

BDS4 SERIES

INSTALLATION AND SETUP MANUAL

M93100 - Issue 2

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WARNING

Dangerous voltages, currents, temperatures, and energy levels exist in this product and in the associated servo motor(s). Extreme caution should be exercised in the application of this equipment. Only qualified individuals should attempt to install, set-up, and operate this equipment. Ensure that the motor, drive, and the end-user assembly are all properly grounded per NEC requirements.

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FOREWORD

The commitment to quality at Industrial Drives is our first priority. In all aspects of our business: research, development, product design and customer service, we strive to guarantee total quality. This pledge is founded on a solid history of innovative technological achievements dating back to 1948. One of the finest tributes to that achievement can now be seen at the Smithsonian which has on display the first stellar inertial navigation system developed by Dr. Charles Stark Draper. This system contains the first models of torque motors built by the founding organization of Industrial Drives. During the period of 1948 to 1960, our "firsts" in the industry numbered more than a dozen; they ranged from the simple but invaluable (such as the direct-drive DC torque motor and movie theater projection motors) to the exotic: submarine periscope drive motors for the U.S. Navy, electric drives, Curtis Wright electric brake coils, and numerous other innovations.

For more than a decade, Industrial Drives (known in the early days as part of Inland Motor Division of Kollmorgen) has continued to enhance its sophisticated engineering solutions to pioneer new product development.

The results of these and other efforts has encouraged some of the most significant innovations in the servo industry. We developed the application of servo motors and drives in the Machine Tool market. We were the first with water-cooled servos, the integral brake, the flux forcing concept and the brushless motor. We developed the electronically commutated electric car motor. Industrial Drives pioneered rare

earth magnet development for the servo motor industry.

Between 1974 and 1980, Industrial Drives continued to lead the industry in servo application innovations. Our commitment to engineering excellence never wavered. In fact, that commitment grew stronger with the development of brushless submarine and submersible motors (visiting the Titanic graveyard), multi-axis electronic drives and antenna pedestal drives (delivering unprecedented accuracy and revolutionizing the entire industrial automation process).

The decade of the 1980's brought continued advancements in technology and penetration of new markets requiring precise motion control. Already in the fifth generation of brushless products, Industrial Drives continues to lead the way with digital servo positioning capability and our newest motor offering, the GOLDLINE Series, incorporating the very latest high-energy, rare earth magnets (neodymium iron boron). Once again, we are setting the standards that others only hope to duplicate. Recently acknowledged by the Frost and Sullivan Foundation, a leading market specialist in the motion control industry, Industrial Drives and its parent, Kollmorgen Corporation, continue to rank first in servo technology.

Other achievements? Yes, too many in fact to mention. Each achievement stands as a testimony to the committed quality and excellence in design technology. This constancy of purpose is unyielding in an era of rapidly changing technology.

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CHAPTER 1

SYSTEM DESCRIPTION

1.1 INTRODUCTION

The information in this chapter will enable you to understand the product's basic functions and features. These concepts will allow you to apply them to your own unique applications.

1.2 PRODUCT DESCRIPTION

Industrial Drives' BDS4 product lines are 3-phase sine wave, brushless motor controllers. They are fully regenerative four-quadrant, bi-directional velocity loop amplifiers designed to be used with Industrial Drives' high performance B series permanent magnet brushless motors.

Although the BDS4 is basically an analog servo amplifier, it contains a microprocessor to implement Industrial Drives' patented Torque Angle Control function for maximum system performance.

The BDS4 amplifier modules are available in sizes of 3, 6, 10, 20, 30, 40 and 55 amps RMS/phase continuous. The modular design provides the flexibility for multiple axes to share a common power supply requiring no input isolation transformer.

The PSR4/5 Power Supply modules are available in sizes of 12, 20, 50 and 75 amps RMS/phase continuous (AC input line ratings).

Numerous Industrial Drives B Series motors with various diameters, stack lengths, and windings are also available.

1.3 FEATURES

Highlighted design features are:

- Modular construction maximizing serviceability.
- Two-part plug connectors interfacing between the BDS4, PSR4/5, and other equipment.
- Routine adjustments accessible from the front of the BDS4.
- High frequency (20 kHz) motor current ripple for quality servo performance, higher efficiency, and less audible noise.
- Differential velocity or current command input.
- Voltage programmable current limit input.
- A removable compensation board containing all the components that make the BDS4 compatible with a particular motor.
- Protection against thermal overload indicates any overtemperature conditions. The BDS4 is protected against peak current overloads by a

current foldback circuit. Also, it is protected from logic bus out-of-tolerance conditions and motor stator short circuit conditions, both line-to-line and line-to-ground.

- Drive-Up contact closes indicating the amplifier is ready for input command signal; opens on fault conditions.
- Standard PSR4/5 Power Supply units contain a Soft Start function and a dynamic bus discharge function.
- The 12 and 20 amp PSR4/5 units have, as standard, 40 watts of internal shunt regulation. There are optional versions available having no shunt regulator. Other options have externally mounted power resistance allowing shunt regulation of up to 700 watts. The shunt regulator is protected from excessive peak current by fuse. It is also protected from excessive duty, if duty cycle exceeds a preset limit, by shunt overload shutdown circuit.
- The 50 and 75 amp PSR4/5 shunt regulation is accomplished with externally mounted power resistor(s) with ratings from 500 to 2000 watts as standard. Special units may be ordered for even higher power. The shunt regulator is protected from excessive peak current by a thermal overload relay. It is also protected from excessive duty, if duty cycle exceeds a preset limit, by shunt overload shutdown circuit.
- Diagnostic LED indicators located on the front panel on both the BDS4 and the PSR4/5 modules.
- Either a 12-Bit Parallel Position Information Card or an Encoder Equivalent Output Card as available options.

1.4 THEORY OF OPERATION

The BDS4 brushless servo system consists of three main components:

1. PSR4/5 - Power Supply Module
2. BDS4 - Amplifier Module
3. B - Brushless Motor

All of the compensation components necessary to match a BDS4 amplifier to a particular motor such as, current loop compensation, velocity loop compensation, and torque angle compensation, are located on the removable BDS4 COMP compensation board located inside the BDS4 amplifier.

The TL (Test Limits and Modification) Sheet contains the compensation component values and such information as maximum operating speed, peak current limits, etc. that are assigned to each BDS4 system.

Only motors having the identical base model number may be run on the BDS4 amplifiers. If a motor having a different base motor model number is to be run on a BDS4, the BDS4-COMP compensation board must be altered or changed accordingly. The BDS4 must remain the same current and voltage rating.

1.4.1 PSR4/5 Power Supply Module

Refer to Figure 1.1 for a quick reference of the PSR4/5 and drawings A-93409, A-93408 and A-93092 for precise details.

The PSR4/5 Power Supply Module is divided into four (4) main sections:

1. The Unregulated Logic Bus, supplied by the Control AC line input voltage (normally single-phase 115 VAC), is described in Section 4.2.
2. The 310/140 Main DC Bus is supplied by the main AC line input voltage (normally three-phase 230 VAC or single-phase 115 VAC).
3. The Soft-Start Feature (standard) resistor limits the inrush current (to charge-up the Main Bus Capacitors) to a specific amount as listed in Appendix D.
4. The Shunt Regulator (regeneration) section includes circuitry which monitors the main bus. During deceleration profiles, the motor basically operates as a DC generator and pumps energy back into the main bus causing the bus to rise. The Shunt

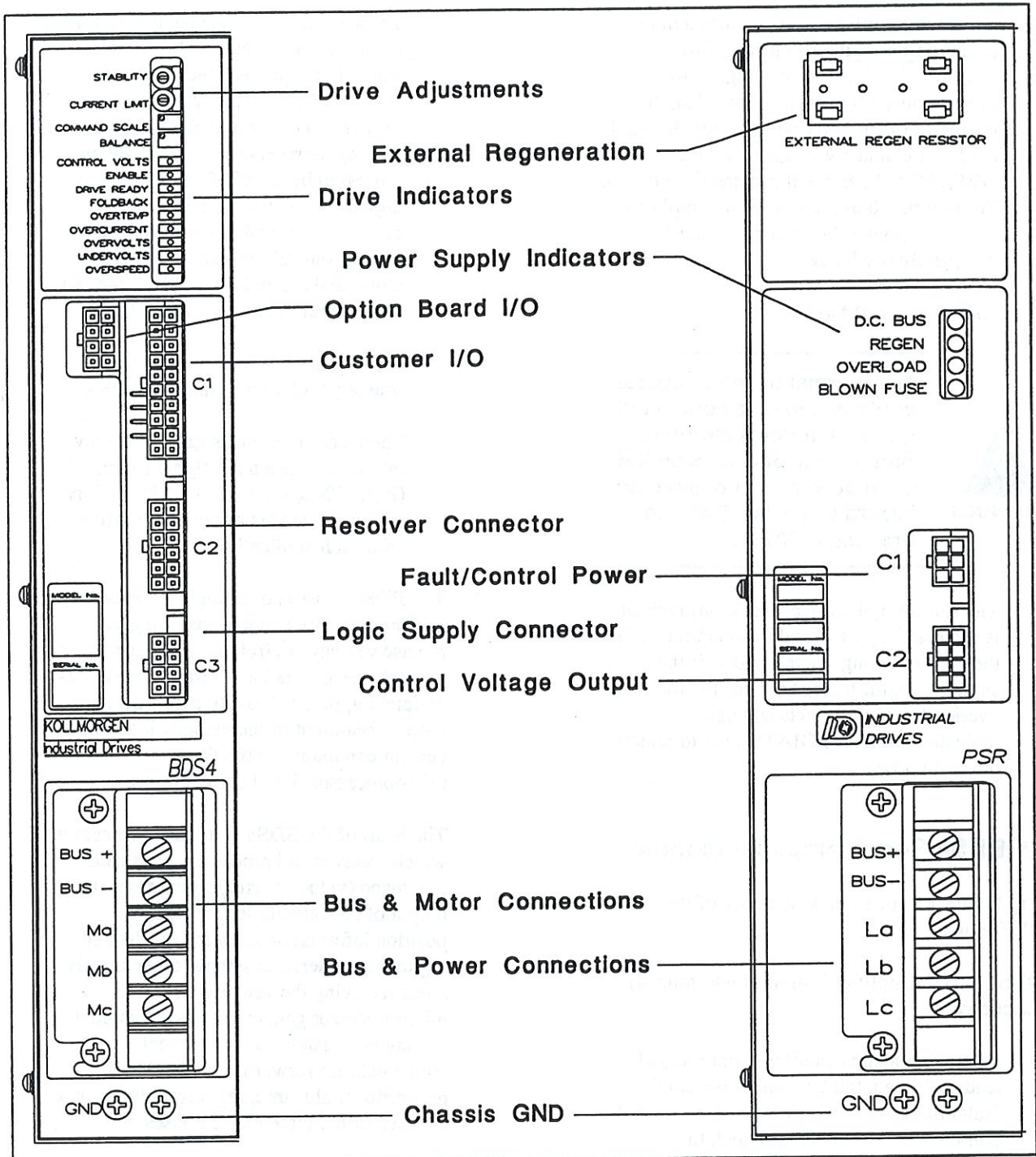


Figure 1.1. BDS4 and PSR4/5 (Low Current Models shown)

Regulator limits the voltage rise during the deceleration periods.

- 12 and 20 AMP Models:

The shunt regulator (regeneration) resistor load is fuse protected. If the shunt regulator

is held on for too long, the shunt regulator power transistor fails, or the shunt regulator load resistor becomes shorted, the fuse will blow and cause the Fault Contact on the PSR4/5 to open and the BLOWN REGEN FUSE LED to become illuminated.

The shunt regulator also includes a duty cycle limit circuit to protect against excessive load resistor heating. If the average duty cycle limit is exceeded, the regeneration circuitry will become disabled, the Fault Contact will open, and the OVERLOAD LED will become illuminated. To reset this fault, remove and reapply all input line power; bus capacitors must completely discharge.

- 50 and 75 AMP Models:



WARNING

The thermal overload output contacts must be connected into a shut down circuit (E Stop string, etc.) to drop the main power or a possible fire hazard will exist. Refer to Drawing A-93231.

The shunt regulator (regeneration) resistor is protected by a thermal overload relay. If the resistor rating is exceeded or if the shunt regulator transistor fails, the thermal overload output contacts will open indicating an IMMEDIATE need to remove the main power.

1.4.2 BDS4 Servo Amplifier Module

Refer to Figure 1.1 for a quick reference of the BDS4's features.

The BDS4 Servo Amplifier is divided into four (4) main sections:

1. Fault Diagnostics monitor various signal leads. When a fault condition occurs the fault circuit will become latched, the BDS4 will become internally inhibited, the appropriate red LED will become illuminated, and the Drive-Up contact will open indicating that the BDS4 is in its Inhibit mode.
2. The Input/Output interface circuitry is divided into two functions:

(A) Signals to and from the motor and BDS4.

These signals are associated with the motor system resolver. A 7.0 kHz excitation signal is generated in the BDS4 and sent to the resolver. Two resolver feedback signals (sine and cosine) are received by the BDS4 and processed by an R/D (resolver-to-digital) converter. The R/D unit generates a digital position word used in electronically commutating the motor and an analog velocity (internal tach) signal to close the servo loop.

(B) Signals to and from the signal source (PLC, CNC, etc.) and BDS4.

There are numerous signals that may interface between the signal source (PLC, CNC, etc.) and the BDS4. These inputs and modes of operation differ with each application.

3. The BDS4 consists of a single velocity loop and three inner current loops. To give precise velocity control, the velocity loop is normally configured as a proportional, plus an integral, plus a derivative gain servo loop. The output of the velocity loop is the current command for the three microprocessor-based current loops.

The heart of the BDS4 is its microprocessor which receives and processes the current command (velocity error) signal from the output of the velocity loop circuit, the position information from the resolver-to-digital converter, and several other signals. After receiving the velocity error, the microprocessor generates three sinusoidal current commands. These current commands are forwarded to the three proportional plus integral current loops, one for each of the three motor phases.

The microprocessor is the key element in the Industrial Drives patented torque angle technique. The microprocessor varies the phase of the currents with respect to motor

flux and significantly improves the motor speed-vs-torque profile.¹

4. The outputs from the three current loop circuits are converted into a 10 kHz pulse width modulation scheme. The modulation is such that the 10 kHz PWM results in 20 kHz current ripple in the motor, resulting in very quiet motor operation.

The PWM switching signals are optically coupled to the power stage gate drive hardware for complete electrical isolation. The BDS4 uses IGBT's (Isolated Gate Bipolar Transistors) for the output power stage; allowing high frequency operation.

1.4.3 Brushless DC Motor

The Industrial Drives' B Series brushless motors feature the latest in permanent magnet technology, utilizing high energy Neodymium-Iron-Boron alloys. These brushless motors consist of permanent magnet rotors and three-phase Y-stator windings. This places the heat producing member on the outside where it can best dissipate heat. These motors (depending on size) are either four- or six-pole motors. Since they are brushless motors, there are no commutators or associated brushes. The motors run as synchronous motors, meaning the rotor speed is the same as the speed (frequency) of the stator's rotating magnetic field. The feedback device is a brushless resolver, mounted internally as part of the overall motor construction. Another available option is the integral brush tachometer. For more information, refer to the Installation and Service Manual, B Series Brushless Motors M-89031.

1.4.4 Power Up/Down Sequencing

First, apply the 115 VAC control voltage. Second, apply the main AC voltage. Third, check for faults and then enable the BDS4. The AC line input voltages may be removed in any sequence.

¹ The BDS4A/V sine-wave controller allows a wider range speed because it has the ability to electronically change the angle between the rotor flux and the stator flux—commonly referred to as torque angle. Industrial Drives, A Kollmorgen Division, Patented Numbers 4,447,771; 4,479,078; and 4,490,661.

1.4.5 With Soft-Start Circuit (Standard)

1. Only the Control AC line input voltage is applied.
 - a. The logic bus comes up.
 - b. A power-up reset pulse is generated in the BDS4.
 - c. If no faults (other than main bus undervolts) are present after the power-up reset pulse is generated (a delay of one second) then the drive is ready to be enabled. However, there can be no motor movement until the main AC line input voltage is applied.
2. The Main AC line input voltage is applied.
 - a. The soft-start circuit charges the Main DC bus capacitors in the PSR4/5 through a current limiting resistor.
 - b. The shunt regulator regeneration circuitry is switched from dynamic bus discharge to regular mode.
 - c. The undervoltage fault in the BDS4 is now cleared (after approximately 3/4 sec. delay), and if jumper J21 is installed on the BDS4-COMP Board, the Drive Ready LED will become illuminated and the Drive-Up contact in the BDS4 (between Pins 10 and 20 of Connector C1) will close. The BDS4 is ready to be enabled and will enable once the enable input is activated.
3. Only the Main AC line input voltage is removed.
 - a. Approximately 30 msec. after the Main AC line input voltage is removed, the shunt regulator is switched from regulate to the dynamic bus discharge mode, and the main DC bus power is discharged.
 - b. The shunt regulator circuit is deactivated.

- c. The Drive-Up contact within the BDS4 will open due to Bus undervolts.
4. Only the Control AC line input voltage is removed.
 - a. The Drive-Up contact in the BDS4 will open. The BDS4 is immediately disabled.
 - b. Operation of the soft-start/dynamic bus discharge and other circuits within the PSR4/5 will not be affected.
 - c. The PSR4/5 fault contact will open.

1.4.6 Without Soft-Start Circuit or Dynamic Bus Discharge (Optional)

1. Only the Control AC line input voltage is applied.
 - a. The logic bus comes up.
 - b. A power-up reset pulse is generated in the BDS4.
 - c. If no faults (other than main bus undervolts) are present after the power-up reset pulse is generated (a delay of one second) then the drive is ready to be enabled. However, there can be no motor movement until the main AC line input voltage is applied.
 2. The Main AC line input voltage is applied.
 - a. The soft-start circuit charges the Main DC bus capacitors in the PSR4/5 through a current limiting resistor.
3. Only the Main AC line input voltage is removed.
 - a. The DC bus will bleed down slowly after approximately five minutes.
 - b. The shunt regulator is deactivated.
 - c. The Drive-Up contact within the BDS4 will open.
 4. Only the Control AC line input voltage is removed.
 - a. The BDS4 will be immediately disabled.
 - b. The BDS4 Drive-Up contact will open.
 - c. The PSR4/5 fault contact will open.

1.5 TYPICAL SYSTEM DIAGRAM

Figure 1.2 illustrates a typical system with all of the major components.

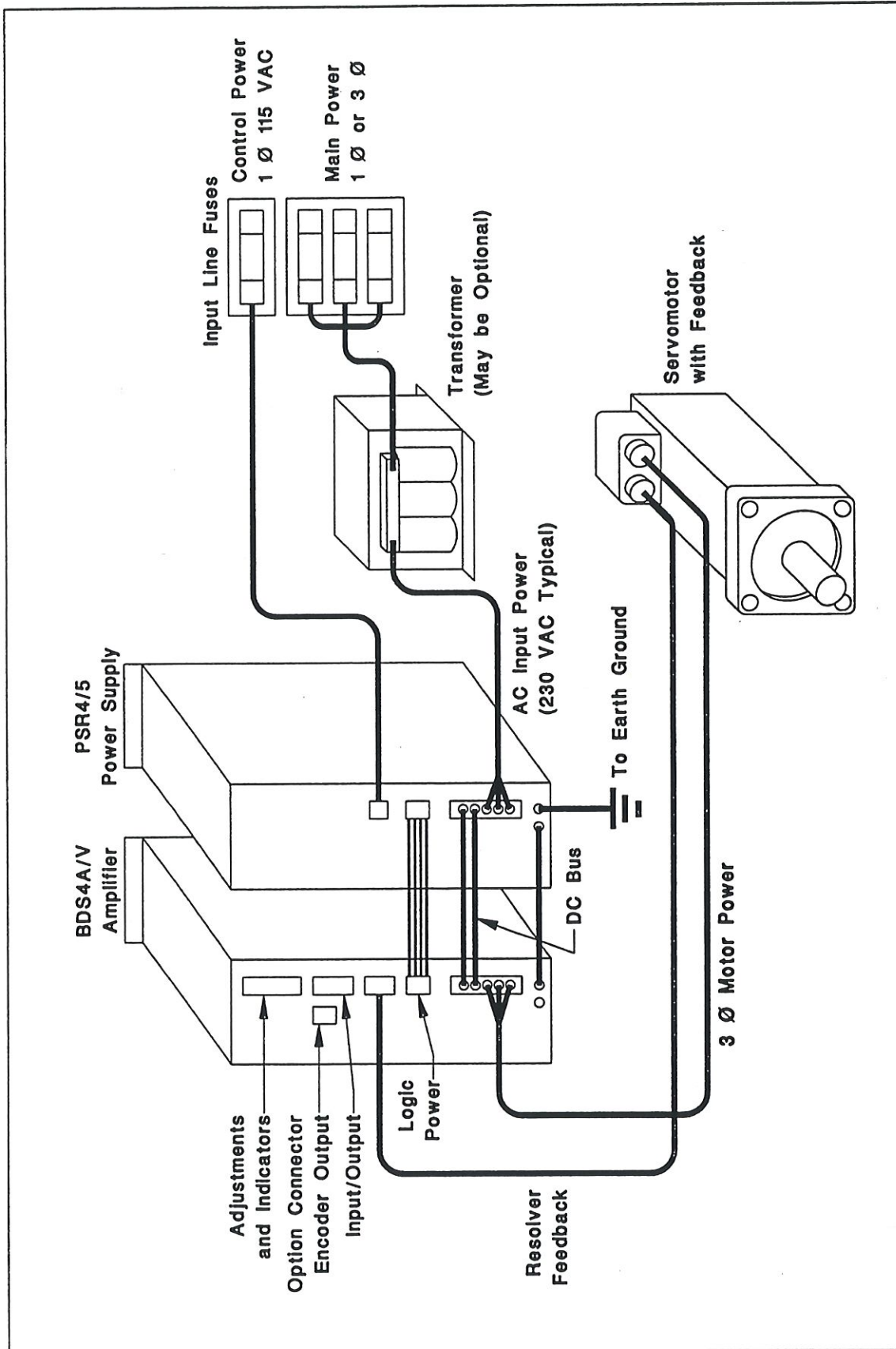


Figure 1.2. Typical System Diagram

CHAPTER 2

INSTALLATION

2.1 INTRODUCTION

The information in this chapter will familiarize you with the safety information, unpacking and inspection, installation requirements, assembly procedures and electrical connections for installing the BDS4. A checklist is provided at the end of this chapter to insure proper installation.

2.2 SAFETY INFORMATION

The purpose of this section is to alert you to possible safety hazards associated with this equipment and the precautions you can take to reduce the risk of personal injury and damage to the equipment.

Safety notices in this manual provide important information. Read and be familiar with these instructions before attempting installation, operation, or maintenance. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

The safety-alert symbols are illustrated in Figure 2.1.



Figure 2.1. Safety-Alert Symbols

When you see these symbols in this manual, be alert to the potential for personal injury. Follow the recommended precautions and safe operating practices included with the alert symbols.

"Warning" refers to personal safety. They alert you to potential danger or harm. Failure to follow warning notices could result in personal injury or death.

"Caution" directs attention to general precautions, which if not followed, could result in personal injury and/or equipment damage.

"Note" highlights information critical to your understanding or use of these products.

2.3 CONVENTIONS

To assist you in understanding the material in this manual, conventions have been established to enhance reader comprehension. Explanations of these conventions are as follows:

- Safety warnings, cautions, and notes present material that is important to user safety. Be sure to read any safety notices you see as they could prevent equipment damage, personal injury, or even death to you or a co-worker.

- **Bold text** highlights other important information that is critical to system operations.
- **CAPITALIZED** text stresses attention to the details of the procedure.
- Underlined text emphasizes crucial words in sentences that could be misunderstood if the word is not recognized.

2.3.1 BDS4 vs. BDS4V vs. BDS4A & PSR4/5 vs. PSR4/5A

The BDS4, BDS4V and the BDS4A differ in according to the following:

BDS4	Original Standard Configuration
BDS4V	Industrial Standard Configuration
BDS4A	U.L. 508 Approved Configuration

The BDS4 is the original amplifier developed by Industrial Drives. It was followed by a value analysis version, the BDS4V. The BDS4A was later developed and submitted to UL for approval.

In a similar manner, the PSR4/5 and PSR4/5A follow this scheme:

PSR4/5	Original Standard Configuration
PSR4/5A	UL 508 Approved Configuration

This indicates that the BDS4A and PSR4/5A meet all the safety standards set by the Underwriter Laboratories. Where differences occur between models, special instructions will be indicated in this manual. For the purpose of referencing all amplifiers and power supplies, the nomenclatures BDS4 and PSR4/5 will be used. Check your model number to verify your model.

2.3.2 Model Numbering Scheme

All Industrial Drives components contain a model and serial number printed on a black and gold tag on the front panel. The model number identifies how the equipment is configured. Refer to Appendix C for the model number scheme tables. These tables explain what the model configurations are. You

should verify that the model numbers represent the equipment desired for your application. Also verify the compatibility between components of the servo system.

2.3.3 Abbreviations

CCW	Counter Clockwise
CW	Clockwise
DIFF CMD	Differential Command
D/L	Direction Limit
GC	Goldline Cable
GCS	Goldline Cable Set
LED	Light Emitting Diode
NEC	National Electrical Code
P/N	Part Number
R/D	Resolver-to-Digital
Regen	Regeneration
TL	Test Limits
UL	Underwriters Laboratories

2.4 UNPACKING AND INSPECTION



CAUTION

Electronic components in this amplifier are static sensitive. Use proper procedures when handling component boards.

Upon receipt of the equipment, closely inspect components to ensure that no damage has occurred in shipment. If damage is detected, notify the carrier immediately.

Carefully remove packing material and remove the equipment from the shipping container. Do not dispose of shipping materials until the packing list has been checked. Parts that are contained within the shipment, but not physically attached to the equipment, should be verified against the packing list. If any parts are missing, notify Industrial Drives at once.

2.5 INSTALLATION REQUIREMENTS

Proper installation and field wiring are of prime importance when considering the application of servo amplifiers. Many problems may be avoided if

installation of the equipment is done properly. Users should familiarize themselves with and follow installation and wiring instruction in addition to all applicable codes, laws and standards. Pay special attention to the following topics when installing Industrial Drives' equipment.

2.5.1 Environmental Considerations

The environment that this equipment is placed in can have dramatic effects on its operation. Industrial Drives recommends that the BDS4 and PSR4/5 be operated and stored under the following conditions:

- Operating Temperature: 0° C to 45° C
- Storage Temperature: -20° C to 70° C
- Humidity: 10% to 90% (Non Condensing)

2.5.2 Enclosures

It is suggested that the BDS4 and PSR4/5 be mounted in a cabinet or other suitable enclosure to protect them from physical and environmental damage. Refer to Appendix D for complete system dimensions.



CAUTION

Allow sufficient clearance for the large "regenerative" heat producing resistor(s) mounted at the upper edge of the PSR4/5 unit and the externally mounted regen (shunt regulator) power resistor(s).

2.6 ASSEMBLY

The BDS4 and PSR4/5 are both constructed prior to shipping from the factory. The only assembly required is the mounting of the devices.

2.6.1 Mounting

Refer to the drawing of your model system in Appendix F for outline and dimensions. Be sure to

look at the proper drawing for mounting measurements.

The PSR4/5 and BDS4 modules should be mounted in the vertical position. To minimize cross talk and enhance air flow, maintain a minimum of 20 millimeters (0.75 in.) on either side of each unit and at least 40 millimeters (1.5 in.) of unobstructed space above and below the units.

Depending on the continuous current ratings of the BDS4 and PSR4/5 modules, a total of six (6) amplifiers may be mounted with a single power supply. However, the maximum number of BDS4 amplifiers mounted on either side of the PSR4/5 power supply module must not exceed four (4).

Mounting combinations for the PSR4/5 and BDS4 modules are as follows:

- PSR4/5-X12; a maximum of four (4) BDS4 amplifiers sequentially or "split mounted" (amplifiers are mounted on both sides of the PSR4/5) at either side of the PSR4/5 in descending order of continuous current ratings.
- PSR4/5-X20; a maximum of four (4) BDS4 amplifiers sequentially or "split mounted" at either side of the PSR4/5 in descending order of continuous current ratings.
- PSR4/5-X50; a maximum of six (6) BDS4 amplifiers ("split mounted" only) to either side, not to exceed four (4) amplifiers on a side, mounted in descending order of continuous current ratings.
- PSR4/5-X75; a maximum of six (6) BDS4 amplifiers ("split mounted" only) to either side, not to exceed four (4) amplifiers on a side, mounted in descending order of continuous current ratings.



NOTE

Refer to the drawing of your model system in Appendix F for the Mounting Hole Pattern Information.



Allow sufficient clearance for the large "regenerative" heat producing resistor(s). The internal resistors are mounted at the upper edge of the PSR4/5 unit. The externally mounted regen (shunt regulator) power resistor(s) are mounted above the PRS4/5A unit.

2.6.2 Mounting the External Regeneration Resistor(s)



External regenerative resistors are a shock hazard!

Mount these resistors properly! Enclose these resistors to protect personnel and equipment!



External regeneration resistors can become extremely hot!

Allow safe clearance around the resistor(s) enclosures. Proper ventilation must be provided.

Some models of PSR4/5 use an externally mounted regen (shunt regulator) resistor. The resistor kit includes mounting hardware and, depending on the model, a thermal overload relay to be wired in with the resistors. A suitable enclosed location outside the equipment cabinet needs to be set aside for mounting these components while observing the heat and shock requirements of these resistors.

2.7 ELECTRICAL CONNECTIONS



Dangerous voltages, currents, temperatures, and energy levels exist in this product and in the associated servo motor(s). Extreme caution should be exercised in the application of this equipment. Only qualified individuals should attempt to install, set-up, and operate this equipment. Ensure that the motor, drive, and the end-user assembly are properly grounded per NEC requirements.

To facilitate wiring, the BDS4 amplifiers must be mounted next to the PSR4/5 power supply module in descending order according to their continuous current ratings. Refer to Section 2.6.



In order to adhere to suitable engineering practice, the A.C. control voltage (115 VAC for the logic bus) must be applied first to activate the control and fault logic circuits prior to applying the main A.C. voltage.

Follow these precautions:

1. Observe all notes on the wiring diagram.
2. All motor stator leads, signal input leads, resolver leads, encoder leads, and tachometer leads must be shielded.
3. Twist all AC leads to minimize electromagnetic emissions (noise).
4. Avoid running signal leads (must be shielded) in close proximity to power leads, motor stator leads, or other sources of electromagnetic noise.
5. Minimize lead lengths as much as possible.

Table 2.1. Torque Values

CONNECTING POINTS	BDS4-3-20 AMP UNITS	BDS4-30-55 AMP UNITS	PSR4/5-12-20 AMP UNITS	PSR4/5-50-75 AMP UNITS
AC Input Screws	12 in. lb.	20 in. lb.	12 in. lb.	20 in. lb.
DC Bus Screws	12 in. lb.	20 in. lb.	12 in. lb.	20 in. lb.
Motor Connecting Screws	12 in. lb.	20 in. lb.		
External Regen Screws			12 in. lb.	20 in. lb.
Ground Screws	12 in. lb.	20 in. lb.	12 in. lb.	20 in. lb.

6. Connect the BDS4 system according to the System Wiring Diagram; pay close attention to the grounding scheme.
7. Provide adequate stress relief for cables.



The notes on BDS4 Wiring Diagram (A-93231) give specific wiring details.

Thermal overload protection for the motor is not provided within the PSR4/5 or the BDS4 and must be provided externally. Refer to the National Electrical Code for proper sizing of overload protection.

With the exception of the hook-up of the motor, the main input voltage, and the main Bus+ and Bus-DC voltage, all interface wiring between the BDS4, PSR4/5, and other equipment is accomplished by connectors supplied with the BDS4 and PSR4/5 units.

The input/output connections are grouped by connector or terminal block. They are input/output, motor, resolver, AC main power and control voltages, main DC bus, and unregulated DC voltages.

To connect the power bus of the PSR4/5 to the BDS4 amplifiers the following is suggested:

- For PSR4/5-X12 modules, use 600 VAC insulated 14 AWG or larger wire.

- For PSR4/5-X20 modules, use 600 VAC insulated 10 AWG wire.
- For PSR4/5-50 and PSR4/5-75 modules, use 600 VAC insulated 8 AWG or larger wire.

Captive screws are used in the power terminals of the PSR4/5-X12 module, PSR4/5-X20 module, and the 3 amp thru the 20 amp BDS4 amplifiers. Do not attempt to remove these screws to use ring terminals. Use locking spring terminals similar to Hollingsworth #XSS20945S or #SS20947SF for 16 and 14 AWG wire and #XSS20836 or #SS20832F for 12 and 10 AWG wire.

2.7.1 Recommended Torque for Electrical Connections

Table 2.1 displays the recommended torque values for terminal block and grounding connecting points. All torques are measured with the wire or terminal lug underneath the screw head.

2.7.2 Grounding Scheme

To prevent shock hazard to personnel and to ensure proper operation of the servo system, the BDS4, PSR4/5, and the servo motor must be grounded according to NEC specifications. Each BDS4 and PSR4/5 have at least two grounding screws on the front of the chassis.



NOTE

Provisions of the National Electrical Code with respect to grounding should be followed. These precautions generally deal with the ground loop currents arising from multiple ground paths. Only one ground path should be used.

One of the screws on the chassis of the PSR4/5 should go to earth or machine ground. The other should be connected to the adjacent BDS4 ground screw along with the ground wire from the motor. The free ground screw on the BDS4 chassis should then be connected to the next BDS4, etc.

For grounding to machine or earth ground, a screw lug should be attached to the ground screw or stud on the PSR4/5 or BDS4. A torque of 12 in.lb. for ground screws and 20 in.lb. for ground studs is recommended. Also refer to the National Electrical Code (NEC) or UL standard 486B for recommended torque's.

2.7.3 Connecting the AC Input Voltages

The Main AC Input Voltage, either single- or three-phase, should be connected at L_a , L_b , and L_c on the power terminal block located on the front of the PSR4/5 unit. The PSR4/5 is not line-phase sensitive. When using the 12 or 20 amp PSR4/5 with single-phase main power, the input lines may be connected to any two (2) terminals L_a , L_b , or L_c .

The Control AC input voltage should be wired to Connector C1 - Pins 2 and 3 on the PSR4/5 and from Connector C1 - Pins 5 and 6 of the PSR4/5 to Connector C4 - Pins 1 and 2 (fan units only) on the BDS4.



NOTE

Connector C4 is present only on BDS4 Amplifiers that have continuous ratings of 20 amps and above.

2.7.4 Connecting the PSR4/5 Fault Output Contact (Connector C1)

Pins 1,4 Fault Contact

The Fault Output Contact closes when power is applied to the PSR4/5. This contact opens on a fault condition within the PSR4/5 only.

The pinouts for C1 are listed in Figure 2.2. Refer to Note 2 of the BDS4 Wiring Diagram (A-93231) for further information concerning the PSR4/5 Fault Output Contact.

2.7.5 Connecting the Unregulated DC Voltage to the BDS4 (Connector C3)

The wiring between the BDS4 Connector C3 and the PSR4/5 Connector C2 (unregulated voltage) is in Table 2.2 and the pinouts are in Figure 2.3.

2.7.6 Connecting the Main DC Bus Voltage

Refer to notes 4 and 6 on BDS4 Wiring Diagram A-93231 for details concerning the hook-up of the Bus + and Bus - circuits between the PSR4/5 and the BDS4 amplifiers.



WARNING

Failure to observe correct polarity will result in damage to the PSR4/5 and BDS4.

2.7.7 Connecting the External Regeneration Resistor(s)

If an external regeneration resistor is specified, connecting points are provided on the PSR4/5 Power Supply Unit (refer to Notes 3 and 10 on BDS4 Wiring Diagram A-93231).

Table 2.2. BDS4 Unregulated DC Voltages (C3)

VOLTAGE	CURRENT	BDS4 CONNECTOR C3 PINS	PSR4/5 CONNECTOR C2 PINS
+18 V Nominal (+17 V to +26.5 V)	NO LOAD	1, 5	1, 5
-18 V Nominal (-17 V to -26.5 V)	NO LOAD	2, 6	2, 6
COMMON	---	3, 7	3, 7
10 V Nominal (+9 V to +14 V)	NO LOAD	4, 8	4, 8
+ 14.5 V MIN.	1 AMP ON PSR4/5 12 OR 20 AMP UNITS 2 AMP ON PSR4/5 50 OR 75 AMP UNITS	1, 5	1, 5
- 14.5 V MIN.	1 AMP ON PSR4/5 12 OR 20 AMP UNITS 2 AMP ON PSR4/5 50 OR 75 AMP UNITS	2, 6	2, 6
COMMON	---	3, 7	3, 7
+ 6.5 V MIN.	2 AMP ON PSR4/5 12 OR 20 AMP UNITS 4 AMP ON PSR4/5 50 OR 75 AMP UNITS	4, 8	4, 8

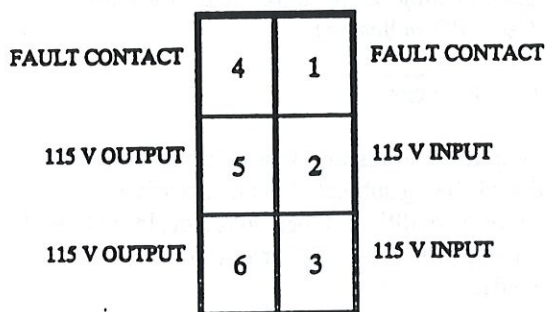
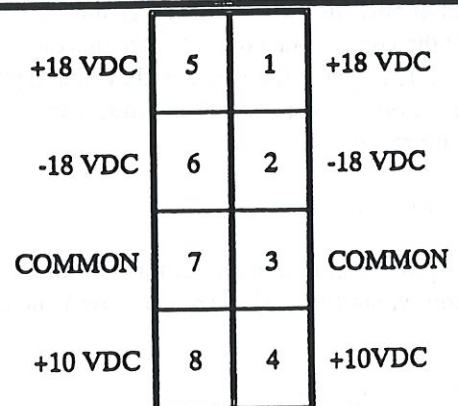


Figure 2.2. PSR4/5 (C1)



**Figure 2.3. BDS4 (C3) & PSR4/5 (C2)
(Nominal, No Load Voltages)**

DIFF HI	11	1	DIFF LO
AUX IN	12	2	ENABLE
I LIMIT	13	3	RESET
TORQUE HOLD	14	4	DIFF SHIELD
COMMON	15	5	SHIELD
COMMON	16	6	SHIELD
COMMON	17	7	OUTPUT FAULT
I MONITOR	18	8	FOLD BACK
SPEED MONITOR	19	9	OVERTEMP
DRIVE-UP	20	10	DRIVE-UP

Figure 2.4. BDS4 Connector (C1)

2.7.8 Connecting the BDS4 Input/Output (Connector C1)

The following descriptions tell the user which inputs and modes of operation are available, enable the user to identify the appropriate connecting points on Connector C1, and help the user decide which inputs and modes of operation to use. The pinouts are listed in Figure 2.4.

Pins 15,16,17 Common

These pins provide commons (returns) between external equipment (numerical controls, etc.) and the BDS4.

Pins 4,5,6 Shield

These pins provide termination points for cable shields. To insure there are no ground loops in the shield common, connect only one end, butt and insulate the other end.

Pin 11 DIFF CMD HI

Pin 1 DIFF CMD LO

Differential velocity or current command input ± 10 V full scale, 20 K Ohm input impedance. Should be shielded.

Pin 2 Enable

Allows the BDS4 to be enabled or disabled without removing the main power. When a circuit is closed between Pin 2 and common, the BDS4 will be put into the Drive-Up mode. Opening the circuit puts the BDS4 into the Inhibit mode [internal 20 K Ohm pull-up resistor to +12 VDC] (Green LED indicated).

Pin 3 Reset

Allows any latched fault circuit except OVERVOLTS or OVERCURRENT faults to be reset by toggling Pin 3 to common. It has a 20 K Ohm pull-up resistor to +12 VDC.

Pin 7 Output Fault

Open collector signal (logic low) to indicate that either an overcurrent or overvoltage fault has occurred in the Power Stage of the amplifier. 25 ma sink capabilities, 30 VDC Max (red LED indicated).

Pin 8 Foldback

Open collector signal (logic low) to indicate that the amplifier has started to reduce peak current due to excessive loading, 25 ma sink capabilities, 30 VDC max (red LED indicated).

Pin 9 Overtemp

This output will transition low to indicate the BDS4 amplifier is being subjected to an excessive temperature condition. Open collector, logic low, 25 ma sink capability, 30 VDC max (red LED indicated).

Pins 10,20 Drive-Up

The Drive-Up contact closure (internally) indicates to the outside world that the BDS4 amplifier is in the Drive-Up mode; or when the contact is open, it indicates the Inhibit mode. The contact is rated at 115 VAC at 2 amps (green LED indicates Drive Ready).

The Drive-Up relay acts in conjunction with the Enable circuit in one of two possible modes of operation as determined by optional jumper J21. To determine which mode of operation is being utilized, refer to J21 on the TEST LIMITS SHEET.

1. Drive-Up Mode

J21 is not installed on the BDS4-COMP Board.

Apply power.

When the Enable input circuit is activated (pulled low), the internal Drive-Up contact will close and the green Drive Ready LED will become illuminated. However, when the Enable input circuit is not activated, or a fault occurs, the internal Drive-Up contact will be open and the green Drive Ready LED will be off indicating that the BDS4 is in the Inhibit Mode.

If a fault occurs within the BDS4, the Drive Ready LED will turn off and the Drive-Up contact will open and remain open regardless of the state of the Enable input circuit.

2. O.K. to Enable/Drive-Up Mode

JR21 is installed on the BDS4-COMP Board (Standard).

Apply power.

When there are I/O faults present, the internal Drive-Up contact will be closed and the green Drive Ready LED will be illuminated indicating that the BDS4 is OK-TO-ENABLE. However if there is a fault present, the Drive-Up contact will be open and the Drive Ready LED off indicating that the BDS4 is in a fault mode. In this case, activating the Enable input circuit will not enable the BDS4.

Pin 12 Aux IN

This is an additional single ended input to the velocity loop. This input may be used in adaptive

mode applications or used as the tach input for integrally motor-mounted tachometer generators.

Pin 13 I Limit

The Current Limit input allows access to the Current Limit circuitry providing a means by which inputs may be applied for adaptive control applications.

This single ended input may also be used to adjust the peak current limit of the amplifier from 7.5% to 100% of its rating. A positive voltage from 0 VDC to 7.5 VDC corresponds to 7.5% to 100% respectively. Also, a resistor to common may be used to program the current limit with 75% of I peak = 8.6 K Ohm, 50% of I peak = 3.3 K Ohm. The Current Limit Adjustment Pot may also be used to adjust the peak torque of the motor to the desired level.

Pin 14 Torque Hold

The BDS4 may be converted from a constant velocity amplifier to a constant torque amplifier (at stall only) by closing a circuit between Pin 14 and common (via internal 20 K Ohm pull-up resistor). The velocity loop operational amplifier is maintained at unity gain while in this mode of operation.

Pin 18 I Monitor

There is a direct relationship between the signal appearing at this output and actual motor current. A DC voltmeter placed between Pin 18 and common, calibrated in either current or torque, can be used to estimate the constant load levels placed on the motor. The current scale factor at Pin 18 is $8V = \text{Peak RMS current rating of the BDS4 (3 K Ohm output impedance)}$. This output is for reference only. Its accuracy decreases as current decreases: +/- 4% at peak current, +/- 9% at continuous current, +/- 12% at 1/2 continuous current.

Pin 19 Speed Monitor

There is a direct relationship between the signal appearing at this output and actual motor speed. A DC voltmeter (or other instrument) placed between Pin 19 and common, calibrated in RPM, can serve as a means by which speeds may be monitored. Refer to the TL Sheet for the scale factor in volts/RPM (8 volts = maximum speed) as listed on the TL Sheet for the particular motor/amplifier combination (3K Ohm output impedance).

2.7.9 Connecting the Motor



B SERIES MOTORS have a thermostat switch wired to the resolver connector at the motor.

BR SERIES MOTORS have a thermostat switch wired to the stator connector at the motor.



The motor thermostat switch is an automatic resetting device and should be connected directly into a latched (locked out) power down type circuit.



Incorrect motor resolver phasing can cause erratic operation, runaway, or damage to the system.

Terminate Pins A, B, C, D, E, and F of the resolver connector at Connector C2 on the BDS4 as shown by Figures 2.5 and 2.6. Also see the BDS4 Wiring Diagram (A-93231) and the appropriate motor HD (hook-up) drawing or Motor Connection Diagram

SIN HI	7	1	SIN LO
SIN SHIELD	8	2	COS SHIELD
COD HI	9	3	COS LO
REF LO	10	4	REF HI
SPARE SHIELD	11	5	REF SHIELD
N/C	12	6	N/C

Figure 2.5. BDS4 (C2)

(A-63542). Use cables with three (3) independently shielded pairs for the resolver.

The leads of the three-phase synchronous motor are brought out to Pins A, B, and C of the motor connector. Pin D is ground for the motor. Refer to Figure 2.7 for pin connections.

Terminate Pins A, B, and C of the motor connector to Ma, Mb, and Mc, respectively, on the power terminal block located on the front of the BDS4 amplifier. Terminate Pin D at the BDS4 chassis ground screw. Refer to Wiring Diagram (A-93231) and the appropriate motor HD (hook-up) drawing.

The optional integrally-mounted tachometer is brought out to Pins R and S on the resolver connector for both the B and BR series motors. Pin R (Tach Hi) should be terminated at Connector C1 - Pin 12 (Aux In) of the BDS4. Pin S (Tach Lo) should be terminated at Connector C1 - Pin 15 (common) of the BDS4. The tachometer is an option and is not installed on most motors.

2.8 INSTALLATION CHECKLIST

Refer to BDS4 Wiring Diagram (A-93231).

Before applying power to the PSR4/5 and BDS4, check the following items to ensure proper operation:



To prevent damage to the equipment, the motor and resolver, the AC line voltage, and the DC bus voltages must be connected as indicated by BDS4 Wiring Diagram (A-93231).

2.8.1 Checking the Motor and Resolver Wiring

Disconnect both the motor stator and resolver connectors from the motor. Using an ohmmeter, check the continuity of each motor stator lead between the motor stator connector pin and the BDS4. Using an ohmmeter, check the continuity of each motor resolver lead between the motor resolver connector pin and the BDS4. The motor stator and resolver leads should be connected according to BDS4 Wiring Diagram (A-93231). There are no other options for connecting the motor stator and resolver leads.

2.8.2 Checking the AC Line Voltages

Open the circuit breaker or remove the fuses in the Main AC lines that are connected to the PSR4/5 at L_a , L_b , and L_c . Remove Connector C1 from the PSR4/5, and remove (if present) Connector C4 from the BDS4.

Apply only the AC main power. Use an AC voltmeter to check and record the 1- or 3-phase line-to-line voltage at the circuit breaker or fuse holders. Remove power. Note the model number of the PSR4/5 and refer to Appendix B to confirm the correct Main AC voltage level.

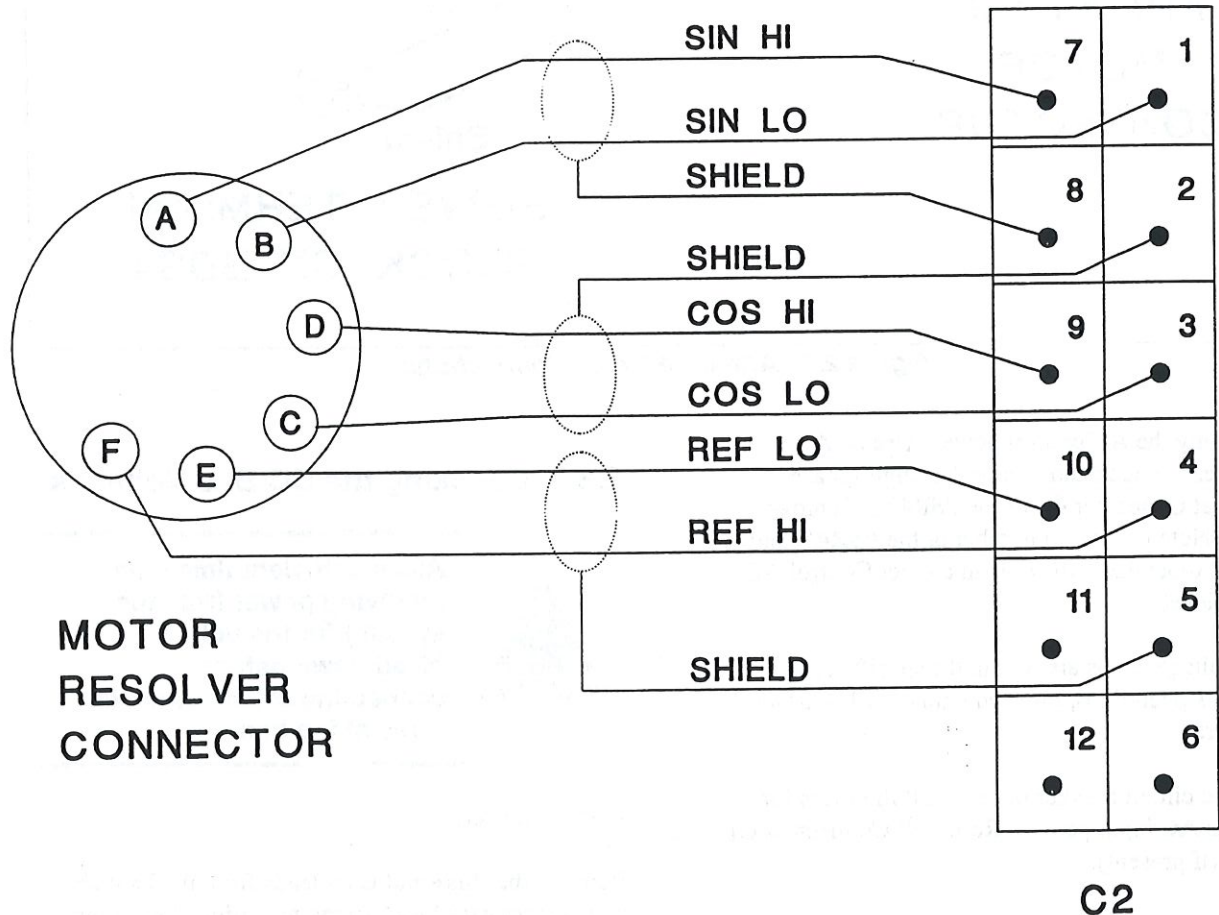


Figure 2.6. Motor Resolver Connections

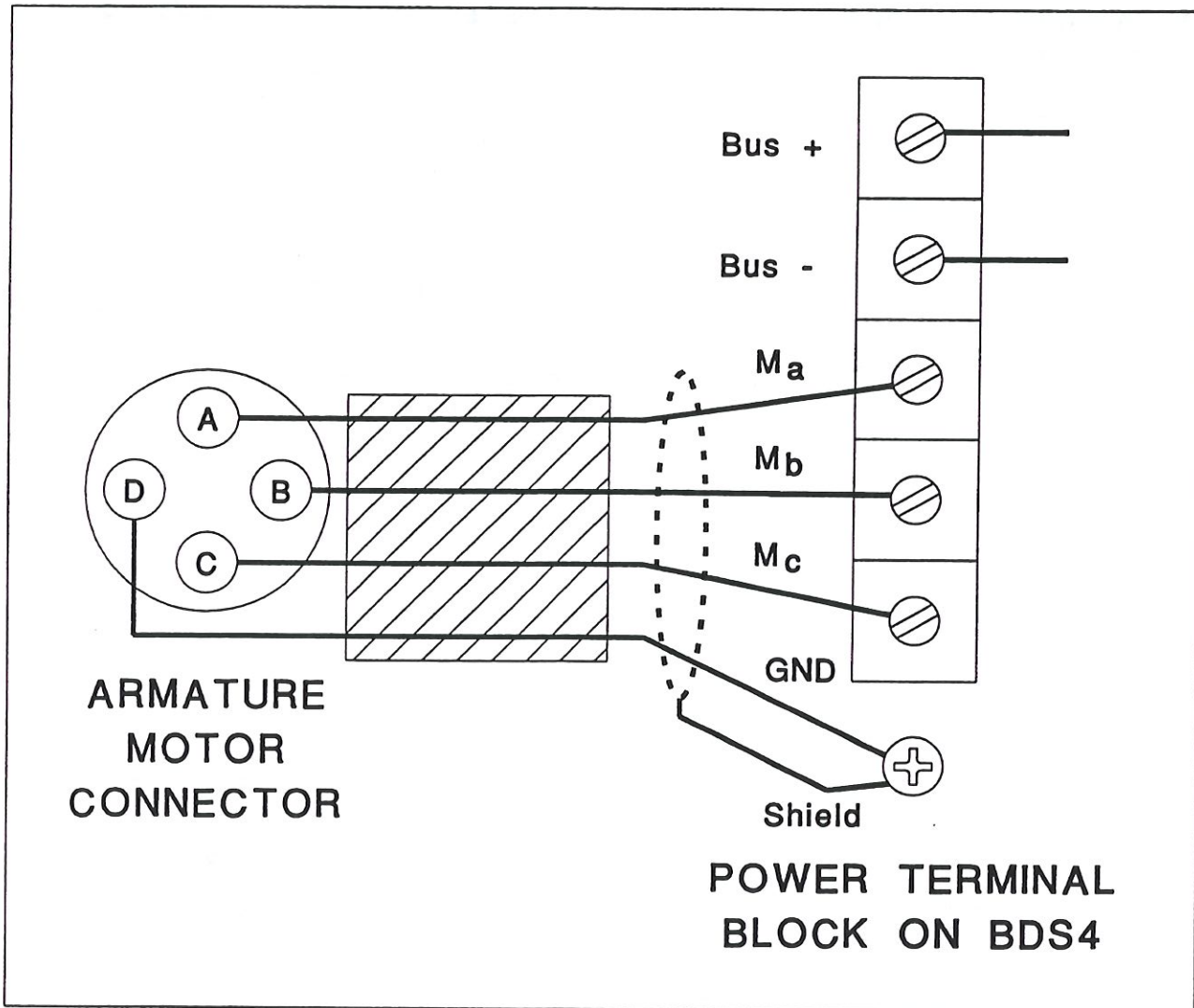


Figure 2.7. Armature Motor Connections

Apply only the AC control power. Use an AC voltmeter to check and record the single-phase voltage at Connector C1 of the PSR4/5. Remove power. Note the model number of the PSR4/5 and refer to Appendix B to confirm correct Control AC voltage level.

If the voltage levels are within the specifications listed in Appendix B, proceed with the Check-Out procedure.

Close the circuit breaker or re-install the fuses for the Main AC input power. Re-install Connectors C1 and C4 (if present).

2.8.3 Checking the DC Bus Voltages



WARNING

Allow sufficient time (after removing power from the system) for the voltage to bleed down before connecting or disconnecting wires at the bus.

Remove power.

Remove the Bus+ and Bus- leads from the PSR4/5 power terminal block. Remove mating Connector C2 from the PSR4/5.

Apply power.

Check and record the Main DC Bus Voltage output at (+) with respect to (-) on the PSR4/5 terminal block according to Section 2.1. Check and record the unregulated DC voltage levels at Connector C3 of the PSR4/5. They should be ± 17 to 26.5 and + 9 to 14.5 VDC per Section 2.7.5.

Remove power.

Note the model number of the PSR4/5 and refer to Section 2.1 to confirm DC voltage levels.

If the voltage levels are within the specifications listed in Appendix D, proceed.

WAIT FOR THE BUS TO BLEED DOWN and reconnect the B(+) and B(-) leads to the power terminal block of the PSR4/5. Be careful to reconnect the leads with the proper polarity. Re-install Connector C2 on the PSR4/5.



CAUTION

Failure to observe correct polarity will result in damage to the PSR4/5 and BDS4.

CHAPTER 3

OPERATION

3.1 INTRODUCTION

The information in this chapter will enable you to become familiar with system components and their dependence upon one another. Also, it will help you ensure each component is configured and functions properly. At this point, all safety stops and other precautions should be in place and working properly. Be prepared to stop the machine if necessary.



CAUTION

Unloaded motors, compensated for a large inertia mismatch, may become unstable when the system is activated. Refer to the test limits (TL) sheet for stable load inertia range. If the system becomes unstable, remove the power immediately.

3.2 INITIAL START-UP

You should now be ready to supply power to test the servo systems functions and features. Work with only one axis section at a time. Confirm all other BDS4 amplifiers are inhibited, meaning the enable circuits are open (high).



CAUTION

Incorrect servo-to-position loop phasing can cause excursion oscillations, or runaways.

Appropriate precautions should be taken to stop the machine if necessary. Limit switches and safety devices should be in place.

3.3 SEQUENCE OF OPERATIONS

This section contains a basic start-up sequence that should be followed the first time the servo system is initialized. **READ THIS ENTIRE SECTION BEFORE PERFORMING ANY OF THESE PROCEDURES.** When you apply power to the system, pay special attention to the LEDs on the BDS4 front panel. The CONTROL VOLTS and DRIVE READY (green) LEDs should be illuminated. This indicates that the system is functioning properly. Should a FAULT (red) LED remain on for more than a instant, immediately disconnect power and consult Chapter 5 - Troubleshooting.

1. Apply power. Enable only one BDS4. Observe the action of the machine. If the direction of the motor shaft rotation is reversed

(motor shaft turns in the wrong direction),
remove power.

2. Reverse the input to the BDS4 at DIFF CMD HI and DIFF CMD LO at Connector C1, Pins 1 and 11. **DO NOT ATTEMPT TO REVERSE DIRECTION OF ROTATION BY INTERCHANGING MOTOR LEADS AND/OR RESOLVER LEADS.**



NOTE

If the motor is commanded to move and does not respond, turn the command scale adjustment several turns CW.

If the servo system performed properly, then read Chapter 4 - Maintenance for adjustments and other information that may be helpful in adapting your system to your own applications.

CHAPTER 4

MAINTENANCE

4.1 INTRODUCTION

The information in this chapter will enable you to maintain the systems components ensuring smooth, efficient operation of the motor. Adjustments to the system are broken in three (3) categories: Set-Up, Response and Application Dependent, and Design Tolerance. These adjustments allow the user to tailor the BDS4 to their specific applications.

4.2 PREVENTATIVE MAINTENANCE



Preventative maintenance to this equipment must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the application.



Electronic components in this amplifier are static sensitive. Use proper procedures when handling component boards.

Preventative maintenance should be performed with the BDS4 system out of operation and disconnected from all sources of power.

4.2.1 Transient Voltages



NOTE

All transient-producing devices must be properly suppressed.

Solid state controls of the BDS4 may be affected by transient voltages. These voltages are in excess of the specified voltage for any given circuit. When these peak voltages occur, even for less than a second, permanent damage to the BDS4 can occur.

In order to help avoid transient voltages that may interfere with electronic circuit functions within the PSR4/5 and BDS4, all switched inductive devices or their wiring (solenoids, relay coils, starter coils, etc.) must be suppressed. A 220 ohm, 1/2 watt resistor in series with a 0.5 micro farad, 600 volt capacitor or equivalent is suggested.

4.2.2 Surge Current

Excessive current greater than that of the specified limits of the PSR4/5 and BDS4 can cause permanent damage to the system. Current limiting means are recommended to protect from these currents.

**CAUTION**

If the short circuit inrush current generated by the power source is in excess of 5000 amps RMS symmetrical current, an isolation transformer or line inductor must be utilized in the incoming power circuit. Failure to observe this precaution could result in damage to, or destruction of the PSR4/5 and BDS4.

Input transformers step up or step down input voltage and can be either autotransformers or isolation transformers. Isolation transformers help eliminate the following:

- Damaging AC line voltage transients reaching the PSR4/5 and BDS4.
- Damaging currents which may develop if a point inside the PSR4/5 or BDS4 becomes grounded.

4.2.3 Electrical Noise

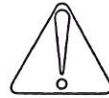
The low levels of energy in the BDS4 control circuits may cause them to be vulnerable to electrical noise. Sources of electrical noise are those pieces of equipment that have large, fast changing voltages and currents when they switch on and off. These devices have the capability of inducing critical current and voltage transients on their respective power lines. These transients must be accommodated for with noise immunity provisions.

Electrical noise is prevented with the same methods as Surge Current and Transient Voltages. However, there are other methods of preventing electrical noise. Such as:

- Maintain physical separation between electrical noise sources and the BDS4 amplifier.
- Maintain physical separation between electrical noise sources and the BDS4 control wiring. This can be accomplished by using separate conduits or wiring trays for control wiring and power wiring.

- Use twisted-pair wiring for control circuits of the BDS4.
- Follow good grounding practices when wiring the PSR4/5 and BDS4. Be careful not to create a grounding loop with multiple ground paths. Follow the NEC's provisions on grounding.

4.2.4 Radio Frequency Energy

**NOTE**

This equipment generates radio frequency energy.

This equipment uses, and can radiate radio frequency energy and must be installed and used in accordance with this installation and service manual in order to prevent possible interference with radio communications or other electronic equipment.

4.3 PERIODIC MAINTENANCE

Periodic maintenance must be performed by qualified personnel familiar with the construction, operation, and hazards involved with the BDS4 and its application. Power should be disconnected during all maintenance procedures.

4.3.1 Ventilation

The PSR4/5 and BDS4 should be mounted vertically to allow maximum ventilation of the components. This configuration allows the heat generated by the components to vent through the top and draft in cooler air through the bottom. The top and bottom of the components are vented to allow this drafting to occur. These ventilation passages should be kept open. If the PSR4/5 requires auxiliary cooling with fans, inspect the fans on a regular basis.

4.3.2 Grounding Integrity

The method employed for grounding or insulating the equipment from ground should be checked to assure its integrity on a regular basis. This check

should be performed with the power off and the testing equipment grounded.

4.4 ADJUSTMENTS



NOTE

Adjust pots with proper adjustment tool.

DO NOT FORCE.

The adjustments are classified into three categories:

1. **Set-Up Adjustments** - Adjustments that are necessary at installation (accessible at the front of the BDS4).

Motor System Resolver Phasing and Alignment - Should be checked the first time (if I.D. cables are not used).

Balance Adjustment.

Command Scale Adjustment.

2. **Response and Application Dependent Adjustments** - These adjustments add versatility to the BDS4 and allow it to be "tailored" to specific applications (accessible at the front of the BDS4).

Stability Adjustment.

Current Limit Adjustment.

3. **Design Tolerance Adjustments** - Factory set and sealed adjustments should never require customer adjustment (internal adjustments).

Current Sensor Offset Adjustments - Pots AZ and CZ.

Resolver Excitation Adjustment - Pot OSCG.

FACTORY ONLY ADJUSTMENTS - Pots R/DTR, R/DG, and R/DZ.

4.4.1 Set-Up Adjustments

At equipment start-up, make these adjustments.

4.4.1.1 Balance Adjustment (Within Position Loop)

If a monitor or readout displays Following Error, adjust Balance Pot for zero Following Error at zero speed.

Optional: Monitor DIFF CMD HI with respect to DIFF CMD LO with a DC voltmeter. Command zero speed from the Numerical Controller. Adjust Balance Pot for zero volts on the meter.

4.4.1.2 Balance Adjustment (Automatic or Manually Operated Machines)

Monitor DIFF CMD HI with respect to DIFF CMD LO with a DC voltmeter. With the input signal at zero volts or with the input shorted to common, adjust Balance Pot for zero speed.

4.4.1.3 Command Scale Adjustment (Within Position Loop)

If the following error is displayed by monitor or readout, command a slow feed rate and adjust Command Scale Pot for the proper amount of Following Error at that speed.

4.4.1.4 Command Scale Adjustment (Automatic or Manually Operated Machines)

Turn the Command Scale Pot fully CCW. Apply an input signal level which equals maximum desired motor speed in RPM. Adjust Command Scale Pot CW for maximum desired motor speed. **DO NOT EXCEED THE MAXIMUM MOTOR SPEED THAT IS LISTED ON THE TL SHEET FOR THE SYSTEM.**

Refer to the Test Limits Sheet (TL) to identify the maximum scaling of input signal. Maximum ± 10 volts is standard.

4.4.2 Response and Application Dependent Adjustments

These adjustments allow versatility in altering the dynamic response of the BDS4 system as needed.

When altering the response of the system, it may be necessary to adjust both the STABILITY and the CURRENT LIMIT adjustments.

4.4.2.1 Stability Adjustment

In many cases, the Stability Pot will not need to be adjusted and may be left in its fully CCW position.

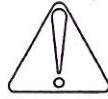
However, this pot can be used to improve the dynamic response of the servo loop, by adjusting the Dynamic (AC) Gain. To adjust the AC Gain to the proper point, use an oscilloscope to monitor the internal tach signal at the SPEED MONITOR test point with respect to A-COM (refer to Figures 1 and 3). Use a second channel of the scope to monitor the current signal at the I MONITOR test point, also with respect to A-COM (refer to Figures 1 and 3). Turn the STABILITY Pot fully CCW. Apply a step input (rapid) command signal. While accelerating and decelerating the motor at approximately 25% of maximum speed, adjust the STABILITY Pot CW and notice the tach and current wave forms at the SPEED MONITOR and I MONITOR test points. Watch for indications of instability (i.e., ringing) in the wave forms while accelerating and decelerating the motor. Turn the STABILITY Pot CCW until the tendency to go unstable disappears.

4.4.2.2 Current Limit Adjustment

The maximum peak current limits are set at the factory and can not be increased above the level listed on the Test Limits sheet (TL). Although the peak current limits cannot be increased above the specified value, they may be decreased.

To reduce the peak current limit level, apply a step input command signal. Use an oscilloscope to monitor the I-MONITOR test point (refer to Figures 1 and 3). Accelerate and decelerate the motor. Adjust the CURRENT LIMIT Pot for desired peak current limit. The current scale factor at the I MONITOR test point is $8V = \text{Peak RMS rating of the BDS4}$ (refer to Section 2.2 for Peak Rating and Section 4.1 for more information on this signal).

4.4.3 Design Tolerance Adjustments (Factory Set and Sealed)



NOTE

These adjustments should not be made in the field. They have been factory set and sealed and should never require adjustment.

The following procedures are to be followed only if the seals are broken.

4.4.3.1 Resolver Excitation Adjustment

Inhibit the BDS4 by opening the Enable input circuit.

Using an oscilloscope, monitor REFERENCE HIGH at TC2-1 (refer to Figure 1 or 3). Adjust Pot OSCG (inside the BDS4) for 12 volts peak-to-peak. This signal should be $7.0 \text{ kHz} \pm 500 \text{ HZ}$.

4.4.3.2 Current Sensor Offset Adjustments

Using a digital DC voltmeter, monitor TC4-1. Adjust Pot AZ (inside the BDS4) for minimum voltage level. Using the digital voltmeter, monitor TC4-3 and adjust Pot CZ (inside the BDS4) for minimum voltage level. Refer to drawing C-84113.

4.4.3.3 Motor System Resolver Alignment



NOTE

This procedure applies only to the system resolver, not the application (position loop) resolver.

The motor system resolver is properly aligned at the factory and should never require realignment. However, this procedure is included here in the event (motor repair, etc.) the resolver should ever need realignment.

In order for the following test to be valid, the motor and resolver phasing must be correct. If there is any doubt as to whether the motor and resolver are wired

correctly, refer to Section 4.6 and check the motor and resolver wiring.

The motor system resolver alignment can be confirmed by conducting the following test:

1. Remove power. Disconnect the motor shaft from any mechanical load.
2. Connect a small jumper between TC1-3 and TC1-4 (refer to Figures 1 and 3). While in this mode (resolver zeroing test mode), the FOLDBACK LED will become the resolver alignment indicator.
3. Apply power. **DO NOT ENABLE THE BDS4.** If necessary have a colleague observe the FOLDBACK LED. The FOLDBACK LED will be either off or slowly blinking. Slowly rotate the motor shaft until the FOLDBACK LED blinks at its fastest rate (rotate slowly then pause, giving the circuitry time to react). The closer the resolver is to being correctly aligned, the faster the LED will blink. The LED should be somewhere between one pulse per second and fully illuminated when it blinks at its fastest rate.



Remove hand from motor shaft before enabling. The shaft will jerk into position with some force.

4. Enable the BDS4 by pulling Connector C1-Pin 2 on the BDS4 to common. The internal software of the BDS4 will cause phase M_a to have zero current. The M_b and M_c phases will have equal, but opposite, currents causing the motor shaft to align itself in a neutral position. The FOLDBACK LED should be fully illuminated indicating correct alignment of the resolver. No further attempt at alignment is necessary. Resolver alignment is correct.
5. If, however, the LED does not become fully illuminated as indicated in Step 4 above, proceed with the alignment procedure.

Inhibit the BDS4.

Remove power.

Remove the end plate (cover) from the rear end of the motor. The shaft-mounted frameless resolver will be in sight.

The frameless resolver rotor is slid forward onto the motor shaft and secured by a large lock nut. This part of the resolver should not be disturbed.

6. Loosen, but do not remove, the two servo clamp screws holding the resolver stator secure. **DO NOT MOVE THE POSITION OF THE MOTOR SHAFT.**
7. Apply power. If necessary, repeat Step 3 above. Enable the BDS4. Slowly rotate the resolver stator (outside element) while a colleague watches the FOLDBACK LED on the front of the BDS4 amplifier.

If the LED does not become fully illuminated, turn the resolver stator in the opposite direction. Continue to rotate the resolver stator until the LED becomes fully illuminated. If the correct alignment position is passed, the LED will blink more slowly. When the LED becomes fully illuminated, discontinue turning the resolver stator and tighten the two servo clamp screws.

Inhibit the BDS4.

Remove power.

8. Repeat Steps 3 and 4 above.
9. Inhibit the BDS4.

Remove power.

Remove the jumper from the test points.

Replace the motor end cover.

4.4.3.4 Factory Only Adjustments



WARNING

Do not adjust Pots R/DTR, R/DG, and Pot R/DZ. These pots are set and sealed at the Factory and cannot be adjusted in the field. If these pot seals are ever broken, return the complete BDS4 amplifier to the Factory for alignment.

The Factory Only Adjustments are not intended, nor should they be used by personnel not employed by Industrial Drives.

CHAPTER 5

TROUBLESHOOTING

5.1 INTRODUCTION

The information in this chapter will enable you to isolate and resolve common system hardware problems. The troubleshooting methods in this manual isolate each component from the system until the problem is resolved.

5.2 FIELD SERVICEABILITY



Dangerous voltages exist in this equipment. Also, motor temperature may exceed 100°C. Extreme caution should be exercised when troubleshooting this equipment. Only qualified individuals should attempt to install, setup, operate, or troubleshoot this equipment.

The BDS4 and PSR4/5 are designed to promote minimum down time situations. Due to the compact package size and to the fact that there are few user-serviceable components on the modules, it is recommended that they be replaced if they cease to function properly. Return the modules, in their entirety, to Industrial Drives for repair.

The only user-serviceable items on the PSR4/5 are the output line fuses in the control DC voltage supply and (in the 12 and 20 amp units) the shunt regulator regeneration load resistor fuse.



To preserve the level of protection for the product as designed, replacement fuses must be the exact same style and ampere rating as those originally installed.

The BDS4 modules may be interchanged, provided the following guidelines are adhered to:

1. The BDS4 modules must be the same rating.
2. The motors being controlled must bear the same model number.
3. In the event the motors have different model numbers, the BDS4-COMP Board must bear the model number of the motor being controlled or the BDS4-COMP Board must be altered, per TL (Test Limits Sheet) to make the BDS4 compatible with the motor.

Before beginning the troubleshooting process, consider the following points:

- I. There are four (4) distinct areas within which a fault may occur:
 - A. External Interface (Circuitry external to, but connecting to, the BDS4.)
 - B. BDS4 Amplifier Module
 - C. PSR4/5 Power Supply Module
 1. Main DC bus voltage
 2. Control DC bus voltages
 3. Shunt Regulator Regeneration Circuitry
 4. Soft-Start/Dynamic Bus Discharge Circuitry
 - D. Motor
 1. Resolver
 2. Tachometer (Optional)
- II. There are only two (2) basic fault characteristics to be considered:
 - A. The motor exhibits very low torque or is totally inoperative.
 - B. The motor is erratic or exhibits an improper mode of operation.

2. All power must be present.
3. The BDS4 must be in the Enable mode, as indicated by the green CONTROL VOLTS, ENABLE, and DRIVE READY LED's.
4. A command signal (other than zero volts) must be present at the input of the BDS4.
5. Command Scale Adjustment should not be fully CCW.
6. Fault circuits must not be activated. Fault modes are identified by red LED's located on the front of the BDS4 and PSR4/5 modules.

5.3.2 The Motor Is Erratic or Exhibits an Improper Mode of Operation.

Prerequisites for proper motor operation:

1. Proper grounding scheme must be provided. The motor ground wire should be connected as shown by BDS4 Wiring Diagram A-93231.
2. Motor armature leads must not be run in conduit or wire ducts with any signal carrying conductors.
3. The resolver leads, tach leads (when used), and motor armature leads must be wired according to BDS4 Wiring Diagram A-93231.
4. The motor system resolver must be set at its zero point (refer to Section 4.4.3.3).
5. Stability Adjustment should not be fully CW.
6. The motor should be loaded with its specified load inertias — see TL sheet for stable load inertia range. Otherwise, the BDS4 may become unstable.

5.3 SYMPTOMS AND CORRECTIONS

If the motor does not respond or responds in a manner other than with smooth operation, remove power and troubleshoot the system with the following guidelines. Also refer to Table 5.1 for more improper motor operation symptoms.

5.3.1 The Motor Exhibits Very Low Torque or is Totally Inoperative

Prerequisites for motor movement:

1. The BDS4 and PSR4/5 must be wired correctly, per BDS4 Wiring Diagram (A-93231).

5.3.3 BDS4-3, 6, 10, 20, 30, 40 and 55 AMP STATUS LED'S

The status of the BDS4 modules is indicated by three (3) Green and six (6) Red LED's. Refer to Figure 5.1 for the LED configuration. The diagnostic

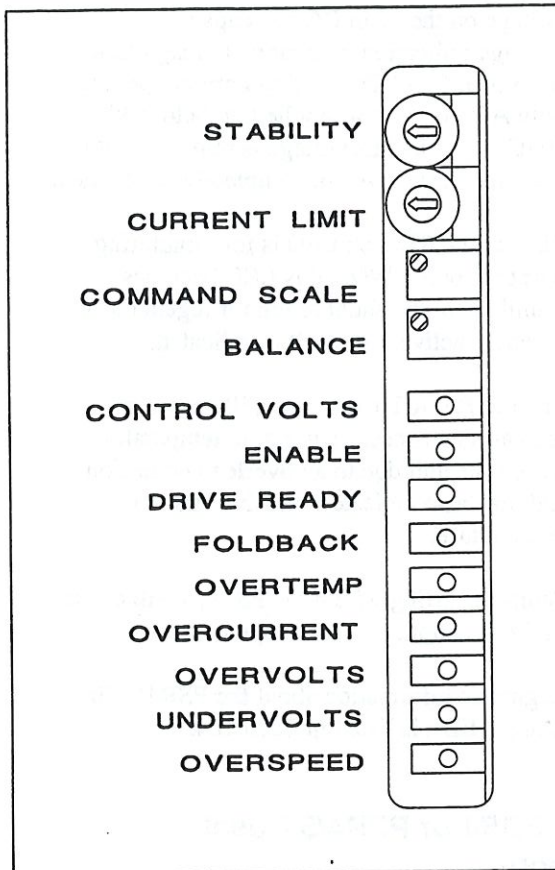


Figure 5.1. BDS4 Status LED's

information indicated by these LED's is listed as follows:

- Approximately one second after all power is applied, the green CONTROL VOLTS LED on the front of the BDS4 module should become illuminated to indicate that the Control AC line input voltage is applied.
- When the Enable input circuit of the BDS4 is closed, the green ENABLE LED should become illuminated indicating that the BDS4 is now in the enabled mode.
- No fault (red) LED's should be illuminated.
- The green DRIVE READY LED may or may not be illuminated, depending on whether or not jumper J21 is installed on the BDS4-COMP Board.

The red FOLDBACK LED will become illuminated during any situation where the RMS current exceeds the continuous rating of the BDS4 (peak current is allowed for only 2.0 seconds). The LED indicates

that the peak current of the BDS4 is automatically being reduced to the RMS continuous rating. Once the current demand is reduced, the FOLDBACK circuit will reset and the LED will turn off. This LED acts only as an indicator.

If the red OVERTEMP LED becomes illuminated, the BDS4 will become latched in the Inhibit mode indicating an overheated BDS4 heatsink.

When the red OVERCURRENT LED becomes illuminated, it indicates an overcurrent condition usually due to a shorted load (motor), wiring, or BDS4 power stage transistor. The BDS4 will become latched in the Inhibit mode.

If the red OVERVOLTS LED becomes illuminated, the BDS4 will become latched in the Inhibit mode, indicating the presence of excessive main DC bus voltage.

When the red UNDERVOLTS LED becomes illuminated, the BDS4 will be put into the Inhibit mode (but not latched) indicating the main DC Bus is insufficient or absent.

If the red OVERSPEED LED becomes illuminated, the BDS4 will become latched in the Inhibit mode indicating that the motor has obtained an excessive speed, or the resolver cable is miswired or has an intermittent connection.

The Fault Output contact located within the PSR4/5 power supply module will not be affected by any faults occurring within the BDS4.

More diagnostic information about the BDS4 is listed in the Table 5.2.

5.3.4 PSR4/5-12 and 20 Amp Status LED's

The status of the PSR4/5-12 and 20 amp modules is indicated by one (1) Green, one (1) Yellow, and two (2) Red LED's. Refer to Figure 5.2 for the LED configuration. The diagnostic information indicated by these LED's is as follows:

- Approximately 0.25 seconds after the main power is applied, the green DC BUS LED will become illuminated to indicate the presence of voltage on the main DC bus capacitors.

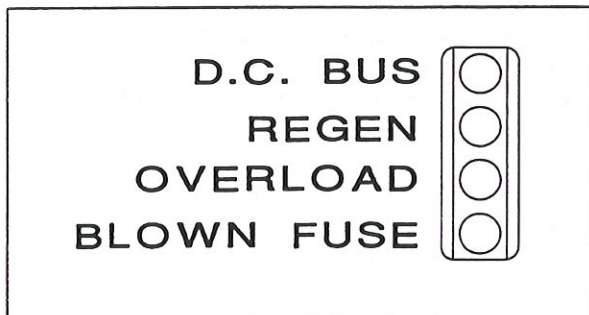


Figure 5.2. PSR4/5 12,20 Status LED's

Voltage indication may range in magnitude from over 300 VDC, during normal operation with AC line voltage applied, to below 50 VDC when the line voltage is removed but the bus capacitors have not completely discharged.

- The yellow REGEN LED is for monitoring purposes only. When this LED becomes illuminated, the shunt regulator regeneration circuit is active. No fault is indicated.
- The red OVERLOAD LED will become illuminated in the event the shunt regulator regeneration circuit experiences an overload condition. The Fault Output contact will also open.
- The red BLOWN REGEN FUSE LED will become illuminated and the Fault Output contact will open in the event the shunt regulator regeneration fuse blows.
- Faults occurring within the PSR4/5 will cause its Fault Output contact to open.

More diagnostic information about the PSR4/5 12 and 20 Amp LED's is listed in Table 5.3.

5.3.5 PSR4/5-50 and 75 Amp Status LED's

The status of the PSR4/5-50 and 75 amp models is indicated by one (1) Green, one (1) Yellow, and one (1) Red LED. Refer to Figure 5.3 for the LED configuration. The diagnostic information indicated by these LED's is as follows:

- Approximately 0.5 seconds after the main power is applied, the green DC BUS LED will become illuminated to indicate the presence of

voltage on the main DC bus capacitors. Voltage indication may range in magnitude from over 300 VDC, during normal operation with AC line voltage applied, to below 50 VDC when the line voltage is removed but the bus capacitors have not completely discharged.

- The yellow REGEN LED is for monitoring purposes only. When this LED becomes illuminated, the shunt regulator regeneration circuit is active. No fault is indicated.
- The red FAULT LED, when illuminated, indicates an excessive heatsink temperature within the unit due to an overload condition and may also indicate excessive ambient temperature.
- Faults occurring within the PSR4/5 will cause its Fault Output contact to open.

More diagnostic information about the PSR4/5 50 and 75 Amp LED's is listed in Table 5.4.

5.3.6 BDS4 or PSR4/5 Reset Procedures

To reset the OVERVOLTS and OVERCURRENT fault latches within the BDS4 and all fault latches within the PSR4/5 power supply units, remove all AC line input voltage for at least five (5) minutes or until the power stage capacitors are fully discharged. All other fault latches within the BDS4 amplifiers may be reset by toggling the RESET input circuit to common or by removing and reapplying the input voltage as described previously.

The thermal overload relay with the PSR4/5 50 and 75 amp modules External Regen Resistor(s) is normally furnished and set for "HAND" reset operation. In the event of excessive shunt regulator activity, its auxiliary contact will open. (THIS

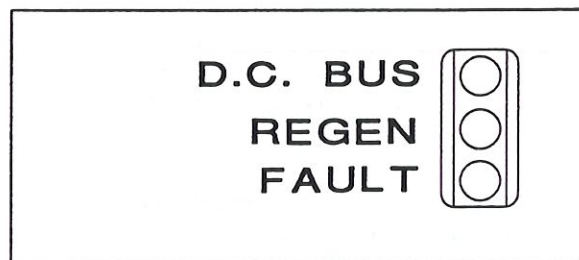


Figure 5.3. PSR4/5 50,75 Status LED's

CONTACT MUST BE WIRED INTO THE E-STOP STRING OR AN EQUIVALENT SHUNT DOWN CIRCUIT.) The thermal overload relay may be reset

by pushing in the reset rod located in the top of the unit.

Table 5.1. Improper Motor Operation Troubleshooting


SYMPTOM	PROBABLE CAUSE
Incorrect Direction of Motor Shaft Rotation	(a) Invert input command signal at Connector C1-1 and 11.
 CAUTION	DO NOT ATTEMPT TO REVERSE DIRECTION OF ROTATION BY INTERCHANGING MOTOR LEADS AND/OR RESOLVER LEADS.
Motor Drifts Slowly with Zero Input	(a) Adjust balance Pot for zero speed (in position loop for zero Following Error or zero input signal).
Uncontrolled Excessive Speed	(a) Motor and/or resolver leads incorrectly connected.
	(b) BDS4 backwards in position loop (motor shaft turns in wrong direction).
	(c) Incorrect alignment of system resolver (refer to Section 4.4.3.3).
	(d) Defective BDS4-COMP Board.
Motor Erratic	(a) Motor and/or resolver leads incorrectly connected.
	(b) Incorrect alignment of system resolver (refer to Section 4.4.3.3).
	(c) Improper grounding scheme (noise corrupting the input signal, tach signal when used, and/or resolver signals).
System Unstable	(a) Stability Pot improperly adjusted.
	(b) Unloaded motor (load motor with TL specified load inertia).
	(c) Incorrect compensation. Check BDS4-COMP Board against TL Sheet.

Table 5.2. BDS4 Status LED Indicator Troubleshooting

SYMPTOM	PROBABLE CAUSE
1) Control Volts LED (Green) <u>Not</u> Illuminated	(a) Control AC line input voltage out of spec or had a momentary interruption.
	(b) Unregulated logic bus not applied to BDS4 from PSR4/5 due to defective wiring or being miswired (fuses inside of PSR4/5 may be blown).
	(c) Defective logic bus supply in BDS4 or PSR4/5 or blown logic bus fuse.
	(d) Defective BDS4.
2) Enable LED (Green) Not Illuminated	(a) Enable input circuit not pulled low.
	(b) Defective BDS4.
3) Drive Ready LED (Green) Not Illuminated	(a) BDS4 faulted (see Red LED's).
	(b) BDS4-COMP Compensation Board not installed or misinstalled.
	(c) Reset input activated (active low).
	(d) Defective BDS4.
4) Foldback LED (RED) Illuminated	(a) BDS4 in resolver alignment test mode (refer to Section 4.4.3.3).
	(b) Excessive RMS current causing BDS4 I ² t protection circuit to activate. Reduce motor duty cycle.
5) Overtmp LED (RED)	(a) Excessive heatsink temperature due to overload or high ambient temperature.
	(b) Defective BDS4.
6) Overcurrent LED (RED) Illuminated	(a) When this LED becomes illuminated, an overcurrent condition [usually due to a shorted load (motor stator winding), shorted stator wiring, or a shorted BDS4 power stage component] is indicated. If this LED becomes illuminated, remove the power and disconnect the motor. Reapply power. If the BDS4 comes up without this LED becoming illuminated, suspect a faulty motor or motor stator wiring. If the BDS4 comes up with the LED illuminated, suspect a faulty BDS4 power stage.
7) Overvolts LED (RED)	(a) This LED will become illuminated if the Main DC Bus rises above 230 VDC for 115 VAC system, 430 VDC for the 230 VAC system. This can happen due to PSR4/5 fault or inadequately sized shunt regulator regeneration resistor.
8) Undervolts LED (RED)	(a) This LED will become illuminated if the Main DC Bus is insufficient or absent.
9) Overspeed LED (RED)	(a) In the event the motor obtains an excessive speed, the OVERSPEED fault circuit will activate, latch the BDS4 in the inhibit mode, and this LED will become illuminated.
	(b) Miswired or intermittent resolver cable.

Table 5.3. PSR4/5 12 & 20 Amp Status LED Indicator Troubleshooting

SYMPTOM	PROBABLE CAUSE
1) DC BUS LED (Green) <u>Not</u> Illuminated	(a) Main DC Bus insufficient or not present. AC input power not applied; check input line fuses.
2) Regen LED (Yellow) Illuminated or Flashing	(a) Not a fault condition. Indicates regeneration circuit activity.
3) Overload LED (Red) Illuminated	(a) Main DC Bus voltage excessively high due to high Main AC line input voltage.
	(b) Shunt regulator regeneration circuit overload.
	(c) Defective PSR4/5.
4) Blown Regen Fuse LED (Red) Illuminated	(a) Shunt regulator regeneration resistor sized too small.
	(b) Defective PSR4/5.

Table 5.4. PSR4/5 50 & 75 Amp Status LED Troubleshooting

SYMPTOM	PROBABLE CAUSE
1) DC Bus LED (Green) <u>Not</u> Illuminated	(a) Main DC Bus insufficient or not present. AC input power not applied; check input line fuses.
2) Regen LED (Yellow) Illuminated or Flashing	(a) Not a fault condition. Indicates regeneration circuit activity.
3) Fault LED (Red) Illuminated	(a) Excessive heatsink temperature due to overload or high ambient temperature.
	(b) Defective PSR4/5.

**NOTE**

Consult Factory if fault occurs during hard deceleration.

CHAPTER 6

SPARE PARTS

6.1 INTRODUCTION

The information in this chapter will enable you to obtain spare parts for your Industrial Drives equipment. Use these tables to order any parts that have become defective or that are required for specific configurations. Ordering instructions are also provided.

6.2 RECOMMENDED SPARE PARTS

It is recommended by Industrial Drives that you have available for use in your BDS4 and PSR4/5, the parts listed in Tables 6.1 and 6.2. It is also very important to note that there are no user serviceable parts on either component other than those fuses and connector kits listed.

Table 6.1. BDS4 Spare Parts List

DESCRIPTION	PART NUMBER	QUANTITY PER UNIT
Connector Kit	BDS4C-100 (3, 6, and 10 amp models)	1
	BDS4C-101 (20 amp model)	1
	BDS4C-200 (30, 40, and 55 amp models)	1

Table 6.2. PSR4/5 Spare Parts List

DESCRIPTION	PSR4/5 MODEL	PART NO.	QUANTITY PER UNIT
CONNECTOR KIT	ALL 12 AND 20A	PSR4/5C-100	1
CONNECTOR KIT	ALL 50 AND 75A	PSR4/5C-200	1
CONTROL VOLTS FUSES	ALL 12 AND 20A	A-78896-008 (1.5 AMP) FUSE 99, 102	2
		A-78896-012 (4 AMP) FUSE 126	1
CONTROL VOLTS USES	ALL 50 AND 75A	A-78896-012 (4 AMP) FUSE 64,65	2
		A-78896-016 (8 AMP) FUSE 24	1
SOFT-START FUSE	115 VAC 12 AND 20 AMP	A-80552-007 (5 AMP) FUSE 121	1
SOFT START FUSE	ALL 230 VAC 12 and 20 AMP	A-80552-001 (10 AMP) FUSE 121	1
SOFT-START FUSE	ALL 50 AND 75 AMP	A-78896-017 (10 AMP) IN-LINE	1
REGEN FUSE	-112, 120	A-80552-013 (7 AMP) FUSE 132	1
REGEN FUSE	-112-02 -120-02	A-80552-001 (10 AMP) FUSE 132	1
REGEN FUSE	-212, 220	A-80552-009 (8 AMP) FUSE 132	1
REGEN FUSE	-212-01, -220-01	A-80552-002 (12 AMP) FUSE 132	1
REGEN FUSE	220-03	A-80552-003 (15 AMP) FUSE 132	1



ALL FUSES MUST BE REPLACED WITH EXACT SAME VALUE AND STYLE OR THEY WILL NOT BE EFFECTIVE.

6.3 ORDERING INSTRUCTIONS

If you need to order parts for the BDS4 and/or PSR4/5, you can order them through your local distributor. For a complete list of Industrial Drives representatives contact us directly at:

INDUSTRIAL DRIVES

201 Rock Road
Radford, VA 24141
U.S.A.

Telephone: 703/639/2495
FAX: 703/731/0847
TWX: 710/875/3743

APPENDIX A

WARRANTY INFORMATION

Industrial Drives, a Kollmorgen Division, warrants that equipment, delivered by it to the Purchaser, will be of the kind and quality described in the sales agreement and/or catalog and that the equipment will be free of defects in design, workmanship, and material.

The terms and conditions of this Warranty are provided with the product at the time of shipping or in advance upon request.

The items described in this manual are offered for sale at prices to be established by Industrial Drives and its authorized dealers.

APPENDIX B

MODEL NUMBERS

Table B.1. PSR4/5 Model Number Scheme

EXAMPLE:	<u>PSR</u>	<u>4/5A-</u>	<u>2</u>	<u>50-</u>	<u>XX*</u>	<u>YY*</u>
LEGEND:	A	B	C	D	E	F

LEGEND	DEFINITION
A	Power Supply with Regeneration (shunt regulation) and soft-start.
B	Power Supply generation indicator.
4/5	Standard Configuration. Used with BDS4 series servo motor amplifiers.
4/5V	Industrial Standard Configuration
4/5A	U.L. 508 listed Configuration. Used with BDS4A series servo motor amplifiers.
C	AC Line Voltage (L-L) RMS.
1	115 VAC, Single-Phase (not available for 50 and 75 amp models).
2	220 VAC, Single-Phase or 230 VAC, Three-Phase.
D	12,20,50,75 AC Line Current, RMS.
E	Mechanical Options.
00	Standard - No Option (all models have side cover)
01	Use "00" for new applications (previously with side cover).
70	Custom.
71	Custom.
72	Custom.
73	Custom.
80	Custom.
91	Special (12 and 20 amp PSR4/5 units only, with cover, without connector kit, 2 axes maximum).
F	Electrical Options.
00	Standard. No Options. 12 and 20 Amp models contain 40 Watt Internal Regeneration Resistor. 50 and 75 Amp Models require Regeneration Resistor Kit EX-2X (must be ordered separately).
01	8.8 Ohms, 400 Watt External Regen, 230 Volt, 12 and 20 Amp Models Only. Requires ER-01 External Resistor Kit.
02	5.5 Ohms, 200 Watt, 115 Volt External Regen, 12 and 20 Amp Models Only. Requires ER-02 External Resistor Kit.
03	5.8 Ohms, 700 Watt, 230 Volt External Regen, 12 and 20 Amp Models Only. Requires ER-03 External Resistor Kit.
20	Custom.
50	Without Soft-Start (50 and 75 Amp Models Only). Requires ER-2X External Resistor Kit.
70	Without Soft-Start and Regeneration (12 and 20 Amp Models Only).
80	Without Regeneration (12 and 20 Amp Models Only).
81	With 240 V logic supply unit, without regen, with soft-start.

*XXYY - Omit when there are no options.

Table B.2. ER-External Resistor Kit Model Number Scheme

EXAMPLE:	<u>ER-</u>	<u>01-</u>	<u>XX</u>
LEGEND:	A	B	C

LEGEND	DEFINITION
A	External Resistor Kit for PSR4/5.
B	Resistor Rating.
01	8.8 ohms, 400W, (12 or 20 amp, 230V models only).
02	5.5 ohms, 200W, (12 or 20 amp, 115V models only).
03	5.8 ohms, 700W, (12 or 20 amp, 230V models only).
20	4.5 ohms, 500W, (50 or 75 amp, 230V models only).
21	4.4 ohms, 1000W, (50 or 75 amp, 230V models only).
22	2.2 ohms, 1000W, (75 amp, 230V models only).
23	2.2 ohms, 2000W, (75 amp, 230V models only).
C	Options (None Available at this Printing).

Table B.3. BDS4 Model Number Scheme

EXAMPLE:	BDS	4A-	2	03	H	XX*	YY*	\	204A	Z
LEGEND:	A	B	C	D	E	F	G	H	I	

LEGEND	DEFINITION
A	Brushless Drive Sinewave Servo Amplifier.
B	Amplifier generation indicator. Original Standard Configuration (no letter designation). V Industrial Standard Configuration. A U.L. 508 listed configuration.
C	Maximum Output Voltage. 1 115VAC (Nominal). 2 230VAC (Nominal).
D	03, 06, 10, 20, 30, 40, 55 Output RMS Current Per Phase, Continuous.
E	R/D Converter. H Standard. Accuracy 22 Arc Min. Maximum. J Special. Accuracy 8 Arc Min. Maximum. Required for 01, 02, 03 Electrical Options or Motors with $N_{max} > 3$ KRPM.
F	Mechanical Options. 00 Standard Unit. No Options. 01 Side Cover Option. 02 Custom. 03 Custom. 70 Custom. 71 Custom. 73 Custom. 80 Custom. 91 Side Cover Option w/ Cover, No Conn. Kit
G	Electrical Options. 00 Standard Unit. No Options. 01 Electronic Encoder Output. Requires Type J R/D Converter. 02 Electronic Encoder with Parallel Output. Requires Type J R/D Converter. 03 Electronic Encoder with Parallel Output and Drive Signals Requires Type J R/D Converter. 05 Custom. 06 Custom. 07 Same as 01 Except Configured for LSB on Channel B. (Refer to Section E.2.2.1.) 08 14-Bit R/D with 3500 RPM Tracking Rate. Requires Type J R/D 09 Comp Card Without Components. 10 Custom. 11 Custom. 12 Custom. 13 Custom. 14 Same as 01 Plus 08. 15 Direction Limit Option Board. 16 14-Bit R/D with 2000 RPM Tracking Rate. Requires Type J R/D Converter.

Table B.3. BDS4 Model Number Scheme (Continued)

LEGEND	DEFINITION
17	14-Bit R/D with 3500 RPM "J" Grade, W Direction Limit Option.
18	Custom.
19	16 Bit R/D 600 RPM "J" Grade R/D.
81	Custom.
83	Custom.
84	Custom.
85	Custom.
91	Custom.
92	Custom.
93	Custom.
94	Custom.
95	Custom.
96	12-Bit R/D 14k RPM "J" Grade with encoder equivalent option.
H	Motor and Winding Designator.
I	Compensation Designator.
2	0 - 5 X Jm.
3	5 - 20 X Jm.
ZZ	Special.

*XXYY Omit when there are no options.

Table B.4. Compensation Card Model Designator

EXAMPLE:	<u>CMP-</u>	<u>BDS4-203H</u>	<u>204A2</u>
LEGEND:	A	B	C

LEGEND	DEFINITION
A	Compensation Card.
B	Amplifier Base Model Number.
C	Motor, Winding, and Compensation Designator.

B.1 CABLE, BUS WIRE, AND MATING CONNECTOR KIT INFORMATION

Extra or spare bus wire and complete cable assemblies are available from Industrial Drives.

Mating connector kits are available from Industrial Drives or may be purchased directly from the connector vendor.

B.2 CABLE MODEL NUMBER SCHEME FOR INDIVIDUAL CABLE SET

Motor cables are designed to provide reliable and cost-effective interconnection between Industrial Drives' Goldline Series Motors and any BDS Series Amplifier. GCS (Goldline Cable Set) models provide both motor (stator) and resolver (feedback) cable of equal length. Cables include motor mating plugs with various termination options at the amplifier end. There are 2 versions of the cable sets; the GCS and the GCSA. The GCS is used with motors that have MS Bayonet-type connectors, while the GCSA is used with motors that have MS screw-type connectors. To assist in ordering, the model number scheme for a cable set is as follows:

Table B.5. Cable Model Number Scheme for Individual Cable Set (Bayonet-Type Thread)

EXAMPLE:	GCS -	M6A /	R -	4/5 -	03
LEGEND:	A	B	C	D	E

LEGEND	DEFINITION
A	Goldline Cable Set. Consists of one motor stator and one feedback cable with Bayonet type thread.
B	Motor Power Cable with mating plug for particular frame size.
M6A	B-60X-X-AX & BX Motors (up to 40 amps continuous).
M6B	B-60X-X-AX & BX Motors (up to 65 amps continuous).
M8A	B-80X-X-AX & BX Motors (up to 65 amps continuous).
M8B	B-80X-X-AX & BX Motors (up to 115 amps continuous).
C	Motor Feedback/Option Cable with Mating Plug.
R	System Resolver Only.
RBT	System Resolver, Brake, Tachometer.
D	Amplifier Termination.
4/5	BDS4 or BDS5, 3-20 Amp Models.
4/5H	BDS4 or BDS5, 30-55 Amp Models.
N	Not Terminated.
E	Cable Length to Motor. 3 to 75 Meters in 3-Meter Increments.

Table B.6. Cable Model Number Scheme for Individual Cable Set (Screw-Type Thread)

EXAMPLE:	GCSA	-	M4	/	R	-	4/5	-	03
LEGEND:	A		B		C		D		E

LEGEND	DEFINITION
A	Goldline Cable Set. Consists of one motor stator and one feedback cable with screw-type thread.
B	Motor Power Cable with mating plug for particular frame size.
M4B	B-40X-X-AX & BX Motors (up to 40 amps continuous).
M6A	B-60X-X-AX & BX Motors (up to 40 amps continuous).
M6B	B-60X-X-AX & BX Motors (up to 65 amps continuous).
M8A	B-80X-X-AX & BX Motors (up to 65 amps continuous).
M8B	B-80X-X-AX & BX Motors (up to 115 amps continuous).
C	Motor Feedback/Option Cable with Mating Plug.
R	System Resolver Only.
RBT	System Resolver, Brake, Tachometer.
D	Amplifier Termination.
4/5	BDS4 or BDS5, 3-20 Amp Models.
4/5H	BDS4 or BDS5, 30-55 Amp Models.
N	Not Terminated.
E	Cable Length to Motor. 3 to 75 Meters in 3-Meter Increments.

B.3. CABLE MODEL NUMBER SCHEME FOR INDIVIDUAL CABLE

Individual cables can be provided by GC (Goldline Cable) Models. To assist in ordering, the model number scheme for an individual cable is as follows:

Table B.7. Cable Model Number Scheme for Individual Cable (Bayonet-Type Connector)

EXAMPLE:	GC -	M2 -	4/5 -	03
LEGEND:	A	B	C	D

LEGEND	DEFINITION
A	Goldline Cable With Bayonet-Type Connector (individual cable).
B	Motor Power Cable with Mating Plug or Feedback/Option Cable.
M1	B-10X Motors.
M2	B-20X Motors.
M4	B-40X Motors.
M6A	B-60X-X-AX & BX Motors (up to 40 amps continuous).
M6B	B-60X-X-AX & BX Motors (up to 65 amps continuous).
M8A	B-80X-X-AX & BX Motors (up to 65 amps continuous).
M8B	B-80X-X-AX & BX Motors (up to 115 amps continuous).
R	System Resolver Only.
RBT	System Resolver, Brake, Tachometer.
AR	Application Resolver.
C	Amplifier Termination.
4/5	BDS4 or BDS5, 3-20A Models.
4/5H	BDS4 or BDS5, High Current Models.
N	Not Terminated.
D	Cable Length to Motor. 3 to 75 Meters in 3-Meter Increments.

Table B.8. Cable Model Number Scheme for Individual Cable (Screw-Type Connector)

EXAMPLE:	<u>GCA</u> -	<u>M4</u> -	<u>4/5</u> -	<u>03</u>
LEGEND:	A	B	C	D

LEGEND	DEFINITION
A	Goldline Cable with screw-type connector (individual cable).
B	Motor Power Cable with Mating Plug or Feedback/Option Cable.
M4	B-40X Motors (up to 40 amps continuous).
M6A	B-60X Motors (up to 40 amps continuous).
M6B	B-60X Motors (up to 65 amps continuous).
M8A	B-80X Motors (up to 65 amps continuous).
M8B	B-80X Motors (up to 115 amps continuous).
R	System Resolver Only.
RBT	System Resolver, Brake, Tachometer.
AR	Application Resolver.
C	Amplifier Termination.
4/5	BDS4 or BDS5, 3 to 20 A Models.
4/5H	BDS4 or BDS5, High Current Models.
N	Not Terminated.
D	Cable Length to Motor. 3 to 75 Meters in 3-Meter Increments.

B.4 SPECIAL CABLES FOR RESOLVER FEEDBACK AND INTERFACE

The GC specials are designed to eliminate the need for the customer to make crimp connections for BDS4 input/output connector (C1) and BDS4 resolver connector (C2). These cables are terminated at C1 and C2 on the BDS4 and are unterminated at the opposite end. The unterminated end is intended to be connected into a customer-supplied terminal block. To assist in ordering, the model number schemes for these special cables are as follows:

Table B.9. Resolver Feedback Cables

GC-RF-4/5-XX	Resolver feedback flying lead cable (not terminated at the motor). XX-length in 3 meter increments; 03, 09, etc.
GC-IOF-4-XX	I/O flying lead cable (not terminated at customer's interface). XX-length in 3 meter increments; 03, 09, etc.

B.5 SPECIAL CABLES FOR LOGIC POWER SUPPLY

Special logic power supply cables are available to accommodate the various physical sizes of BDS4 and PSR4/5 modules and are designed based on standard module spacing requirements. Refer to drawing B-84929 for information concerning decoding the model numbers of special logic bus cables. To assist in ordering, the model number scheme for this cable is:

GC-LOGIC-XXXXXXX

APPENDIX C

CONNECTOR KITS & TOOLS

C.1 INTRODUCTION

Mating connectors are customer furnished items which may be ordered either from Industrial Drives or purchased directly from the connector vendor. Ordering information is as follows:

Table C.1. Connector Kit BDS4C-100

INDUSTRIAL DRIVES CONNECTOR KIT -- PART NUMBER---BDS4C-100			
BDS4 - 3, 6 and 10 AMP MODELS			
CONNECTOR	DESCRIPTION	MOLEX PART NO.	I.D. PART NO.
C1	Connector Housing, 20 Position Female	39-01-2205	A-83908-020
C2	Connector Housing, 12 Position Female	39-01-2125	A-83908-012
C3	Connector Housing, 8 Position Female	39-01-2085	A-83908-008
C1, C2, C3	PIN, Female, (18-24 AWG)	39-00-0039	A-83909-002

Table C.2. Connector Kit BDS4C-101

INDUSTRIAL DRIVES CONNECTOR KIT -- PART NUMBER---BDS4C-101			
BDS4 - 20 AMP MODELS			
CONNECTOR	DESCRIPTION	MOLEX PART NO.	I.D. PART NO.
C1	Connector Housing, 20 Position Female	39-01-2205	A-83908-020
C2	Connector Housing, 12 Position Female	39-01-2125	A-83908-012
C3	Connector Housing, 8 Position Female	39-01-2085	A-83908-008
C4	Connector Housing, 4 Position Male	39-01-2045	A-83908-004
C1, C2, C3, C4	PIN, Female, (18-24 AWG)	39-00-0039	A-83909-002

Table C.3. Connector Kit BDS4C-200

INDUSTRIAL DRIVES CONNECTOR KIT -- PART NUMBER---BDS4C-200			
BDS4 - 30, 40, and 55 AMP MODELS			
CONNECTOR	DESCRIPTION	MOLEX PART NO.	I.D. PART NO.
C1	Connector Housing, 20 Position Female	39-01-2205	A-83908-020
C2	Connector Housing, 12 Position Female	39-01-2125	A-83908-012
C3	Connector Housing, 8 Position Female	39-01-2085	A-83908-008
C4	Connector Housing, 4 Position Male	39-01-2045	A-83908-004
C1, C2, C3, C4	PIN, Female, (18-24 AWG)	39-00-0039	A-93105-002

Table C.4. Connector Kit PSR4/5C-200

INDUSTRIAL DRIVES CONNECTOR KIT -- PART NUMBER----PSR4/5C-200			
PSR4/5 - 12, 20, 50 and 75 AMP MODELS			
CONNECTOR	DESCRIPTION	MOLEX PART NO.	I.D. PART NO.
C1	Connector Housing, 6 Position Female	39-01-2065	A-83908-006
C2	Connector Housing, 8 Position Female	39-01-2085	A-83908-008
C1, C2	PIN, Female (18-24 AWG)	39-00-0039	A-83909-002

Table C.5. Connector Tools

CONNECTOR TOOLS (PINS, MINI FIT JR.) FROM MOLEX		
Description	Engineering Number	Order Number
Hand Crimping Tool	HTR-60622	11-01-0122
Extractor Tool	HT-60630A	11-03-0038
MOLEX TELEPHONE NUMBER: (708) 969-4550		

