Drive Control Systems

PR8700 and PR8701

Closed-Loop Motor Speed Control

Operating Manual

Version 2.0

For Technical Assistance Call Drive Control Systems:

1-800-323-0504

In MN (612) 941-8217

Fax (612) 941-6860

Introduction:

The PR8700 and PR8701 are closed-loop controls that are used with A.C. and D.C. drives to run motors at precise speeds. The PR Series Motor Speed Controls supply the 0 to 10Vdc (typical) reference voltage to the drive, which then controls the motor speed based on that reference voltage. A sensor system on the motor (or a critical shaft) provides actual speed feedback to the PR Series Control so that it can adjust the reference voltage to hold the speed setting precisely.

Drive Compatibility:

The PR-Series controls are compatible with POSITIVE REFERENCE VOLTAGE drives. The drives may have a reference input of anything up to 0 to +20Vdc.

The PR-Series controls can control speeds within a 30:1 range. Under no circumstances can the unit control motor speed beyond the speed rating of the motor.

Feedback Transducer Selection:

The acceptable feedback frequency to the PR-Series controls is 10 to 2000 Hz. To avoid using a frequency that is too high, check your output using the following formula:

Frequency = (Pulses Per Revolution x Maximum RPM) + 60

If the result of this formula is a number higher than 2000, you must use a transducer that produces fewer pulses per revolution (or monitor a slower shaft). Also, if the number is lower than 10, higher PPR (or a faster shaft) must be used.

The PR-Series controls can use Magnetic Pick-ups (2-wire) or NPN Open Collector (3-wire) transducers such as Optical Encoders, Proximity Sensors, or Hall Effect Sensors. The supply voltage provided for powered transducers is +12Vdc.

Installation

Warnings:

Improper installation can cause equipment failure or serious physical injury. This equipment must be installed, adjusted, and serviced by qualified electrical maintenance personnel who are familiar with the construction and operation the equipment and the hazards involved.

It is the responsibility of the individual installing the control to take to take diligent care during installation. Compliance with the National Electrical Code, with any and all sound pertinent local electrical and safety codes, and with the Occupational Safety and Health Act (OSHA) is required.

All exposed points on the control circuit board are electrically HOT with respect to Earth Ground. The

chance of electric shock, fire, or explosion can be reduced by proper consideration of grounding, thermal, and over-current protection, type of enclosure, and maintenance procedures.

Installing the PR8700 or PR8701:

1. The PR-Series controls are factory set for use with NPN Open Collector output sensors. If a magnetic pick-up is used, two board mounted DIP switches located in the case behind the signal input terminals must be adjusted. *Set the DIP switches before you connect the PR unit to AC power.*

The DIP switches are located above the COM terminal on the back of the unit. If the near end of the DIP is Down, that switch is On.

Sensor Type	Left DIP	Right DIP
Mag Sensor	Off	On
All Others	On	Off

2. Cut a rectangular hole in the panel, 1 25/32" high, by 3 3/8" wide.

3. Unscrew each mounting bracket screw to bring its threaded tip almost to the edge of the bracket bushing.

4. Slide the PR unit into the panel opening.

5. Insert the mounting bracket hooks into the slots provided on both sides of the PR unit case. The screws must point toward the panel.

6. Tighten both screws to "bite" the panel enough to hold the unit securely. Do not over tighten.

CONNECTIONS

Feedback Signal:

Mag Pick-up
- Since there is no fixed polarity with a magnetic pick-up, simply connect one wire to terminal IN and the other to terminal COM.

Other Sensors (Powered)
- Transducer Common to terminal COM
- Transducer Signal to terminal IN
- Transducer Power to +12Vdc Supply
- Shield to terminal COM

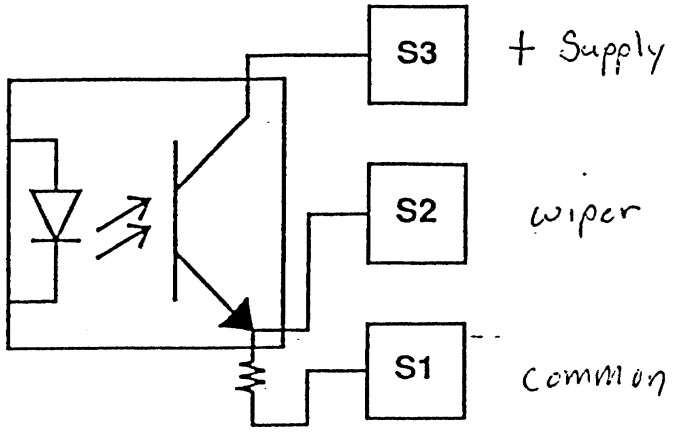
Note: If the sensor does not have an internal pull-up resistor, a pull-up resistor must be installed between the +12 and signal terminals.

Connection to Drive:

The drive must use a positive reference voltage. Connections are as follows:

- Terminal S1 to Drive CCW side of reference input* (Common)
- Terminal S2 to Drive Wiper (Signal)
- Terminal S3 to Drive CW side of reference input (Reference Voltage)

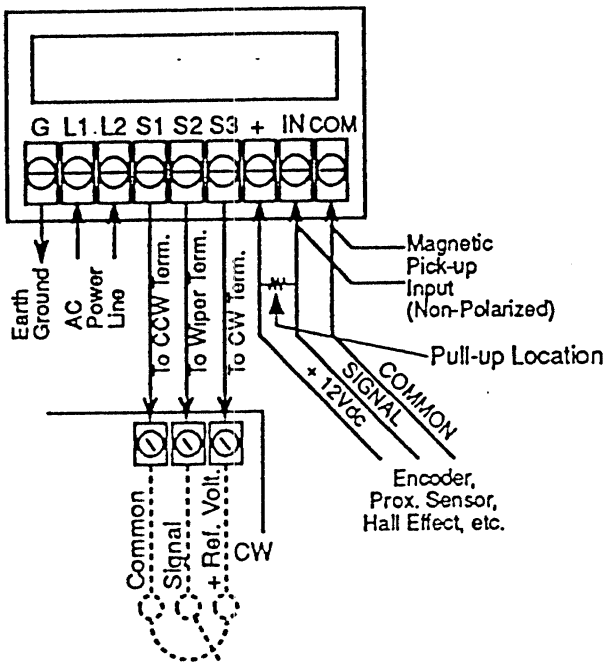
* If the drive has a clamping resistor between its wiper and CCW terminals, do not make the connection between S1 and CCW.



Line Connection:

- Earth Ground to terminal G
- AC Power to terminals L1 and L2

Important: Positive Disconnects in the AC supply to the speed control unit itself must be in place to ensure an emergency shutdown of the entire system. Merely disconnecting the PR-Series unit will not provide an adequate safeguard against a runaway condition.



PROGRAMMING MODE:

Programming can be done at any time, as long as the drive/motor is OFF. It is recommended that the programming be done before the PR-series unit is connected to the drive.

Entering Programming Mode - With power to the PR-series unit OFF, press and hold the front panel button marked "E" (enter) while applying power.

Four parameters must be programmed:

- Speed Scaling Factor, which tunes the output of the unit to the desired shaft speed.
- Load Response Number, which controls the speed at which the unit will respond to a difference between set speed and actual speed.
- Display Scaling Factor, which allows the LED display to display speeds in user units such as GPM, FPM, etc.
- Decimal Point Location, which places the fixed decimal point in the LED display.

As each of these parameters is entered, the PR-Series unit will cycle to the next parameter to be programmed. Each parameter is identified by the number of decimal points displayed; Speed Scaling Factor shows one decimal, Load Response Number shows 2 decimals, Display Scaling Factor shows 3 decimals, and Decimal Point Location shows 4 decimals. These decimals are indicators only and are not used in the number. All entries are whole numbers.

Programming the Speed Scaling Factor:

The Speed Scaling Factor is the result of the following formula:

$$SSF = [(\text{Speed Setting}) / (\text{Shaft RPM})] \times [3000 / PPR]$$

Note - The Speed Setting is the number that will be entered by the operator into the PR-Series unit as the process speed. Shaft RPM is the RPM of the shaft that has the feedback device mounted on it when the process is running at the speed that is set by the operator. For example: if the operator will be entering the Speed Setting as Motor Speed, the speed setting might be 1750 RPM. If the monitored shaft is the motor shaft, then Shaft RPM would also be 1750. However, if the monitored shaft is a shaft that is downstream of the motor, after a 10:1 reduction gear box, the shaft speed might be 175.

Important - ALWAYS DROP THE DECIMAL FROM THE SPEED SETTING VALUE. For example, a Speed Setting of 250.0 is used in the formula as 2500.

The following examples will demonstrate solving for this formula.

Example 1 - Speed Setting is Motor Speed (1750 RPM); Shaft RPM is a downstream shaft after 10:1 reduction (175 RPM); the number of Pulses Per Revolution generated by the feedback device is 120 PPR.

SSF = [1750 / 175] x [3000 / 120]

SSF = 10 x 25

SSF = 250

Example 2 - Speed Setting is GPM output from a pump (250.0 GPM); Shaft RPM is the RPM of the motor driving the pump (1700); the number of Pulses Per Revolution generated by the feedback device is 60 PPR.

SSF = [2500 / 1700] x [3000 / 60]

SSF = 1.470 x 50

SSF = 73.5

The SSF Number is entered by pressing the up or down arrow keys until the number desired is displayed. Pressing and holding the arrow keys advances the display rapidly; discreet presses advance the numbers by one digit. The default setting from the factory is 0050.

The SSF Number is always a whole number, so if there is a decimal as the result of the formula (as in our example 2) round the number off to the nearest whole number.

The number entered for example 1 would be 0250.

The number entered for example 2 would be 0074.

When the number has been set properly, press the Enter button and the display will cycle to the Load Response Number.

Setting the Load Response Number:

The Load Response Number is ideally set after the response of the system is analyzed. The factory default setting, which has proven to be an effective setting for most applications, is 000.8. Unless you have run your system and determined that the desired response may require fine tuning of the Load Response Number, leave the setting at the factory default.

The Load Response Number is a number from 0 to 30. Before changing the Load Response Number, check to be sure that oscillations in speed are not the result of shock loading; a change to the LRN will not improve oscillations resulting from shock loading. Also, check the accel and decel potentiometers of the drive to see if minor adjustments to those settings may eliminate "hunting" upon start-up or speed change.

Changes in response from LRN occur as follows:

- If the speed of the process oscillates rapidly and with wide amplitude around the set point, reduce the LRN slightly and evaluate the results. Repeat, if necessary until the oscillation is no longer present.

- If the motor accelerates too slowly, or if it oscillates slowly around its set speed, the response is too slow and should be increased by increasing the LRN.

Note - When handling highly inertial loads, it may be that no amount of adjustment of the LRN will eliminate the hunting problem. In these cases a regenerative type drive may be required, or, a more sophisticated control such as the MicroSpeed 196 should be used.

To change the Load Response Number, press the up or down arrow keys until the desired number is displayed (holding the arrow keys depressed will cause the numbers to change more rapidly). The display cycles at 0 and 30.

When the desired Load Response Number is reached, press the Enter button. The display will cycle over to the Display Scaling Factor parameter.

Setting the Display Scaling Factor:

The Display Scaling Factor causes the display to read out in user units (units of production) rather than simply in RPM. Technically, the DSF is adjusting the update time of the display. The PR-Series unit will display 3 decimals to let the programmer know that the Display Scaling Factor is being programmed.

The formula for determining the DSF is nearly identical to the formula for determining the Speed Scaling Factor. The formula is:

$$DSF = [(\text{Speed Display}) / (\text{Shaft RPM})] \times [3000 / PPR]$$

Note: the "Speed Display" does not necessarily have to be the same as the "Speed Setting." For example, if the user wanted to adjust speed in RPM, while having the display readout in percentage, the two formulas would appear as follows:

$$SSF = [1800 / 1800] \times [3000 / PPR]$$

$$DSF = [1000^{*} / 1800] \times [3000 / PPR]$$

* The decimal is always ignored so that 100.0 is figured in the formula as 1000.

To avoid update times that are too long (which may miss slight variances in speed) or too short (which may make the display unstable) the best possible result of the formula is a number between 25 and 125. A DSF of 25 results in a display update of .5 seconds. A DSF of 125 results in a display update of 3 seconds. The relationship between DSF number and the time base is linear as indicated by these figures (DSF of 50 is 1 sec., DSF of 75 is 1.5 sec. etc.).

If the result of the formula is outside of this 25 to 125 range, there are several options. If the number is less than 25: the display can be made 10 times greater with a decimal point moved one place left, the number of pulses per revolution on the feedback sensor can be reduced, or a slower shaft can be monitored.

If the number is greater than 125: larger units of measure can be used, higher PPR feedback sensors can be used, or the display can be reduced and the decimal point moved to the right.

If the result of the formula contains a decimal place (i.e. 73.57) round the result to the nearest whole number. This will result in a minor inaccuracy in the display.

Enter the DSF by pressing the arrow keys until the desired number is reached. Pressing and holding an arrow key will cause the display to cycle quickly. When the desired number is reached, press the Enter key to enter the Decimal Point Location parameter.

TROUBLESHOOTING

If the Motor Will Not Run:

1. Check wiring from the PR unit to the drive.
2. Check the continuity of all output leads, from the PR unit to the drive and from the drive to the motor.
3. The drive may be defective. Try running the drive using the speed potentiometer to see if it runs normally.
4. Test for a faulty motor.

If the Motor Will Not Lock Onto Speed:

1. The Load Response Number may be too low (if the oscillation is gradual) or too high (if the oscillation is rapid).
2. The drive may be incorrectly calibrated. Check that the accel, decel and IR comp are at their minimum values.
3. Check to see if S1 is connected to CCW on the drive input when the drive already has a clamping resistor in place between the wiper and CCW terminals. If so, remove the connection between S1 and CCW.
4. Check the feedback sensor.
5. Check the continuity and shielding of sensor leads.
6. Rapid shifts in load may be pulling the motor out of its set speed. Consider the use of a regenerative drive.

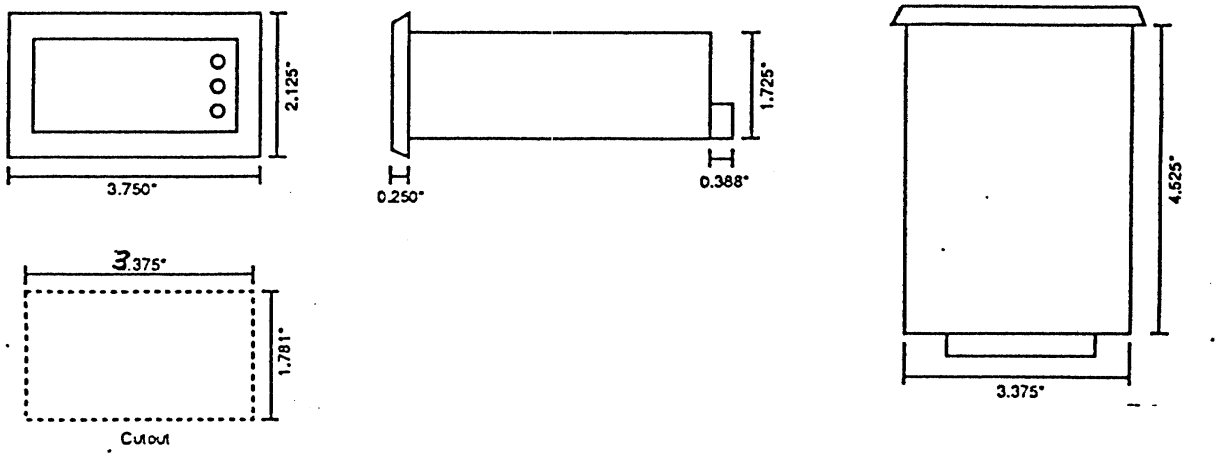
If the Motor Runs at Top Speed Regardless of the Set Speed:

1. Check the feedback. Loss of feedback will cause the motor to run at top speed.
2. Check the drive for its proper operation using the speed potentiometer.

Specifications:

Input Voltage	PR8700 - 115Vac PR8701 - 230Vac
Input Power	5 Watts
Maximum Feedback	10 to 2000 Hz
Maximum Output	20 Vdc
Feedback Sensor Types	12V NPN Type Encoder 12V NPN Type Proximity Switch Hall Effect Sensor Magnetic Pickup
Temperature Range	10° to 40° C
Weight	1lb.

Dimensions:



Setting the Decimal Point Location:

The Decimal Point Location is a fixed location for the decimal for display purposes only. Four decimals will appear on the display when the parameter for selecting the decimal location is active.

There are 4 locations available for the Decimal Point Location:

DPL Selection	Decimal Placement
0.0.0.0.	XXXX.
0.0.0.1.	XXX.X
0.0.0.2.	XX.XX
0.0.0.3.	X.XXX

To adjust the Decimal Point Location press the up or down arrow keys until the proper positioning is selected.

Saving the Programming and Entering Operating Mode:

Pressing the UP Arrow and the ENTER button simultaneously will cause the programming to be entered into non-volatile memory. The display will change to the operating display and the unit will be ready for a set speed to be entered. At this point, the drive/motor should be powered.

Important: It is best to be sure that the speed set when turning on the drive/motor is 0000. Otherwise, the PR-Series unit will immediately supply the reference voltage corresponding to the speed set and the motor will run.

Adjusting the Speed Setting During Operation:

1. Press the Enter key any time after power is applied (when not in programming mode). The left most (i.e. the Most Significant Digit) will begin flashing.

2. Press the up or down arrow key until the digit is set to the desired number.

3. Press the Enter key.

4. The 3rd digit (i.e. MSD -1) will flash.

5. Press the arrow keys until the desired number is displayed.

6. Press the Enter key.

7. Follow the same procedure for the other two digits.

8. When the last digit has been set, press the Enter key. The unit will immediately supply the reference voltage corresponding to the entered speed to the drive.

Note:. Be careful not to exceed the maximum speed rating of the motor when entering the Speed Setting.