0	0	1	0
4	0	0	0	1	1	0
5	0	0	0	1	1	1
6	0	0	0	1	0	1
7	0	0	0	1	0	0
8	0	0	1	1	0	0
9	0	0	1	1	0	1
10	0	0	1	1	1	1
11	0	0	1	1	1	0
12	0	0	1	0	1	0
13	0	0	1	0	1	1
14	0	0	1	0	0	1
15	0	0	1	0	0	0
16	0	1	1	0	0	0
17	0	1	1	0	0	1
18	0	1	1	0	1	1
19	0	1	1	0	1	0
20	0	1	1	1	1	0
21	0	1	1	1	1	1
22	0	1	1	1	0	1
23	0	1	1	1	0	0
24	0	1	0	1	0	0
25	0	1	0	1	0	1
26	0	1	0	1	1	1
27	0	1	0	1	1	0
28	0	1	0	0	1	0
29	0	1	0	0	1	1
30	0	1	0	0	0	1
31	0	1	0	0	0	0
32	1	1	0	0	0	0
33	1	1	0	0	0	1
34	1	1	0	0	1	1
35	1	1	0	0	1	0
36	1	1	0	1	1	0
37	1	1	0	1	1	1
38	1	1	0	1	0	1
39	1	1	0	1	0	0
40	1	1	1	1	0	0
41	1	1	1	1	0	1
42	1	1	1	1	1	1
43	1	1	1	1	1	0
44	1	1	1	0	1	0
45	1	1	1	0	1	1
46	1	1	1	0	0	1
47	1	1	1	0	0	0
48	1	0	1	0	0	0

Electro Cam 8-position Gray Code selector switches are available as accessories for PS-6144 and other PLuS controls.

Notes Common to All Three Formats

- Because the standard PS-6144 has 48 programs available, **any program select value larger than 48 selects program number 48.**
- The Default Program is determined by programming the DEFAULT PROGRAM function, Section 3.

Output Wiring

Output Types

The outputs available depend on the PS-6144 Model:

Output Type	Model 6144-24M17	Model 6144-24-X16-M09
Transistor	None	Outputs 1-16
AC/DC/RR Modules Only	Outputs 1-15	Outputs 17-23
AC/DC/RR or Analog Modules	Outputs 16 & 17	Outputs 24 & 25

The load device to be driven must match the output type.

Power Output Modules

Output modules can directly switch inductive loads and resistive loads that require more current or voltage than the transistor outputs can supply. **The modules do not supply the power for the load; they simply switch it.** Each output module has two dedicated terminals and therefore does not share any common signal with the other modules. This allows AC and DC modules to be mixed on the same control. DC modules can be wired to sink or source as shown in Figure 9.

Analog Output Modules

Analog output modules generate signals that are proportional to the resolver RPM. They can be used only in the output positions shown above. Either a 0-10 VDC or 4-20 mA analog module can be used in either module position. ANALOG QTY must be programmed for the number of analog modules installed. An external power supply is not needed because the analog modules get the power they source from the controller. The analog output signal is completely isolated.

Transistor Outputs

PS-6144-24-X16-M09 models include 16 transistor outputs to drive the electronic input circuits of other control devices. The outputs are limited to 30 VDC, 50 mA each and should not be used to control inductive devices such as solenoids, solenoid valves or relays.

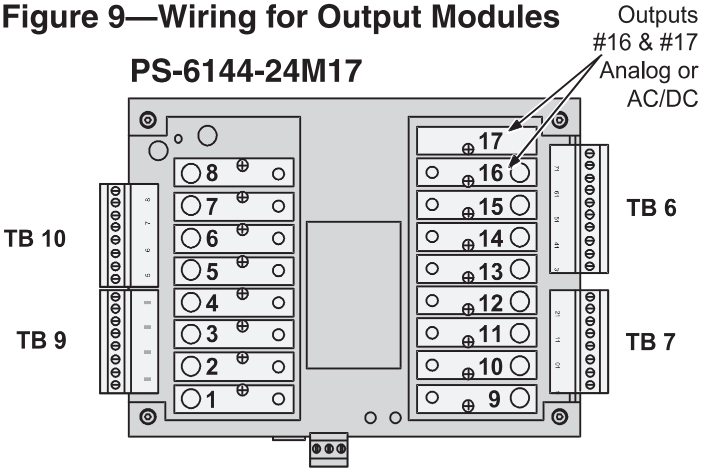
The control can be ordered with either sinking or sourcing transistor outputs. Both types require a 10-30 VDC power supply connected to TB 11 to drive the transistor output circuitry. The transistor output fuse will blow if the power supply polarity is incorrect, but the circuitry will not be damaged. See Figs. 17 & 18 for fuse and transistor chip replacement.

Sinking transistor outputs (N16 controls, Figure 10) conduct to the negative terminal of TB 11. Therefore the common for TB 11 and the load must be electrically the same. This may require connecting commons together if the power supplied to TB 11 is not also the load power supply. Electronic counters/ratemeters often fall into this category. The power supply that powers the load does not have to be the same voltage as the transistor power supplied to TB 11.

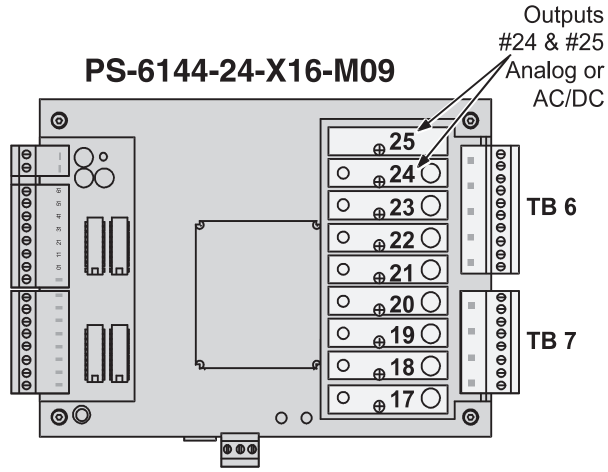
Sourcing transistor outputs (P16 controls, Figure 11) conduct to the positive power terminal of TB 11. The load is therefore powered from the same supply that is providing the transistor power.

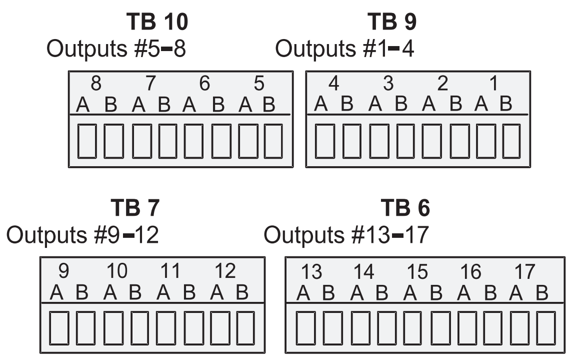
Figure 9—Wiring for Output Modules

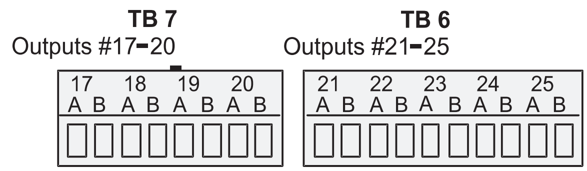
PS-6144-24M17

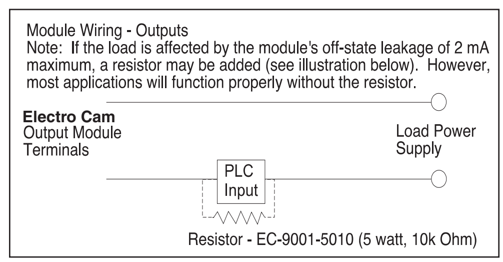


PS-6144-24-X16-M09

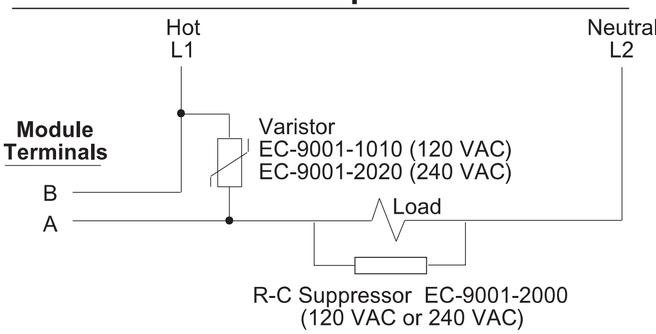








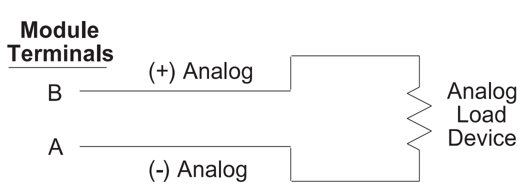
AC Output



Most applications will not need the varistor or R-C suppressor shown above. However, when other switching devices are in series or parallel with the AC module, voltage spikes may damage the module. Use one of the following two methods to suppress voltage spikes.

- For infrequent switching, connect a varistor (MOV) across the terminals.
- For continuous switching, wire an R-C suppressor in parallel with the load.

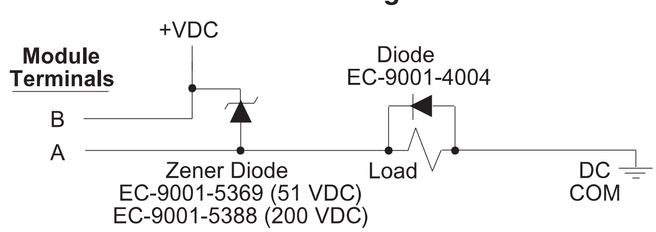
Analog Output



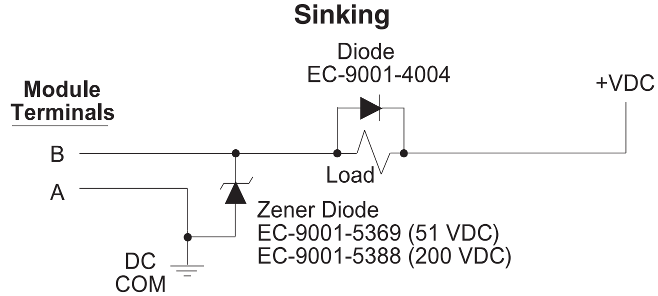
- Analog output modules source the analog signal.
- No external supply is required.
- Analog output signals are isolated.

DC Output

Sourcing



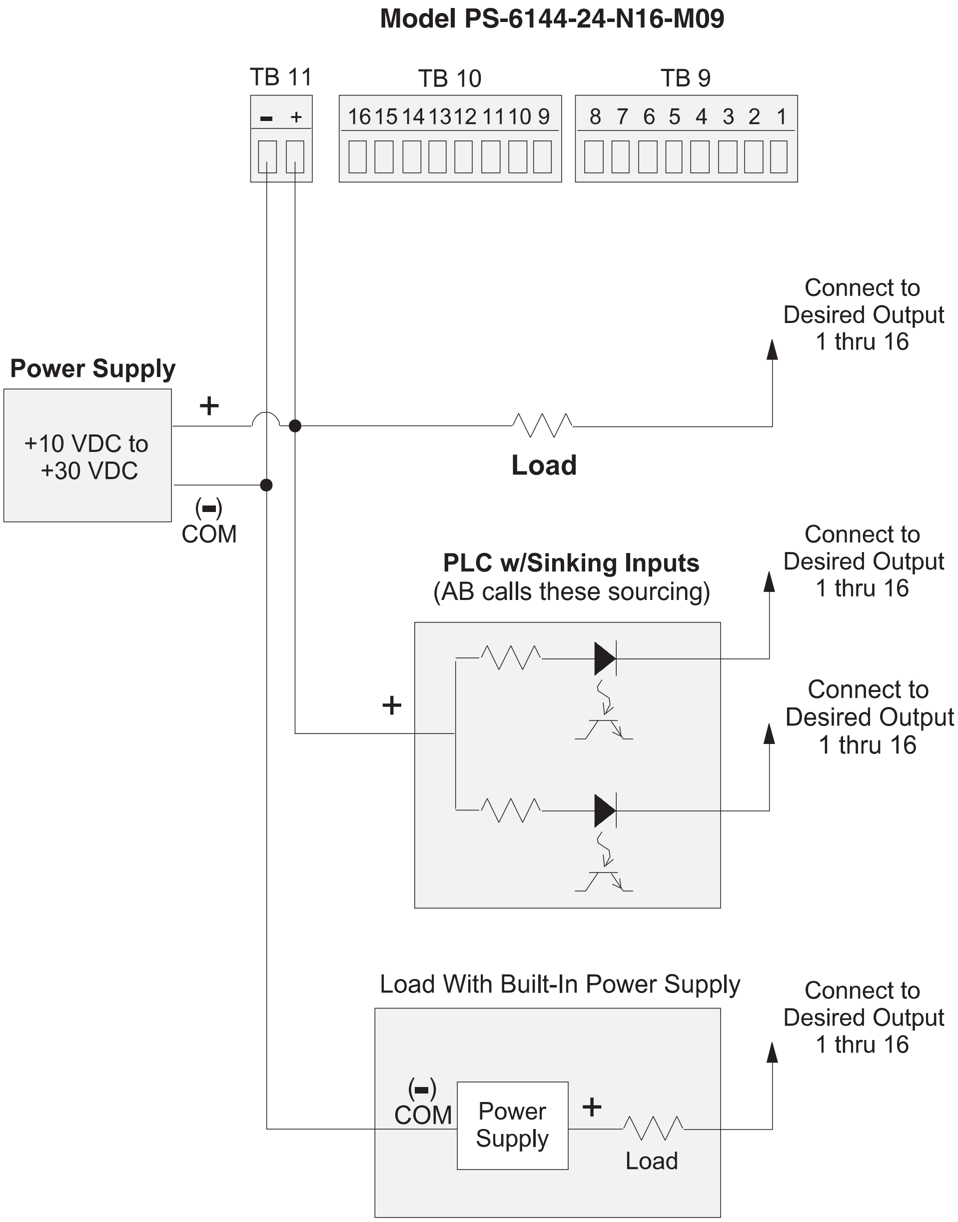
Sinking



Most applications will not need the diodes shown above. However, highly inductive DC loads may damage modules by generating voltage spikes when switched off. Suppress these voltage spikes using one of these two methods:

- Connect a Zener diode across the terminals. This will not significantly increase the load turn off time. Voltage rating of the diode must be greater than the normal circuit voltage.
- Connect a reverse-biased diode across the load. This may increase the load turn off time.

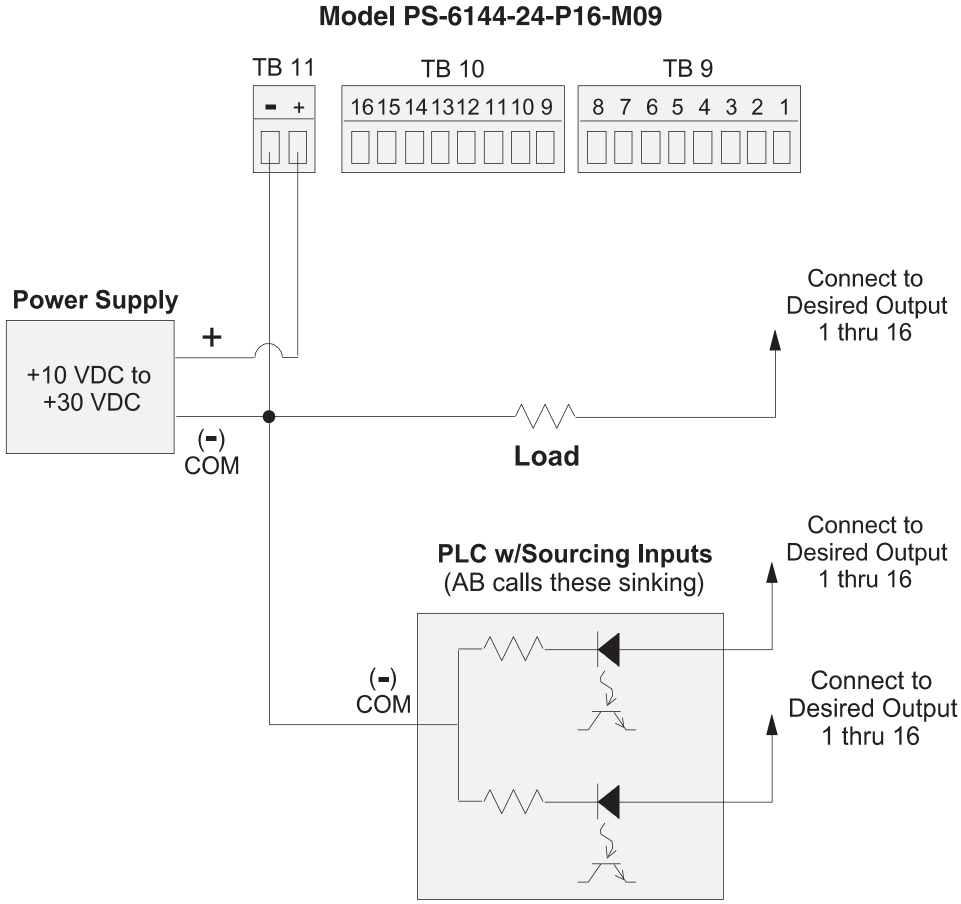
Figure 10—Wiring for Sinking Transistor Outputs (See Figure 6 for Terminal Block Locations)



Please Note:

- Outputs are rated at 30 VDC, 50 mA.
- Transistor outputs should not be used to switch inductive devices such as solenoids or relays.
- Sinking outputs conduct to the negative terminal of TB 11 when "on."
- The power supply shown in "Load with Built-In Power Supply" does not have to be the same voltage as the power supply connected to TB 11.

Figure 11—Wiring for Sourcing Transistor Outputs (See Figure 6 for Terminal Block Locations)



Please Note:

- Outputs are rated at 30 VDC, 50 mA.
- Transistor outputs should not be used to switch inductive devices such as solenoids or relays.
- Sourcing outputs conduct to the positive terminal of TB 11 when "on."

Sinking/Sourcing Defined

Sinking means that when the logic is true and the output (or input device) is ON, the output (or input device) is providing a DC common or ground to the connected device.

Sourcing means that when the logic is true and the output (or input device) is ON, the output (or input device) is providing a +DC voltage to the connected device.

This information is important when interfacing an Electro Cam Corp. product with another electronic device. If you are using an Electro Cam Corp. product input to an Allen-Bradley 1746-IN16 "sinking" input card* or similar A-B device, you have to supply a +DC voltage (Electro Cam Corp. ***Sourcing*** output) to this card, NOT a DC common or ground. In these cases, ***Sinking*** is what the card does with the input voltage; sinks it to common or ground.

*Other manufacturers include, but not limited to: Koyo (formerly GE Series 1, Texas Instruments, or Siemens SIMATIC PLS's) that use descriptions similar to Allen-Bradley.

Keypad Wiring

Number of Keypads

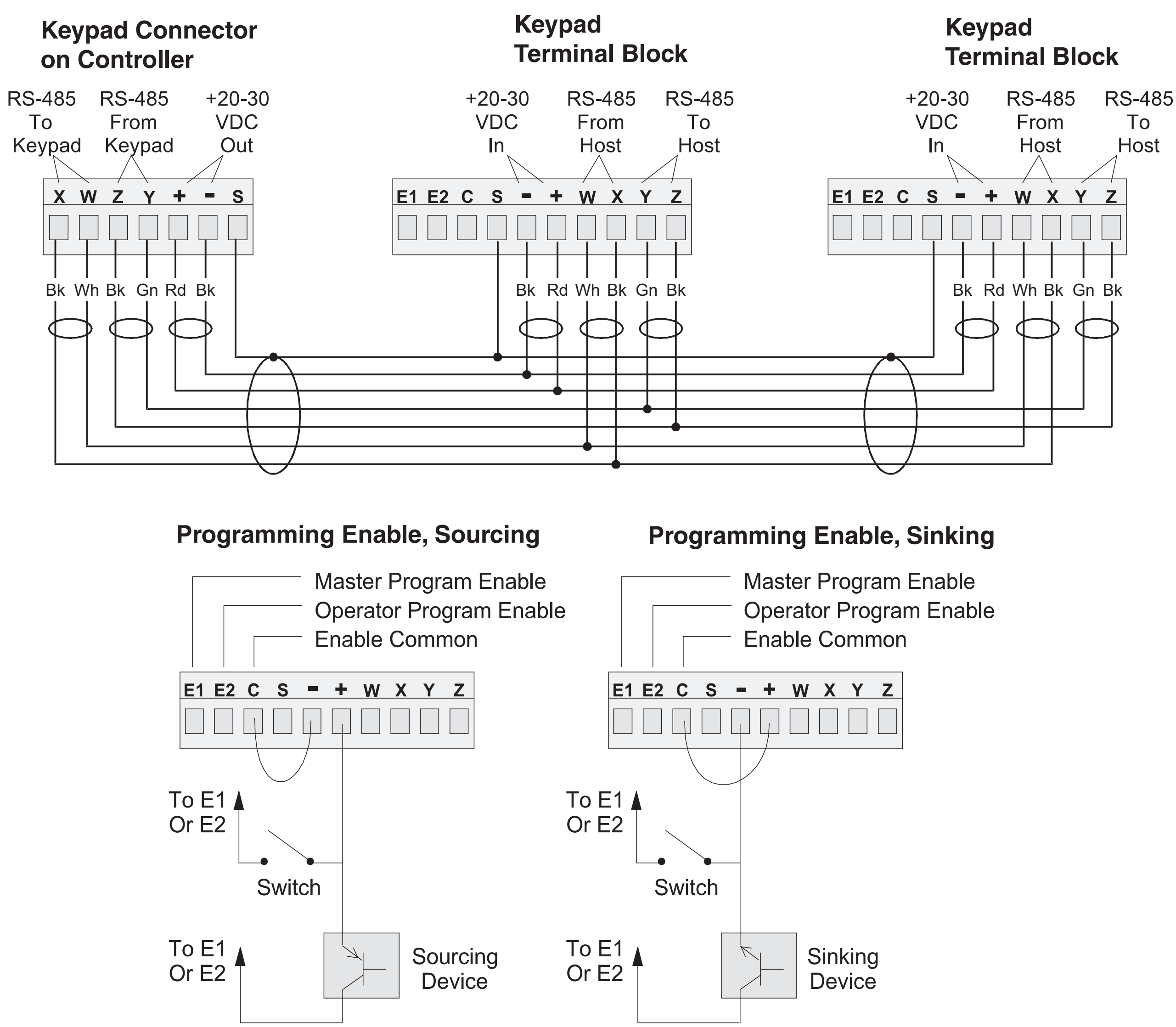
One or two keypads may be connected to a PS-6144 controller as shown in Figure 12. See Figure 14 for possible system configurations.

Programming Enable

The wiring connector on the back of each keypad includes terminals to select Operator or Master level programming for that keypad. These terminals can be temporarily jumpered during set-up to allow entry of programming access codes, or they can be switched with a variety of devices including mechanical switches, relay contacts, and PLC DC outputs. See ENABLE CODES in the programming section for details on programming access.

If a solid state device will be activating the Programming Enable terminals, that device will determine whether sourcing or sinking wiring should be used. For mechanical devices such as jumpers or key switches, either sourcing or sinking wiring may be used.

Figure 12—Keypad Wiring



DIP Switch Configurations

DIP Switches

Each keypad and controller has a DIP switch as shown in Figure 13. For convenience, set the DIP switches correctly before mounting the units in a panel.

Keypad Settings

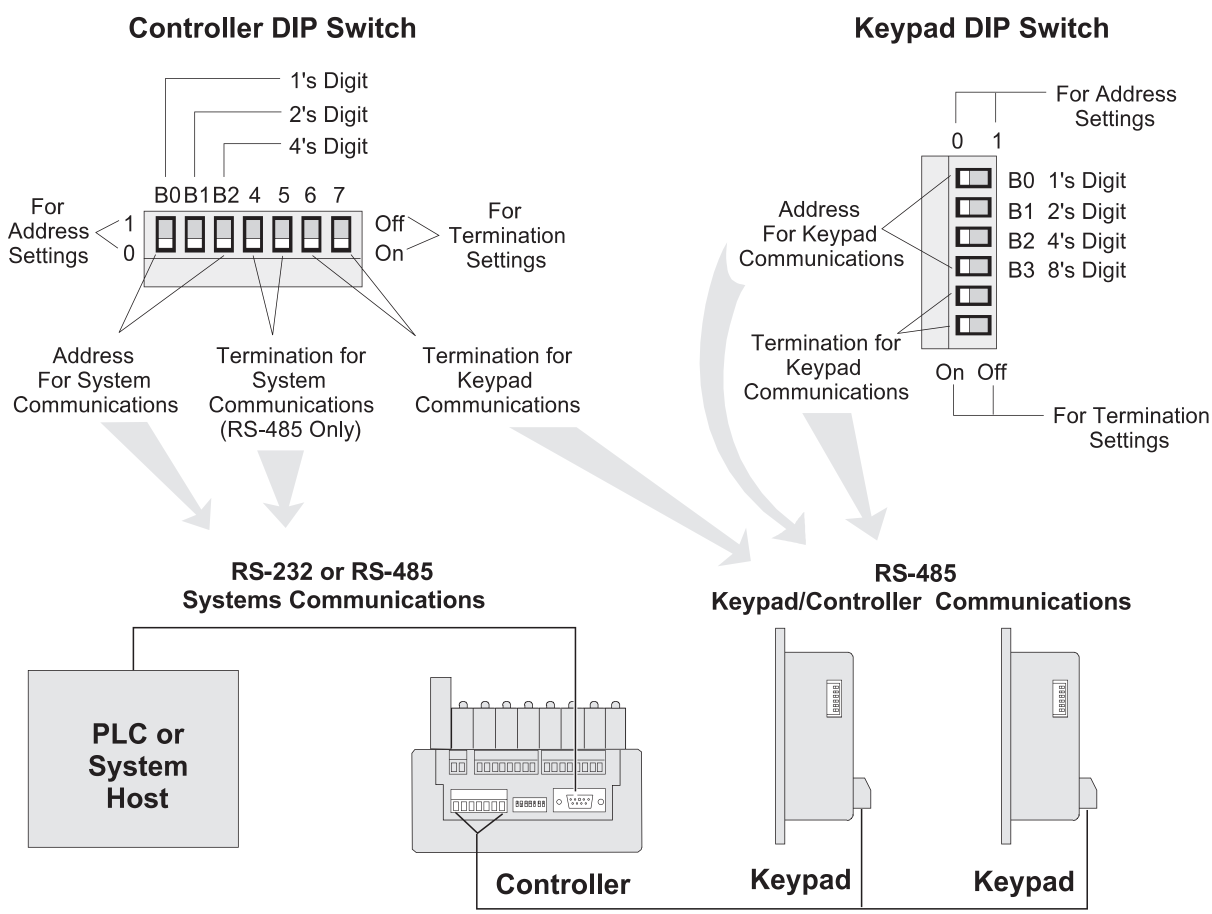
The address and termination settings on the **keypad** DIP switch apply to the RS-485 network that connects it to the controller. See Figure 14 for guidelines and sample settings.

Controller Settings

The address settings on the **controller** DIP switch apply to a network connecting the controller to a PLC or other system host. When the DIP switch is set to zero, the default address programmed through the COMMUNICATIONS function takes affect. Whereas the DIP switches can set a maximum address of “7”, the COMMUNICATIONS function can establish much higher address numbers. **These settings are not related to communications with the keypads.**

Two sets of termination switches are included on the controller. One set establishes the termination value for an RS-485 network connecting the controller to a PLC or other system host. It does not apply to an RS-232 network. The other termination switches apply to the keypad network. See Figure 14 for guidelines and sample settings.

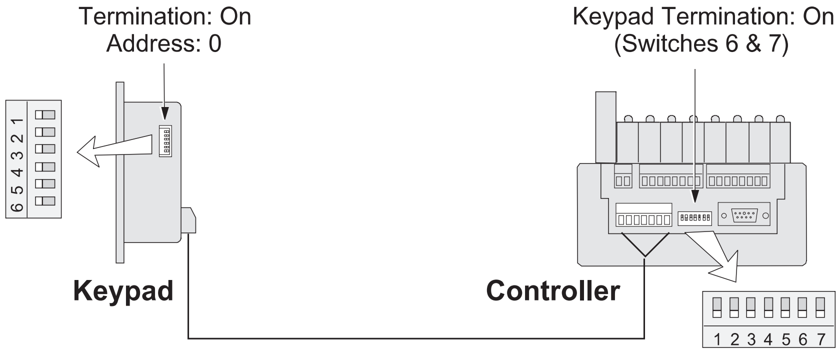
Figure 13—DIP Switches and Related Communications Networks



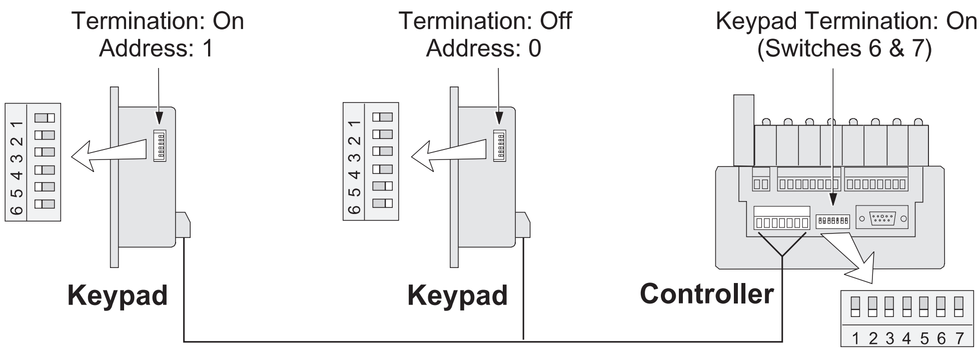
NOTE: Both termination switches in a pair must be in the same position.

Figure 14—DIP Switch Settings for Typical Systems

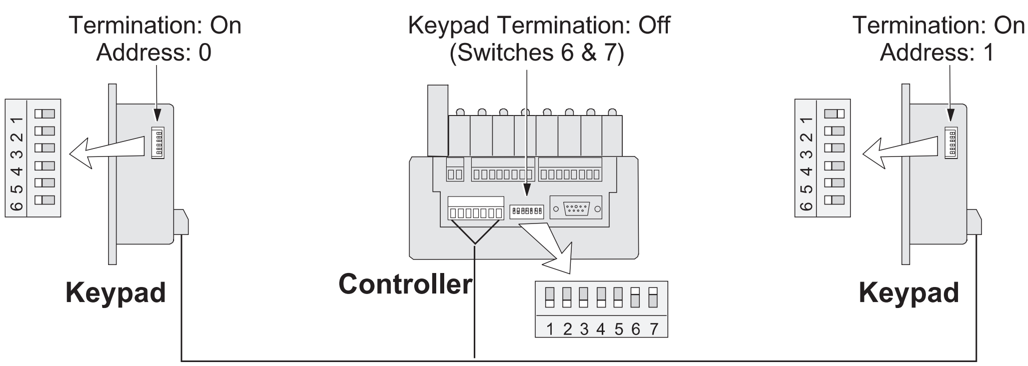
One Keypad



Two Keypads, Controller on End



Two Keypads, Controller in Middle



DIP Switch Guidelines

Termination:
- Termination must be "on" for devices on each end of the chain.
- Termination must be "off" for devices in the middle of the chain.
- Both termination switches in a pair must be in the same position.

Address:
- Keypad addresses must be assigned starting with "0" and increasing sequentially.
- The physical location of a keypad in the chain has no relationship to its address.
- During initial programming, the KEYBOARD QTY function must be used to enter the number of keypads in the chain. KEYBOARD QTY can be accessed only through the keypad whose address is "0."

Communications Wiring

DB-9F Port Serial communication to a PLC or other system host is provided through a DB-9 female connector as shown in Figures 5 & 6. This connector can be wired for RS-232 or RS-485 communications.

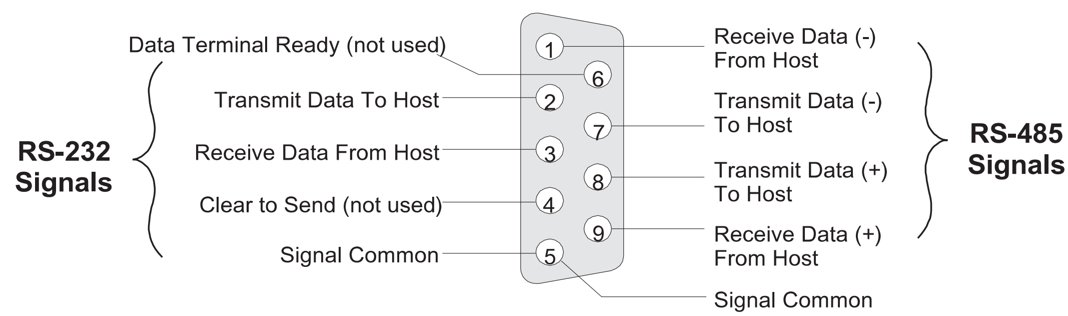
RS-485 RS-485 can be used for “multi-drop” networks where more than one controller could be connected to the system host.

RS-232 RS-232 can connect only a single PS-6144 to a system host.

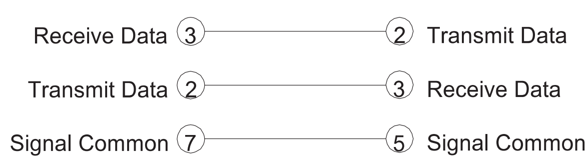
RS-232/485 Selection Use the COMMUNICATIONS function to select RS-232 or RS-485 communications.

Figure 15—Communications Wiring

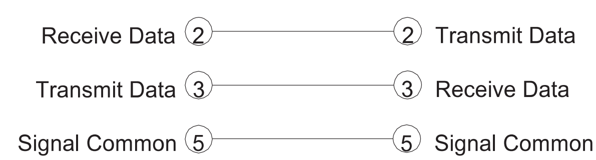
DB-9 Female Connector on Controller
(See Figures 5 & 6 for Location)



RS-232 Cable Wiring
DB-25 (Host) **to DB-9F** (PS-6144)*



RS-232 Cable Wiring
DB-9 (Host) **to DB-9F** (PS-6144)*



*Pins 1, 4, 6, 7 and 8 must NOT be connected. Damage may result from using an off-the-shelf RS-232 communications cable.

Be sure to follow illustrations, as they are NOT STANDARD configurations!

Resolver Installation

General Information

Choose a mounting location for the resolver that allows convenient mechanical connection of the resolver shaft to the machine. The resolver is normally driven at a 1:1 ratio to machine cycles, but this is not true in all applications. The shaft can be coupled to the machine using a chain and sprocket, timing pulley and belt, or a direct shaft-to-shaft coupling. If a shaft-to-shaft coupling is used, Electro Cam Corp. recommends the use of a FLEXIBLE coupling. Flexible couplings are available through Electro Cam Corp. and are included on the price list.

WARNING **Turn power to the machine OFF prior to installation!**

No provision need be made for physically rotating the resolver shaft with respect to the machine shaft. The PS-6144 can be easily programmed to set any resolver position as the 0° position.

If possible, select a location that shelters the resolver from accidental mechanical abuse, lubricants, washdown chemicals or any other liquids. Most Electro Cam resolvers have a NEMA 4 rating or better, but avoiding contaminants will maximize their reliability and service life.

Figure 16 shows three commonly used Electro Cam resolvers.

Ambient Temperature

Electro Cam resolvers have an ambient temperature range of -40° to +125°C (-40° to +257°F).

Resolver Wiring

Cables for non-stainless Electro Cam resolvers are shipped with one end soldered to the resolver connector. The connector for the other end is mounted on the controller.

The shield is connected at both ends of the cable to prevent damage due to electrostatic discharge. If electrical noise problems are suspected when the control is in operation, call Electro Cam Corp. for advice regarding shielding.

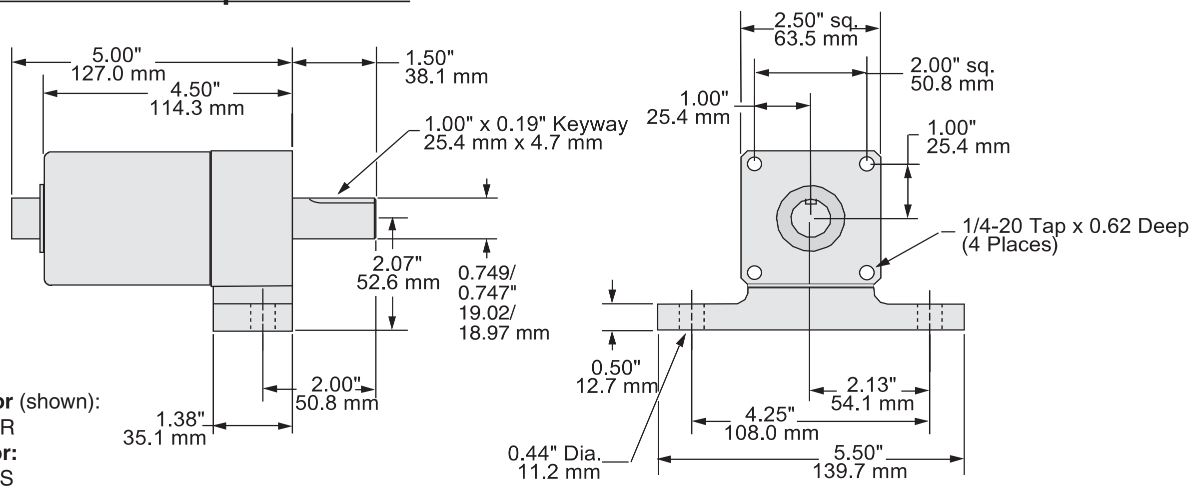
The resolver cable used with the stainless steel resolvers (PS-5300-02-XXX) does not have a connector at the resolver end because screw terminals are used inside that resolver. When properly connected, both ends of the cable shield will be connected. If electrical noise problems are suspected when the control is in operation, call Electro Cam Corp. for advice regarding shielding.

Resolver cables supplied by Electro Cam are a special type consisting of three individually twisted/shielded pairs with a common braid shield. This insures that reliable position information is being received by the controller. The use of other cable types could degrade the accuracy of the position signals and make them more susceptible to electrical noise. For these reasons, it is recommended that customers do not make their own resolver cables. Electro Cam will make resolver cables any length up to 1000' and can expedite shipment as required.

Resolver Dimensions

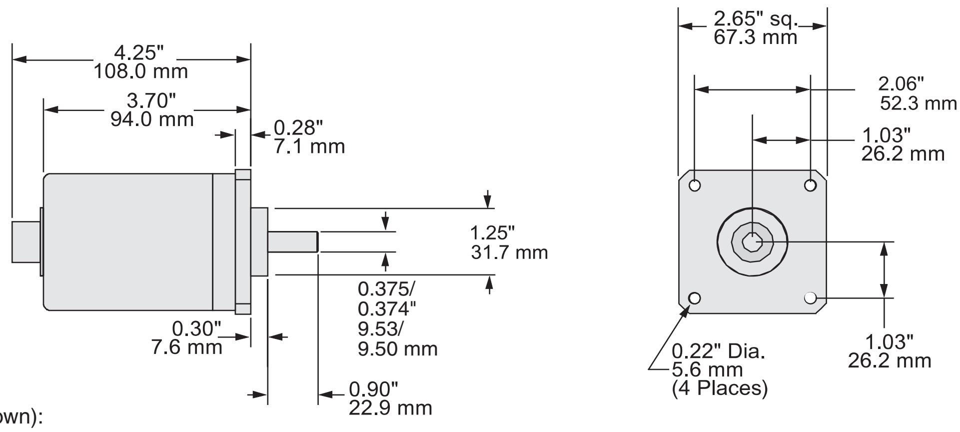
Figure 16 - Electro Cam Corp. Resolvers

Foot Mount



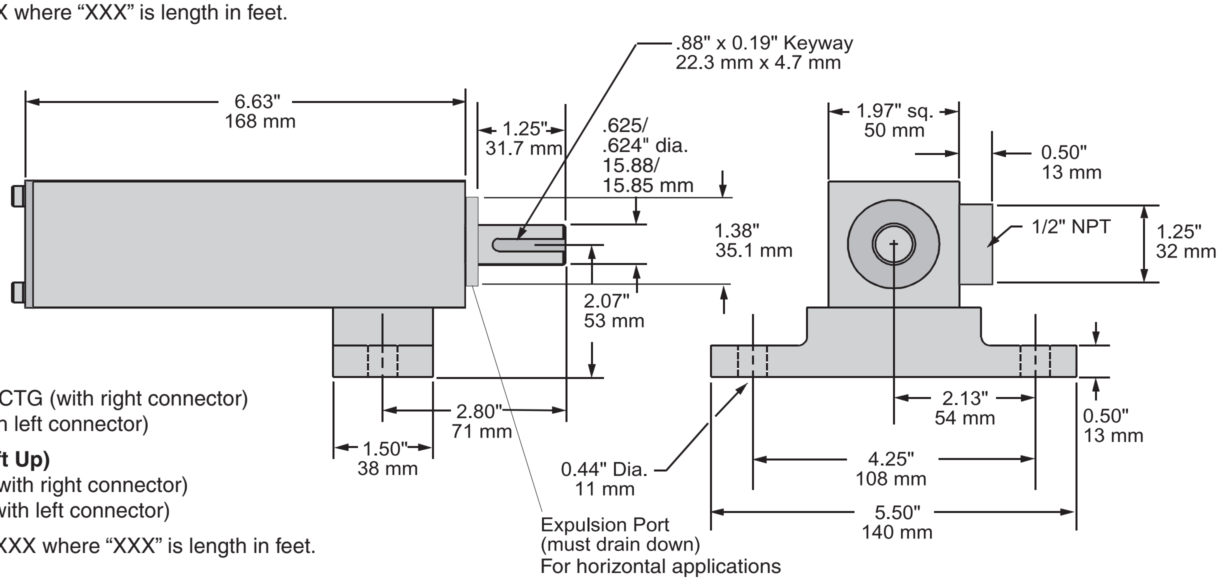
With Rear Connector (shown):
PS-5275-11-ADR
With Side Connector:
PS-5275-11-ADS
Cable:
PS-5300-01-XXX where "XXX" is length in feet.

Flange Mount



With Rear Connector (shown):
PS-5238-11-ADR
With Side Connector:
PS-5238-11-ADS
Cable:
PS-5300-01-XXX where "XXX" is length in feet.

Stainless Steel



Horizontal Mount
(shown) PS-5262-11-CTG (with right connector)
PS-5262-11-CTL (with left connector)

Vertical Mount (Shaft Up)
PS-5262-11-CTG-V (with right connector)
PS-5262-11-CTL-V (with left connector)

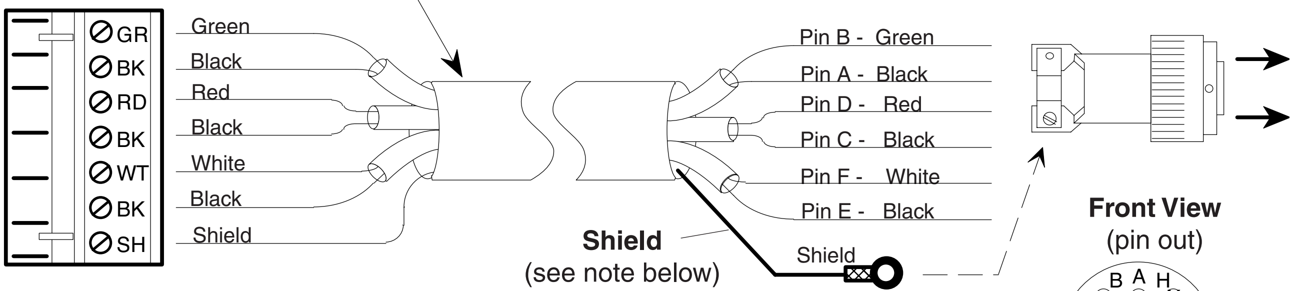
Cable: PS-5300-02-XXX where "XXX" is length in feet.

Cable for Resolver with Cannon Connector

PT# PS-5300-01-XXX (XXX = Length in Feet)

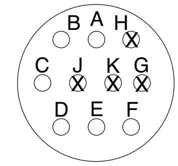
Connector - Controller End
PT# PS-5300-01-TER
(Weidmuller # BLA7 12822.6)

Cable Type:
3 individually shielded pairs, 22 gauge



Shield
(see note below)

Front View
(pin out)



⊗ = Not Used

CAUTION

Shielding Note: Resolver cables made after 3-2-93 have a ring lug on a black shield wire at the resolver end. The ring lug should be attached to one of the resolver connector strain relief screws to protect against static discharge through the resolver cable. In some installations, it may be advisable to disconnect the ring lug to prevent ground loops through the cable shield. Consult Electro Cam if electrical noise problems are suspected.

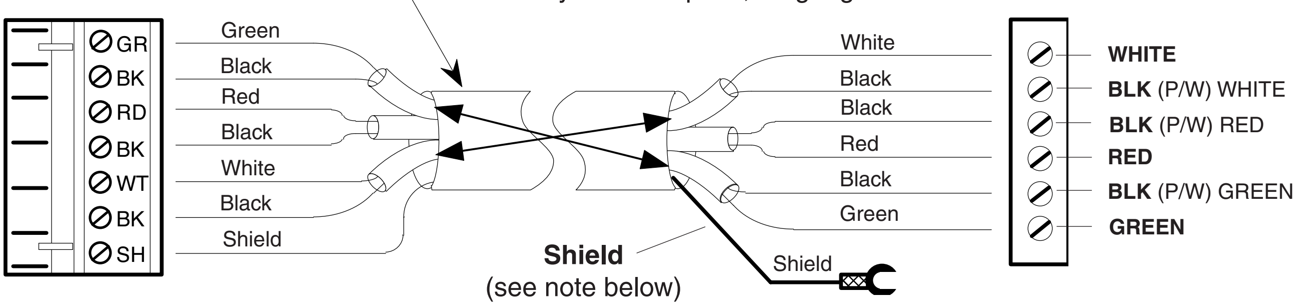
Cable for Stainless Steel Resolver with Terminal Strip Connections

PT# PS-5300-02-XXX (XXX = Length in Feet)

Connector - Controller End
PT# PS-5300-01-TER
(Weidmuller # BLA7 12822.6)

Cable Type:
3 individually shielded pairs, 22 guage

Connector Inside Resolver
(cable is stripped and tinned at both ends)



Shield
(see note below)

CAUTION

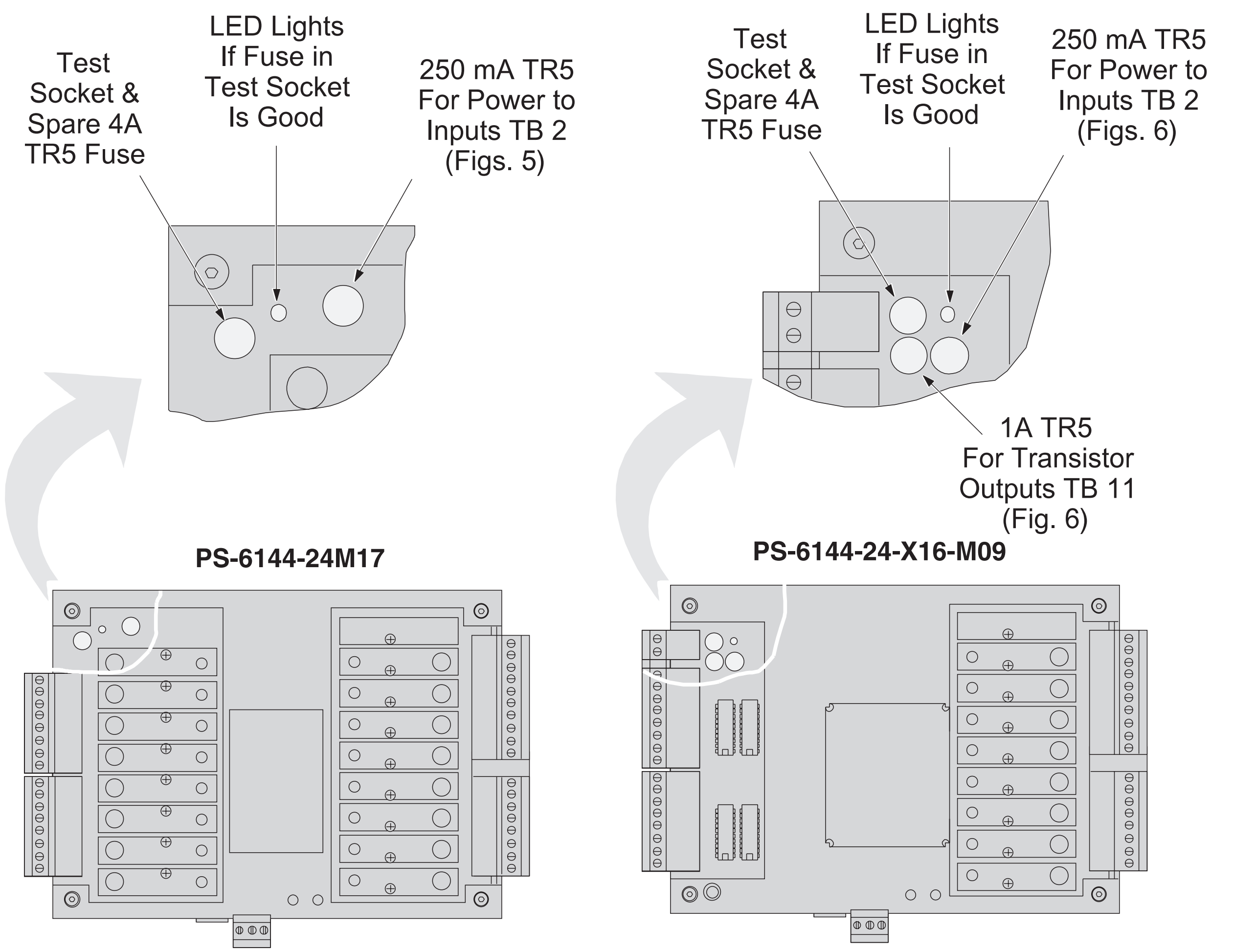
Shielding Note: This type of resolver cable will have a spade lug connected to the shield at the resolver end. The lug should be attached to the grounding stud on the cover plate of the resolver. In some installations, it may be advisable to disconnect the lug to prevent ground loops through the cable shield. Consult Electro Cam if electrical noise problems are suspected.

Fuse Tester & Fuse Replacement

Fuse Tester

Figure 17 shows the location of a fuse test socket and LED which can be used to test TR5 style fuses. PS-6144 controllers are shipped with a spare 4A fuse mounted in the test socket.

Figure 17—TR5 Fuse Tester and Fuse Locations



Replacement TR5 Fuse Part Numbers

Rating	Function	ECC Part #	Wickmann Part #
250 mA	Power for Inputs (TB 2)	PS-9005-0250	19374-035
1 A	Power for Transistor Outputs (TB 11)	PS-9005-0001	19370-048
4 A	Fuse for Output Modules	PS-9005-0004	19370-062

Output Transistor Replacement

Check Fuse First

If all of the transistor outputs fail to work, check the 1A fuse shown in Figures 17 & 18. Also check to be sure that a 10–30 VDC power supply is connected to TB 11, Figure 6.

Correct Problems

Chips will most likely be damaged by one of two events:

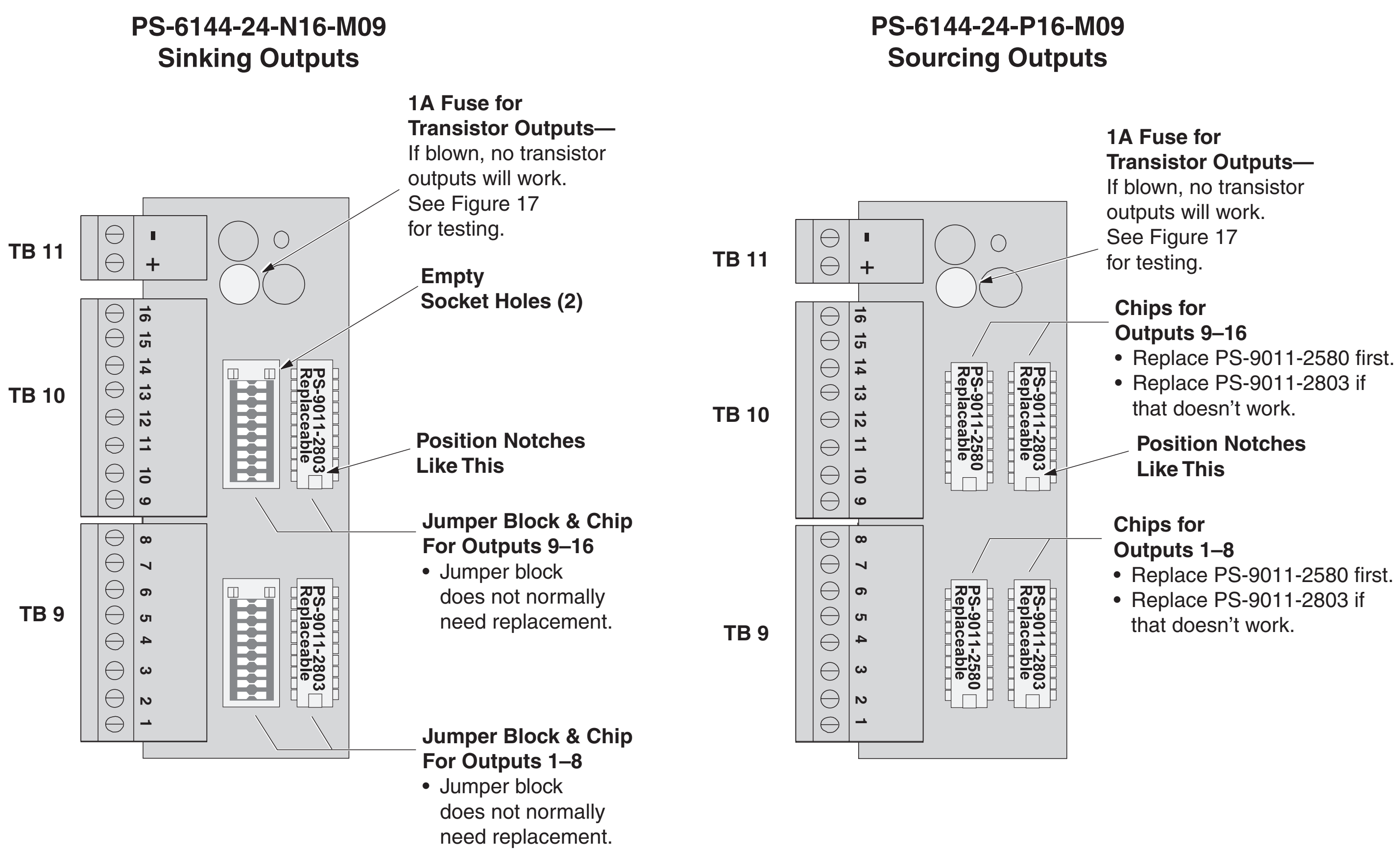
- A short circuit connected to one of the transistor outputs.
- A load exceeding 50 mA connected to one of the transistor outputs.

Before replacing a transistor output chip, fix the problem that damaged it.

Proper Placement

When replacing a chip, be sure that all of the pins are properly seated in the socket. Position the notch on the end of the chip as shown below.

Figure 18—Transistor Chip Replacement



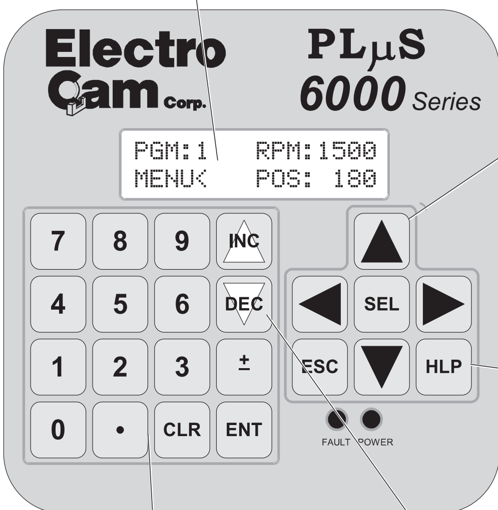
Replacement Part Numbers

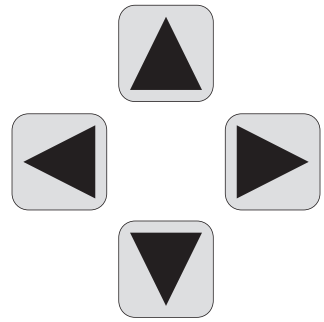
Description	ECC Part #
Replacement Chip-Sourcing	PS-9011-2580
Replacement Chip-Sinking	PS-9011-2803
DIP Jumper Block	PS-9006-0015

Figure 19—Keypad Keys and Corresponding Functions

Main Screen

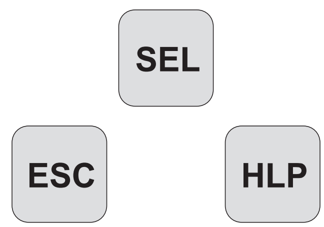
- Shows Active Program, RPM, Position, and Group # if applicable.
- **See MAIN SCREEN** in this Section for details.
- **Press SEL key when cursor is on "MENU"** to enter Menu Tree (Fig. 20) and initiate programming.





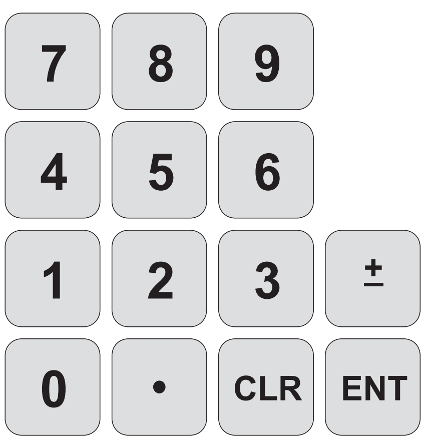
Cursor Keys

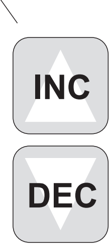
- Scroll through Menu Tree (Fig. 20).
- Move around **within a screen.**
- Scroll through setpoints.



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

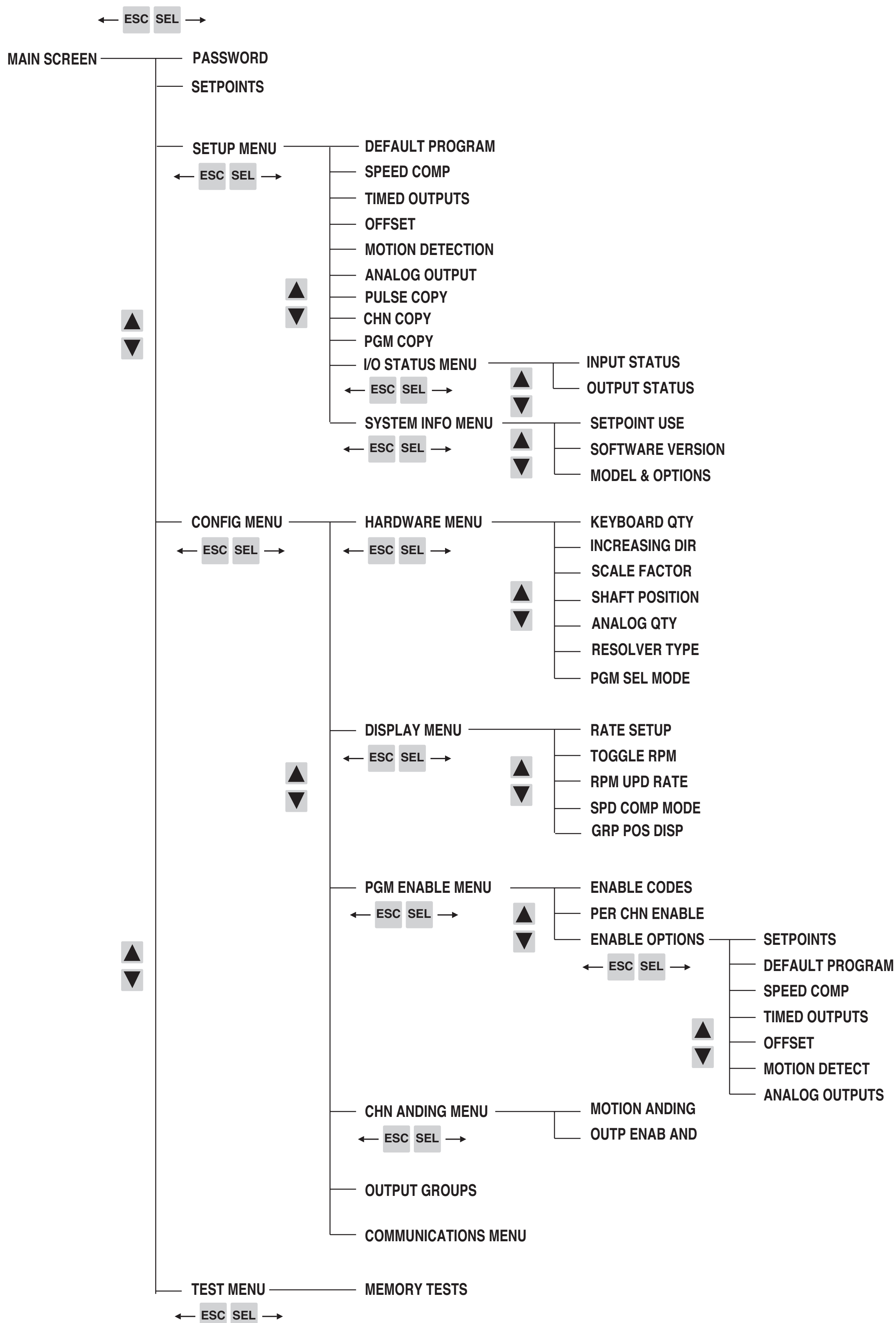
- Increment or decrement a value **within a field.**
- Hold for rapid scrolling of value.

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.
- **±** will convert a positive number to a negative number, or vice versa.

Figure 20—PS-6144 Menu Tree

- **Functions are listed alphabetically in Section 3 of this manual starting on page 3-4.**



Bench Test

To test the PS-6144 prior to installing it, do the following:

1. Plug output modules into the controller beginning with Position 1 on the PS-6144-24M17, or Position 17 on the 6144-25. See Figure 9.
2. Connect a resolver. See Figure 16.
3. Connect the keypad/display to the controller. See Figure 12.
4. Set the **keypad** DIP switch to address “0” and termination “on,” as shown in Figure 13. Set switches 6 and 7 on the **controller** DIP switch to “on,” also shown in Figure 13.
5. Use two jumper wires to enable Master Level programming as shown in Figure 12. Connect one jumper from “+” of the keypad terminal block to “C.” Connect the other jumper from “–” to “E1.” These jumpers will permit access to the entire menu tree shown in Figure 20.
6. Connect DC input power.

When experimenting with the controller, note that the LED on an output module will light when that output channel is turned on. By hand-turning the resolver shaft and watching the module LED’s, you can observe the effects of programming setpoint values. Remember that on a PS-6144-24-X16-M09, outputs 1-16 are transistor outputs. To activate the LED on a module installed in Position 17, enter the setpoint values into Output Channel 17.

Machine Setup

Before installing the PS-6144 on a machine, be sure the DIP switches are properly set as shown in Figures 13 & 14. After installing the unit, program the following set-up information into the controller before attempting any other programming:

Information	Menu Selection	Page
Direction of Rotation	INCREASING DIR	3-11
Scale Factor	SCALE FACTOR	3-25
Shaft Position	SHAFT POSITION	3-28
No. of Keypads	KEYBOARD QTY	3-12
No. of Analog Outputs	ANALOG QTY	3-5
No. of Output Groups	OUTPUT GROUPS	3-18
Modes for Output Groups	OUTPUT GROUPS	3-18
Group Display Mode	GRP POS DISP	3-10
Group Offsets	OFFSET	3-16

Once this information is entered, setpoints can be established and modified in the groups and output channels desired. Refer to Section 5 for information on using groups and modes.

Analog Output

Menu Path

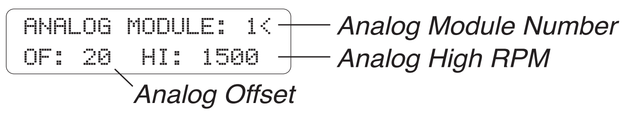
MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to ANALOG OUTPUT SEL

Purpose

Analog output signals are linearly proportional to the resolver RPM. Two types of analog output modules are available: 0-10 VDC and 4-20 mA.

This function assigns Offset and High RPM values to output positions for analog modules.

Screen



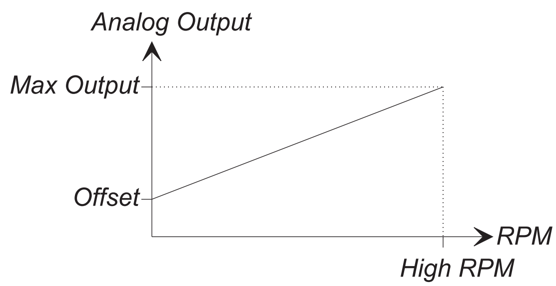
Module Number

The following table shows the relationship between the analog module number on the screen and the module position on the controller back. See Figure 9 for an illustration of analog module positions.

Model	Module #1 On Screen	Module #2 On Screen
PS-6144-17	Output #17	Output #16
PS-6144-25	Output #25	Output #24

- Analog characteristics can be programmed for Modules #1 and #2 even if no analog modules are physically mounted on the controller. Programming can be done first, and modules mounted later.
- To program Offset and High RPM for Module #2, be sure the ANALOG QTY function (next page) is set to “2.” If ANALOG QTY is set to “1,” programming for Module #2 will not be available.
- When two analog outputs are used, the two outputs can have different values for Offset and High RPM.

To program Module Number, move the cursor to “Module” and use the numeric keys and ENT.



High RPM

Analog High RPM is the resolver speed at which full scale analog output will occur. It is programmed in whole RPM. When this speed is reached, the analog output signal level will be at full scale (10 VDC or 20 mA). Increasing speed beyond the High RPM will **not** increase the analog output beyond full scale.

To program High RPM, move the cursor to “Hi” and use the numeric keys and ENT.

Analog Output (Cont'd)

Offset

Analog Offset is the analog signal level that will be output when the resolver is at zero RPM. This allows the minimum analog signal to be greater than zero volts or 4 mA. Because the analog output module has 4096 increments (12 bits) of signal level available, the offset is specified as the number of increments of signal that should be output at zero RPM. Calculate Analog Offset values as follows:

For 0-10 VDC: (Minimum Signal/10) x 4096

Example: For a 2 VDC minimum signal; Offset = (2/10) x 4096 = 819

For 4-20 mA: ((Minimum Signal - 4)/16) x 4096

Example: For a 5 mA minimum signal; Offset = ((5-4)/16) x 4096 = 256

To program Analog Offset, move the cursor to "Of" and use the numeric keys and ENT.

See Also

OUTPUT STATUS

Analog Quantity

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL HARDWARE MENU SEL ▼ to ANALOG QTY SEL

Screen

```
ANALOG
QTY: 1<
```

Number of Analog Outputs

Purpose

This screen displays the number of analog outputs that will be programmed into the controller.

The controller can have zero, one or two analog outputs, and each can be offset and scaled by different values. See ANALOG OUTPUT for details.

Programming

Use the numeric keys to enter "0," "1," or "2" analog channels. An analog output module is required to generate an analog output signal.

See Also

ANALOG OUTPUT
OUTPUT STATUS

Channel Copy

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to CHN COPY SEL

Purpose

Channel Copy allows you to copy all setpoints to another channel in the specified program.

Screens

The Channel Copy function consists of four screens:

```
SOURCE PGM:---<
```
Program containing channels

```
DEST PGM:---<
```
Program containing channel to be copied

```
SOURCE CHN:---<
```
Channel to be copied

```
DST CHN:---<
```
Destination channel to be copied to

```
DEST CHN:
       EXECUTE<
```
Move cursor to EXECUTE, then press SEL to copy program

Programming

Use the numeric keys and SEL to enter program numbers.

During programming, the cursor keys allow you to move between the Source and Destination screens to allow you to change values before selecting EXECUTE.

Communications

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to COMMUNICATION SEL

Purpose

This function sets the communications type, **controller** address, and baud rate for communicating with a host computer.

Screen

```
TYPE:485 ADR:  1<
   BAUD:  9600
```
Communications Type: RS-232 or RS-485

Address: 0-255

Baud Rate: 4800, 9600, 19.2Kb, 38.4Kb

Type

Use SEL to toggle between RS-232 and RS-485 communications on units shipped with date code 9549 or newer (default setting is RS 485).

Address

The address must be unique for each controller installed on a network. This address is used by a host computer to identify and send information to a particular controller. A PLuS controller will ignore incoming information if the address field of the communication packet does not match the address of the controller.

The address set through COMMUNICATIONS programming takes effect only when the DIP switch shown in Figure 13 is set to an address value of zero. Whereas the DIP switch can set a maximum address of “7,” the COMMUNICATIONS function can set addresses ranging from 0-255.

Use the numeric keys and ENT to program the address.

Baud Rate

Use SEL to toggle between the available baud rates. The baud rate must match that of the host computer. Available baud rates are:

4,800; 9,600; 19,200; and 38,400.

Note: Effective with Software Versions 1.97 and higher, the communications screen has been revised as shown below:

```
TYPE: 232  ADR:1<
 TRM: ON   BR: 9600
```

Termnination Setting

The termination setting should be ON if TYPE is set to RS-232, or if TYPE is set to RS-485 and only one PS-6144 controller is in the multi-drop network. **Setting the termination to OFF in these configurations may cause inaccurate RPM readings.**

If multiple PS-6144 controllers are connected in an RS-485 network, termination should be set to OFF on one and only one PS-6144 controller.

The termination setting in this screen is independent of all DIP switch settings. Use the SOFTWARE VERSION function to determine version number.

Default Program

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL to DEFAULT PROGRAM SEL

Background

The PS-6144 controller can store up to 48 programs in its memory. The **Default Program** is the program that controls the output channels when terminals 1–8 of TB 3, Figure 7, are "off."

The **Active Program** is the program number that is currently controlling the output channels. If there are program select inputs on TB 3, those inputs will determine the Active Program, and the Default Program will be ignored. If no hardware inputs are "on," the Default Program will become the Active Program.

For installations where the program select inputs on TB 3 are not used, the Default Program will always be the Active Program.

This function displays the current Default Program and allows you to select a different one.

Screen

```
DEFAULT PGM: 0
ACTIVE PGM:  0
```

Enter new Default Program through Numeric Keypad, then press ENT.

Programming

Use the numeric keys and ENT to enter or modify the Default Program.

⚠ WARNING

Injury and property damage hazard may occur due to changes in machinery operation. Program the Default Program with settings that will eliminate this hazard in the event of sudden activation.

See Also

PGM SEL MODE

Enable Codes

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL
▼ to PGM ENABLE MENU SEL to ENABLE CODES SEL

Background

The PS-6144 has three levels of programming access: Operator, Setup, and Master in order of increasing capabilities. Figure 21 lists the menu functions that can be programmed under the various levels of access.

Programming levels can be activated, or "enabled," by entering a password on the keypad, or by activating Terminals E1 or E2 on the back of the keypad as shown in Figure 12. The first two rows of Figure 21 show which methods can be used to enable the various levels of programming access.

Screen

```
LEVEL: OPERATOR
PASSWORD: 1234
```

Enable Level: Operator, Setup, or Master
Password Number

This screen is used to establish the numbers that will be used as passwords to enable the Operator, Setup, and Master levels.

Use the SEL key to toggle between enable levels.

Use the numeric keys, followed by ENT to assign codes.

Operation

- Each programming level can have only one code. That code is stored in the controller and applies to all keypads connected to that controller.
- If a code is entered into a keypad that has a programming enable terminal energized, the access level will be the highest of the two.
- If one keypad in a two-keypad system is enabled, the other keypad will continue to operate in the "Normal Display" mode.
- If both keypads in a two-keypad system are enabled, each keypad will operate at the programming level enabled on it. For example, if Operator Level is enabled on Keypad 1, and Setup Level is enabled on Keypad 2, Keypad 1 will operate at the Operator Level and Keypad 2 will operate at the Setup Level.

See Also

PER CHN ENABLE
ENABLE OPTIONS
PASSWORD

Figure 21—Programming Access Levels for Various Menu Items

	Normal Display	Operator	Setup	Master
	Programming Level			
Can Be Enabled By…				
Keypad Terminal	---	Yes (E2)	No	Yes (E1)
Password	---	Yes	Yes	Yes
Menu Item Access				
Password	Enter	Enter	Enter	Program
Setpoints	View	Program[1]	Program	Program
Setup Menu				
Default Program	View	Program[1]	Program	Program
Timed Outputs	View	Program[1]	Program	Program
Speed Comp	View	Program[1]	Program	Program
Offset	View	Program[1]	Program	Program
Motion Detect	View	Program[1]	Program	Program
Analog Output	View	Program[1]	Program	Program
Pulse Copy	View	---	Program	Program
CHN Copy	View	---	Program	Program
PGM Copy	View	---	Program	Program
I/O Status Menu				
Input Status	View	View	View	View
Output Status	View	View	View	View
System Info Menu				
Setpoint Use	View	View	View	View
Software Version	View	View	View	View
Model & Options	View	View	View	View
Config Menu				
Hardware Menu				
Keyboard Qty	---	---	---	Program[2]
Increasing Dir	---	---	---	Program
Scale Factor	---	---	---	Program
Shaft Position	---	---	---	Program
Analog Qty	---	---	---	Program
Resolver Type	---	---	---	Program
Pgm Sel Mode	---	---	---	Program
Display Menu				
Rate Setup	---	---	---	Program
Toggle RPM	---	---	---	Program
RPM Update	---	---	---	Program
Spd Comp Mode	---	---	---	Program
Grp Pos Disp	---	---	---	Program
Pgm Enable Menu				
Enable Codes	---	---	---	Program
Per Chn Enable	---	---	---	Program
Enable Options				
Setpoints	---	---	---	Program
Default Program	---	---	---	Program
Speed Comp	---	---	---	Program
Timed Outputs	---	---	---	Program
Offsets	---	---	---	Program
Motion Detect	---	---	---	Program
Analog Output	---	---	---	Program
Chn ANDing Menu				
Motion ANDing	---	---	---	Program
Outp Enab AND	---	---	---	Program
Output Groups	---	---	---	Program
Communications	---	---	---	Program
Test Menu				
Memory Tests	---	---	---	Run

[1] Can be programmed only if specified through PER CHN ENABLE and ENABLE OPTIONS.
[2] KEYBOARD QTY can be programmed only through the keypad whose address is “0.” See Figure 14.

Enable Options

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL
▼ to PGM ENABLE MENU SEL ▼ to ENABLE OPTIONS SEL

Purpose

The Enable Options screen controls Operator Level access to SETUP MENU programming as indicated in Figure 21, note 1.

Screen

```
SETPOINTS<
ENABLE: ON
```

SETPOINTS or SETUP MENU screen.
Scroll through choices with UP and Down cursor keys.

OPERATOR ENABLE: ON/OFF
(Toggle with SEL key)

This screen lists the various items in the SETUP MENU, and allows you to turn Operator access to those items on or off.

IMPORTANT

Access to the "on" items will be available only for those output channels that have been turned ON in PER CHN ENABLE.

Programming

Press the Up Cursor and Down Cursor keys to select the function you wish to change. Press the SEL key to turn Operator access ON or OFF.

Setup Menu Items

Access can be turned on or off for the following SETUP MENU items:

SETPOINTS, DEFAULT PROGRAM
SPEED COMP
OFFSET
MOTION DETECT
ANALOG OUTPUTS

See Also

PER CHN ENABLE

Group Position Display

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL DISPLAY MENU SEL
▼ to GRP POS DISP SEL

Purpose

The Group Position Display determines whether each output group can have its own position in the machine cycle, or if all groups share one position. Because the position of a group operating in Mode 1 or 2 changes each time the group's input terminal is energized, **GRP POS DISP must be set to EACH if any groups are assigned to Mode 1 or Mode 2.**

Screen

```
GROUP POSITION
DISPLAY: EACH<
```

Group Position Display Mode: EACH = Each ouput group has its own offset value; ONE = One value of offset is shared by all output groups.

Group Position Display (Cont'd)

The value selected in this screen determines the appearance of the main screen as shown below:

Main Screen—

- **One Output Group, and GRP POS DISP Set to "One" or "Each"**
- **Multiple Output Groups, and GRP POS DISP set to "One"**

Active Program

```
PGM: 1 RPM: 1500
MENU< POS:  180
```

Machine Speed

Machine Position = Shaft Position + Offset

To enter Menu Tree, press SEL when cursor is here

Main Screen—

- **Multiple Output Groups and GRP POS DISP Set to "Each"**

```
PGM: 1 RPM: 1500
MENU< GRP1:  180
```

Mode 1 or 2: Position = Preset + change since last reset
Mode 0, 3, 4, 5: Position = Shaft Position + Group Offset

Group #: To change, put cursor here and press SEL

To enter Menu Tree, put cursor here and press SEL

Programming

Enter the GRP POS DISP function and press SEL to toggle between "ONE" and "EACH."

⚠ IMPORTANT

- GRP POS DISP must be set to "EACH" to assign different offsets to groups through OFFSET programming.
- If groups have been assigned different offsets through OFFSET programming, setting GRP POS DISP to "ONE" will immediately change the individual group offsets to the value of Group 1.

See Also

OFFSET
SHAFT POSITION
OUTPUT GROUPS
MAIN SCREEN

Increasing Direction

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL HARDWARE SEL ▼ to INCREASING DIR SEL

Purpose

The Increasing Direction screen displays the direction of resolver rotation (CW or CCW as viewed from the shaft end) that will cause the position display to increase in value.

Screen

```
  INCREASING
  DIR: CCW<
```

Direction of resolver shaft rotation (viewed from shaft end) that will cause the postion display to increase in value.

This is normally set so the position value increases as the machine turns in its forward direction.

Changing Direction

Press SEL to toggle the value of increasing direction. The new value will begin flashing. Press the ENT key to confirm your selection.

Input Status

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to I/O STATUS SEL ▼ to INPUT STATUS SEL

The input status screen displays the On/Off status of the DC inputs on Terminal Blocks TB 1 and TB 3, Figure 7.

Screens

```
12345678 INPUT
01001001 1-8<
```

Input Numbers (1-8)

Input On/Off Status (0=Off, 1=On)

```
90123456 INPUT
01001001 9-16<
```

Input Numbers (9-16)

Inputs are numbered 1 through 16, but only 8 inputs are shown at one time. The On/Off status is shown under the input number; 0=Off, 1=On.

Selecting Inputs

You may view inputs 1-8 or 9-16. Press SEL to toggle between the two groups of inputs.

Keyboard Quantity

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL HARDWARE MENU SEL to KEYBOARD QTY SEL

Purpose

The Keyboard Quantity screen shows the number of keypads the controller will communicate with.

Screen

```
   KEYBOARD
    QTY:  1<
```

Number of keyboard/display units attached to controller

The controller will attempt to establish communication with as many keypads as are programmed through this screen. Keypads are assumed to be addressed sequentially, starting at address “0” as shown in Fig. 14.

Keypad “0”

You can change the number of keypads shown in KEYBOARD QTY only from the keypad whose address is “0.”

⚠ IMPORTANT

If KEYBOARD QTY is set to “2,” but only one keypad is physically connected, Menu Tree operation will be very slow. Change KEYBOARD QTY to “1” to restore normal Menu Tree speed.

Main Screen

Two Screens

On power-up, or after five minutes of keypad inactivity, the controller will display one of two main screens:

Main Screen—

- **One Output Group, and GRP POS DISP Set to "One" or "Each"**
- **Multiple Output Groups, and GRP POS DISP set to "One"**

Active Program

```
PGM: 1 RPM: 1500
MENU<  POS:  180
```

Machine Speed

Machine Position = Shaft Position + Offset

To enter Menu Tree, press SEL when cursor is here

Main Screen—

- **Multiple Output Groups and GRP POS DISP set to "Each"**

```
PGM: 1 RPM: 1500
MENU< GRP1:  180
```

Mode 1 or 2: Position = Preset + change since last reset
Mode 0, 3, 4, 5: Position = Shaft Position + Group Offset

Group #: To change, put cursor here and press SEL

To enter Menu Tree, put cursor here and press SEL

Active Program

The PS-6144 can store up to 48 programs of setpoints. The "Active Program" is the program currently controlling the output channels.

If hardware inputs are being used to select the Active Program, the display will indicate the program selected by the inputs. If all hardware inputs are off, the Active Program will be the Default Program specified through the DEFAULT PROGRAM function. For information on using hardware inputs to select the Active Program, see "Controller Input Wiring" in Section 2.

If hardware inputs are not used, the Active Program will be the program specified through the DEFAULT PROGRAM function.

Machine Speed

When the machine is moving, Machine Speed is displayed in user selectable units of RPM (revolutions per minute), BPM (bags per minute), or CPM (cartons per minute). Machine Speed is displayed as a value which is 1X, 2X, or 3X the resolver RPM. See RATE SETUP for details.

Toggle RPM

Machine or Group Position is displayed only when the resolver speed is below the TOGGLE RPM speed. At higher speeds, Machine Position will be blank. See TOGGLE RPM for programming details.

```
PGM: 1 RPM: 1500
MENU<
```

Machine position not shown above toggle RPM

Entering Menu Tree

To enter the Menu Tree from the Main Screen, move the cursor to "MENU" and press the SEL key.

See Also

DEFAULT PROGRAM
RATE SETUP
TOGGLE RPM
GRP POS DISP
OFFSET

Memory Tests

Menu Path

MAIN SCREEN SEL ▼ to TEST MENU SEL ▼ to MEMORY TESTS SEL

Purpose

This menu selection provides three functions that allow you to clear programmed values from the controller. An additional function tests the controller's watchdog timer.

Screen

```
MEMORY TESTS
FCN:----<
```

Enter function here

Programming

To perform one of the memory test functions, enter the function number using the numeric keys and press SEL.

Function 7000

Clears all setpoints and configuration settings from the controller's EEPROM. After clearing the setpoints, the controller will reload the factory default settings listed in the Appendix.

Function 7001

Clears all configuration settings from the controller's EEPROM. These include all of the programming performed through the Setup Menu and Config Menu on the menu tree, Figure 20. When finished, the controller will reload the factory default settings listed in the Appendix.

Function 7002

Clears all setpoints from the controller's EEPROM. These include any on/off setpoints programmed through SETPOINTS. All other settings will remain intact.

Function 7998

Watchdog Timer Test. The "Watchdog Timer" monitors the operation of the controller's microprocessor and shuts the controller down if any internal malfunction is detected. If the Watchdog Timer fails, the controller may continue to operate. However, any subsequent malfunctions or noise-induced irregularities may go undetected, and the controller may begin to operate erratically.

To test the Watchdog Timer, run Function 7998. If the controller's Watchdog Timer is working properly, the controller will reset. If Function 7998 does not reset the controller, the Watchdog Timer has failed. Replace the controller immediately and return the faulty unit to the factory.

⚠ WARNING

Failure of controller to pass the watchdog timer test can cause erratic operation, resulting in injury and damage to equipment.

Motion ANDing

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to CHN ANDING MENU SEL to MOTION ANDING SEL

Purpose

This function is used to tie the operation of output channels to the Motion Detection levels programmed through MOTION DETECTION. Each output channel may be ANDed with either Motion Detection level. If an output is Motion ANDed, it will turn on only when the resolver RPM is in the range specified for that Motion Detection level, AND the setpoints programmed for that channel are "on."

Outputs that must always operate, regardless of machine speed, should **not** be ANDed with a Motion Detection level.

Screen

```
CHN: 12
MOTION AND: L1
```

Channel number

Motion ANDing level: L1, L2, or OFF.
(Toggle with SEL key)

This screen displays the channel number and the Motion Detection level for Motion ANDing: L1, L2, or OFF. The channel will not be Motion ANDed if the enable is OFF.

Motion ANDing (Cont'd)

Programming

Select a new channel by pressing the INC/DEC keys, or through direct numeric entry followed by ENT.

Press the SEL key to toggle the ANDing to L1, L2, or OFF.

Operation

- Any number of output channels can be ANDed to a single Motion Detection level.
- Motion ANDing and Output Enable ANDing can be combined for any given output channel.
- When Motion ANDing is activated for a channel, it will apply to that channel in all programs.

Motion Detector

An output channel can be used as a motion detector by programming it to be on at "1" and off at "1," and then ANDing it with the desired Motion Level. This will turn the output on constantly as long as the machine speed is within the specified Motion Level range.

See Also

MOTION DETECTION

Motion Detection

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to MOTION DETECT SEL

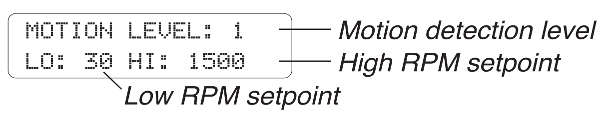
Background

Motion Detection establishes one or two "Motion Levels," or speed ranges, with low and high RPM values. These two ranges are independent of each other.

Each output channel can be ANDed with either Motion Level. ANDed outputs will be enabled only when the resolver speed is within the specified speed range. Output channels that are not ANDed will be "on" whenever the machine position is within their programmed setpoints, regardless of machine speed. One use of Motion Levels and Motion ANDing is to turn off devices such as glue guns if the machine stops or jams.

The MOTION DETECTION function is used to establish one or two Motion levels. Once the Motion Levels are programmed, use MOTION ANDING to tie individual output channels to the Motion Levels.

Screen



The Motion Detection screen displays the Motion Level, the Low RPM, and the High RPM.

Programming

Use the numeric keys and ENT to change values for Motion Level, Low RPM, and High RPM.

Motion Detector

An output channel can be used as a motion detector by programming it to be on at "1" and off at "1," and then ANDing it with the desired Motion Level. This will turn the output on constantly as long as the machine speed is within the specified Motion Level range.

See Also

MOTION ANDING

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to OFFSET SEL

Background

Because the PS-6144 is a programmable device, it can be set to display a position of “zero” 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.

In addition, each output group operating in **Mode 0, 3, 4, or 5** 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.

Note: When programming a controller, there must be more than one group defined in the CONFIG MENU in order fro a user to adjust OFFSET for a group in the SETUP MENU.

Setting a group to its own zero position can simplify setpoint programming for output channels by clarifying the relationship between the setpoints and the machine component controlled by the group. For example, suppose that an output group controls a glue head on a cartoning machine. By jogging the machine and viewing POS on the PS-6144 display, you realize that the glue head must turn on at 347° and off at 22° when using the position set through SHAFT POSITION. Since other output channels correlate well with SHAFT POSITION, you don’t want to change it. Instead, using the OFFSET function for this group, you could add 13° to the shaft position so that the glue head would turn on at a **group position** of 0° and off at 35°. Although the group position has been “offset” by 13°, the gun would still turn on at 347° and off at 22° in terms of **shaft position**.

For output groups operating in **Mode 1 or 2**, 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.

Units with the gray code output option “-G” generate an 8-bit position signal across Outputs 1 through 8. This gray code position signal always corresponds to the position as programmed through SHAFT POSITION, and is not affected by group positions programmed through the OFFSET function.

Screens

OFFSET Screen—Group Mode 0, 3, 4 or 5

Output Group

```
GRP:1< POS:   0     — Group Position = Shaft Position + ABS Offset
       ABS: 132     — Absolute Offset Value for this Group
```

OFFSET Screen—Group Mode 1 or 2

Output Group

```
GRP:1< POS: 359     — Group Position = PRE + Change Since Last Reset
       PRE:  30     — Group Preset Value (If Group is Mode 1 or Mode 2)
```

(continued)

Offset Programming

To change the offset for an output group in Mode 0, 3, 4, or 5, first select the group by moving the cursor to GRP. Use INC or DEC, or the numeric keypad and ENT to select the group.

Offset can be programmed in two ways:

Direct Entry—Enter the offset directly by moving the cursor to ABS and entering the offset value on the numeric keypad, followed by ENT.

Group Position—Jog the machine to a position that corresponds to the desired group position, move the cursor to POS, and enter the group position using the numeric keypad, followed by ENT. For example, jog the machine to a point where the group position should be zero, then press "0" ENT while the cursor is at POS.

- For standard PS-6144 controllers using Electro Cam resolvers, the ABS value will directly show the relationship between the group position and machine 0 (shaft position) in scale factor increments. For example, suppose that SHAFT POSITION is set to machine 0 and SCALE FACTOR is set to 360. If the ABS of a group is 20, its position will always be 20 dgrees ahead of the machine position.
- If groups have been programmed with their own offsets, changing SHAFT POSITION will change all of the group positions at once.

CAUTION

It is usually best to set SHAFT POSITION to the desired zero position in the machine cycle before programming individual group offsets.

- If groups have been programmed with their own offsets, changing GRP POS DISP to ONE will change ABS for all groups to the value programmed for Group 1.

Programming Preset

To change the preset for an output group in Mode 1 or 2, first select the group by moving the cursor to GRP. Use INC or DEC, or the numeric keypad and ENT to select the group. Move the cursor to PRE and enter the preset value, followed by ENT. Preset is programmed in scale factor units.

- The **preset** value is stored in the controller on power down. However, the last **group position** is not. On power up, the group position will be the same as SHAFT POSITION. When the group's input terminal is energized, then the group position will reset to the preset value.

See Also

SHAFT POSITION
GRP POS DISP
OUTPUT GROUPS

Section 5 for details on Output Grouping & Modes

Output Enable ANDing

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to CHN ANDING MENU SEL ▼ to OUTPUT ENABLE ANDING SEL

Purpose

Output Enable ANDing allows you to AND any output channels with Input Terminal #16, Figure 7. A channel ANDed with this terminal will be enabled to turn on at its programmed setpoints only while the terminal is energized.

Screen

```
     CHN: 12<
 OUTPUT AND: OFF
```

Channel number
Output Enable ANDing: ON or OFF.
(Toggle with SEL key)

Programming

Select a new channel by pressing INC/DEC, or using the numeric keys followed by ENT.

Use the SEL key to toggle ANDing on and off.

Output Groups

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL
▼ to OUTPUT GROUPS SEL

Purpose

This function allows you to divide output channels into groups, and assign operating modes to the groups. Operating modes provide a powerful tool for relating output channel operation to sensor signals or other inputs. Incorporating modes into a control system can greatly improve line efficiency, reduce scrap, and improve control accuracy between machine sections at high speeds. See Section 5 for a complete explanation of the uses and applications of operating modes.

Screen

Selected group number

```
GRP:1 <GRP QTY:2
CHNS: 15 MODE: 3
```

Number of output groups
Enable mode of selected group
Number of channels in selected group

Establishing Groups

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

- Output channels are assigned to groups sequentially. Group 1 will begin with Output 1 and include the specified number of outputs; Group 2 will begin with the next output and continue sequentially for its specified number of outputs; and so on. The last group will automatically include all of the remaining outputs.
- 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

Output Group	Includes Outputs	Mode
1	1 thru 25	3

Grouping Example 2—Two Groups

Output Group	Includes Outputs	Mode
1	1 thru 4	2
2	5 thru 25	0

(continued)

Grouping Example 3—Three Groups

Output Group	Includes Outputs	Mode
1	1 & 2	0
2	3 & 4	4
3	5 thru 25	0

Programming

Begin by moving the cursor to GRP QTY and entering the number of groups desired, followed by ENT.

Next, move the cursor to GRP and enter "1" followed by ENT.

Move the cursor to CHNS and enter the number of output channels to be included in Group 1, followed by ENT.

Move the cursor to MODE and enter the operating mode for the group from zero to five, followed by ENT. See Section 5 for an explanation of the operating characteristics of each mode.

Move the cursor back to GRP and repeat these steps for each group to be programmed.

Main Screen

When output channels are divided into groups, the appearance of the Main Screen will change slightly. See MAIN SCREEN for details.

See Also

MAIN SCREEN
OFFSET
GRP POS DISP

Output Status

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to I/O STATUS SEL ▼ to OUTPUT STATUS SEL

Purpose

This screen shows the On/Off state of the output channels, and it allows the outputs to be forced.

Screens

Both Models, Outputs 1-8

```
12345678 OUTPUT
01001001 1-8<
```

Output Numbers (1-8)

Output On/Off Status (O=Off, 1=On)

PS-6344-17, Outputs 9-17

```
901234567 OUTPUT
0100100AA 9-17<
```

Output Numbers (9-17)

Analog Modules shown with "A"

PS-6344-25, Outputs 9-25

```
90123456 OUTPUT
01001000 9-16<
```

Output Numbers (9-16)

```
789012345 OUTPUT
0100100AA 17-25<
```

Output Numbers (17-25)

Analog Modules shown with "A"

If any output positions have been programmed as analog outputs, the On/Off status will show "A" instead of "0" or "1."

Output Status (Cont'd)

Selecting Outputs Press the SEL key to change the set of outputs displayed.

Forcing Outputs Forcing outputs allows you to force an output on or off for diagnostic purposes. This function is not available on earlier software models.

Note: When leaving the Output Status screen, keep in mind that any outputs that have been forced will return to their originally programmed state.

Programming Press ◀ to access Output 1, causing the "0" to blink. Press SEL to turn this output on. The "0" will change to a "1". Select other desired outputs by pressing ▶ or ◀. If the output is already on, a "1" will be present instead of a "0". So, the "1" will change to a "0" when the output is forced.

Press ESC to return to output number selection. Outputs will remain forced until you leave the Output Status screen. Press SEL to access Outputs 9-17 on the PS-6144-17 and Outputs 9-16 or 17-25 on the PS-6144-25.

Password

Menu Path MAIN SCREEN SEL PASSWORD SEL

This screen provides an area to enter a password. It also shows the current programming access level and the status of the Programming Enable terminals on the back of the keypad, Figure 12.

Screen

```
PASSWORD:****<
LEV:NONE INP:OFF
```

Password entry area

Keypad programming terminal input status

Current programming level (hardware or software)

Enable Levels There are three programming access levels; OPERATOR, SETUP, and MASTER. See Figure 21 for a summary of the programming functions available to the different levels. The codes that correspond to each level are established in the ENABLE CODES screen.

Entering a Password Enter a password through the numeric keypad followed by ENT. As you press the number keys, the asterisks will be replaced by dashes. If you make a mistake, press CLR to erase the last key you pushed.

If you enter a password that has been programmed through ENABLE CODES, the keypad will function at the corresponding programming level. See ENABLE CODES for a description of the various levels.

If either of the programming enable terminals on the back of the keypad is active when a password is entered, the programming level will be whichever is greater.

```
PASSWORD:--**<
LEV:NONE INP:OFF
```

Dashes replace asterisks as numbers are entered

```
PASSWORD:****<
LEV:MAS INP:OFF
```

Dashes change back to asterisks with ENT

Enable level shown if number matches programmed password value

Clearing a Password

When programming operations are completed, enter a password value of "0," then ENT to clear the enable level.

If a keypad is left unattended with an active password, the access code will clear after five minutes of keypad inactivity and the keypad will revert to the "Normal Display" mode shown in Figure 21.

See Also

ENABLE CODES

Per Channel Enable

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to PGM ENABLES SEL ▼ to PER CHN ENABLE SEL

Purpose

This screen is used to enable Operator Level access to individual output channels. PER CHN ENABLE is used in conjunction with the ENABLE OPTIONS screen to assign Operator Level access to selected programming functions.

Screen

```
     CHN: 12<          — Channel number
 CHN ENABLE: ON        — Per channel enable: ON/OFF
                         (Toggle with SEL key)
```

Channel Select

Press the INC/DEC keys, or use the numeric keys and ENT.

Enable Toggle

Press the SEL key to toggle the enable ON or OFF.

See Also

ENABLE OPTIONS

Program Copy

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to PGM COPY SEL

Purpose

Program Copy allows you to copy all of the channels and setpoints from one program to another. It is often easier to copy an existing program and modify it, than to enter a new program from scratch.

Screens

The Program Copy function consists of four screens:

```
SRC PROGRAM:---<       — Program to be copied from
```

```
DST PROGRAM:---<       — Destination to be copied to
```

```
DST PROGRAM: 6<
       EXECUTE<        — Move cursor to EXECUTE, then press SEL
                         to copy program
```

```
DST PROGRAM: 6
       COMPLETE<       — COMPLETE indicates program
                         successfully copied
```

Programming

Use the numeric keys and SEL to enter program numbers. During programming, the cursor keys allow you to move between the Source and Destination screens to allow you to change values before selecting EXECUTE.

Program Select Mode

Menu Path MAIN SCREEN SEL ▼ to CONFIG MENU SEL HARDWARE SEL ▼ to PGM SEL MODE

Purpose This screen allows you to specify the format for the hardware Program Select inputs on Terminals 1 through 8 of Terminal Block 3, Figure 7.

Screen

```
PROGRAM SELECT
 MODE: BIN<
```

Hardware Program Select Format: BIN = Binary, GRAY = Gray Code, BCD = Binary Coded Decimal

The Program Select inputs can operate in Binary, BCD, or Gray Code formats as shown in Figure 8.

Use the SEL key to toggle the input format.

⚠ WARNING **Injury and property damage hazard may occur due to changes in machinery operation. If the input signals controlling program selection are lost due to a malfunction, the Default Program will activate. Program the Default Program with settings that will eliminate this hazard in the event of sudden activation.**

See Also DEFAULT PROGRAM

Pulse Copy

Menu Path MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to PULSE COPY SEL

Purpose Pulse Copy allows you to program a series, or "train" of pulses into a channel without having to enter the On and Off setpoints for each pulse. The Pulse Copy function prompts you for the beginning and ending setpoints for the pulse train; the number of pulses in the train; and the duration of a pulse. Pulse Copy then divides the designated portion of the resolver cycle into the specified number of pulses, evenly dividing the unused portion of the segment between the pulses.

Screens The Pulse Copy function consists of eight screens:

```
PROGRAM:---<
```

Program to add pulses to; Enter number, then SEL to go to next screen

```
CHANNEL:---<
```

Channel to add pulses to; Enter number, then SEL to go to next screen

```
ON:---<
```

"On" time of leading edge of first pulse; Enter number, then ENT & SEL to go to next screen

```
OFF:---<
```

"Off" time of trailing edge of last pulse; Enter number, then ENT & SEL to go to next screen

```
COUNT---<
```

Total number of pulses to be added; Enter number, then ENT & SEL to go to next screen

```
DURATION:---<
```

Duration of each pulse added; Enter number, then ENT & SEL to go to next screen

```
DURATION: 35
    EXECUTE<
```

Move cursor to EXECUTE, then press SEL to generate pulses. To review values before executing, move cursor to top row and press SEL as needed

```
DURATION: 35
   COMPLETE<
```

COMPLETE indicates pulses have been generated

(continued)

Example

Generate a train of pulses as follows:

Pulse	On	Off
1	0	50
2	100	150
3	200	250
4	300	350
5	400	450
6	500	550
7	600	650
8	700	750
9	800	850
10	900	950

Each pulse is 50 increments wide, separated from the next pulse by 50 increments.

Program PULSE COPY as follows:

```
PROGRAM:---<
```

Program to add pulses to;
Enter number, then SEL to go to next screen

```
CHANNEL:---<
```

Channel to add pulses to;
Enter number, then SEL to go to next screen

```
ON:   0<
```

"On" time of leading edge of first pulse;
Enter 0, then ENT & SEL to go to next screen

```
OFF:950<
```

"Off" time of trailing edge of last pulse;
Enter 950, then ENT & SEL to go to next screen

```
COUNT 10<
```

Total number of pulses to be added;
Enter 10, then ENT & SEL to go to next screen

```
DURATION: 50<
```

Duration of each pulse added;
Enter 50, then ENT & SEL to go to next screen

```
DURATION: 50
    EXECUTE<
```

Move cursor to EXECUTE, then press SEL to generate pulses.

```
DURATION: 35
   COMPLETE<
```

COMPLETE indicates pulses have been generated

Go to SETPOINTS to confirm the pulse train:

```
<-P-> CH: 1 <EDG
  ON: 0   OF: 50
```

Move cursor to OF and use arrow keys to review pulse setpoints

Rate Setup

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to DISPLAY SEL RATE SETUP SEL

Purpose

The Rate Setup function allows you to configure the RPM display on the Main Screen. Three parameters can be programmed:

- **Units—**The Main Screen can label the resolver speed as Revolutions Per Minute (RPM), Bags Per Minute (BPM), Cartons Per Minute (CPM), or Inches Per Minute (IPM).
- **Rate—**The ratio of actual resolver RPM to displayed RPM. This ratio is a fraction consisting of a multiplier (MPY) over a divider (DIV).
- **Decimal Points—**The controller divides the Rate by 1, 10, 100, or 1000 to display 0, 1, 2, or 3 decimal places, respectively.

Screen

Multiplier: 0 through 1091

```
MPY: 1< DP: 0
DIV: 1 RPM
```

Number of decimal points displayed: 0, 1, 2, or 3

Units: RPM, BPM, CPM, IPM

Divider: 1 through 63

Following are a few examples of the relationships between multiplier (MPY), divider (DIV), decimal points (DP), actual resolver speed, and displayed resolver speed:

If MPY Is…	And DIV Is…	And DP Is…	Then MPY/DIV Is…	And a Resolver Speed Of…	Is Displayed As…
1	2	0	.5	100 RPM	50 RPM
1	2	1	.5	100 RPM	5.0 RPM
1	2	2	.5	100 RPM	.50 RPM
1	2	3	.5	100 RPM	.050 RPM
1	1	0	1.0	100 RPM	100 RPM
1	1	1	1.0	100 RPM	10.0 RPM
1	1	2	1.0	100 RPM	1.00 RPM
1	1	3	1.0	100 RPM	.100 RPM
2	1	0	2.0	100 RPM	200 RPM
2	1	1	2.0	100 RPM	20.0 RPM
2	1	2	2.0	100 RPM	2.00 RPM
2	1	3	2.0	100 RPM	.200 RPM

Programming

Units—Move the cursor to the “Units” field and use SEL to toggle between values.

MPY & DIV—Move the cursor to MPY or DIV and use the numeric keys followed by ENT to enter a value.

DP—Move the cursor to DP and use SEL to toggle between values.

Resolver Type

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to HARDWARE MENU SEL RESOLVER TYPE SEL

Purpose

The PS-6144 can operate with resolvers that have a transformation ratio of .454 or 1. Standard Electro Cam resolvers have a ratio of .454. Some resolvers made by other manufacturers have a ratio of 1.

Screen

```
   RESOLVER
TYPE:     ECC<
```

Pressing the SEL key changes resolver type to OTHER.

RPM Update Rate

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to DISPLAY SEL RPM UPD RATE SEL

Purpose

The RPM Update Rate is how often the RPM display on the Main Screen is updated. This rate can be programmed to be 1/Sec, 2/Sec, or 10/Sec.

Screen

```
RPM UPDATE
RATE: 1/S<
```

RPM Update Rate: How often RPM display on main screen is updated; 1/Sec, 2/Sec, or 10/Sec.

Press the SEL key to toggle the selection.

Scale Factor

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to HARDWARE MENU SEL SCALE FACTOR SEL

Purpose

This function controls the number of increments into which one resolver revolution is divided. A scale factor of 360 (0 to 359) allows the controller to operate in degrees. A scale factor of 1024 (0 to 1023) allows positions to be programmed more accurately. In some applications the scale factor can be set so each increment equals a unit of linear travel.

Screen

```
    SCALE
FACTOR: 360<
```

Number of increments each revolution is broken into

Limits

Scale factors range from two to 1024 on standard controllers. For controllers equipped with the “-H” option, scale factor can be as high as 4096.

Recalculations

When the scale factor is changed, all programmed setpoints are recalculated to convert them to the new scale factor. The keypad/display will be inoperative until the calculations are done.

Setpoint Use

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to SYSTEM INFO SEL
SETPOINT USE SEL

Purpose

This function displays the total number of setpoint On/Off pairs, or "pulses" available for programming, and the number of pulses that have been programmed.

Screen

```
  TOTAL: 1200
     USED: 64
```

Total number of pulses available for programming (TOTAL)
Number of pulses programmed into all channels of all programs (USED)

The number of setpoints shown as "Used" is the sum of all pulses that are programmed into all channels of all programs. The "Total" value is the number of pulses that can be stored in non-volatile EEPROM memory. The difference between the two numbers is the number of pulses available for programming.

The number of pulses programmed into all channels of all programs cannot exceed the value displayed as Total.

There are no values that can be changed in this screen.

Setpoints

Menu Path

MAIN SCREEN SEL ▼ to SETPOINTS SEL

Screens

When SETPOINTS is selected, a preliminary screen specifies the program whose setpoints will be programmed.

```
  PGM NUMBER: <
```

Program to view or modify

The active program is displayed, but any other program can be specified by using the numeric keys or INC and DEC to choose a program, then pressing SEL to move to setpoint programming.

Blank if only 1 pulse in channel
Channel

```
      CH: 1 <EDG
  ON: 90 OF: 270
```

Pulse mode
OFF setpoint
ON setpoint

<-P-> indicates multiple pulses in channel

```
  <-P-> CH:1<EDG
  ON: 90 OF: 270
```

Channel to Edit

Use the numeric keypad and ENT to select the channel to program.

- **Channels 91 through 96 are special channels used for Output Grouping and Modes. See Section 5 for details.**

Setpoint Values

Use the left and right arrow keys to move between the ON and OFF setpoints.

- If a channel has more than one pulse, you may view the other pulses by pressing the right cursor key when viewing the OFF setpoint, or by pressing the left cursor key when viewing the ON setpoint.

(continued)

- If a channel contains no pulses, the ON and OFF setpoints will be "0."
- If a channel is always on, both the ON and OFF setpoints will be "1."

```
     CH:1 EDG
ON: 0< OF: 0
```

ON and OFF setpoints both 0 if no pulses in channel. Both 1 if channel always ON

Adding a Pulse

You may add a new pulse to a channel by pressing the SEL key when the cursor points to either the ON or the OFF setpoint.

```
      CH:1 EDG
ON:---< OF:---
```

Enter ON setpoint, then ENT or right cursor to OF. Enter OFF setpoint, then press ENT.

The display will change to show blank ON and OFF setpoints; the cursor will point to the ON setpoint. Enter the ON setpoint through the numeric keypad, and then press the ENT key or the right cursor to move to the OFF setpoint. Enter the OFF setpoint through the numeric keypad and then press the ENT key.

Adding Multiple Pulses

If ON and OFF setpoints for a pulse are visible on the screen and you press SEL to program a new pulse, the original pulse will remain in the output channel. If the ON or OFF setpoints entered overlap an existing pulse in the channel, you will see an "Error: Pulse Overlap" message.

To abort entering a pulse at any time, press ESC.

Changing Setpoints

Change a setpoint value with the numeric keys followed by ENT, or with the INC and DEC keys.

Pulse Modes

The Pulse Mode controls how the INC and DEC keys modify setpoints. There are three modes; **EDG** (edge), **PUL** (pulse), and **CHN** (channel.) Change the Pulse Mode by pressing the SEL key when the cursor points to the Pulse Mode.

In **EDG** mode, the INC and DEC keys will affect the selected ON or OFF setpoint only.

In **PUL** mode, both ON and OFF setpoints will be incremented or decremented simultaneously.

In **CHN** mode, **all** ON and OFF setpoints for all pulses in the channel will be incremented or decremented simultaneously.

Deleting a Pulse

A pulse may be deleted by making ON equal to OFF, or vice versa. If there is more than one pulse in the channel, the next pulse will appear in the on/off setpoint area. If the channel has no more pulses, the ON and OFF setpoint will both be zero.

Clearing a Channel

To clear a channel of all pulses, enter a new pulse with ON and OFF setpoints of "0."

Channel Always ON

A channel may be programmed to be on for a full revolution (always on) by entering a new pulse with both ON and OFF values equal to "1."

Record Setpoints

Photocopy the form inside of the back cover and use it to write down setpoints for each program.

! IMPORTANT

For most installations, before programming setpoints, it is best to set SHAFT POSITION to zero at the start of a machine cycle. This allows you to jog the machine to various points in the machine cycle where output channels must turn on or off, note these machine positions from the PS-6144 display, and enter them into setpoint programming. Setpoints programmed in this manner will relate directly to the machine position. If setpoints are programmed before SHAFT POSITION is set, and SHAFT POSITION is subsequently changed, the setpoints will no longer correlate with the machine zero position.

The same logic applies if OFFSET will be used for individual output groups. Program the offsets before establishing setpoints for the channels in the groups.

Shaft Position

Menu Path MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to HARDWARE MENU SEL ▼ to SHAFT POSITION SEL

Purpose Because the PS-6144 is a programmable device, it can be set to display a position of "zero" at any point in the machine cycle. Usually, the machine is jogged to the beginning of a cycle, and SHAFT POSITION is set to zero at this point. This function eliminates the need to adjust the physical coupling between the machine and resolver in order to change the displayed machine position.

Screen

```
   SHAFT
 POS: 260<
```

Resolver Position Without Offset

Programming Use the INC/DEC keys, or the numeric keys followed by ENT to change shaft position.

- Set SHAFT POSITION before doing any SETPOINT or OFFSET programming.

Software Version

Menu Path MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to SYSTEM INFO SEL ▼ to SOFTWARE VERSION SEL

Purpose The Software Version screen displays the revision number of the firmware contained within the controller. This information may be useful if the unit needs to be returned for service.

Screen

```
MAJOR REV:1.75
 BASE REV:1.17
```

There are no values that can be changed in this screen.

Speed Compensation

Menu Path MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to SPEED COMP SEL

Background Some devices such as pneumatic cylinders and glue guns require a fixed amount of time to perform their function. As a machine speeds up, these devices need to be actuated earlier in the cycle in order to complete their action at the required time. Speed compensation automatically advances the On/Off setpoints of specified output channel(s) as the machine speeds up, maintaining proper synchronization at all speeds. See Section 4 for a detailed discussion of speed compensation.

Screens For standard controllers, one value of speed compensation applies to both the ON and OFF setpoints in a channel The SPEED COMP screen for standard controllers looks like this:

Output Channel

```
CH:1<SC: 10.5
```

Speed Compensation (10.5 msec shown)

For units with the "-L" option (Leading /Trailing edge), the ON and OFF edges in a channel can have different values of speed comp. If SPEED COMP MODE in these models is set to "One," the same value will apply to both ON and OFF edges, and the screen above will show. If SPEED COMP MODE is set to L/T, Leading/Trailing Edge speed comp is activated, and the following screen appears:

Output Channel

```
CH: 1<LE:  10.0
      TE:  20.0
```

Leading edge compensation (10 msec shown)
Trailing edge compensation (20 msec shown)

Speed Compensation (cont'd)

Speed Comp Units

Speed compensation is programmed by entering the response time of the output device in milliseconds (.001 Sec). The output will always turn on this number of msec before the programmed ON position is reached, and turn off this number of msec before the programmed OFF position is reached. As speed increases, the number of degrees of advance will automatically increase to maintain the number of msec of advance.

Programming

To change output channels, move the cursor to the channel number and enter a new one. You may also INC or DEC the channel number.

To change speed comp values, use the numeric keys or INC and DEC. To enter tenths of msec, use the decimal point. When entering even msec, the decimal point is not needed: "12 ENT" will result in a value of 12.0.

Negative Speed Comp

Negative values of speed compensation cause an output channel to lag its programmed machine position by the specified number of msec. See Section 4 for details on applying negative speed compensation.

To program negative speed comp, press the +/- key **after** entering a number but **before** pressing ENT. You may also decrement a value below zero.

NOTE: Regardless of the number of outputs available, speed compensation is limited to any 16 of those available outputs.

Speed Comp Mode

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to DISPLAY MENU SEL ▼
to SPD COMP MODE SEL

Purpose

For units with the "-L" option (Leading/Trailing Edge Speed Comp), Speed Comp Mode determines whether standard or leading/trailing edge speed compensation is in effect.

Screen

```
SPEED COMP
MODE:ONE
```

Speed Comp Mode: ONE = Leading/Trailing edge have same speed comp; L/T = Each edge can have a different value of speed comp.

When the Speed Comp Mode is ONE, the same value of speed comp is used for both leading and trailing edges.

When the Speed Comp Mode is "L/T", the leading and trailing edges of a pulse may have different values of speed comp.

Programming

Press the SEL key to toggle between ONE and L/T. Press ENT to confirm your selection.

See Also

SPEED COMPENSATION

Timed Outputs

Menu Path

MAIN SCREEN SEL ▼ to SETUP MENU SEL ▼ to TIMED OUTPUT SEL

Purpose

Any four outputs can be programmed to time out rather than remain on until an OFF setpoint is reached. This makes the output duration constant regardless of machine speed. If the OFF setpoint is reached before the specified time has elapsed, the timing will be aborted and the output will turn off immediately.

Once an output times out, it will not turn on until the next ON setpoint is reached. Each timed output can have a unique time delay length.

Outputs are timed in one msec increments up to a maximum of 9999 msec (9.999 seconds).

Screen

```
CHANNEL:    1      — Channel
TIME(mS):  20      — Time duration
```

Pulse Required

A timed output must be programmed with ON and OFF position setpoints in order for output timing to take effect.

Reverse Rotation

If the machine is rotating in the reverse direction, timed outputs will energize when the OFF edge of the pulse occurs.

Toggle RPM

Menu Path

MAIN SCREEN SEL ▼ to CONFIG MENU SEL ▼ to DISPLAY MENU SEL ▼
to TOGGLE RPM SEL

Purpose

Toggle RPM is the resolver speed at which the Position display on the Main Screen will disappear. At speeds below the Toggle RPM the Position display will be visible; at speeds above the Toggle RPM the Position will not be shown.

Screen

```
   TOGGLE
RPM:  50      — Toggle RPM: Position display on main screen
                is not shown at speeds above Toggle RPM
```

Programming

Use the numeric keys and ENT to enter a new value, or use INC and DEC to change an existing value.

Introduction To Speed Compensation

What Is It?

"Speed compensation" refers to the ability of the PS-6144 controller to automatically advance or retard setpoints in any output channel depending on the speed of the machine. Speed compensation allows devices with fixed response times, such as glue guns, to perform their functions with high accuracy over a wide range of machine speeds. Without speed compensation, a glue bead may tend to "drift" out of position as machine speed increases. By properly programming speed compensation for the output channel controlling the glue gun, the glue bead position can be maintained precisely over the complete range of machine speeds.

Benefits

Proper use of speed compensation can provide substantial benefits:

- **Increased Productivity—**If a machine incorporates components with fixed response times, the use of speed compensation can often increase line speeds by as much as 50%.
- **Reduced Scrap Rate—**Speed compensation maintains the accuracy of critical operations such as gluing, thereby reducing rejects, rework, and scrap.
- **Simplified PLC Systems—**Programming speed compensation into standard motion control equipment such as PLC's, stepper motors, and stepper motor controls is difficult. In addition, to perform speed compensation at high machine speeds, the PLC hardware must be extremely fast, and therefore expensive. Integrating a PS-6144 into the control system eliminates the need to write custom PLC speed compensation programming, and provides excellent high speed control at a fraction of the hardware cost.

Fixed Response Times

Electromechanical components of automated systems often have fixed response times regardless of the line speed. For example, a glue gun may require ten milliseconds from the time the gun is actuated to the time that glue begins flowing. At the slowest line speed, the gun might need to be triggered when the carton is one inch away, so that the carton arrives under the gun just as glue begins flowing. As the line speed increases and the product travels faster, the lead distance from the carton to the gun must increase in order for the gun, with its fixed response time, to still hit the correct spot on the product. By programming speed compensation into the PS-6144, the timing of glue guns and similar mechanisms can be automatically advanced as speed increases, maintaining proper operation over a wide range of machine speeds.

NOTE: Regardless of the number of outputs available, speed compensation is limited to any 16 of those available outputs.

Example

Figure 22 illustrates a simple carton gluing application. A conveyor moves cartons under a glue gun which releases glue onto the flaps. The conveyor is connected through a timing chain and sprocket to a transducer which rotates one revolution for each carton that passes under the gun.

As the transducer dial shows, SHAFT POSITION has been programmed so that the leading edge of the box passes under the gun at 110° and the trailing edge at 360°. Glue begins flowing ten msec after the gun is energized, and it stops flowing ten msec after the gun is de-energized. Once the glue leaves the nozzle, it requires another five msec to travel to the carton. Combining the glue gun response time with the travel time results in a system response time of 15 msec, regardless of line speed.

At very slow, or essentially zero speed, the gun would be energized at a transducer position of 110° and de-energized at 360°. As the line speed increases, however, the gun needs to be energized before 110° to allow the glue to hit the carton in the correct spot. The faster the line speed, the earlier in the transducer cycle the gun must be triggered.

Calculation

To calculate the amount of speed compensation required, use the following relationships between the transducer's RPM (revolutions per minute) and degrees of rotation:

1 RPM = 360°/min = 6°/sec = 0.006°/msec,

RPM x 0.006 = deg/msec,

thus: @ 100 RPM, the transducer will rotate 0.6°/msec
@ 1000 RPM, the transducer will rotate 6.0°/msec

The gluing system requires 15 msec from the time the gun is energized to the time the glue hits the carton. At 100 RPM, the transducer will rotate 0.6°/msec. Therefore, in the 15 msec response time, the transducer will rotate (15 msec x 0.6°), or 9°. This means the glue gun must be energized at 101°, which is 9° before the box arrives under the gun, and de-energized at 351°. At 1000 RPM, the transducer will rotate (15 msec x 6°), or 90° during the response time, and the gun must be energized at 20° and de-energized at 270°. These values are visually represented in Figure 23.

Figure 22—Simple Application Using Speed Compensation

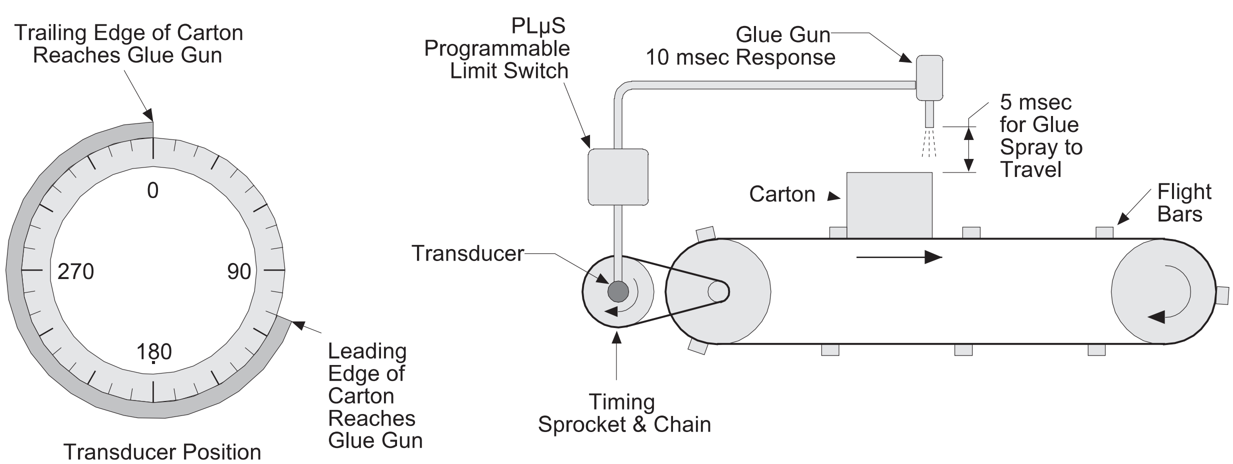
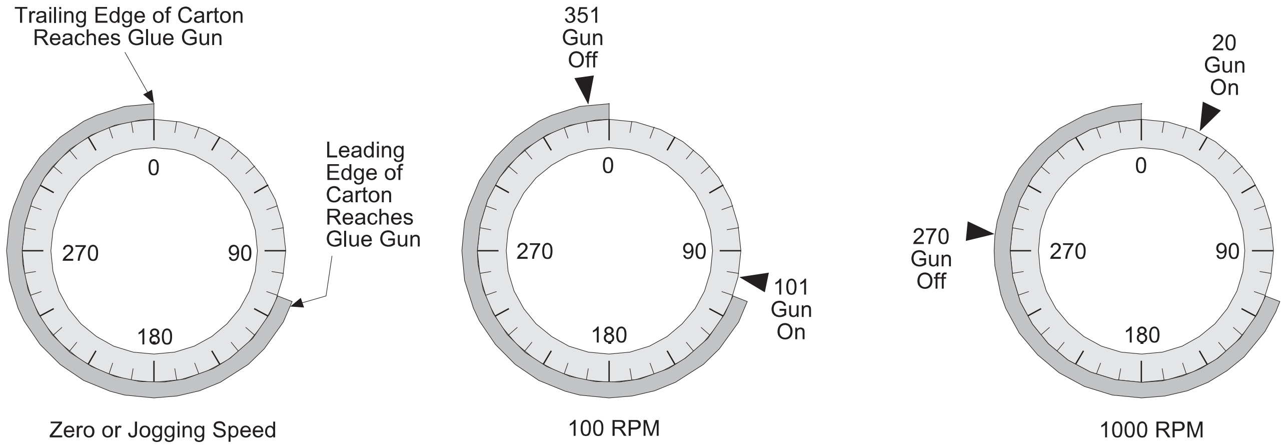


Figure 23—Speed Compensation at Various Speeds



Setting Speed Comp

In many applications, speed compensation can be set by jogging the line to determine ON and OFF setpoints at zero speed, then entering the speed compensation value into the controller. In the previous example, the line would be jogged until the leading edge of the box reaches the gun at 110° of transducer rotation. The glue gun output would be set to turn on at this point. Then, the line would be jogged until the trailing edge is under the gun at 360°, and the glue gun output would be set to turn off.

Once these on and off setpoints are entered, the glue system response time of 15 msec would be entered through SPEED COMP programming as described in Section 3. As line speed increases, the PS-6144 will automatically advance the setpoints to maintain the accuracy of the glue bead position.

⚠ CAUTION

When setting speed compensation on a system where zero speed setpoints have been established, always adjust the speed compensation value. Do not adjust the individual output setpoints!

Response Time Unknown

Suppose that in the previous example, the response time was unknown.
To set up the machine, jog a carton through the machine and set the glue gun ON and OFF setpoints as described earlier. Then, estimate a response time and enter it into the controller using the SPEED COMP function described in Section 3.

Start the line and run cartons through it at a fixed line speed. Program SPEED COMP to adjust the **speed compensation value** as required for proper gluing. This can be done while the line is in motion. Once programmed, vary the line speed to confirm proper operation at all speeds, and fine tune the SPEED COMP value if necessary.

Can't Be Jogged?

Some machinery can't be jogged to determine ON and OFF setpoints. To set up this type of equipment, start the line, run cartons through it at a fixed line speed, and set the ON and OFF setpoints as required for proper gluing. Write them down for reference in the next step. SPEED COMP should be set to zero.

Next, increase the line speed and adjust the **setpoints** to restore proper gluing. You might be tempted to enter a speed compensation value to do this. However, since the setpoints were adjusted at the first speed with zero compensation, any change in compensation value now will upset the first pair of setpoints.

Once the second pair of setpoints is established, compare them to the first pair that you wrote down. Establish a ratio of degrees the setpoints advance versus the speed as shown in Figure 24. Convert this ratio to response time and enter it as the speed compensation value.

(continued)

Standard Speed Comp (cont'd)

Since the new speed compensation value will affect the ON and OFF setpoints already programmed, you will need to start the line one more time and, at a constant speed, adjust the **ON and OFF setpoints** for proper gluing. Once set, vary the line speed to confirm that the speed compensation value is accurately adjusting the setpoints over the operating speed range.

Figure 24—Example for Calculating Speed Compensation

	RPM	Glue On	Glue Off	Difference
1st Line Speed:	200	73°	156°	83°
2nd Line Speed:	680	49°	132°	83°

Difference in Position: 73° - 49° = 24°
Difference in Speed: 680 RPM - 200 RPM = 480 RPM

Speed Compensation Value: Divide difference in position by difference in speed:

24°/480 RPM = 0.05° per 1 RPM

Since a shaft at 1 RPM rotates 0.006°/msec (see page 4-2), this shaft would require (0.05/0.006), or 8.3 msec to rotate 0.05°. The speed compensation value is 8.3.

Leading Trailing Speed Comp

Leading/Trailing

In the previous example, the response time of the glue gun was the same whether turning on or turning off. While this applies to many systems, some devices have different on/off response times. For these devices, PS-6144 controllers with the "-L" option (Leading/Trailing Edge) provide the ability to program different speed compensation values for the leading and trailing edges of the pulse driving the device.

Setting Leading/Trailing Speed Comp

If the ON and OFF response times are known, jog the line to determine ON and OFF setpoints at zero speed. Then enter the speed compensation values through SPEED COMP programming as described in Section 3. When programming SPEED COMP, enter the leading edge, or ON response time at the "LE" prompt, and the trailing edge, or OFF response time at the "TE" prompt.

IMPORTANT

When setting speed compensation on a system where zero speed setpoints have been established, always adjust the speed compensation value. Do not adjust the individual output setpoints!

Response Times Unknown

If the response times are unknown, jog the line to determine ON and OFF setpoints at zero speed. Estimate both ON and OFF response times and enter them through the SPEED COMP function. The leading edge, or "LE" value will control the ON timing, while the trailing edge, or "TE" value will control the OFF timing. Start the line, run product through it at a fixed speed, and adjust each **speed compensation value** as required for proper gluing. This can be done while the line is in motion. Once programmed, vary the line speed to confirm proper operation at all speeds, and fine tune the SPEED COMP values if necessary.

Can't Be Jogged?

If it is impossible to jog the line, run the line at a fixed speed and set the ON and OFF setpoints as required with SPEED COMP set to zero for both the leading and trailing edges. Write down the ON and OFF setpoints.

Next, increase the line speed and adjust the **setpoints** to restore proper gluing. You might be tempted to adjust speed comp values to do this. However, since the setpoints were adjusted at the first speed with zero compensation, any change in compensation value now will upset the first pair of setpoints.

Once the second pair of setpoints is established, calculate separate leading and trailing edge speed comp values as shown in Figure 25.

Since the new speed compensation value will affect the ON and OFF setpoints already programmed, you will need to start the line one more time and, at a constant speed, adjust the **ON and OFF setpoints** for proper gluing. Once set, vary the line speed to confirm that the speed compensation values are accurately adjusting the setpoints over the operating speed range.

Figure 25—Example for Calculating Leading and Trailing Edge

	RPM	Glue On	Glue Off	Difference
1st Line Speed:	200	73°	156°	83°
2nd Line Speed:	680	49°	144°	95°

Note that the length of the pulse 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: **Difference in Position:** 73° - 49° = 24°
Difference in Speed: 680 RPM - 200 RPM = 480 RPM

Speed Compensation Value: Divide difference in position by difference in speed:

24°/480 RPM = 0.05° per 1 RPM

Since a shaft at 1 RPM rotates 0.006°/msec (see page 4-2), this shaft would require (0.05/0.006), or 8.3 msec to rotate 0.05°. The speed compensation value is 8.3.

Trailing Edge: **Difference in Position:** 156° - 144° = 12°
Difference in Speed: 680 RPM - 200 RPM = 480 RPM

Speed Compensation Value: Divide difference in position by difference in speed:

12°/480 RPM = 0.025°/1 RPM

Since a shaft at 1 RPM rotates 0.006°/msec (see page 4-2), this shaft would require (0.025/0.006), or 4.2 msec to rotate 0.05°. The speed compensation value is 4.2.

Negative Speed Compensation

Negative Speed Comp

Normal speed compensation **advances** the setpoints in an output channel to compensate for a fixed response time in the device being controlled. In some applications, however, **negative** speed compensation is required to **retard** the setpoints in an output channel. Negative speed 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 speed compensation can be used to retard an output channel's setpoints from the true resolver position, thus maintaining output accuracy.

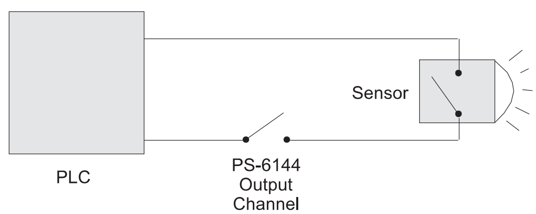
Sensor Lag

While output channels are usually used to switch devices on and off, another use is to "gate" a sensor into a PLC or other computer. Figure 26 illustrates a basic sensor gating scheme. In the illustration, the signal from the sensor reaches the PLC only when the output channel from the PLS is turned on.

Most sensing devices have very fast response times. However, if a sensor's response time is slow, its signal will appear later and later in the machine cycle as the machine speeds up. Eventually, the sensor may lag the resolver so much that its signal fails to appear during the window programmed into the PS-6144's output channel.

Negative speed compensation will correct this problem by causing the output channel to lag its programmed machine position by a specified number of milliseconds. Negative speed compensation is calculated using the same method as standard speed compensation. See SPEED COMP in Section 3 for details.

Figure 26—Simple Sensor Gating Scheme



Speed Comp Guidelines

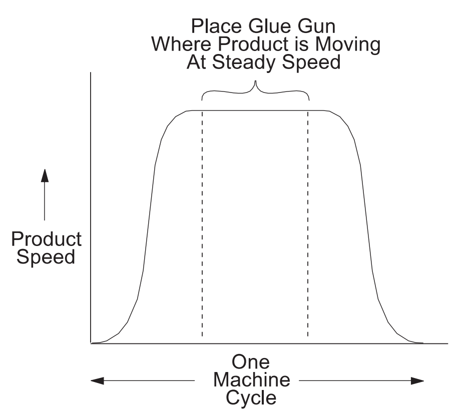
Device Placement

For speed 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 is moving past the device at a constant speed. See Figure 27 for an example. In the case of a glue gun, if the gun is ON when the speed is changing, the glue distribution may be inconsistent from carton to carton at varying machine speeds.

Speed Comp & Modes

When using Operating Modes as discussed in Section 5, be aware of the effects of speed compensation on the relationship between the setpoints, the Group Input signal, and the pulse programmed into the Group Channel. **Speed compensation will not affect Group Channels 91 through 96.**

Figure 27—Product Speed Should be Constant Past Controlled Device



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.

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

Output Group	Group Input Terminal TB 1, Fig. 7	Group Channel
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

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

Grouping Example 2—Two Groups

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

Grouping Example 3—Three Groups

Output Group	Includes Output Channels	Group Input Terminal TB 1, Fig. 7	Group Channel	Mode
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

- 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.

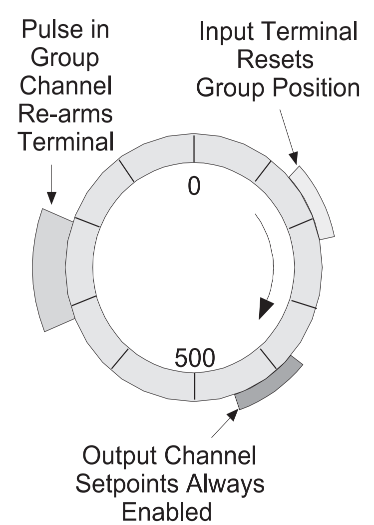
Applications

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

- 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.

Mode 1 Typical Setup



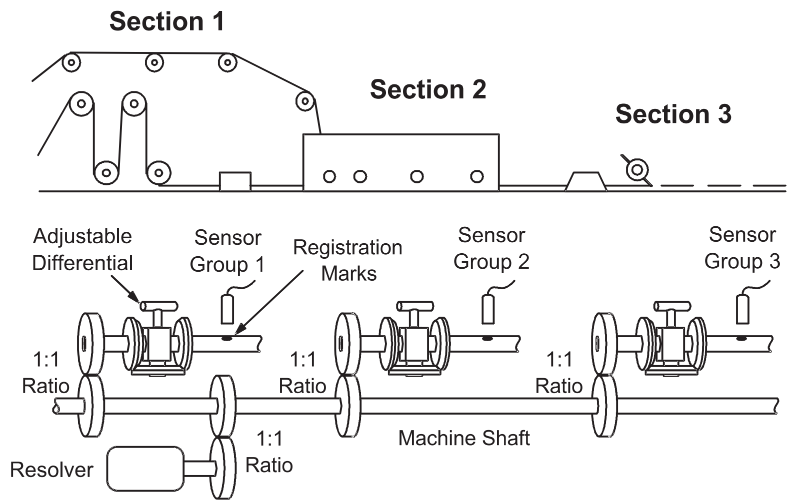
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MOTION ANDING and OUTPUT ENABLE ANDING can be used with outputs in a Mode 1 group.

(continued)

Figure 29—Mode 1 Example Application

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

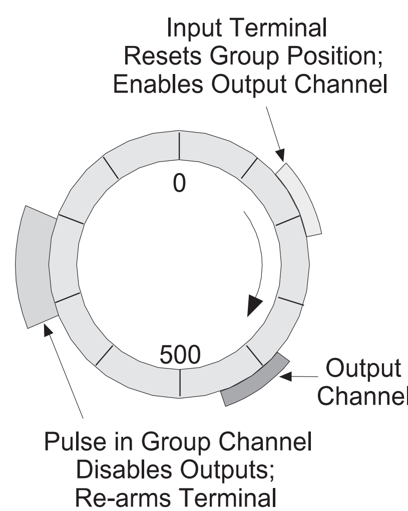
1. Program OUTPUT GROUPS, Sect. 3, to establish groups and modes.
2. Program the "Preset" value for each Mode 1 group using OFFSET, Section 3.
3. Jog the machine to the point where the group input terminal will energize. Using this point as a reference, program setpoints into the output channels in the 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.

Mode 2 Typical Setup



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.

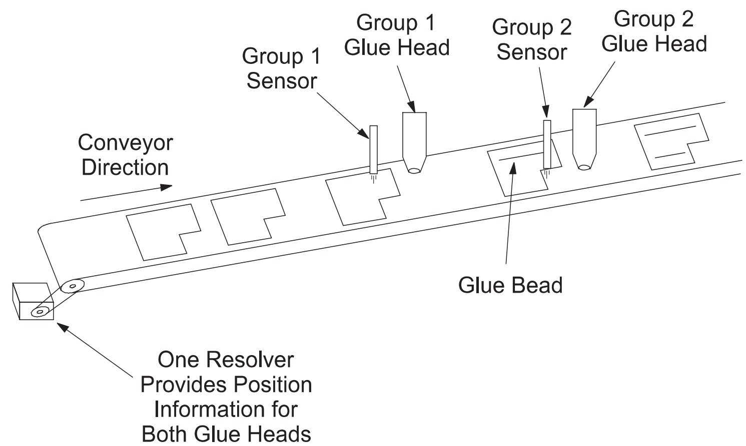
- Either edge of a pulse in the group channel can re-arm the input terminal. If the resolver shaft is rotating in the forward direction (position is increasing as shaft rotates) the "on" edge of the pulse will re-arm the terminal. If the shaft is rotating in the reverse direction (position decreasing 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 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 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.

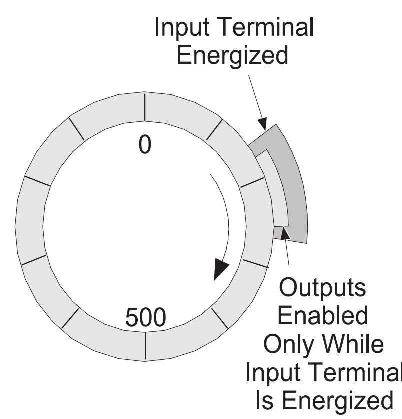
1. Program OUTPUT GROUPS to establish groups and modes.
2. Use OFFSET to program the "Preset" value for any Mode 2 groups.
3. Jog the machine to the point where the group input terminal will energize. Using this point as a reference, program setpoints into the output channels in the group.
4. Program 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.

Mode 3 Typical Setup



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.

(continued)

Mode 3 Operation (Cont'd)

Mode 3 Programming

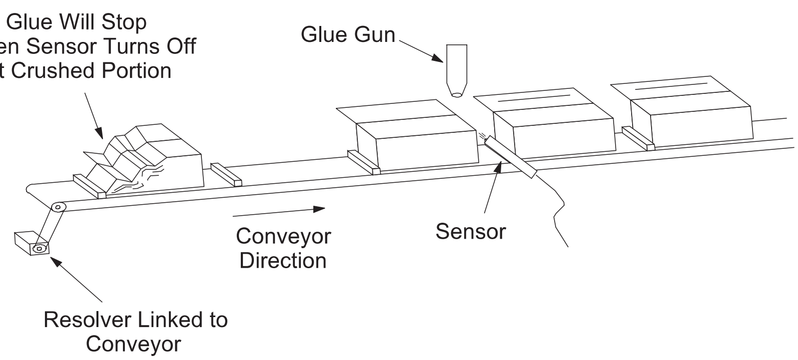
See Figure 28 for input terminal assignments.

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 hardwire 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.

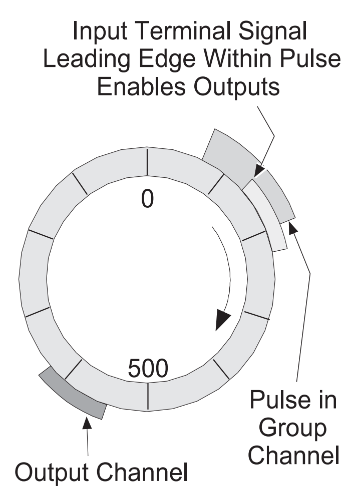
Applications

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.

Mode 4 Typical Setup



- 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 Operation (Cont'd)

Mode 4 Programming

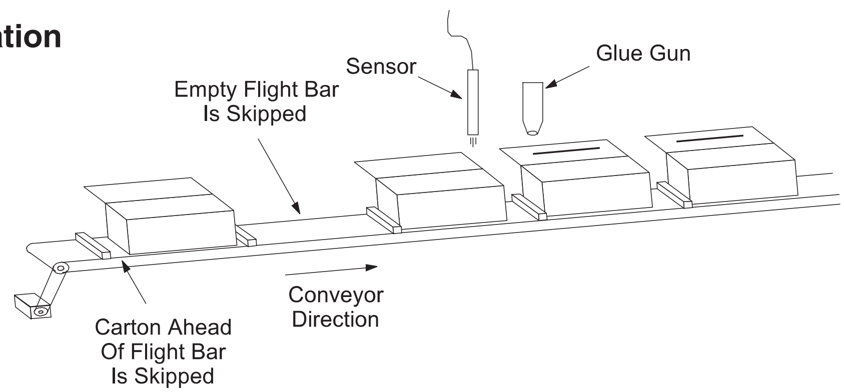
See Figure 28 for input terminal and group channel assignments.

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

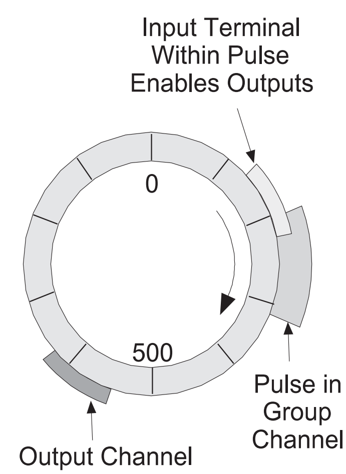
Description

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.

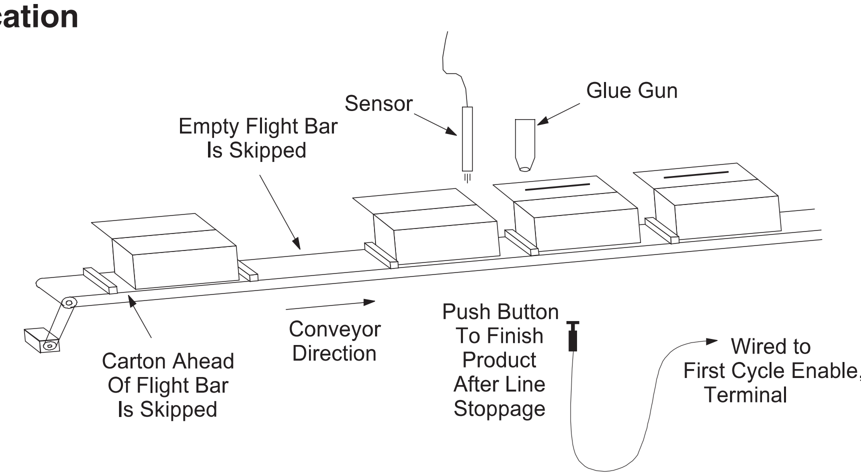
- Regardless of its programmed "off" point, the pulse in the group channel will end as soon as any of the outputs in the group turn on.
- Each program in the controller can have different setpoints for output channels and the corresponding group channel.
- MOTION ANDING and OUTPUT ENABLE ANDING can be 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.

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.

PLµSNet II Upload/Download Program

Description

PLµSNet II is a DOS program that will run on most IBM-PC compatible computers. When the serial port of the PC is connected to a PLµS Programmable Limit Switch, PLµSNet II can transfer programming values between the computer and the controller in either direction. PLµSNet II includes its own communications software with selection of baud rate, PLµS controller address, and the computer's COM port. No other communication software is needed.

Functions

PLµSNet II provides two main functions: **Uploading** a controller's complete set of programming values from the controller to an ASCII file on the PC; and **downloading** the contents of an ASCII from a computer to the PLµS controller. PLµSNet II also provides a text editor to view and change the contents of an ASCII file.

Applications

Hard Copy Reference—Using PLµSNet II, a PLµS controller's programming can be saved as an ASCII file and printed out for reference. The printout can be used to study line operation or to program other PLµS controllers in the plant.

Archival Storage—The ASCII file containing a PLµS controller's programming can be stored on a hard drive or floppy disk. In the event of accidental alteration or erasure of the controller's programming, PLµSNet II can be used to download the ASCII file to the controller to restore normal operation.

Programming Multiple Units—If several PLµS controllers will have the same values, one controller can be programmed correctly and its setpoints uploaded to a PC using PLµSNet II. The programming can then be downloaded to the other PLµS controllers, eliminating the need to manually reenter setpoints for each controller.

Modify Programming—Once a program has been saved as an ASCII file, it can be studied and edited to create other versions of the program.

Contents

The PLµSNet II Communications Software Program includes these materials:

(1) Introduction sheet.

(1) One disk containing the PLUSNET.EXE file.

Cable

To use PLµSNet II, a serial communications cable is required to connect the PLµS controller to an IBM compatible personal computer. This cable can be purchased from Electro Cam Corp., or it can be built by the customer using the wiring information shown in the PLµS Programming and Installation Manual.

Installation

Copy the PLUSNET.EXE file to the desired directory on the PC.

Operation

Connect the PC and the PLµS controller with a communications cable and turn both units ON.

Start PLUSNET.EXE from the DOS command line, or from a DOS window within Microsoft Windows. The menus in the program are self-explanatory.

Sample ASCII Program Copied from PS-6144 Using PLµSNET II

```
2: 6144                ;Model
3: 316                 ;Firmware revision
4: 17                  ;Output quantity
5: 5,1                 ;Option: -H; High resolution
5: 6,1                 ;Option: -L; Leading/trailing speed comp
5: 7,1                 ;Option: -A; Analog output
6: 1                   ;Default Program
9: 1,0                 ;Offset: group#, offset
9: 2,0                 ;Offset: group#, offset
10: 1,0,2000           ;Analog output: Analog chn#, offset, high RPM
11: 1,10,3000          ;Motion detection: level#, low rpm, high rpm
11: 2,10,3000          ;Motion detection: level#, low rpm, high rpm
14: 0                  ;Map limit
16: 1                  ;Keyboard quantity
17: 0                  ;Direction of increasing rotation: 0=CCW, 1=CW
18: 360                ;Scale factor
19: 0                  ;Shaft offset
20: 1                  ;Analog quantity
21: 0                  ;Resolver type: 0=ECC, 1=Other
22: 0                  ;Program select mode: 0=bin, 1=BCD, 2=Gray
24: 0                  ;Time base: 0=1mS, 1=.5mS
25: 1,1                ;Termination resistors: grp1 on/off, grp2 on/off
27: 1,1,0,0            ;Rate setup: mpx, div, dec pt, units
28: 20                 ;Toggle rpm
29: 0                  ;Rpm update rate: 0=1/Sec, 1=2/Sec, 2=10/Sec
30: 1                  ;Speed comp mode: 0=Single, 1=L/T
31: 0                  ;Group pos display mode: 0=Each, 1=One
32: 1                  ;Operator ID number
33: 2                  ;Setup ID number
34: 3                  ;Master ID number
35: 1;1,1,1,1,1,1,1,1  ;Per chn enable: chns 1-8; chn on/off
35: 2;1,1,1,1,1,1,1,1  ;Per chn enable: chns 9-16; chn on/off
35: 3;0,0,0,0,0,0,0,0  ;Per chn enable: chns 17-24; chn on/off
36: 1                  ;Operator enable: Setpoints
37: 1                  ;Operator enable: Default program
38: 1                  ;Operator enable: Speed comp
39: 1                  ;Operator enable: Timed outputs
40: 1                  ;Operator enable: Offsets
41: 1                  ;Operator enable: Motion detection
42: 1                  ;Operator enable: Analog values
43: 1                  ;0,0,0,0,0,0,0,0;Motion ANDing: chns 1-8; chn levels (0=none)
43: 2;0,0,0,0,0,0,0,0  ;Motion ANDing: chns 9-16; chn levels (0=none)
43: 3;0,0,0,0,0,0,0,0  ;Motion ANDing: chns 17-24; chn levels (0=none)
44: 1;0,0,0,0,0,0,0,0  ;Output enable ANDing: chns 1-8; chn on/off
44: 2;0,0,0,0,0,0,0,0  ;Output enable ANDing: chns 9-16; chn on/off
44: 3;0,0,0,0,0,0,0,0  ;Output enable ANDing: chns 17-24; chn on/off
45: 2                  ;Output group quantity
46: 1,10,0             ;Output group config: group, #chns, mode
46: 2,6,4              ;Output group config: group, #chns, mode
49: 1,1,0,90           ;Pulse: pgm, chn, on, off
49: 1,1,180,270        ;Pulse: pgm, chn, on, off
49: 1,2,0,180          ;Pulse: pgm, chn, on, off
49: 1,3,45,270         ;Pulse: pgm, chn, on, off
```

Serial Communications Using Electro Cam Corp. Protocol (Standard 6144 Units)

Background

PS-6144 controllers include programming that allows them to accept and respond to a set of serial commands issued by a system host such as a PLC or other computer. The commands can interrogate the PS-6144 for operating and control data, and they can also change programming values within the PS-6144.

Serial communications are initiated when the system host sends a command to the PS-6144. The PS-6144 processes the command and sends a reply to the host. Modbus ASCII protocol is available (see page 6-16).

Syntax

All commands are sent and received as ASCII character strings in the following syntax. **Do not include spaces between fields.**

Command from Host: STX ADR CMD <DTA> CSM ETX

Reply from PLuS: ACK or NAK <DTA> CSM ETX

Field	No. of Characters	Description
STX	1	Start of text. The PLuS uses “!” for this character.
ADR	2 hex	Address of PLuS controller on network (0-255)
CMD	2 hex	Command number. Commands are listed later in this chapter.
DTA	n hex	The number and type of data elements is determined by the command, reply, or the error. **All data is sent and received in hex.**
CSM	2 hex	Checksum. The method by which the PS-6144 calculates the checksum is described later in this chapter. When the host sends a command, it must include a checksum calculated in the same way so that the PS-6144 can check the command for communication errors. The host should also use this calculation method to analyze the reply from the PS-6144 for possible communication errors.
ETX	1	End of text. The PLuS uses a carriage return, or <CR>, for this character
ACK	1	Positive acknowledge. The PLuS uses the letter “A” for ACK.
NAK	1	Negative acknowledge, or error condition. The PLuS uses the letter “N” for NAK. A list of error replies are included later in this section.

The specified number of ASCII characters must be sent for each field. Include leading zeroes if the data in a field is less than the field length. The control will also include leading zeroes in its replies.

Set the host's communication parameters to 8N1: eight data bits, no parity, one stop bit.

Serial Commands

Description

The PS-6144 controller recognizes a set of 95 commands. Some of these commands involve testing and diagnostic functions performed at the factory. Because these commands are of little use in field installations, they are not included in the following pages. For information on the complete command set, contact the factory.

The commands are grouped by general function. In the syntax shown for each command and reply, the characters used for STX, ETX, ACK, and NAK are substituted, as listed on the previous page.

The commands are listed in hex.

CMD (hex)	Name		Function
04	Hello		Are you there?
		Cmd:	! ADR **04** CSM <CR>
		Reply:	A <CR>

Supervisory Commands

CMD (hex)	Name		Function
06	Com Stop		Stop operation & idle; changes will be written directly to EEPROM with no other action taken.
		Cmd:	! ADR **06** CSM <CR>
		Reply:	A <CR>
07	Checksum		Sets new checksums in EEPROM.
		Cmd:	! ADR **07** CSM <CR>
		Reply:	A <CR>
08	Start		Resume operation.
		Cmd:	! ADR **08** CSM <CR>
		Reply:	A <CR>
09	Reset		Create hard reset through watchdog.
		Cmd:	! ADR **09** CSM <CR>
		Reply:	A <CR>

Status Commands

CMD (hex)	Name		Function
0A	RPM		Current RPM.
		Cmd:	! ADR **0A** CSM <CR>
		Reply:	A XXXX CSM <CR>
			where “XXXX” = current RPM in hex.
38	Shaft Pos		Shaft position.
		Put:	! ADR **38** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **38** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where “XXXX” is the shaft position in hex.
0B	Grp Pos		Current position.
		Cmd:	! ADR **0B** XX CSM <CR>
		Reply:	A YYYY CSM <CR>
			where “XX” is the group number minus one. “YYYY” is that group’s position in hex.

Configuration Commands

CMD (hex)	Name		Function
56	Kbd Qty		Number of keypads connected.
		Put:	! ADR **56** P XX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **56** G CSM <CR>
		Reply:	A XX CSM <CR>
			where "XX" = number of keypads connected.
0D	Setup ID		Setup ID code.
		Put:	! ADR **0D** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **0D** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" = Setup Enable Code in hex.
0E	Operator ID		Operator ID code.
		Put:	! ADR **0E** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **0E** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" = Operator Enable Code in hex.
58	Master ID		Master ID code.
		Put:	! ADR **58** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **58** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" = Master Enable Code in hex.
0F	User Pgm		User programming enable/disable.
		Put:	! ADR **0F** P XX <00 or 01> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **0F** G XX CSM <CR>
		Reply:	A <00 or 01> CSM <CR>
			where "XX" is the channel number minus 1, in hex. "00" = disable, and "01" = enable.
10	Motion Enab		Motion detection on/off for a specified output channel.
		Put:	! ADR **10** P XX <00, 01, or 02> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **10** G XX CSM <CR>
		Reply:	A <00, 01, or 02> CSM <CR>
			where "XX" is the channel number minus 1, in hex. "00" = L1 & L2 off; "01" = L1 on; "02" = L2 on.

Configuration Commands (cont'd)

CMD (hex)	Name		Function
12	Inc Direction		Direction of increasing rotation.
		Put:	! ADR **12** P <00 or 01> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **12** G CSM <CR>
		Reply:	A <00 or 01> CSM <CR>
			where "00" = CCW, and "01" = CW
13	Scale Factor		Scale factor.
		Put:	! ADR **13** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **13** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" = scale factor in hex.
48	Lo Limit		Motion detection low limit.
		Put:	! ADR **48** P <00 or 01> YYYY CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **48** G <00 or 01> CSM <CR>
		Reply:	A YYYY CSM <CR>
			where "YYYY" = low limit RPM in hex. "00" = Level 1, "01" = Level 2.
49	Hi Limit		Motion detection high limit.
		Put:	! ADR **49** P <00 or 01> YYYY CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **49** G <00 or 01> CSM <CR>
		Reply:	A YYYY CSM <CR>
			where "YYYY" = high limit RPM in hex. "00" = Level 1, "01" = Level 2.
17	Time Delay		Delay value for Timed Output channels.
		Put:	! ADR **17** P XX YYYY CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **17** G XX CSM <CR>
		Reply:	A YYYY CSM <CR>
			where "XX" is the channel minus 1, in hex, and "YYYY" is the delay in msec, in hex.
18	Default Pgm		Default program.
		Put:	! ADR **18** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **18** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" is the Default Program minus 1, in hex.

Configuration Commands (cont’d)

CMD (hex)	Name		Function
1A	Spd Cmp Mode		Standard or Leading/Trailing mode.
		Put:	! ADR **1A** P <00 or 01> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **1A** G CSM <CR>
		Reply:	A <00 or 01> CSM <CR>
			where “00” = Standard, “01” = Leading/Trailing
1B	Spd Cmp Val		Speed comp value.
		Put:	! ADR **1B** P XX YYYY ZZZZ CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **1B** G XX CSM <CR>
		Reply:	A YYYY ZZZZ CSM <CR>
			where “XX” is the channel minus 1, in hex. “YYYY” is the value in tenths of a msec for the leading edge, and “ZZZZ” is the value for the trailing edge. For standard speed comp, “YYYY” = “ZZZZ”. “Y” and “Z” values are hex.
4B	Analog Qty		Number of analog outputs used.
		Put:	! ADR **4B** P XX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **4B** G CSM <CR>
		Reply:	A XX CSM <CR>
			where “XX” is the number of analog outputs used. “XX” can be 00, 01, or 02.
1C	Analog		Analog values.
		Put:	! ADR **1C** P XX YYYY ZZZZ CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **1C** G XX CSM <CR>
		Reply:	A YYYY ZZZZ CSM <CR>
			where “XX” is the channel minus one, in hex. “YYYY” is the Offset from 0 to 4095, converted to hex. “ZZZZ” is the High RPM in hex.
1D	Grp Qty		Output group quantity.
		Put:	! ADR **1D** P XX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **1D** G CSM <CR>
		Reply:	A XX CSM <CR>
			where “XX” is the number of output groups, from one to six.
4A	Offset Mode		One offset for all groups, or individual offset for each group.
		Put:	! ADR **4A** P <00 or 01> CSM <CR>
		Reply:	A <CR>
		Get:	ADR **4A** G CSM <CR>
		Reply:	A <00 or 01> CSM <CR>
			“00” = Each; “01” = One.

Configuration Commands (cont'd)

CMD (hex)	Name		Function
1E	Grp Offset		Output group offset value.
		Put:	! ADR **1E** P XX YYYY CSM <CR>
		Reply:	A <CR>
		Get:	ADR **1E** G XX CSM <CR>
		Reply:	A YYYY CSM <CR>
			where "XX" is the group number minus 1. "YYYY" is the offset value for that group, in hex.
3C	Shaft Offset		Shaft position offset.
		Put:	! ADR **3C** P XXXX CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **3C** G CSM <CR>
		Reply:	A XXXX CSM <CR>
			where "XXXX" is the shaft offset in hex.
1F	Grp Chn Qty		Number of channels in a specified output group.
		Put:	! ADR **1F** P XX YY CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **1F** G XX CSM <CR>
		Reply:	A YY CSM <CR>
			where "XX" is the group number minus one. "YY" is the number of output channels in that group, in hex.
21	Mode		Mode for the specified output group.
		Put:	! ADR **21** P XX YY CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **21** G XX CSM <CR>
		Reply:	A YY CSM <CR>
			where "XX" is the group number minus one. "YY" is the operating mode, from zero to five.
47	Output Enab		Output Enable ANDing on or off for specified channel.
		Put:	! ADR **47** P XX <00 or 01> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **47** G XX CSM <CR>
		Reply:	A <00 or 01> CSM <CR>
			where "XX" is the channel number minus one, in hex. "00" = ANDing "off"; "01" = ANDing "on".
4D	Pgm Sel Mode		Program select terminals use Binary, Gray Code, or BCD format.
		Put:	! ADR **47** P <00, 01, or 02> CSM <CR>
		Reply:	A <CR>
		Get:	! ADR **47** G CSM <CR>
		Reply:	A <00, 01, or 02> CSM <CR>
			"00" = Binary; "01" = Gray Code; "02" = BCD.

Setpoint Commands

CMD (hex)	Name	Function

22 Spt Count — Return number of pulses.

Cmd: ! ADR **22** CSM <CR>
Reply: A XXXX CSM <CR>

where “XXXX” is the total number of pulses in hex. Includes all pulses in all channels and programs in the controller.

23 Wipe Spt — Deletes all pulses from EEPROM.

Cmd: ! ADR **23** CSM <CR>
Reply: A <CR>

24 Get Spt — Return program, channel, and on/off points for the specified pulse.

Cmd: ! ADR **24** XXXX CSM <CR>
Reply: A XX YY ZZZZ TTTT CSM <CR>

where “XXXX” is the number of the pulse in hex. Pulses are numbered starting at Channel 1, Program 1, Position 0. As the transducer rotates through a complete cycle, each pulse encountered is numbered sequentially. After one cycle, the pulses in Channel 2 are numbered, and so on.

In the reply, “XX” is the program number of the specified pulse, minus one. “YY” is the channel number, minus one. “ZZZZ” and “TTTT” are the “on” and “off” points of the pulse, respectively. All values are in hex.

25 Add Spt — Adds a setpoint.

Cmd: ! ADR **25** XX YY ZZZZ TTTT CSM <CR>
Reply: A <CR>

where “XX” is the program number minus one, and “YY” is the channel number minus one. “ZZZZ” and “TTTT” are the “on” and “off” points of the pulse, respectively. All values are in hex.

26 Del Spt — Deletes a setpoint.

Cmd: ! ADR **26** XX YY ZZZZ TTTT CSM <CR>
Reply: A <CR>

where “XX” is the program number minus one, and “YY” is the channel number minus one. “ZZZZ” and “TTTT” are the “on” and “off” points of the pulse, respectively. All values are in hex.

27 Mod Spt — Modifies one edge of a setpoint.

Cmd: ! ADR **27** XX YY ZZZZ TTTT MM NNNN CSM <CR>
Reply: A <CR>

where “XX” is the program number minus one and “YY” is the channel number minus one.

“ZZZZ” and “TTTT” are the **current** “on” and “off” points of the pulse, respectively.

“MM” is the edge to be modified: “00” is the “off” edge, “01” is the “on” edge.

“NNNN” is the new value for the specified edge. All values are in hex.

	CMD (hex)	Name		Function
Setpoint Commands (cont'd)	**28**	Inc Spt		Advances one edge of a pulse, both edges, or all pulses in a channel, by one scale factor increment.
			Cmd:	! ADR **28** XX YY ZZZZ TTTT MM CSM <CR>
			Reply:	A <CR>
				where "XX" is the program number minus one, and "YY" is the channel number minus one.
				"ZZZZ" and "TTTT" are the **current** "on" and "off" points of the pulse, respectively.
				"MM" specifies the scope of the change: "00" is the "off" edge; "01" is the "on" edge; "02" is both edges of the pulse; and "03" is all edges of all pulses in the channel. All values are in hex.
	29	Dec Spt		Retards one edge of a pulse, both edges, or all pulses in a channel, by one scale factor increment.
			Cmd:	! ADR **29** XX YY ZZZZ TTTT MM CSM <CR>
			Reply:	A <CR>
				where "XX" is the program number minus one, and "YY" is the channel number minus one.
				"ZZZZ" and "TTTT" are the **current** "on" and "off" points of the pulse, respectively.
				"MM" specifies the scope of the change: "00" is the "off" edge; "01" is the "on" edge; "02" is both edges of the pulse; and "03" is all edges of all pulses in the channel. All values are in hex.
Display Commands	**30**	Def Disp		Default display on start-up.
			Put:	! ADR **30** P XX CSM <CR>
			Reply:	A <CR>
			Get:	! ADR **30** G CSM <CR>
			Reply:	A XX CSM <CR>
				where "XX" is the display mode: "00" is Speed, "01" is Position, and "02" is Auto.
	31	Tog RPM		Toggle RPM speed.
			Put:	! ADR **31** P XXXX CSM <CR>
			Reply:	A <CR>
			Get:	! ADR **31** G CSM <CR>
			Reply:	A XXXX CSM <CR>
				where "XXXX" is the toggle RPM speed in hex.
	57	Rate Setup		Multiplier and units for RPM display.
			Put:	! ADR **57** P XX YY CSM <CR>
			Reply:	A <CR>
			Get:	! ADR **57** G CSM <CR>
			Reply:	A XX YY CSM <CR>
				"XX" is the multiplier: "01" = 1X; "02" = 2X; "03" = 3X; "04" = .5X.
				"YY" = units: "00" = RPM; "01" = BPM; "02" = CPM

Special Commands

CMD (hex)	Name	Function
2A	Key Press	Adds a value to the keyboard buffer; just like pressing a key.

Cmd: ! ADR **2A** XX CSM <CR>
Reply: A <CR>

where "XX" is the key number in hex. See "Keypad Diagnostics" in Section 7 for a method to determine the key number for each key on the keypad.

CMD (hex)	Name	Function
2B	En Mot Spt	Enable "Motion ANDing" programming at operator level.

Put: ! ADR **2B** P <00 or 01> CSM <CR>
Reply: A <CR>

Get: ! ADR **2B** G CSM <CR>
Reply: A <00 or 01> CSM <CR>

where "00" = disabled, "01" = enabled.

CMD (hex)	Name	Function
2C	En Offset	Enable "Offset" programming at operator level.

Put: ! ADR **2C** P <00 or 01> CSM <CR>
Reply: A <CR>
Get: ! ADR **2C** G CSM <CR>
Reply: A <00 or 01> CSM <CR>

where "00" = disabled, "01" = enabled.

CMD (hex)	Name	Function
2D	En Act Pgm	"Active Program" enable at operator level.

Put: ! ADR **2D** P <00 or 01> CSM <CR>
Reply: A <CR>

Get: ! ADR **2D** G CSM <CR>
Reply: A <00 or 01> CSM <CR>

where "00" = disabled, "01" = enabled.

CMD (hex)	Name	Function
2E	En Spd Cmp	Enable "Speed Comp" programming at operator level.

Put: ADR **2E** P XX <00 or 01> CSM <CR>
Reply: A <CR>

Get: ! ADR **2E** G XX CSM <CR>
Reply: A <00 or 01> CSM <CR>

where "XX" is the channel number minus 1, in hex. "00" = disabled, "01" = enabled.

CMD (hex)	Name	Function
2F	En Timed Out	Enable "Timed Output" programming at operator level.

Put: ! ADR **2F** P XX <00 or 01> CSM <CR>
Reply: A <CR>

Get: ! ADR **2F** G XX CSM <CR>
Reply: A <00 or 01> CSM <CR>

where "XX" is the channel number minus 1, in hex. "00" = disabled, "01" = enabled.

Error Codes

Error Replies

If a command sent to the PS-6144 cannot be processed for any reason, the controller sends a reply in the following format:

N <error code> CSM <CR>

The error codes are listed below.

Code	Name	Meaning
00	OK	Processed ok.
01	BAD BUFFER	Buffer not correct.
02	NOT OUR ADDRESS	To someone else.
03	BAD COMMAND	Illegal command.
04	BAD DATA	Illegal data.
05	NOT IN MOTION	Can’t do while running.
06	TOO MANY TIMERS	Too many timers for time base.
07	NOT AN OPTION	Option not on unit.
08	NOT STOPPED	Can’t do this unless STOPPED.
09	BAD FORMAT	Bad input or output format string.
0A	TIMEOUT	Timeout error.
0B	BAD KEY	Illegal key value.
0C	FLASH ERROR	Flash programming error.
0D	BAD PROGRAM#	Illegal program number.
0E	BAD CHANNEL#	Illegal channel number.
0F	KEYBOARD CONFLICT	Conflict with keyboard activity.

Checksum

Calculating Checksum

The PS-6144 calculates checksums in four steps:

1. Add the ASCII values of the command string, not including STX (!) or ETX (<CR>).
2. Make the decimal value from Step 1 negative.
3. Convert the value from Step 2 to hex.
4. Use the two least significant digits from Step 3.

The following examples will clarify how Checksums are calculated:

Example 1—Command 0A: Request RPM from Controller #1

Command: !010A<CSM><CR>

Checksum Calculation:

```
   0  1  0  A
   |  |  |  |
  48+49+48+72 = 217(decimal)
```

–217 decimal = FF27 hex; therefore: Checksum = 27

String sent to controller = !010A27<CR>

Example 2—Command 25: Add Pulse to Control #2

Pulse Values: Program 15, Output Channel 9, “On” at 25, “Off” at 290

Command: !02250E0800190122<CSM><CR>

Checksum Calculation:

```
 0  2  2  5  0  E  0  8  0  0  1  9  0  1  2  2
 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
48+50+50+53+48+69+48+56+48+48+49+57+48+49+50+50 = 821(decimal)

–821 decimal = FCCB hex; therefore: Checksum = CB
String sent to controller = !02250E0800190122CB<CR>
```

Data Organization

This section describes the internal data structure of PLuS controllers, and how this data may be accessed via serial communications. The data has been organized as a series of "Coils" and "Registers" compatible with PLC programming techniques. You access and/or change the data within a PLuS controller by forcing coils ON or OFF, and by reading and writing register data.

A PLuS Controller can be completely programmed via the serial interface. All controller data, such as pulses, speed compensation, timed output values, etc., are available as registers. Configuration data, such as the direction of rotation, number of keyboards, number of analog outputs, etc., is also available as register data. The controller is programmed by writing to these registers. Data is monitored within the controller by reading from these registers.

Note: The ability of the EEPROM to retain data is reduced after 100,000 write cycles. Do not set up routines that constantly write data to the EEPROM's.

Mapping

In addition to accessing controller data via dedicated registers, specific indexed data items can be accessed through the 240 data display registers. This is done by "mapping" a specific indexed data element to a data display register; a data display register is assigned to represent a pulse, speed comp value, etc. Once an indexed data element is mapped it can be accessed either through the data display register or through the dedicated register.

Mapping is useful when displaying more than one instance of an indexed data element at once. For instance, speed compensation is accessed via three registers; 1) a channel index, 2) a leading edge value, and 3) a trailing edge value. This means that the values of speed compensation for all channels can be accessed, but only one at a time. To display more than one value of speed compensation at once, simply map the values to a series of data display registers.

You must define how many mappings are available through the Map Limit register.

Modbus

Modbus ASCII protocol is used for serial communications.

Set host controller communication parameters to 7 data bits, 2 stop bits, no parity.

Limit the number of consecutive registers or coils read to 32.

Discrete Elements

Inputs

10001 - 10016	DC Inputs

Outputs

00001 - 00100	Channel Outputs

ORing and NOT ANDing

00101 - 00200	Channel ORing
00201 - 00300	Channel NOT ANDing

Special Purpose

00301 - 00400	Special Purpose

00301	Global Unforce
00302	Pulse Register Enable
00303	Create New Pulse
00304	Move Both Edges of Pulse
00305	Move All Pulses in Channel
00314	NAK Bad Address Reads
00315	Execute Special Function
00316	Auto Increment

Registers

Special Purpose & Data Display

40001	Message and Special Function (16 registers)
40017	Data Display (240 registers)

RPM

40257	RPM

Position

40258	Position Mapping
40259	Position Index
40260	Position

Pulse Programming

40261	Pulse Mapping
40262	Total Pulse Count
40263	Channel Pulse Count

Pulse Programming (Cont.)

40264	Program Index
40265	Channel Index
40266	Pulse Index
40267	Pulse On
40268	Pulse Off
40269	New On
40270	New Off

Default Program

40271	Default Program

Speed Compensation

40272	Speed Comp Mapping
40273	Channel Index
40274	Leading Edge Comp
40275	Trailing Edge Comp

Timed Outputs

40276	Timed Output Mapping
40277	Channel Index
40278	Time Delay

Offset

40279	Offset Mapping
40280	Group Index
40281	Group Offset

Motion Detection

40282	Motion Detection Mapping
40283	Channel Index
40284	Low Motion Detection RPM
40285	High Motion Detection RPM

Analog Output

40286	Analog Output Mapping
40287	Channel Index
40288	Analog Offset
40289	Analog High RPM

Gray Code Speed Compensation

40290	Gray Code Speed Comp

Mapping Registers

40296	Map Limit
40297	Map Quantity
40298	Map Store
40299	Map Recall

Model Information

40300	Model
40301	Revision
40302	Output Quantity
40303	Option Index
40304	Option

Hardware Configuration

40305	Keyboard Quantity
40306	Increasing Direction
40307	Scale Factor
40308	Shaft Position
40309	Shaft Offset
40310	Analog Quantity
40311	Resolver Type
40312	Program Select Mode
40313	Gray Level
40314	Time Base
40315	Termination Resistor One
40316	Termination Resistor Two

Display Configuration

40317	Default Display
40318	Rate Multiplier
40319	Rate Divisor
40320	Rate Decimal Point Position
40321	Rate Units
40322	Toggle RPM
40323	RPM Update Rate
40324	Speed Comp Display Mode
40325	Group Position Display Mode

Password ID Numbers

40326	Operator ID
40327	Setup ID
40328	Master ID

Per Channel Enable

40329	Per Channel Enable Index
40330	Per Channel Enable

Operator Function Enable

40331	Operator Function Enable Bitmask

Motion ANDing

40332	Channel Index
40333	Motion Enable Level

Output Enable ANDing

40334	Output Enable Index
40335	Output Enable

Group Programming

40336	Group Quantity
40337	Group Index
40338	Channel Quantity
40339	Group Mode

Run Time Control

40340	Stop Control
40341	EEPROM Checksum
40342	EEPROM Changed

The following registers are not supported by early versions of Modbus Controllers.

Active Program

40343	Active Program

I/O Control

40350 - 40359	Input Status
40360 - 40369	Output Status
40370 - 40379	ORing Bits
40380 - 40389	ANDing Bits

Communications

40390	Type (RS485/RS232)
40391	Baud Rate
40392	Address

Discrete I/O

Inputs

10001 - 10016 **DC Inputs**
These points represent the status of the DC inputs.

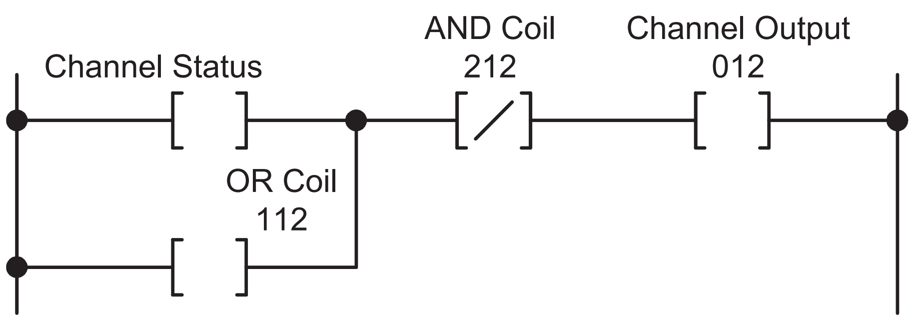
Outputs

00001 - 00100 **Channel Outputs**
These coils represent the status of the channel outputs. Forcing these coils directly will set/clear the appropriate ORing and ANDing coils as required.
The Channel Output Coil status before OR/ANDing is determined by setpoints, group modes, speed compensation, motion ANDing, enable input ANDing, timed outputs, and resolver fault status.

ORing and NOT ANDing

00101 - 00200 **Channel ORing**
Setting these coils to '1' will force the corresponding Channel Output Coil ON.

00201 - 00300 **Channel NOT ANDing**
Setting these coils to '1' will force the corresponding Channel Output Coil OFF.



Ladder Diagram Example of ORing/ANDing Coils

Note: The "Pulse Register Enable" coil (#302) is intended for mass downloads.
When a pulse is created using this mode, the new pulse does not appear in the channel until the unit is power cycled. This enables pulses to be added faster in a batch type situation.
When pulses need to be created and take effect immediately, "Create New Pulse" coil (#303) should be used instead. "Pulse Register Enable" coil (#302) should be set to 0.
A pulse created with "Create New Pulse" coil will take effect immediately and not require the unit to be power cycled.

Special Purpose

00301 - 00400 **Special Purpose**

301 **Global Unforce**
Clears all OR and NOT AND coils when set from '0' to '1' (edge active).

302 **Pulse Register Enable**
When '1', this coil enables the creation of new pulses through writes to the New Off Register. When this coil is '0', writes to New Off Register do not create a new pulse.

303 **Create New Pulse**
Creates a new pulse defined by the New On and New Off registers when set from '0' to '1' (edge active). This coil is ignored if coil 302 is '1'.

304 **Move Both Edges of Pulse**
When '1', this coil will cause both edges of a pulse to move when either the leading or trailing edge is changed by '1' (incremented or decremented).

305 **Move All Pulses in Channel**
When '1', this coil will cause all edges of all pulses in a channel to move when either the leading or trailing edge is changed by '1' (incremented or decremented).

314 **NAK Bad Address Reads**
When '1', this coil will cause the controller to NAK attempted reads to non-existent registers. When this coil is '0', reads to non-existent registers return a value of zero.

315 **Execute Special Function**
Executes the special function defined by the contents of the Special Purpose Registers (40001-40017) when set from '0' to '1'.

316 **Auto Increment**
When '1', this coil enables the auto increment feature on index registers. This feature allows sequential reading of indexed values without changing the index register.

Registers

Special Purpose & Data Display

40001 **Special Function (16 registers)**
The first 16 registers (001 - 016) are used for entering data used by the special functions.

40017 **Data Display (240 registers)**
These registers (017 - 256) are used by the Mapping functions to display individual instances of indexed data.

RPM

40257 **RPM**
Read only
Returns the current RPM.

Position

40258 **Position Mapping**
Read/write
Values: 17 - 256
Specifies the general purpose register used to display the position for the output group specified by the Group Index Register.

40259 **Position Index**
Read/write
Values: 1 - 6
Specifies the output group whose position is displayed in the Position Register.

40260 **Position**
Read only
Values: 0 - (Scale Factor - 1)
returns the current position for the output group specified by the Group Index Register.

Pulse Programming

40261 **Pulse Mapping**
Read/write
Values: 17 - 255
General Purpose register used for mapping the On and Off values for the pulse specified by the index registers. Two registers will be used; the first will contain the On value, the second will contain the Off value.

40262 **Total Pulse Count**
Read/write
Values: 0 - n
Returns the total number of pulses for all channels. Writing a value of '0' to this register will erase all pulses. You can only write to this register when the Stop register is '1'.

40263 **Channel Pulse Count**
Read only
Values: 0 - n
Returns the number of pulses in the channel defined by the index registers below.

40264 **Program Index**
Read/write
Values: 0 - Max Program Number
Contains the current program number for pulse access. Writing to this register resets the Channel Index Register and the Pulse Index Register to '1'. When this register is '0', the current active program is used for setpoint access and for mapping (setpoints mapped with a program index of '0' will automatically change when the active program changes).

Pulse Programming (Con'td)

40265 **Channel Index**
Read/write
Values: 1 - Max Channel Number
Contains the current channel number for pulse access. Writing to this register resets the Pulse Index Register to '1'. This register is reset to '1' when the Program Index Register is changed.

40266 **Pulse Index**
Read/write
Values: 1 - n
Contains the current pulse number for pulse access.
This register is reset to '1' when the Program Index Register or Channel Index Registers are changed.

40267 **Pulse On**
Read/write
Values: 0 - (Scale Factor - 1)
Pulse On Value.

40268 **Pulse Off**
Read/write
Values: 0 - (Scale Factor - 1)
Pulse Off Value.

40269 **New On**
Read/write
Values: 0 - (Scale Factor - 1)
New Pulse On Value.
Writing to this register loads the On setpoint of a new pulse for the program and channel specified by the index registers above.

40270 **New Off**
Read/write
Values: 0 - (Scale Factor - 1)
New Pulse Off Value.
Writing to this register loads the Off setpoint of a new pulse for the program and channel specified by the index registers above. The pulse is stored when the Off value is written if the Pulse Register Enable Coil is set to '1'; otherwise the pulse is stored when the Create New Pulse Coil is changed form '0' to '1' (edge active).

Default Program

40271 **Default Program**
Read/Write.
Values: 1 - Max program number
Defines the program that will be active if no hardware program select inputs are active.

Speed Compensation

40272 **Speed Comp Mapping**
Read/Write
Values: 17 - 255
General purpose register used for mapping speed compensation values. Two registers will be used; the first will contain the leading edge value, the second will contain the trailing edge value.

40273 **Channel Index**
Read/Write
Values: 1 - Max Channel Number
Channel index for speed comp values.

Speed Compensatin (Cont'd)

40274 **Leading Edge Comp**
Read/Write
Values: 0 - n (.1mS)
Specifies the leading edge speed comp value.

40275 **Trailing Edge Comp**
Read/Write
Values: 0 - n (.1mS)
Specifies the trailing edge speed comp value.

Timed Outputs

40276 **Timed Output Mapping**
Read/write
Values: 17 - 255
General purpose register used for mapping timed output values.

40277 **Channel Index**
Read/Write
Values: 1 - Max Channel Number
Channel index for time delay values.

40278 **Time Delay**
Read/write
Values: 0 - n (1mS)
Specifies the maximum time in milliseconds that a channel may stay on after it has bee turned on.

Offset

40279 **Offset Mapping**
Read/write
Values: 17 - 256
General purpose register used for mapping Group Offset values.

40280 **Group Index**
Read/write
Values: 1 - 6
Group index for offset values.

40281 **Group Offset**
Read/write
Values: 0 - (Scale Factor - 1)
Offset value for the specified group.
Note that this value is a PRESET value for groups in modes 1 or 2.

Motion Detection

40282 **Motion Detection Mapping**
Read/write
Values: 17 - 255
General purpose register used for mapping low and high motion detection values. Two registers will be used; the first will contain the low motion detection rpm value, the second will contain the high motion detection rpm value.

40283 **Channel Index**
Read/write
Values: 1, 2
Motion detection level index for high and low motion detection values.

Motion Detection (Cont.)

40284 **Low Motion Detection RPM**
Read/write
Values: 0 - n
Motion detection low limit for the level specified by the index register.

40285 **High Motion Detection RPM**
Read/write
Values: 0 - n
Motion detection high limit for the level specified by the index register.

Analog Output

40286 **Analog Output Mapping**
Read/write
Values: 17 - 255
General purpose register used for mapping analog offset and high RPM values. Two registers will be used; the first will contain the analog offset value, the second will contain the high RPM value.

40287 **Channel Index**
Read/write
Values: 1, 2
Analog channel index for analog offset and high RPM values.

40288 **Analog Offset**
Read/write
Values: 0 - 4095
Analog output at 0 RPM.

40289 **Analog High RPM**
Read/write
Values: 0 - 3000
RPM at which analog output is 4095.

Gray Code Speed Compensation

40290 **Gray Code Speed Comp**
Read/write
Values: 0 - n (.1mS)
In controllers equipped with the "-G" option, the Gray code bit pattern is speed compensated by this amount.

Mapping Registers

40296 **Map Limit**
Read/write
Values: 0 - 256
Sets the maximum number of data mappings.

40297 **Map Quantity**
Read/write
Values: 0 - 256
Returns the number of data mappings active in the controller.
NOTE: Writing a '0' to this register will delete all data mappings!

40298 **Map Store**
This register is only for use by utility programs.

40299 **Map Recall**
This register is only for use by utility programs.

Model Information

40300 **Model**
Read only
Returns the PLuS model number (5144, 6144, etc.).

40301 **Revision**
Read only
Returns the major software revision.

40302 **Output Quantity**
Read only
Returns the number of output channels (8, 9, 16, 17, 25, etc).

40303 **Option Index**
Read/write
Values: 1 - n
Used as index for reading installed controller options through the Option Register.

40304 **Option**
Read only
Values: 0 - n
Returns installed controller options as specified through the Option Index Register. A value of '0' at index '1' means no options are installed.

Hardware Configuration

40305 **Keyboard Quantity**
Read/write
Values: 1, 2
Number of keyboards attached to PS-6000 controller.

40306 **Increasing Direction**
Read/write
Values: 0 = CCW, 1 = CW
Specifies the direction of rotation of the resolver (viewed from the shaft end) that will result in an increasing numerical display of position.

40307 **Scale Factor**
Read/write
Values: 2 - 1024 (4096 with "-H" Option)
Scale factor used for pulse, position, and offset programming.

40308 **Shaft Position**
Read only
Values: 0 - (Scale Factor - 1)
Returns the current resolver shaft position, including the shaft offset.

40309 **Shaft Offset**
Read/write
Values: 0 - (Scale Factor - 1)
Offset that is added to raw resolver position to make Shaft Position.

40310 **Analog Quantity**
Read/write
Values: 0, 1, 2
Specifies the number of analog modules active.

40311 **Resolver Type**
Read/write
Values: 0 = Electro Cam, 1 = Other
Specifies type of resolver attached to controller.

40312 **Program Select Mode**
Read/write
Values: 0 = Binary, 2 = BCD, 1 = Gray code
Specifies how the program select inputs determine the active program.

Hardware Configuration (Cont'd)

40313 **Gray Level**
Read/write
Values: 0 = Positive True, 1 = Negative True
On controllers equipped with the "-G" Option, this register specifies the logic level of the Gray code bit pattern.

40314 **Time Base**
Read only
Values: 0 = 1mS, 1 = .5mS, 2 = .2mS
Returns the timer interrupt rate.

40315 **Termination Resistor One**
Read/write
Values: 0 = Off, 1 = On
Termination resistor On/Off RS485 port; keyboard port for 6000's, RS485 Communication port for 5144's.

40316 **Termination Resistor Two**
Read/write
Values: 0 = Off, 1 = On
Termination resistor On/Off for RS232/RS485 port; communication port for 6000's with 5144A Input Board.

Display Configuration

40317 **Default Display**
Read/write
Values: 0 = RPM, 1 = Position, 2 = Auto Select
Specifies Pos/Rpm display mode; only applicable on 5XXX controllers.

40318 **Rate Multiplier**
Read/write
Values: 1 - 1091
RPM rate multiplier; 6000 controllers only.

40319 **Rate Divisor**
Read/write
Values: 1 - 63
RPM rate divisor, 6000 controllers only.

40320 **Rate Decimal Point Position**
Read/write
Values: 0 - 3
RPM decimal point position; 6000 controllers only.

40321 **Rate Units**
Read/write
Values: 0 = RPM, 1 = BPM, 2 = CPM, 3 = IPM
RPM display units; 6000 controllers only.

40322 **Toggle RPM**
Read/write
Values: 0 - n
Specifies RPM which will cause position display to blank (6000 series) or to change from Position to RPM (5000 series).

40323 **RPM Update Rate**
Read/write
Values: 0 = 1/Sec, 1 = 2/Sec, 2 = 10/Sec
Rate at which the RPM display is updated.

Display Configuration

40324 **Speed Comp Display Mode**
Read/write
Values: 0 = One, 1 = L/T
Specifies whether speed comp values are displayed as one value for both leading and trailing edges, or as a value for each.

40325 **Group Position Display Mode**
Read/write
Values: 0 = Each, 1 = One
Specifies whether the positions for output groups are individually displayed, or if they are displayed as one value for all groups. Output group positions can only be displayed as one if none are in mode 1 or mode 2 (rezero modes).

Password ID Numbers

40326 **Operator ID**
Read/write
Values: 0 - n
Specifies the Operator ID number used to enable the Operator access level for programming.

40327 **Setup ID**
Read/write
Values: 0 - n
Specifies the Setup ID number used to enable the Setup access level for programming.

40328 **Master ID**
Read/write
Values: 0 - n
Specifies the Master ID number used to enable the Master access level for programming.

Per Channel Enable

40329 **Per Channel Enable Index**
Read/write
Values: 1 - Max Channel Number
Channel index for the Per Channel Enable register.

40330 **Per Channel Enable**
Read/write
Values: 0=No Operator access, 1=Operator access enabled
Specifies whether channel data can be modified under the Operator access level (0=no, 1=yes).
Channel data such as speed comp and timed output values can be individually enabled per channel for operator access through this register.

Operator Function Enable

40331 **Operator Function Enable Bitmask**
Read/write
Values: 0 - 0FFFFH
Bit mask which specifies which programming functions the operator may perform.
Bit 0: Pulse on/off values.
Bit 1: Default program.
Bit 2: Speed compensation.
Bit 3: Timed outputs.
Bit 4: Offsets.
Bit 5: Motion detection.
Bit 6: Analog offset & high rpm.

Motion ANDing

40332 **Channel Index**
Read/write
Values: 1 - Max Channel Number
Channel index for the Motion Enable Level Register.

40333 **Motion Enable Level**
Read/write
Values: 0 = Off, n = Motion Detection Level
Specifies the motion detection level used for a channel.

Output Enable ANDing

40334 **Output Enable Index**
Read/write
Values: 1 - Max Channel Number
Channel index for the Output Enable register.

40335 **Output Enable**
Read/write
Values: 0=Channel not ANDed, 1=Channel ANDed
Specifies whether a channel is ANDed with the Enable Input.

Group Programming

40336 **Group Quantity**
Read/write
Values: 1 - 6
Specifies the number of output groups.

40337 **Group Index**
Read/write
Values: 1 - 6
Group index for Channel Quantity and Group Mode Registers.

40338 **Channel Quantity**
Read/write
Values: 0 - n
Defines the number of channels in the output group specified by the Group Index Register.

40339 **Group Mode**
Read/write
Values: 0 - 5
Defines the operating mode for the output group specified by the Group Index Register. Note that groups in mode '0' do not need (or have) an enable input.

Run Time Control

40340 **Stop Control**
Read/write
Values: 0 = Running, 1 = Stopped
When PLuS is STOPPED, changes written to registers do not update the checksum in EEPROM memory. Changes are faster when unit is stopped, but you must read from the Checksum Register when changes are complete to establish a valid checksum. Writing a '1' value to this register will place the PLuS in STOPPED mode. Writing a '0' to this register will restart the PLuS via a watchdog timer reset.

40341 **EEPROM Checksum**
Read only
Returns the current checksum of EEPROM memory. If computed checksum of EEPROM memory does not match the current value (i.e. if changes were made while unit STOPPED), a new value will be written to EEPROM memory.

Run Time Control (Cont'd)

40342 **EEPROM Changed**
Read only
Values: 0 = no change, 1 = changed.
A value of '1' in this register means that the EEPROM has been changed (through the keyboard) since the last time this register was read. Reading this register sets it to '0'.

Active Program

40343 **Active Program**
Read/Write.
Values: 1 - Max program number
Returns to program currently active; determined either by hardware inputs or by the value of the default program. If hardware inputs are active, writes to this register will change the default program, but the active program will not change.

I/O Control

40350 - 40359 Input Status
Read Only.
Values: 0 - 65535
Each register represents the status of 16 inputs.

40360 - 40369 Output Status
Read/Write.
Values: 0 - 65535
Each register represents the status of 16 outputs. The least significant bit of the register corresponds to the lowest numbered output. Writing to one of these registers will force 16 outputs. The ORing and ANDing registers (and coils) will reflect the forced conditions.

40370 - 40379 ORing Bits
Read/Write.
Values: 0 - 65535
Each register represents the status of 16 ORing bits. The least significant bit of the register corresponds to the lowest numbered output. When a '1' is present in an outputs' bit position, the output will be forced ON. The OUTPUT STATUS register will reflect the forced condition.

40380 - 40389 ANDing Bits
Read/Write.
Values: 0 - 65535
Each register represents the status of 16 ANDing bits. The least significant bit of the register corresponds to the lowest numbered output. When a '1' is present in an outputs' bit position, the output will be forced OFF. The OUTPUT STATUS register will reflect the forced condition.

Host Communications Setup

40390 **Communication Type (RS485/RS232)**
Read/Write.
Values: 0/1 (0=RS485, 1=RS232)
Determines the communication type used by the controller. This register may only be written to when the controller is stopped (via the STOP CONTROL register).

40391 **Communication Baud Rate**
Read/Write.
Values: 2/3/4/5 (2=4800, 3=9600, 4=19200, 5=38400)
Determines the baud rate used by the controller. This register may only be written to when the controller is stopped (via the STOP CONTROL register).

Host Communications Setup (Cont'd)

40392 **Communication Address**
Read/Write.
Values: 1-255
Determines the address used by the controller. This register may only be written to when the controller is stopped (via the STOP CONTROL register).

NOTE: If the three address switches on the input board are all UP (address 7), the controller will be automatically configured to be RS232, 9600 baud, address 1. Use this feature to enable communications with a controller if no keyboard is available or if you are unsure of the communication parameters currently in use.

Special Functions

Overview

Special functions are used to implement features not directly defined by the standard registers. Special functions are executed by loading the special purpose registers (40001-40016) with data, and then bringing the Execute Special Function Coil (00315) from '0' to '1'.

The data loaded into the special purpose registers is dictated by the special function being performed; each different special function will define the number and use of the special purpose registers.

Register 40001 will define the special function to be performed; registers 40002-40016 will hold the data needed for the special function.

Pulse Copy

This function will add a series of pulses to a specific program and channel.

Register Use:

40001: 1 (Pulse Copy)
40002: Program number.
40003: Channel number.
40004: Beginning on value of pulse envelope.
40005: Ending off value of pulse envelope
40006: Number of pulses within envelope.
40007: Duration (width) of each pulse within envelope.

Registers 40004 and 40005 define the on and off values of the envelope pulse that will be divided into a series of smaller pulses.

Register 40006 contains the number of pulses that the envelope pulse will be divided into.

Register 40007 contains the duration of each of the smaller pulses.

This function will not be completed if the envelope pulse would overlap any other pulse in the specified program and channel, or if the count and duration values would result in overlapping pulses within the envelope pulse.

Once the registers have been loaded, bring the special purpose coil number 315 from '0' to '1'. The command will be acknowledged when pulse programming is complete. Special purpose coil number 315 must be made '0' before this function can be used again.

EEPROM Clearing

This function will clear various areas of EEPROM memory.

Register Use:

40001: -3 (EEPROM Clearing)
40002: EEPROM Clearing Function Number:
7000: Clear all EERPOM memory.
7001: Clear configuration memory.
7002: Clear setpoint memory.

Controller Diagnostics

CAUTION **The controller cannot be repaired in the field. If a unit fails, do not disassemble it. Return it to the factory for replacement.**

Status LED

The yellow Status LED on the controller, Figures 5 & 6, blinks in various patterns to indicate the controller status.

Normal Operation
The Status LED blinks on and off rapidly.

Keypad Not Connected
If the controller is powered without a keypad connected, the LED blinking pattern will be "off" for one second, followed by four quick "on" blinks.

Internal Errors
If the LED blinking pattern is "on" for a second, followed by one or more quick blinks "off," the controller is experiencing internal errors. The specific error is indicated by the number of "off" blinks:

One "Off" Blink—Corrupt RAM

Two "Off" Blinks—Checksum error indicating EPROM corruption.

Three "Off" Blinks—System error.

Four "Off" Blinks—System error.

If any of the above four patterns occur, power cycle the control. If the pattern occurs again, remove the controller from service and return it to the factory.

Five "Off" Blinks—Internal error; possibly noise problems.

Six "Off" Blinks—Internal error; possibly noise problems.

If either of these two patterns occur, check for loose connections and fix any obvious noise problems. If the problem persists, remove the controller from service and return it to the factory.

Keypad Diagnostics

⚠ CAUTION **The keypad cannot be repaired in the field. If a unit fails, do not disassemble it. Return it to the factory for replacement.**

Keypad Fault LED

If the Fault LED on the keypad lights, turn the controller off and back on. If the keypad Fault LED does not go off, the keypad microprocessor has malfunctioned. Return the keypad to the factory.

Keypad Diagnostics

The 6400 Keypad includes a series of diagnostics that show the status of various keypad functions. To start the diagnostics, turn the controller off, then restart the controller while pressing any key on the keypad.

```
15 REV 1.00
CS:024B 07APR94
```

Unique key ID# appears here when any key is pressed.
Keypad software revision #.
Keypad software revision date.
Keypad checksum.

▼

`FAULT LED` — SEL → *Fault LED blinks ON one second, OFF one second. Press up or down arrow to return to menu.*

▼

`PROGRAM ENABLE` — SEL → *1 = E1 jumpered; 2 = E2 jumpered. Press up or down arrow to return to menu.*

▼

`ADDRESS SWITCHES` — SEL → *Shows keypad DIP switch address setting. Press up or down arrow to return to menu.*

▼

`COMM PORT` — SEL → *Tests communication. Press up or down arrow to return to menu.*

▼

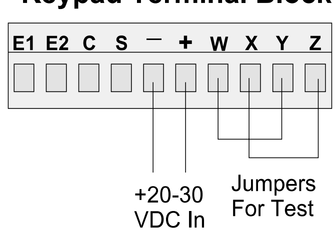
`DISPLAY` — SEL → *Complete character set scrolls across both lines. Press up or down arrow to return to menu.*

▼

`KEYBOARD` — SEL → *Displays unique key# for each key pressed. Press hidden key on face below HLP key to exit.*

Figure 34—Keypad Communications Port Test Setup

Keypad Terminal Block



When the COMM PORT diagnostic is run with keypad terminals W, X, Y, and Z jumpered as shown, a string of “plus” signs will scroll across the display. When either jumper is removed, the scrolling will stop.

Resolver Troubleshooting

Mechanical Problems

If the resolver is generating erratic RPM or position readings, or the position appears to be shifting periodically with respect to the machine cycle, check the mechanical coupling between the resolver and the machine.

If the coupling is not slipping, loosen the coupling and rotate the resolver shaft in both directions with sudden, jerky motions. If the controller displays unusual position or RPM readings, the resolver may be need to be replaced.

IMPORTANT

Resolvers cannot be repaired in the field. If a unit fails, do not disassemble it. Return it to the factory for replacement.

Electrical Problems

Page 2-18 shows the wiring diagrams for Electro Cam Corp. resolvers and cables. If any wire in one of the three individually shielded pairs becomes disconnected, the following error message will appear on the keypad/display:

```
ERROR: RESOLVER
NOT CONNECTED!
```

The output channels will immediately be disabled until the resolver is re-connected. Press ESC to clear the error message.

Note that ESC will clear the message and restore access to keypad programming even if the resolver has not been re-connected.

Follow this procedure to troubleshoot electrical problems:

1. Verify that the electrical connections at each end of the resolver cable are secure.
2. Disconnect the cable at the controller. Measure the resistances between all wires on the terminal block. The paired wires should have the resistances shown in the table below, while the resistance between every other combination of wires should be infinite. If the resistances are correct, the controller may need to be replaced.
3. If the resistances in Step 2 are incorrect, the problem may be in the cable or in the resolver. Disconnect the cable at the resolver and measure the resistances at the resolver pins. If the resistances are correct, the cable is bad. If the resistances are wrong, the resolver should be replaced.

Wire Pair	Resistance	or	Resistance
White/Black	15 to 25 ohms		60 to 85 ohms
Red/Black	20 to 40 ohms		135 to 185 ohms
Green/Black	20 to 40 ohms		135 to 185 ohms

General Troubleshooting

⚠ IMPORTANT The controller and keypad cannot be repaired in the field. If a unit fails, do not disassemble it. Return it to the factory for replacement.

Problem	Possible Solution
Controller & keypad dead.	1. Check main fuse shown in Figs. 5 & 6. 2. Check power supply to controller.
Keypad dead, but controller LED's are on.	1. Check wiring between keypad and controller, Figure 12.
Keypad Fault LED "On"	1. Keypad microprocessor has malfunctioned. Turn the controller off and back on. If the keypad Fault LED does not go off, return the keypad to the factory.
Menu operation Slow on keypad display	1. Check KEYBOARD QTY programming. If it is set for two keypads, but only one is connected, menu operation will be very slow.
Power up is Slow	1. When more than one keypad/display is attached to one controller, some power supplies will take longer to come up (i.e., Condor HB24-1.2-A+).
COMM FAILURE—HOST TO KEYBOARD message	1. This message may flash briefly on power-up under normal conditions. 2. If the message persists, check keypad wiring connections at keypad and controller, Figure 12. 3. Check DIP switch settings, Figures 13 & 14. 4. While performing processor-intensive programming tasks such as recalculating many setpoints due to a change in SCALE FACTOR, or creating many setpoints through PULSE COPY, the controller may briefly lose contact with the keypad. Once the calculations are complete, contact will be re-established. Press ESC to clear any remnants of the error message.
Programming functions not accessible.	1. Programming not enabled. See Figure 12, and also ENABLE CODES for details.
ERROR: Analog Malfunction!	1. This is a non-fatal error, indicating the controller's internal analog chip is not working. A bad or missing analog module will not cause this message. 2. Replace the controller.
ERROR: RESOLVER NOT CONNECTED message	1. Resolver or resolver cable may have failed. See Resolver Troubleshooting, pg. 7-3.
ERROR: WD RESET message	1. This indicates that the watchdog timer has timed out. To clear, turn power to keypad OFF and ON. If this doesn't help, keypad is probably defective.
POS (position) moves opposite to machine direction.	1. Check INCREASING DIR for the correct direction of rotation. 2. Check resolver wiring, page 2-18.
POS (position) does not match machine position.	1. Verify that OFFSET is correct. Once set, the offset value should not change. If it does, check the resolver coupling to be sure it is not loose. Also see "Resolver Troubleshooting," page 7-3.
Serial communications not working	1. Check COMMUNICATIONS programming to be sure type, baud rate, and address are correctly set. 2. Be sure the DIP switches for the PLµS-to-host communications are set correctly as shown in Figure 13. 3. Check communication cable wiring, Figure 15.
	1. Check that the correct program number is active. 2. Check the setpoints of the output(s) in question. Also check SPEED COMP settings. 3. Verify that OFFSET is correct.

Erratic Operation	1. Run the Watchdog Timer test described under MEMORY TESTS in the programming section of this manual. 2. See "Resolver Troubleshooting," page 7-3.
Analog output not working.	1. Check that ANALOG QTY and ANALOG OUTPUT are programmed correctly. 2. Check that analog output module is located in the correct module position. See Figure 5 or 6. 3. Check correct wiring of analog output. 4. Verify that analog load device is within specifications for the analog module. 5. Try a different analog output module.
Some transistor outputs not working	1. Check that the correct program number is active. 2. Use OUTPUT STATUS to see if the controller is activating the output(s) at the correct position in the resolver revolution. If not, verify that the SETPOINTS are correctly programmed. Other programming that may prevent an output from energizing includes MOTION ANDING and OUTPUT ENABLE ANDING. 3. If OUTPUT STATUS shows the output is on, use a meter to see if the output terminal is energized. If so, check the load device and its wiring. If not, go to Step 4. 4. Check the transistor array chips, Figure 17.
All transistor outputs not working	1. Check that the correct program number is active. 2. Use OUTPUT STATUS to see if the controller is activating the output(s) at the correct position in the resolver revolution. If not, verify that the SETPOINTS are correctly programmed. Other programming that may prevent an output from energizing includes MOTION ANDING and OUTPUT ENABLE ANDING. 3. If OUTPUT STATUS shows the output is on, use a meter to see if the output terminal is energized. If so, check the load device and its wiring. If not, check the transistor output fuse, Figure 18. Use the fuse tester built into the controller, Figure 17. 4. Check that 10-30 VDC power is connected to TB 11, Figure 10 & 11.
AC/DC module not working	1. Check that correct program number is active. 2. Use OUTPUT STATUS to see if the controller is activating the output(s) at the correct position in the resolver revolution. If not, verify that the SETPOINTS are correctly programmed. Remember that AC/DC output modules are controlled by Channels 17-25 (1-17 on M17). Other programming that may prevent an output from energizing includes MOTION ANDING and OUTPUT ENABLE ANDING and TIMED OUTPUTS. 3. If OUTPUT STATUS shows the output is on, but the LED on top of the module does not light, try replacing the module. 4. If the LED on the module lights but the output terminal does not energize, check the fuse built into the top of the module. Use the fuse tester built into the controller, Fig. 17. 5. Check that load power is present in the circuit and correctly wired. Remember that modules do not supply power to loads; they simply switch the load circuit on and off.

Fuse Part Numbers

Fuse	Description	Mfct. Part #	Electro Cam Part #
Main Fuse (Figs. 5 & 6)	1-1/4 Amp Slo-Blo Glass	Bussman MDL-1-1/4	PS-9000-4114
Module Fuse	4 Amp TR-5	Wickmann 19370-062	PS-9005-0004
Input Fuse (Fig. 17)	250 mA TR-5	Wickmann 19372-035	PS-9005-0250
Output Transistor Fuse (Fig. 17)	1 Amp TR-5	Wickmann 19370-048	PS-9005-0001

PS-6144 Controller Specs

Electrical	
Input Power	20-30 VDC. Keypad/display is powered from controller.
Input Current	500 mA maximum (control only)
Power Consumption:	35 W
Permanent Memory:	EEPROM (no battery required)
Accessory Power Out:	20-30 VDC, 250 mA Max (same source and voltage as input power)
Environment	
Operating Temp:	0° to 55°C (32° to 131°F)
Storage Temp:	-40° to 70°C (-40° to 160°F)
Humidity:	95% maximum relative non-condensing
NEMA Rating:	Keypad/Display: NEMA 4
Physical	
Overall Dimensions:	See Figure 4
Weight:	Controller: 3.5 lbs (1.6 kg). Keypad/Display: 0.5 lbs. (0.2 kg)
Mounting	
Controller:	Brackets accept EN-50035 (“G” profile) or EN-50022 (“Top Hat” profile) DIN rail.
Keypad/Display:	Mounts up to 1000' from controller. Multiple keypads may be connected to one controller.
Inputs	
DC Inputs:	16 sinking or sourcing DC inputs, optically isolated.
Input ON State Voltage:	10-30 VDC
Input Current:	11 mA @ 24 VDC
Program Select Response:	100 ms typical; may be longer with large numbers of setpoints.
Response of All Other Inputs:	1-2 scans
Outputs: PS-6144-24-(P16 or N16)M09	
Real World Outputs:	Up to nine Slimline modules may be mounted on controller. Modules may be any mix of AC, DC, reed relay, and up to two analog. All modules optically isolated.
DC (Transistor) Outputs:	16 sinking (N16) or sourcing (P16), optically isolated. Sinking or sourcing must be specified on order.
Outputs: PS-6144-24-M17	
Real World Outputs:	Up to 17 Slimline modules may be mounted on controller. Modules may be any mix of AC, DC, reed relay, and up to two analog. All modules optically isolated.
Analog Output	
Output Types:	4-20 mA or 0-10 VDC, proportional to RPM.
Resolution:	12 bit
Update Frequency:	10 times/sec minimum
Linearity:	±0.3% of full scale @ 25°C (77°F)
Set-up:	Offset and full scale RPM are programmable.
Operation	
Scan Time:	300-500 µs (exact time determined by programming) For higher speeds, interrupt-driven versions available—consult factory.
Position Resolution:	10 bits (1024 increments). 12 bits (4096 increments) available with “-H” option.
Speed Compensation:	Programmed in 0.1 msec steps. 16 individually compensated outputs max. Updated ten times per second. Separate leading/trailing edge compensation available with option “-L” (update time typically five times per second).
Output Timeout:	1.0 ms time base (accuracy: +1, -0 ms)
Number of Timed Outputs:	Four maximum
Multiple Programs:	48 programs standard (256 available with “-F” Option)
Total Pulse Memory:	1258 pulses standard (4589 available with “-F” Option)
Pulses per Program:	512 maximum standard (512 available with “-F” Option)
Pulses per Output:	512 maximum standard (512 available with “-F” Option)
Maximum Speed:	3000 RPM
RS-232 Serial Communication	
Port Types:	1 RS-282 or 1 RS-422/485—R-485 can be configured as a “Multi-Drop” network.
Baud Rates:	4800, 9600, 19.2K, 38.4K

Slimline Output Module Specifications

AC Outputs	**Part # EC-OAC240-3**		
		Output Voltage:	24 VAC rms minimum 280 VAC rms maximum
		Output Current:	30 mA rms minimum 3 amps rms maximum @/below 35°C (95°F). Above 35°C derate 50 mA/°C (27.8 mA/°F)
		Input Voltage:	5 VDC nominal 8 VDC maximum
		Turn On Time:	100 µs maximum @ 60 Hz
		Turn Off Time:	8.3 ms maximum @ 60 Hz
		Off State Leakage:	2 mA AC rms @ 120 VAC rms, 60 Hz
		Operating Temp.	-30°C to +70°C (–22° to +158°F)
DC Output, 60 VDC	**Part # EC-ODC060-3**		
		Output Voltage:	0 to 60 VDC
		Output Current:	3 amps DC @/below 35°C (95°F) Above 35°C derate 35.7 mA/°C (19.8 mA/°F)
		Turn On Time:	50 µs maximum
		Turn Off Time:	50 µs maximum
		Off State Leakage:	1 µA DC maximum @ 24 VDC
		Operating Temp.	-30°C to +70°C (–22° to +158°F)
DC Outputs, 200 VDC	**Part # EC-ODC200-1 (SLIMLINE)**		
		Output Voltage:	0 to 200 VDC
		Output Current:	1 amp DC @/below 45°C (113°F). Above 45°C derate 18 mA/°C (10 mA/°F)
		Turn On:	50 µs maximum
		Turn Off:	50 µs maximum
		Off State Leakage:	1 µA maximum
		Operating Temp.	-30°C to +70°C (–22° to +158°F)
Analog Output, 0-10 VDC	**Part # EC-SANL-010V**		
		Resolution:	12 Bits (4096 Increments)
		Output Voltage:	0 to 10 VDC
		Output Current:	10 mA maximum
		Load Resistance:	1 K Ohm minimum
		Linearity:	±0.3% full scale @ 25°C (77°F)
Analog Output, 4-20 mA	**Part # EC-SANL-420M**		
		Resolution:	12 Bits (4096 Increments)
		Output Current:	4 to 20 mA DC
		Load Resistance:	450 Ohm maximum
		Linearity:	±0.3% full scale @ 25°C (77°F)
Reed Relay	**Part# EC-ORR000-0 (SLIMLINE)**		
		Output Type:	N/O Reed Relay Contacts
		Contact Rating:	10 VA maximum
		Switching Voltage:	100 VDC or 130 VAC maximum
		Switching Current:	0.5 A maximum
		Carry Current:	1.5 A maximum
		Turn On Time:	500 µs
		Turn Off Time:	500 µs
		Mechanical Life:	5 x 10^6 cycles
		Operating Temp:	-30 to +70°C (-22° to +158°F)

Transistor Output Specifications

Sinking Transistor Output	**Part # PS-9011-2803**		
		Output Type:	Current Sinking (NPN)
		Output Voltage:	5 to 30 VDC
		Output Current:	50 milliamp cont. max (each output)
Sourcing Transistor Output	**Part # PS-9011-2580**		
		Output Type:	Current Sourcing (PNP)
		Output Voltage:	5 to 30 VDC
		Output Current:	50 milliamp cont. max (each output)

Resolver Specifications

Operating Temp:	-40° to 125°C (-40° to 257°F)
Storage Temp:	-40° to 125°C (-40° to 257°F)
Operating Humidity:	95% Relative non-condensing
NEMA Rating:	NEMA 4
	NEMA 4X
Maximum RPM:	3000 RPM
Max Cable Length:	1000 Ft.
Type:	Single Turn - Brushless
Resolution (all):	12 Bits (4096 increments)
Linearity (standard):	+/-20 arc minutes (resolver only)
	(+/-30 arc minutes combined with R/D converter in controller)
Linearity (specials):	+/-3 to +/-10 arc minutes (resolver only)
	(+/-7 to +/-14 arc minutes combined with R/D converter in controller)

Note: A resolver's linearity errors are repeatable at all positions of its 360 degree rotation. Therefore, once appropriate setpoints are established, machine performance is consistent every cycle.

Factory Defaults

Analog Outputs		
	Quantity:	0
	Offset:	0
	High RPM:	2000
Communications		
	Type:	RS-232
	Baud Rate:	9600
Default Program:		1
Enable Codes		
	Operator:	1
	Setup:	2
	Master:	3
Enable Options:		ON for all functions
Increasing Direction:		CCW
Input ANDing:		OFF
Keyboard Quantity:		1
Motion ANDing:		OFF
Motion Detection:		Lo 10 RPM, Hi 3000 RPM both levels
Offset:		0
Per Channel Enable:		All channels ON
Program Select Mode:		BIN (Binary)
Rate:		1X, RPM
RPM Update:		1/S
Output Enable ANDing:		OFF
Speed Comp:		All channels 0
Toggle RPM:		20 RPM

PLuS 6144 Setpoint Record Date:

PLuS Program #:________ **Description:**

CHN	Group	Mode	On	Off	ANDed With… Output Enable	Motion Level #	Timed Output	Speed Comp	**Comments** (multiple pulses, etc.)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
91									
92									
93									
94									
95									
96									

Analog Outputs

Output Channel #:______ ☐ 4-20mA ☐ 0-10 VDC Offset:______ High RPM: ______

Output Channel #:______ ☐ 4-20mA ☐ 0-10 VDC Offset:______ High RPM: ______

Global Settings

Motion Detection Levels

L1:____ RPM

L2:____ RPM

Group Offsets

Group #1 Offset/Preset: _______ Group #4 Offset/Preset: ________

Group #2 Offset/Preset: _______ Group #5 Offset/Preset: ________

Group #3 Offset/Preset: _______ Group #6 Offset/Preset: ________

Index

Symbols

(-F) Option 1-4
(-G) Option 1-4, 3-16
(-G10) Option 1-4
(-H) Option 1-4
(-L) Option 1-4
(-MB) Option 1-4
(-MSV) Option 1-4
(-V) Option 1-4
(-W) Option 1-4

A

Absolute Offset 3-16
Access Codes, Entering 3-20
Access Codes, Programming 3-8
Access Levels 1-3, 2-12, 3-8, 3-10
Active Program 3-7, 3-13
Address, DIP Settings 2-13, 2-14, 7-2
Address, Programming 3-6
Analog High RPM 3-4
Analog Malfunction 7-4
Analog Modules, Mounting 2-9
Analog Modules, Specifications A-2
Analog Offset 3-5
Analog Output 3-4
Analog Outputs, Introduction 1-4
Analog Quantity 3-5

B

Baud Rate 3-7
BCD Program Select 2-7
Binary Program Select 2-7
Boot, Washdown 1-4

C

Cables, Keypad 2-12
Cables, Resolver 2-18
Channel Copy 3-6
Channels, Definition 1-3
Channels, Group 1-3, 5-2
Checksum, Serial Commands 6-12
Clear Memory 3-14
Clear Setpoints 3-14
Codes, Access 3-8
Communcations, RS-232/RS-485 2-15
Communications 3-6
Communications, Address DIP Settings 2-13, 2-14
Communications, Baud Rate 3-6
Communications, Introduction 1-4, 6-1
Communications, Serial 6-3
Communications, Wiring 2-15
Communticications, PLμSNET II 6-1
Components, Layout 2-3, 2-4
Controller Diagnostics 7-1
Controller Specifications A-1
Copy, Program 3-21
Copy, Pulse 3-22

D

Default Program 3-7
Defaults, Factory Settings A-3
Diagnostics, Controller 7-1
Diagnostics, Keypad 7-2
Dimensions 2-2
DIN Rail 2-2
DIP Switches, Controller 2-13, 2-14
DIP Switches, Keypad 2-13, 2-14
Direction of Rotation 3-11
Display, Main 3-13
Display, Testing 7-2
Downloading Programming 6-1

E

Enable Codes 3-8
Enable Options 3-10
Environment, Mounting 2-1
Error Codes, Serial Commands 6-12

F

Factory Defaults A-3
Fault LED, Keypad 7-2
First Cycle Enable 2-5, 2-6, 5-6
Function 7000 3-14
Function 7001 3-14
Function 7002 3-14
Function 7998 3-14
Fuse Locations 2-3, 2-4
Fuse Part #'s 2-3, 2-4, 2-19, 7-6
Fuse Tester 2-19

G

Gray Code Program Select 2-7
Group Channels, Definition 1-3
Group Input Terminals 2-5, 2-6, 5-2
Group Offset 3-16
Group Position Display 3-10
Group Preset 3-16

H

Hardware Inputs 1-3, 2-5, 2-6
High RPM, Analog 3-4

I

Increasing Direction 3-11
Input Status 3-12
Input Terminals 2-5, 2-6
Inputs, Introduction 1-3
Inputs, Wiring 2-6

K

Keyboard Quantity 3-12
Keypad Diagnostics 7-2
Keypad Disable Terminal 2-5, 2-6
Keypad, Mounting 2-1
Keypad Operation 3-1
Keypad, Test 7-2
Keypad Wiring 2-12
Keys, Layout 3-1
Keys, Using 3-1

L

Leading/Trailing Speed Comp 1-4, 3-28, 4-4
LED, Keypad Fault 7-2
LED, Status 7-1

M

Machine Position, Display 3-13
Machine Setup, Initial 3-3
Machine Speed, Display 3-13
Main Screen 3-13
Memory Clearing 3-14
Memory Tests 3-14
Menu Tree 3-2
Menu Tree, Entering 3-13
Mode 0 5-3
Mode 1 5-3
Mode 2 5-4
Mode 3 5-5
Mode 4 5-6
Mode 5 5-7
Modes, Introduction 5-1
Module Specifications A-2
Modules, Mounting 2-1
Motion ANDing 1-4, 3-14
Motion Detection 3-15
Mounting, General 2-1

N

Negative Speed Compensation 3-29, 4-6

O

Offset 3-16
Offset, Analog Output 3-4
Operator Level Access 3-10, 3-21
Options, Controller 1-4
Output Channels, Definition 1-3
Output Enable ANDing 3-18
Output Enable Terminal 2-5, 2-6, 3-18
Output Forcing Function 3-19
Output Groups 3-18
Output Groups, Introduction 5-1
Output Groups, Programming 3-19, 5-2
Output Modules, General 2-8
Output Modules, Specifications A-2
Output Modules, Wiring 2-9
Output Status 3-19
Output Transistors, General 2-8
Output Transistors, Replacement 2-20
Output Transistors, Specifications A-3
Output Transistors, Wiring 2-10, 2-11
Outputs, Analog 1-4, 2-8, 3-4
Outputs, Timed 1-4, 3-30

P

Password, Entering 3-20
Per Channel Enable 3-21
PLµSNET II Software 6-1
PLC, Wiring Input From 2-6
PLC, Wiring Output To 2-10, 2-11
Position, Display 3-10, 3-13
Position, Shaft 3-28
Program, Active 3-7, 3-13
Program Copy 3-21
Program, Default 3-7
Program Select Formats 2-7
Program Select Mode 3-22
Program Select Terminals 2-5, 2-6, 2-7
Program Selection Thru Keypad 3-7
Programming Access, Enable Options 3-10
Programming Access, Functions 3-9
Programming Access, General 1-3
Programming, Factory Defaults A-3
Programming, Initial 3-3
Programs, General 1-3
PS-6144-17 Description 1-2
PS-6144-25 Description 1-2
Pulse Copy 3-22
Pulse Modes 3-27
Pulses, Definition 1-3
Pulses, Programming 3-26

R

Rate Setup 3-24
Resolver Cables 2-18
Resolver Dimensions 2-17
Resolver Direction 3-11
Resolver Specifications A-3
Resolver Troubleshooting 7-3
Resolver Type 3-25
Resolver Wiring 2-16
RPM, Toggling 3-30
RPM Update Rate 3-25
RS-232 2-15
RS-485 2-15

S

Scale Factor 3-25
Sensors, Input Wiring 2-6
Serial Command Checksum 6-12
Serial Command Error Codes 6-12
Serial Commands 6-3
Serial Communications 6-3
Serial Communications, General 1-4
Setpoint Use 3-26
Setpoints 3-26
Setpoints, Adding 3-27
Setpoints, Always ON 3-27
Setpoints, Changing 3-27
Setpoints, Clearing 3-14, 3-27
Setpoints, Definition 1-3
Setpoints, Deleting 3-27
Setpoints, Program Copy 3-21
Setpoints, Pulse Copy 3-22
Setpoints, Pulse Modes 3-27
Setpoints, Pulses 3-26
Shaft Position 3-28
Sinking, Input Wiring 2-6
Sinking, Output Wiring 2-8
Sinking/Sourcing 2-11
Software Version 3-28
Software Version, Keypad/Display 7-2
Sourcing, Input Wiring 2-6
Sourcing, Output Wiring 2-8
Specifications, Controller A-1
Specifications, Module A-2
Speed Comp Mode 3-29
Speed Compensation 3-28
Speed Compensation & Modes 5-8
Speed Compensation, Definition 1-4, 4-1
Speed Compensation, Guidelines 4-6
Speed Compensation, Leading/Trailing 1-4, 3-28, 4-4
Speed Compensation, Negative 3-29, 4-6
Speed, Display Machine 3-13
Status, Input 3-12
Status, LED 7-1
Status, Output 3-19

T

Terminal Block, Keypad 2-12
Terminal Block Part #'s 2-3, 2-4
Terminal Blocks, Controller 2-1, 2-3, 2-4
Terminals, Input 2-5, 2-6
Termination, Communications 2-13, 2-14, 2-15
Testing, Initial 3-3
Tests, Memory 3-14
Timed Outputs 1-4, 3-30
Timer, Watchdog 3-14
Toggle RPM 3-30
Transistor Outputs, General 2-8
Transistor Outputs, Wiring 2-10, 2-11
Tree, Menu 3-2
Troubleshooting, General 7-4

U

Uploading Programming 6-1

V

Version, Software 3-28, 7-2

W

Washdown Boot 1-4
Watchdog Timer Test 3-14
Wiring, Communications 2-15
Wiring, General 2-1
Wiring, Inputs 2-5, 2-6
Wiring, Keypads 2-12
Wiring, Output Modules 2-9
Wiring, Output Transistors 2-10, 2-11
Wiring, Power Supply 2-1

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256 9/14