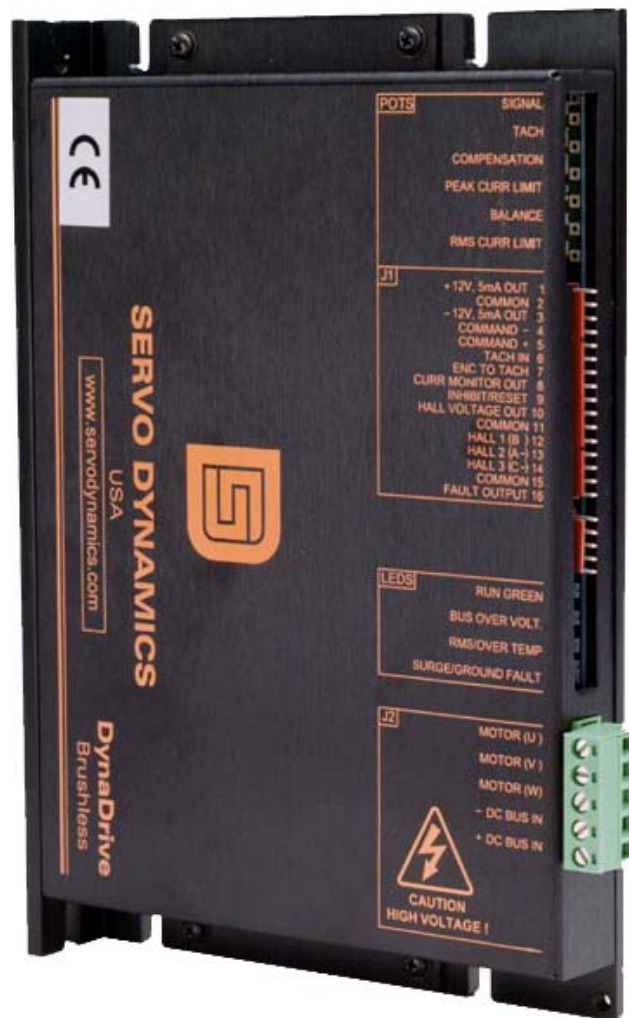




1525-BL

SERVO AMPLIFIER

FOR BRUSHLESS SERVOMOTORS



USER GUIDE

October 2004

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1. Introduction

This information manual provides the product specifications, wiring diagram, operational modes (torque and velocity) and troubleshooting procedures for the brushless DynaDrive 1525-BL.

1.1 Description

The DynaDrive 1525-BL supplies 15 amps continuous current and 25 amps peak current at 150 VDC for a total of 2250 watts of continuous power. The DynaDrive is a current source type PWM amplifier.

The DynaDrive is a power duplicator of the command signal. A battery, a motion controller, or a signal generator can be the source of the command signal input.

Please read this manual thoroughly to the end as it contains important system information and warnings.

1.2 Technical Specifications

| Performance Characteristics | |
|---------------------------------|---|
| Peak Power | 3.75 kW |
| Peak Output Voltage | ± 150 vdc (shut off @ 205 vdc) |
| Peak Output Current | ± 25 amps (1 sec.) |
| Max. Continuous Current | ± 15 amps (50 °C), ± 19 amps (25 °C) |
| Electrical Characteristics | |
| Input Signal Voltage | ± 10 vdc (typ.), ± 35 vdc (max.) |
| System Gain | 0 to 5100 amps/volt |
| Input Impedance | 40 k Ohms |
| Typical Input Drift | 10 µV/°C |
| Bandwidth | 3kHz with 2.4 mHy Inductance |
| Dead Band | Zero |
| Input Power Requirements | |
| Input Voltage | 60-170 vdc |
| Adjustments | |
| Peak Current Limit | 0 to 25 amps |
| RMS Current Limit | 0 to 19 amps |
| Signal Command Input | Scaling |
| Balance | Zero velocity offset |
| Compensation | System response |
| Tachometer | Scaling |
| Diagnostics | |
| Green | LED 1 – RUN GREEN - AMPLIFIER OPERATIONAL |
| Red | LED 2 – BUS OVER VOLTAGE |
| Red | LED 3 – EXCESSIVE RMS CURRENT/ OVER TEMP |
| Red | LED 4 – SURGE/GROUND FAULT |
| Physical Characteristics | |
| Module Dimensions (L x W x H) | 7.6 in. x 1.0 in. x 5.2 in. |
| Weight | 1.4 lbs |
| Ambient Temperature – Operating | 0 °C to 50 °C |
| Shutdown Temperature | 80 °C at heat sink |
| Relative Humidity | 5 - 95% non-condensing |

Table 1: Technical Specifications for DynaDrive 1525-BL

2. Safety Information

2.1 Electrical Cautions

Make sure that all voltages and tests are made with battery powered or electrically isolated instruments.

3. Installation

3.1 Matching the DynaDrive to the Motor

The factory preset potentiometer settings of the DynaDrive 1525-BL may need to be adjusted to match the continuous current rating of your motor. To accomplish this, find the continuous current rating of the motor to be used and adjust the RMS, PEAK CURR LIMIT and SIGNAL pot per Table 2 below. If the continuous current rating is between the values shown in the table, you may set to the lower value or use linear interpolation for each pot value. The signal pot settings are based on +/- 10 vdc input command signal.

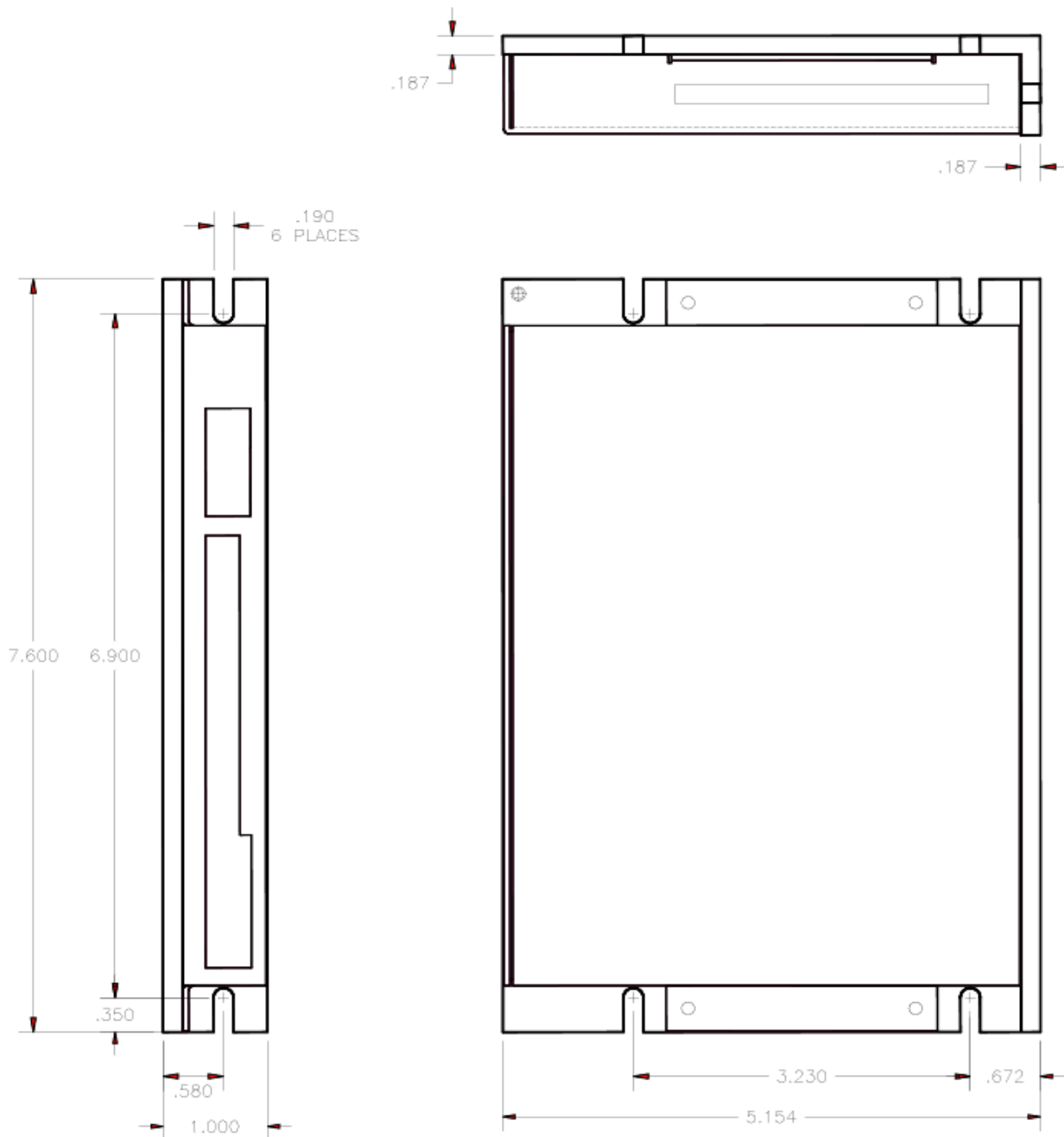
| Continuous Current Rating of Motor (Amps) | RMS Pot Setting TP7 K Ohms (Amps) | PEAK CURRENT LIMIT Pot Setting TP5 K Ohms (Amps) | SIGNAL Pot Setting TP2 K Ohms |
|---|--------------------------------------|---|----------------------------------|
| 3 | 0.5 (3 Amps) | 0.7 (9 Amps) | 2.0 |
| 6 | 4.0 (6 Amps) | 1.6 (18 Amps) | 3.8 |
| 9 | 7.0 (9 Amps) | 2.2 (25 Amps) | 4.8 |
| 12 | 9.3 (12 Amps) | 2.2 (25 Amps) | 4.8 |
| 15 | 10.2 (15 Amps) | 2.2 (25 Amps) | 4.8 |

Table 2: Motor Specs

Note: All Measurements are with respect to TP1 (Common) with J1 removed.

3.2 Mounting Dimensions

Note: Units in inch



3.3 Connector Information

3.3.1 J1 – Control I/O Connection

| J1 | Label | Description |
|----|------------------------------|--|
| 1 | +12V, 5mA OUT | Auxiliary voltage that has 1K ohm resistor in series with this output. |
| 2 | COMMON | Connected to the other commons and connected to the metalwork of the amplifier mounting plate. |
| 3 | -12V, 5mA OUT | Auxiliary voltage that has 1K ohm resistor in series with the output. |
| 4 | COMMAND- | Differential input. This pin can also be used as a single ended input. Use J1, Pin 2 as common. |
| 5 | COMMAND+ | Differential input |
| 6 | TACH IN | Single ended input that has additional tach filtering and conditioning. |
| 7 | ENCODER to TACH OUT (option) | Jumper to Pin 6 if Encoder to Tach option is being used. |
| 8 | CURR MONITOR OUT | Current monitor output. +/- 10 Vdc out equals approx. +/- 25 amps. |
| 9 | INHIBIT/RESET | Connect to +5Vdc to enable amplifier. Remove +5Vdc to inhibit and reset amplifier. |
| 10 | HALL VOLTAGE OUT | +5Vdc to hall sensors (30 mA max) |
| 11 | COMMON | Common connection for hall sensors. See Pin 2 above. |
| 12 | HALL 1 | Internally pulled up to +5 Vdc. |
| 13 | HALL 2 | Internally pulled up to +5 Vdc |
| 14 | HALL 3 | Internally pulled up to +5 Vdc |
| 15 | COMMON | See Pin 2 above |
| 16 | FAULT OUTPUT | Uncommitted collector output that is high (Off) during normal operation and low (On) if a fault occurs. Note: Use an external pull up resistor to 5 – 24 Vdc at 10 mA max. |

3.3.2 J2 - Servomotor Connection

| J2 | Label | Description |
|----|-------------|----------------------------------|
| 1 | MOTOR(U) | Output power to motor |
| 2 | MOTOR(V) | Output power to motor |
| 3 | MOTOR(W) | Output power to motor |
| 4 | - DC BUS IN | - Bus power input, power return |
| 5 | + DC BUS IN | + Bus power input, 60 to 170 Vdc |

3.4 Wiring Diagram

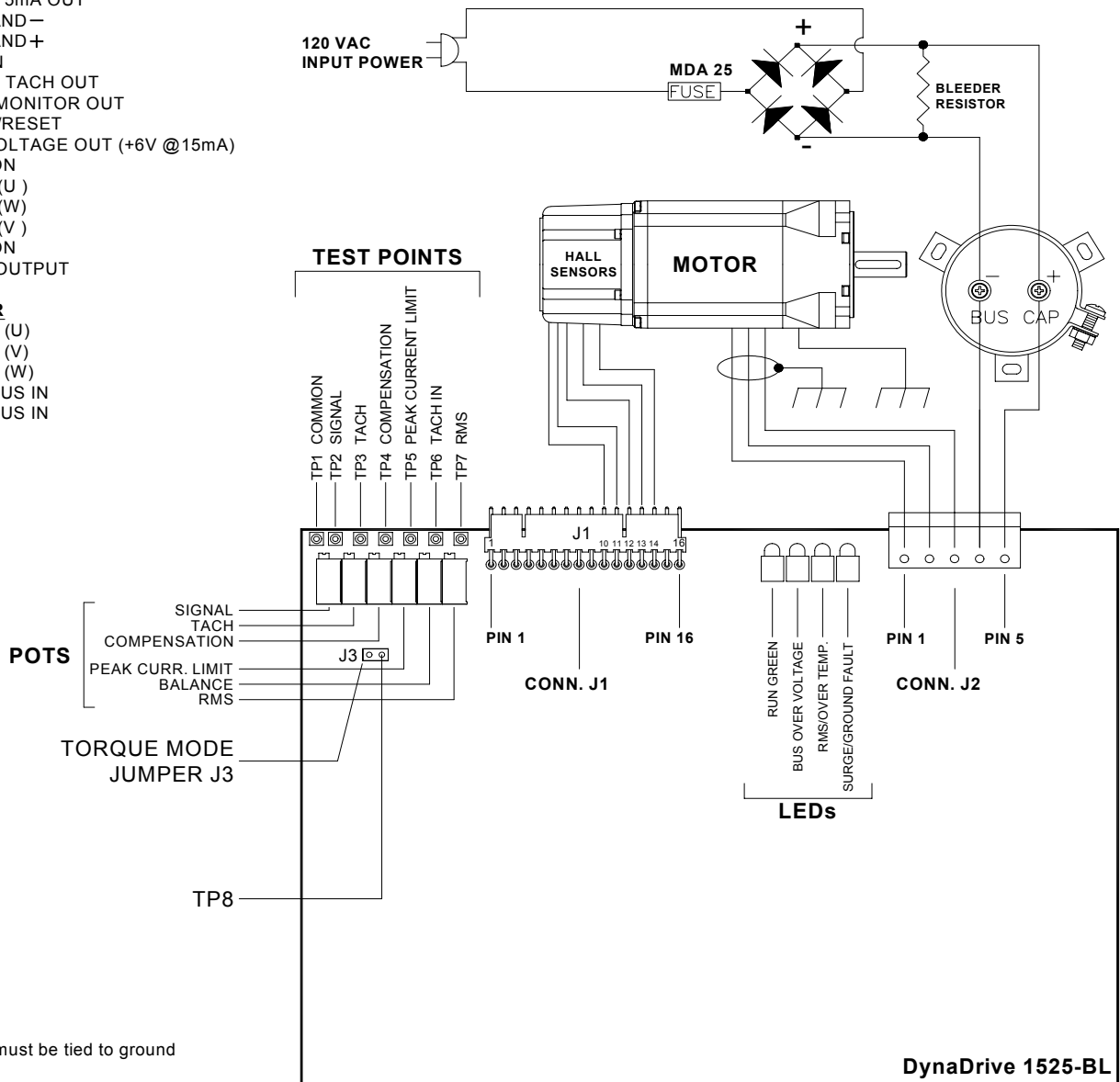
3.4.1 DynaDrive 1525-BL and Motor with Hall Sensors

J1 CONNECTOR

- PIN 1 + 12 V, 5mA OUT
- PIN 2 COMMON
- PIN 3 - 12 V, 5mA OUT
- PIN 4 COMMAND -
- PIN 5 COMMAND +
- PIN 6 TACH IN
- PIN 7 ENC TO TACH OUT
- PIN 8 CURR. MONITOR OUT
- PIN 9 INHIBIT/RESET
- PIN 10 HALL VOLTAGE OUT (+6V @15mA)
- PIN 11 COMMON
- PIN 12 HALL 1 (U)
- PIN 13 HALL 2 (W)
- PIN 14 HALL 3 (V)
- PIN 15 COMMON
- PIN 16 FAULT OUTPUT

J2 CONNECTOR

- PIN 1 MOTOR (U)
- PIN 2 MOTOR (V)
- PIN 3 MOTOR (W)
- PIN 4 - DC BUS IN
- PIN 5 + DC BUS IN



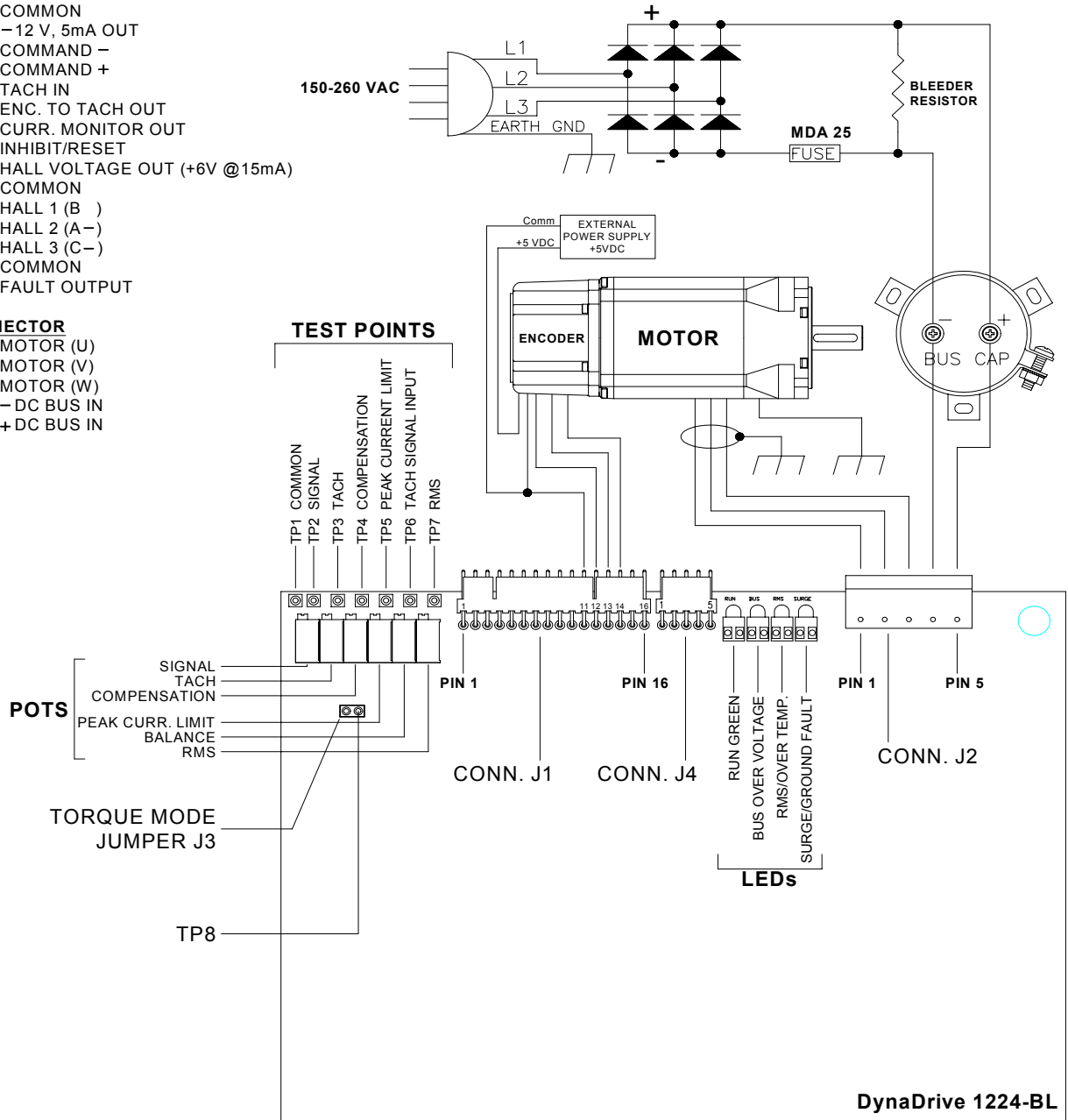
3.4.2 DynaDrive 1525-BL and Motor with Encoder with Hall Tracks

J1 CONNECTOR

- PIN 1 +12 V, 5mA OUT
- PIN 2 COMMON
- PIN 3 -12 V, 5mA OUT
- PIN 4 COMMAND -
- PIN 5 COMMAND +
- PIN 6 TACH IN
- PIN 7 ENC. TO TACH OUT
- PIN 8 CURR. MONITOR OUT
- PIN 9 INHIBIT/RESET
- PIN 10 HALL VOLTAGE OUT (+6V @15mA)
- PIN 11 COMMON
- PIN 12 HALL 1 (B)
- PIN 13 HALL 2 (A-)
- PIN 14 HALL 3 (C-)
- PIN 15 COMMON
- PIN 16 FAULT OUTPUT

J2 CONNECTOR

- PIN 1 MOTOR (U)
- PIN 2 MOTOR (V)
- PIN 3 MOTOR (W)
- PIN 4 -DC BUS IN
- PIN 5 +DC BUS IN



3.5 Potentiometers -Adjustments

The following is a description of the function of each pot. The pot settings can be measured at test points TP1 thru TP7.

| Potentiometer | Description |
|------------------------|---|
| SIGNAL | The signal potentiometer is used for scaling the command signal. Turning the potentiometer CW increases the amount of command signal to the front end of the amplifier. |
| TACH | The tachometer potentiometer is used for scaling the various tachometer voltage gradients. This input has to be used because of special signal conditioning. Turning the pot CW increases the amount of tach-feedback into the amplifier. |
| COMPENSATION | The Compensation potentiometer is used to increase or decrease the response (bandwidth) of the amplifier. Turning the potentiometer CW increases the response of the amplifier. |
| PEAK CURR LIMIT | The peak current limit potentiometer is used to increase or decrease the peak output current of the amplifier. Turning the potentiometer CW increases the output current of the amplifier from zero amps to maximum peak amps. |
| BALANCE | The balance potentiometer is used to stop motor rotation when no input signal exists. The function of this pot is such that for zero input volts the output current should be at zero amps. |
| RMS | The RMS potentiometer is for changing the level of the RMS current. The amplifier is capable of providing maximum RMS current when fully CW. The minimum current is approximately 0 amps when fully CCW. |

4. Operational Modes

The DynaDrive can operate in a Torque or Velocity mode.

In the Torque mode, the DynaDrive only closes the torque loop. The velocity loop is closed in the motion controller.

In the Velocity mode, the DynaDrive itself closes both the torque and velocity loop.

4.1 Torque Mode

4.1.1 Torque Mode – Factory Potentiometer Settings

Unless otherwise specified by the customer, the DynaDrive 1525-BL is shipped in the torque mode by installing the torque mode jumper at J3 and presetting the potentiometers for the torque mode. The factory potentiometer settings for the torque mode are as follows: (See ADJUSTMENTS section for a more complete description of the potentiometer functions)

| Potentiometer Description | Potentiometer Setting | Potentiometer Test Point |
|---------------------------|-------------------------|--------------------------|
| N/A | N/A | TP1 – COMMON |
| SIGNAL | 4.8 k Ohms | TP2 – SIGNAL |
| TACH | Full CCW | TP3 – TACH |
| COMPENSATION | Full CW | TP4 – COMPENSATION |
| PEAK CURR LIMIT | 2.2 k Ohms (25 Amps) | TP5 – PEAK CURR LIMIT |
| BALANCE | No Preset | None |
| RMS | 10.2 k Ohms (15 Amps) | TP7 – RMS |

Table 3: Torque Mode POT settings

Note: All Measurements are with respect to TP1 (Common) with J1 removed.

4.1.2 Torque Mode - Setup

The factory preset potentiometer settings are adjusted for the torque mode operation.

To set up and run the DynaDrive 1525-BL in the torque mode, perform the following:

1. Turn power off.
2. Remove J1.
3. Check all wiring connections. Verify that J3 jumper is installed.
4. Set the RMS, PEAK CURRENT LIMIT and SIGNAL pots to match the motor as indicated in Table 2. For preliminary testing under no load, use the factory preset pot settings.
5. Check that the TACHOMETER pot is full counterclockwise (CCW).
6. Check that the COMPENSATION pot is full clockwise (CW).
7. Replace J1.
8. Inhibit the DynaDrive by leaving pin 9 of J1 open or by pulling to common.
9. Turn power on.
10. Insure that the voltage at COMMAND + and COMMAND – is zero.
11. Enable the DynaDrive by pulling pin 9 of J1 to + 5 VDC
12. The green LED should be the only LED on. No other LEDs should be on at this point. If any other situation exists, check the TROUBLESHOOTING section of this manual.
13. Adjust the BALANCE pot to give less than zero volts at CURRENT MONITOR OUT, J1 pin 8.
14. Apply a voltage (0 to +/- 10 VDC) at COMMAND + and COMMAND -. The motor shaft should turn CW when COMMAND + is positive and should turn CCW when COMMAND + is negative. At low COMMAND voltage, holding the shaft can stall the motor. At higher COMMAND voltage, the torque is much greater and it should be difficult to stall the motor.

4.2 Velocity Mode

4.2.1 Velocity Mode – Factory Potentiometer Setting

To set the DynaDrive in the Velocity Mode, remove the cover to expose the Torque Mode Jumper at J3. Remove the Torque Mode Jumper at J3 that is located right behind the Tach pot. The pot settings must be adjusted for Velocity mode per Table 3 below. The Velocity mode requires a tachometer feedback signal from the motor or motion control system.

To match the motor to the DynaDrive 1525-BL, set the RMS and SIGNAL pots per Table 2. Set the PEAK CURR LIMIT pot to full CCW. Set the remaining pots per Table 3 below. Now perform the Velocity Mode Setup procedure on the next page.

| Potentiometer Description | Potentiometer Setting | Potentiometer Test Point |
|---------------------------|-----------------------|--------------------------|
| N/A | N/A | TP1 – Common |
| SIGNAL | See Table 2 | TP2 – SIGNAL |
| TACH | 7.0 k Ohms | TP3 – TACH |
| COMPENSATION | Full CCW | TP4 – COMPENSATION |
| PEAK CURR LIMIT | Full CCW | TP5 – PEAK CURR LIMIT |
| BALANCE | No Preset | None |
| RMS | See Table 2 | TP7 – RMS |

Table 3: Velocity Mode POT settings

Note: All Measurements are with respect to TP1 (Common) with J1 removed.

4.2.2 Velocity Mode- Setup

To set up and run the DynaDrive 1525-BL in the Velocity mode, perform the following:

1. Turn power off.
2. Remove J1.
3. Check all wiring connections. Verify that J3 jumper is removed.
4. Check that the pots are set per Table 3.
5. Inhibit the DynaDrive by leaving pin 9 of J1 open or by pulling it to common.
6. Replace J1.
7. Turn power on.
8. Insure that the voltage at COMMAND + and COMMAND – is zero.
9. Enable the DynaDrive by pulling pin 9 of J1 to + 5 VDC.
10. The green LED should be the only LED on. No other LEDs should be on at this point. If any other situation exists, check the TROUBLESHOOTING section of this manual.
11. Slowly turn the PEAK CURR LIMIT pot CW. If the motor runs away, turn the power off, reverse the velocity feedback leads and repeat above. If the motor does not run away, turn power off and wait for the green LED to go out, disconnect J1. Set the PEAK CURR LIMIT pot to the value given in Table 2.
12. Turn the COMPENSATION pot CW until the motor starts buzzing. Now turn the pot CCW until the motor stops buzzing and then turn another 1 ½ turns CCW.
13. The motor shaft should not be rotating at this point. If it is slowly rotating, adjust the BALANCE pot until rotation is stopped.
14. With zero voltage at COMMAND + and COMMAND –, the motor shaft should be stiff and difficult to turn. A low voltage at COMMAND + will cause the motor to turn at a slow speed with high torque and the motor should be difficult to stall. The motor speed should be proportional to the COMMAND voltage.

5. Troubleshooting

5.1 Diagnostic LEDs

The DynaDrive 1525-BL has four diagnostic LEDs:

- 1) RUN GREEN
- 2) BUS OVER VOLTAGE
- 3) RMS/ OVER TEMP
- 4) SURGE/ GROUND FAULT

5.1.1 Green LED

RUN GREEN - Indicates the amplifier is working properly. When the green LED goes OFF and there is no red LEDs ON, the following may have occurred:

1. Loss of power to the amplifier.
2. Bus Voltage less than 60 VDC.
3. Amplifier has been inhibited by J1, Pin 9.

5.1.2 Red LEDs:

Note: When a red LED is ON, the amplifier has been inhibited and remains inhibited until reset. To reset, toggle J1 pin 9 momentarily to Common.

5.1.2.1 BUS OVER VOLTAGE

Indicates that the bus voltage has exceeded 205 VDC. This condition may be caused by rapid deceleration or back driving of the motor. A shunt regulator is required to dissipate the motor energy. If a shunt regulator is present in the system check its fuses.

5.1.2.2 RMS/OVER TEMP

- **Excess RMS** - The amplifier delivered current beyond its continuous capability. This condition can exist if a machine is asked to perform a task greater than its design capabilities. This would include a motor that is mechanically stalled or binding or a motor with shorted stator (armature) wires.
- **Over temperature** - The heat sink has exceeded 80 °C. An over temperature condition may exist for the following reasons:
 1. Insufficient airflow across the heat sink.
 2. Ambient cabinet temperature too high.

5.1.2.3 SURGE/GROUND FAULT

- **Surge** - Indicates an excessive amount of current through the power transistors in the output power bridge. This condition may be due to a damaged output power device or shorted output leads to the motor.
- **Ground fault** - One of the output wires to the motor is shorted to ground. This condition may be due to faulty or pinched wiring or the motor is arcing to the case ground.

5.2 Other Conditions

| Problem | Possible Solution |
|--|--|
| <p>MOTOR OR MACHINE RUNS AWAY</p> | <ol style="list-style-type: none"> 1. Check the tachometer voltage to the amplifier by testing TP3 with respect to TP1. Then look at TP6 with respect to TP1 with a voltmeter. 2. Ensure the tachometer signal is phased correctly. 3. Check to see if the position loop phasing (CNC command) is correct relative to the position encoder feedback device. |
| <p>MOTOR RUNS ERRATIC OR PRODUCES VERY LOW TORQUE IN VARIOUS SHAFT POSITIONS</p> | <ol style="list-style-type: none"> 1. Check the phase relationship of the motor commutator (Hall) sensors wires (J1, Pins 12, 13, and 14) relative to the motor power wires at the motor terminals of the amplifier chassis. 2. Check the wires from the motor commutator sensors and make sure the motor commutator signals are making connection in J1, Pins 12, 13 and 14 on the connector on the amplifier module. |

5.3 Test Points

| Test Point Pin | Observed Signal |
|----------------|--|
| TP1 | COMMON |
| TP2 | SIGNAL input POT wiper |
| TP3 | TACH input wiper |
| TP4 | COMPENSATION POT wiper |
| TP5 | PEAK CURR LIMIT POT wiper |
| TP6 | TACH IN signal directly connected to J1, pin 6 thru a 10K resistor |
| TP7 | RMS current setting pot wiper |
| TP8 | Front-end opamp output (J3, pin 2) |

5.4 Contact Information

If you are unable to resolve the problem, consult our web page located at:

<http://www.servodynamics.com/>

Contact the service department at Servo Dynamics:

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