

B8501

Brushless Analog Position Control Manual Supplement

P/N PCW-4712 Rev. 1.01 6/95

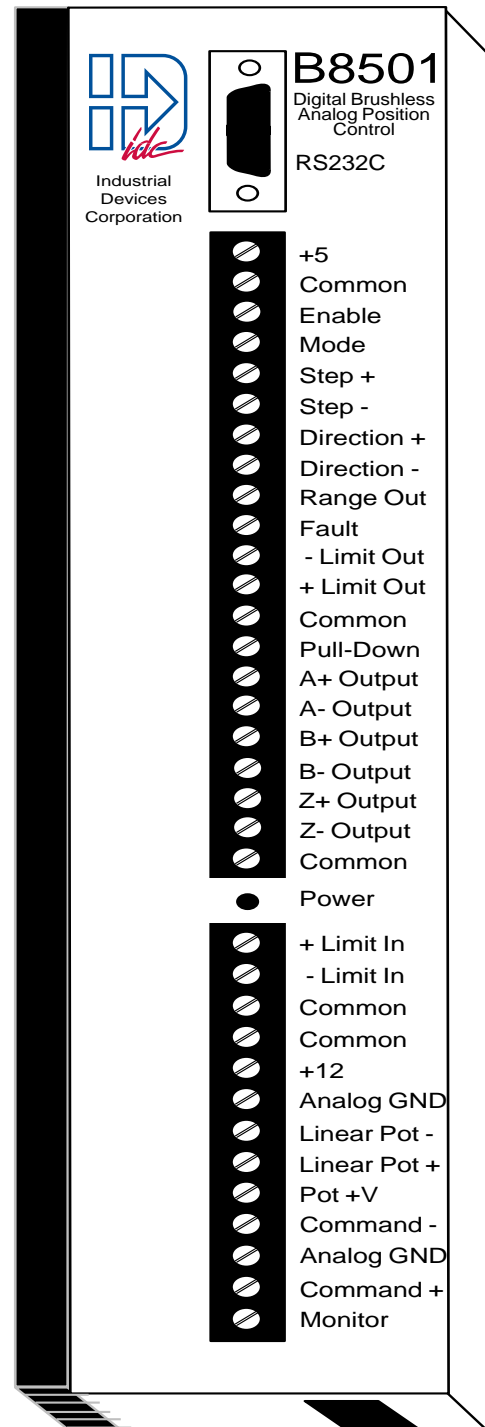
This manual covers the following
IDC Products:

B8501—Brushless Analog
Position Control

READ THIS FIRST!

This manual should be read before the
B8001 and Servo Tuner manuals also
included with this shipment.

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B8501 Product and Manual Overview

About this Manual

This manual is a supplement to IDC's B8001 Brushless Servo Drive operator's manual (P/N PCW-4679). It provides installation, hardware, and software tuning details for B8501 users who plan use absolute linear potentiometer feedback in electric cylinder applications.

This supplement is organized into three sections to clearly and concisely document the various hardware and software features unique to applying the B8501 Analog Position Control in a typical electric cylinder application. Product features and hardware connections that are common to the B8001 and B8501 are fully documented in the B8001 operator's manual.

Section 1: Product Overview and Application: Gives a brief functional overview of the B8501, as well as a conceptual overview of an analog feedback position system.

Section 2: Installation and Wiring: Details on hardware connections unique to the B8501.

Section 3: Tuning and Configuring a B8501 System: Provides a step by step process for setting up and tuning the servo loop in a analog position feedback application.

Though the B8501 supports analog feedback devices other than linear potentiometers, only operation with linear pots is documented in this supplement. Please call the factory for details on using other analog output sensors for feedback to the B8501.

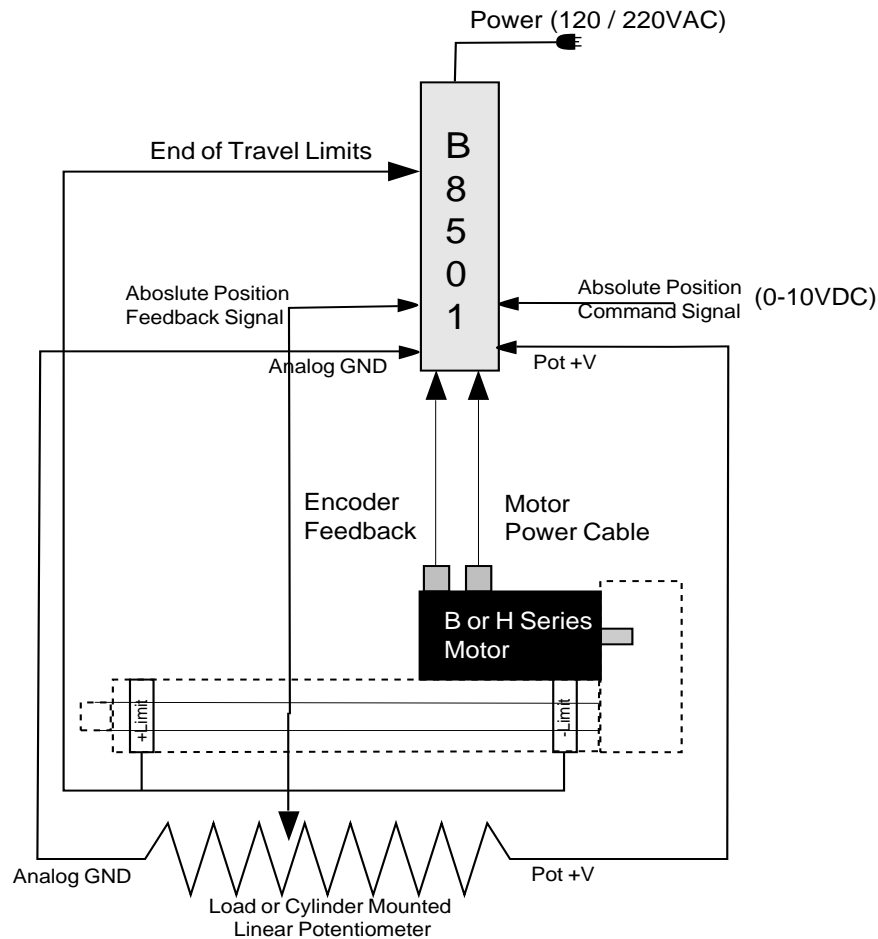


Section 1

Product Overview and Application

The B8501 is a 5 amp continuous, 10 amp peak, digital brushless servo drive using state of the art DSP technology to provide high performance, closed loop servo control to a wide variety of permanent magnet brushless and brushed servo motors and actuators offered by Industrial Devices.

Compact and easy to mount, the single axis drive is designed for easy setup and operation. In addition to industry standard step and direction and +/-10V control inputs, the B8501 features absolute analog position feedback capabilities. This 12 bit resolution analog input allows the position loop to be closed from a load mounted linear potentiometer. (see diagram below) This unique feature provides absolute, digital, closed loop, brushless servo motor control in a single package.



B8501 with Absolute Position Feedback

The ability to position to an absolute position provides several benefits. Since the B8501 knows where it is on power up, time consuming homing operations are



eliminated. In the case of an unexpected power loss, this absolute position information can prevent a machine damaging homing move. Valve positioning is also an ideal candidate for absolute positioning control. The controller can determine the current position of the valve without making a potentially damaging move.

Another benefit of closing an analog position loop in the B8501 is the elimination of a full featured servo controller. A PLC analog output, or even a simple rotary potentiometer can provide the analog position input signal. This allows full digital servo positioning control from PLC ladder logic.

The theory of operation is quite straight forward. The B8501 compares the position command signal to the position feedback signal from a load mounted linear potentiometer and moves the linear actuator to minimize the difference between the command signal and the analog feedback signal. Please see *Section 2* of this document for details on connecting an analog command signal as well as the linear potentiometer feedback signal.

The analog command input can be configured for 0-10 V operation where 0 corresponds to full extend and 10 volts signals full retract. The command input can also be setup to operate with a +/- 10 volt command signal. This configuration puts the 0 volt position at the mid-travel point of the cylinder. The top speed of the cylinder, in both modes of operation, is set from the **Input and Limits** dialog box in IDC's Servo Tuner software. Please reference *Section 3* of this supplement for details on the system tuning and performance.

The B8501 can also be driven by a step and direction or analog command signal from a motion controller, just like IDC's B8001. The step and direction signal can control position, velocity, and torque, while the analog command signal controls velocity or torque. Details on these modes of operation can be found in the B8001 Operator's Manual.

The B8501 drive is pre-tuned (for IDC motors and actuators) and can be optimized for a specific application using an advanced, yet easy to use tuning software, IDCMotion™ Servo Tuner. The MS-Windows™ interface communicates with the B8501 via an RS232C serial link, allowing the user access to a clear and intuitive menu set. On-board diagnostic monitors allow you to connect an oscilloscope to quantitatively view the dynamic response of your system. For repeat systems, tuning parameters can be stored on disk and downloaded into the new control.

Benefits:

- ◇ Analog position feedback provides actual load position information.
- ◇ Reduces controller cost and complexity.
- ◇ Absolute positioning eliminates the need for homing.
- ◇ Expanded torque-speed leads to higher throughput versus a brushed motor system
- ◇ Vector control offers improved torque and velocity control when compared to sinusoidal or hall effect commutation.
- ◇ High bandwidth, closed-loop operation for consistent performance
- ◇ Ease of integration speeds time-to-market
- ◇ Ease of setup during production lowers costs
- ◇ Smooth, non-resonant performance permits faster, smoother motion.



Compatibility:

The B8501 drives a variety of brushed and brushless servo motors available through Industrial Devices, as well as most encoder equipped servo motors from other vendors. Motor data files, necessary for operation, are provided, free of charge with all IDC supplied motors. Data files for other vendors motor can be supplied for a nominal charge.

Section 2

Installation and Wiring

The **Installation** section of the B8001 manual provides complete information on installing and wiring the B8000 family of servo products. This section is intended to supplement, not replace, that portion of the B8001 manual.

Inputs

All of the inputs work the same on the B8501 as they do on the B8001. The *+Limit In*, *-Limit I*, and *Enable* inputs all need to be grounded before motion can occur. Details on these inputs are provided in the B8001 manual.

The *Mode* input should be left open when the B8501 is operating as an analog position controller. (This input is pulled high internally.)

Outputs

Outputs such as the *Limit Out* and the encoder outputs retain the same functionality in the B8501 as described in the B8001 manual. Outputs such as the *Range Out*, and *Fault* can also be used to communicate move and operating status back to a PLC or any other machine controller.

Command Signal Wiring

The Command+ and Command- signal inputs can be used in three basic ways. The most common command signal is a 0-10 VDC, analog PLC output that is proportional to the desired position. (0-10VDC commands 0-100% travel.) The actual travel distance commanded in inches/volt will be cylinder and transmission dependent.

Another common command configuration is a -10 to +10 VDC signal. This provides the same functionality as the 0-10 VDC signal, but puts the 0 VDC position at the mid-point of the cylinder travel instead of at the full extend position. Please note that



B8501 Manual Supplement

the standard IDC supplied linear potentiometer needs to be modified to be compatible with a +/-10VDC signal.

A third common command signal source is a simple rotary potentiometer where full CW rotation commands full retract and full CCW rotation commands full extend.

There are an almost infinite number of hardware combinations that can produce a command signal to the B8501, but the three generic examples below will cover most cases. With the exception of the potentiometer example, only three hardware connections are required.

0-10 Volt Analog Command Input

- 1) Command- : Connect to the “plus” side of the voltage source.
- 2) Command+ : Connect to the “minus” or ground side of the voltage source.
- 3) Analog GND : Jumper to Command - if the voltage source is single ended. Connect to the voltage source ground when working with a differential voltage source.

+/- 10 Volt Analog Command Input

The standard IDC linear potentiometer is not a suitable feed back source for this type of control signal. A “ganged” pot, or a specially modified single linear pot must be used. Please contact the factory for more information on this control option.

- 1) Command- : Connect to the “plus” side of the voltage source.
- 2) Command+ : Connect to the “minus” or ground side of the voltage source.
- 3) Analog GND : Jumper to Command - if the voltage source is single ended. Connect to the voltage source ground when working with a differential voltage source.

Potentiometer Command Input

When using a rotary or linear potentiometer as a command signal a reference voltage must be provided between the positive and ground connections of the pot. This can be an externally supplied voltage, or the +12 VDC supply on the B8501 can be used. To use the B8501's supply connect the +12 terminal to the positive side of the command potentiometer. Connect the ground side of the pot to the **Common** terminal.

- 1) Command-: Connect to the wiper arm of the command potentiometer.
- 2) Command+: Connect to the ground side of the command potentiometer. To take advantage of the common mode noise rejection capabilities of this input, it is very important to *physically* make this connection out at the potentiometer terminal.
- 3) Analog GND: Jumper to the **Common** terminal.



Feedback Signal Wiring

Linear Potentiometer Feedback Wiring

The B8501 has four connections intended to be used with a linear pot providing position feedback. (Color codes applicable to IDC supplied feedback potentiometers only)

1) Pot + V: This highly regulated 5 volt signal is connected to the “high” or powered side of the pot. (black)

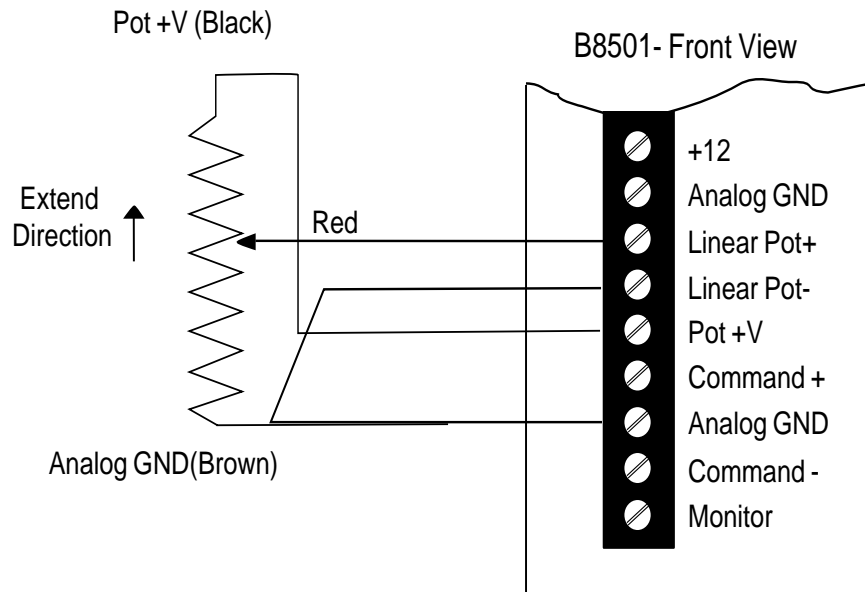
2) Analog GND: Connected to the ground side of the linear pot.

These two signals reference the voltage across the linear pot to the Command +/- voltage. Do not use an external voltage supply to power the linear pot.

3) Linear Pot- : For a single ended linear pot feedback (IDC supplied), connect to the ground side of the feedback potentiometer. To take advantage of the common mode noise rejection capabilities of this input, it is very important to *physically* make this connection out at the potentiometer terminal. Please consult the factory if you wish to use a differential feedback signal for increased noise immunity.

4) Linear Pot+ : Connect to the wiper or variable signal lead of the pot. (Red)

B8501 Linear Potentiometer Feedback Wiring



Section 3

Tuning and Configuring a B8501 System

The B8501 is typically used to drive a brushed or brushless servo motor in a closed loop, absolute position mode. The feedback device is normally a load, or cylinder



B8501 Manual Supplement

mounted linear potentiometer. An internally mounted linear potentiometer is available as an option on many IDC supplied actuators, but a customer supplied, load mounted, linear pot is also a common configuration. The directions that follow assume you are using this type of configuration.

Analog Command Input (Command + and Command -)

The analog command inputs can be utilized in three different ways. The “best” mode to operate in will be determined by a specific applications requirements.

The B8501’s analog command inputs can be used with a torque or velocity signal from a traditional servo controller. Operation in this mode is fully addressed in the B8001 manual.

They also operate as absolute, analog position inputs from almost any voltage source. When used as a position input, a load mounted linear potentiometer must also be used for position feedback.

For use with other types of analog feedback devices, such as force or pressure transducers, please call the factory.

Absolute Analog Position Control

When used in conjunction with a analog position feedback device, the Command +/- inputs command an absolute position. The actual velocity of the move will depend on the gains used, the load being positioned, and the setting of the Analog Velocity Scale parameter from IDC’s Servo Tuner program. The range of the input will depend on the type of feedback device being used.

-A single ended, IDC supplied linear potentiometer uses a 0-10Vdc signal scaled from full retract to full extend. The 0 Vdc position will be located at full extend.

-A differential feedback signal uses a +/-10Vdc signal scaled from full retract to full extend. The 0 Vdc position will be located at mid-travel on the cylinder.

Tuning a B8501 system with Analog Position Feedback

When using the Command +/- inputs as an absolute position command, a special tuning process is required.

1. Configure the B8501 for the appropriate motor using the IDC supplied motor data file as described in the Servo Tuner manual.

2. Tune the system, with the load attached, as described in IDC’s Servo Tuner manual.

3. Divide the Kp value by 10. $K_{p_{new}} = K_{p_{old}}/10$

When used in this mode, the Kp term acts as an integrator. If you have a large steady state load (like gravity), this value may have to be raised. If you have an extremely underdamped system, the value may have to be lowered to get a “ring free” response.

4. Set the *Analog Velocity Maximum*, also in the **Inputs and Limits** screen, to 120 rpm. (or slower if using a low gear ratio actuator)

5. From IDC’s Servo Tuner software **Inputs and Limits** screen, select the *Analog Input* type radio button.



B8501 Manual Supplement

6. Connect your analog control device to the Command +/- inputs. When the drive is enabled, it will move the motor to zero the difference between the Command and Linear Pot + signals. If the cylinder runs to the limit switches, without slowing down, the polarity of the linear potentiometer is reversed. Switch the Analog GND and the Pot +V leads.

7. From IDC's Servo Tuner software **Inputs and Limits** screen, adjust the analog velocity maximum value while executing your actual moves. This parameter determines your overall system response speed.



Hardware Specifications

General Mounting dimensions: Weight:	10.5" X 5.93" X 2.50" 5lbs
Environmental Drive Temperature: Motor Temperature: Humidity:	Thermal Shutdown occurs if the drive heatsink temp. exceeds 75C(167F). Max winding temp 155C (thermostat protected) 0 - 90% non-condensing
Power Input:	90-253VAC, single phase, 50/60Hz 1150VA@115VAC, 2300VA@230VAC
Motor Output Current: Protection:	5 amps continuous, 10 amps peak Protected against phase to phase shorts and shorts to ground. Internally fused.
Encoder Input Type: Max Rate: Power:	Incremental, Dual channel encoder Differential, quadrature output 2MHz 5VDC @200ma
RS232C Data Format:	RS232C Serial Interface, half-duplex, 9600 Baud, 8 data bits, no parity, 1 stop bit Three wire implementation(no handshaking)
Diagnostic Output Format: Variables	0 to 5VDC analog signal(centered @2.5v) Velocity, position error, velocity error, programmable scaling
Logic Power: Inputs: Outputs:	5VDC @250ma, 12VDC @100ma Optically isolated, sinking input, draws 20ma@12VDC Optically isolated, open collector outputs, rated for switching non-inductive loads up to 12VDC@7ma
Command Signal Step & Direction Current range: Max frequency: Resolution: Analog Command	5-15 mA 2Mhz 200-65,534 steps/revolution (programmable) Even numbers only +/-10VDC differential velocity or torque signal, 10Kohm input impedance, scale is digitally programmed.
B8501 linear pot input	0-5 Vdc, 250Kohm high impedance 12 bit resolution analog input