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BALDOR
MOTORS AND DRIVES

DC SERVO DRIVES

TSD SERIES
DC Servo Control

INSTALLATION & OPERATING MANUAL

2/96 MN1201

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FORWARD

The purpose of this manual is to provide the necessary information for the installation, operation and troubleshooting of the Baldor TSD high frequency series servo controls. The user should be familiar with the contents of this manual before any connections are made to the servo control or any support equipment.

This manual does not intend to cover every possible contingency to be met in connection with installation, operation or troubleshooting. Should further information be desired or should particular problems arise which are not detailed in this manual, contact your sales representative or equipment supplier.

EMC CONFORMITY AND CE

This product is a component only and not ready for immediate or instant use with the meaning of the “EMC” directive. The final conformity and guarantee is defined only by insertion and verification by the manufacturer of the machine or equipment.

To ensure electromagnetic compatibility in hostile environments; only proper implementation of grounding, shielding/screening, and filtering will reduce interference to required values.

All metal parts should have a ground. All cables for signal, power, and regen resistor; must be shielded and connected on both sides, and grounded.

The electronics should be protected from high frequency interference. This may be accomplished with line reactors.

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LIMITED WARRANTY AND SERVICE POLICY

Baldor products are warranted against defects in workmanship and materials for a period of one (1) year, from the date of shipment from the factory, providing the company receives immediate notice of such defects.

Baldor will not be responsible for: the cost of removal or reinstallation of any products from any equipment, cost of delivery to the Baldor factory or Authorized Service Center; the cost of any incidental or consequential damages resulting from the claimed defects. Any implied warranty given by law shall be limited to the duration of the warranty period hereunder.

Baldor has no liability for any repairs or modifications made outside Baldor's factory. Any disassembly or modifications will void the warranty.

Any recommendations offered by Baldor's engineers or sales representatives are to be considered as their best judgement and as matters of opinion, without liability to Baldor. Under no circumstances shall Baldor be liable for damage to good will, loss of profits or for any type of consequential damage.

In-Warranty Service

Baldor will, at its option, repair or replace, without charge, within a reasonable period of time, products which fail due to defects in workmanship of materials during limited warranty period if:

1. The purchaser delivers the defective product, freight prepaid, to the Baldor factory only after obtaining a written or verbal return authorization (RA) number.

2. The purchaser gives written notification concerning the product and the claimed defect, including the purchase date, the task performed by the product, and the problem encountered.

Out-of-Warranty Service

Baldor does not recommend field repair of motors or electronic items by the customer. Defective items should be returned to the Baldor factory. All returns must be first authorized and then accompanied by a written or verbal return authorization (RA) number.

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Section 1
General Information

1.1 INTRODUCTION

The Baldor "TSD" Series "Twin Servo Driver" is a one or two axis pulse width modulated (PWM), high performance servo control designed to be used with DC brush type permanent magnet servo motors. This transistorized servo control is a key component in motion control applications, providing not only converted DC power to the motor, but also precisely controlling current and velocity at the motor. Its compact design requires very little panel (enclosure) space, while its modular package and connectors makes servicing easy. The "TSD" Series comes in a number of possible configurations to best suit your application.

The "TSD" Series can be used with many different position controllers due to its versatility and standardized ± 10 VDC input signal.

1.2 FEATURES

The Baldor "TSD" Series switching concept enables the user to operate with the highest possible bandwidth with reduced switching losses, ripple current, EMI and RFI. The servo control is easily installed by inserting four mounting screws and plugging in connectors. The unit comes in two possible output power levels with a maximum output of 100 VDC and 5 Amps continuous, 10 Amps peak.

The "TSD" module provides protection features and status indicators including:

- Voltage error (VE)
- Excess current (EC)
- Over-temperature (OT)
- Surge current (SC)
- Short circuit protection
- Logic voltage status

Other standard features include:

- Inaudible switching frequency (20 KHz)
- Minimized set up time with individual "personality modules"
- User friendly Phoenix style screw terminals
- Simple jumper settings for easier setup
- Right and left limit over-travel protection with external reset line
- Factory supplied power input cable
- Simplified front panel adjustments
- Front panel mounted "on/off" switch

1.3 PHYSICAL DESCRIPTION

The “TSD” servo control comes as a complete unit ready to plug into the wall. It comes complete with the power supply, power input cable, input connectors, and Installation and Operating Manual. The servo control translates analog input speed information and amplifies this into an output for the servo motor with a defined velocity and direction.

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1.3.1 Inputs

The "TSD" servo control provides for front panel accessible input control signals (see Figure 1-1). These include:

Input Speed Command -- Differential or single ended analog input signal (± 10 VDC) which is directly proportional to desired operating speed.

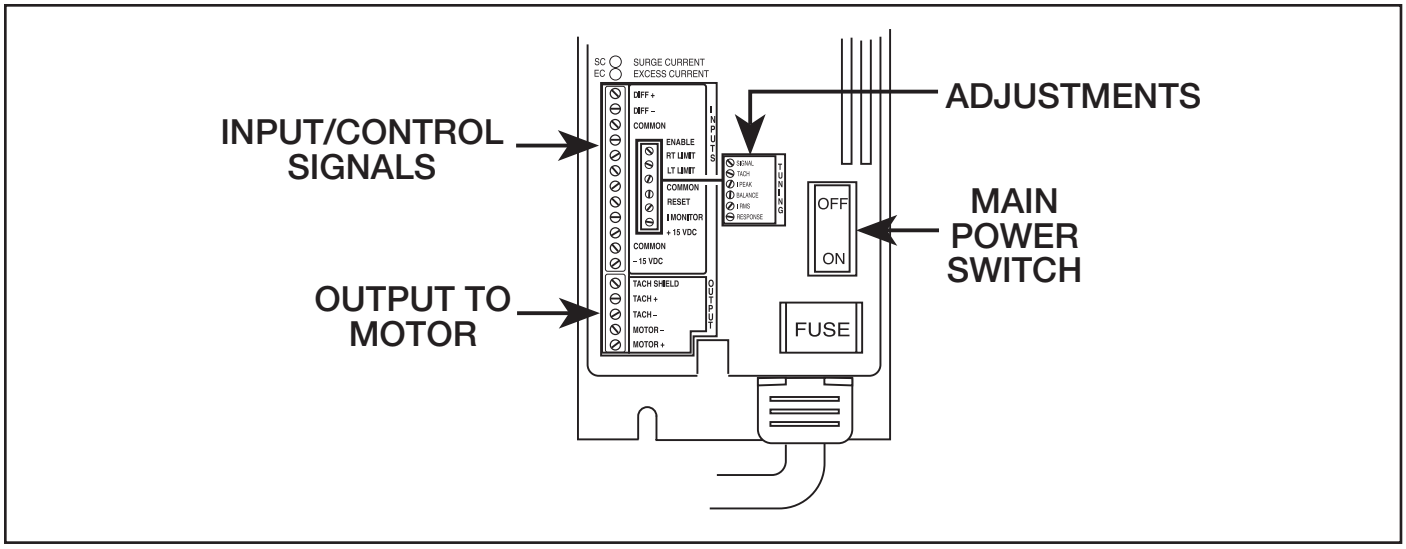
Enable -- The enable line must be connected to ground, or common, before the servo control can deliver power to move the motor/load.

CW and CCW Limits -- Travel limit inputs are provided for those applications requiring safety end of travel (EOT) limits. Normally closed switches (i.e. grounded) should be connected to enable operation in the appropriate direction.

Reset -- After a fault condition is fixed, the servo control must be reset before operation can occur again. A normally open switch connected between this input and ground will reset the "TSD".

Current Monitor -- An output that provides an easy to use analog signal representing current applied to the motor.

Figure 1-1 TSD FRONT PANEL



1.3.2 Outputs

A separate, easily accessible, front panel connector provides output to the motor/tachometer. Clearly labeled identification indicates motor power and tachometer terminals (see Figure 1-1).

Motor (+ and -) -- Provides main power to the motor.

Tachometer (+ and -) -- The prime feedback for proper closed loop velocity control of the “TSD”. Note that when the “TSD” is used in the current (torque) mode of operation, it is not necessary to make this connection, since the host motion controller will be closing the velocity/position loop.

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1.3.3 On/Off Switch

A conveniently located on/off switch is located in an easily accessible location on the front panel. This turns the "TSD" servo control on and off.

1.3.4 Adjustments

The servo control contains six tuning adjustments (15 turn potentiometer) which are accessed through the front panel (see Figure 1-1). A description of each potentiometer is provided below:

Signal -- Adjusts the gain of a single ended or differential input voltage between ±10 VDC. This enables the user to fine tune the motor speed for a given signal input voltage.

Tach -- Adjusts the tachometer circuit gain enabling the servo control to handle a variety of tach voltage gradients. This enables the user to adjust system stiffness as it is commanded to change speeds.

Response -- Adjusts the overall velocity loop gain. This enables the user to adjust overshoot to minimize the overshoot of the axis when responding to a step input voltage.

I Peak -- Limits peak current output to the servo motor. This reduces peak current in applications which are subjected to constant acceleration and deceleration changes protecting a motor from either demagnetizing or burning up.

Balance -- Used to compensate for offset drift errors. This will allow for fine tuning to prevent system movement with zero input signal voltage.

I RMS -- Limits the continuous current output to the servo motor. This reduces current in applications when a smaller motor is used, protecting the motor from burning up.

Optional Adjustments

Personality Module: Each servo control contains one personality module per axis. This module aids in testing and servicing because it allows you to swap modules without recalibrating the drive. Each personality module contains one jumper that can be configured for either velocity or current (torque) mode. This is the “P1 Jumper” The personality module is located under the cover of the “TSD”, it is a small PC board, mounted on pins which connect it to the main PC board; it can be identified easily since the pot adjustments are mounted on it.

Excess Current Latch vs. Foldback: If the drive continuously exceeds rated current, it will fault (latch) and light the excess current LED. This can be changed to foldback to 50% of current by moving a jumper on the main drive card. There is one for each independent axis.

Dual Fault Mode: In this mode the fault logic is interlocked between the two axes such that when a fault occurs on either or both axis, both are disabled. A fault indication is only on the true faulting axis. When jumper P101 is in position 1-2 the drives are not interlocked and each can fault independently.

For further information on jumper options, refer to “Section 6 - Special Functions”.

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1.3.5 Indicators

Each servo axis contains four (4) red fault indicators with an additional green indicator located on the front of the unit (see Figure 1-2). Each fault indicator is a latch type fault function in which the servo control will not function when tripped. A reset must be done in order to restart. Refer to “Section 4 - Troubleshooting” for detailed information.

Voltage Error (VE) -- Identifies either excess bus voltage or insufficient logic voltage at the servo driver.

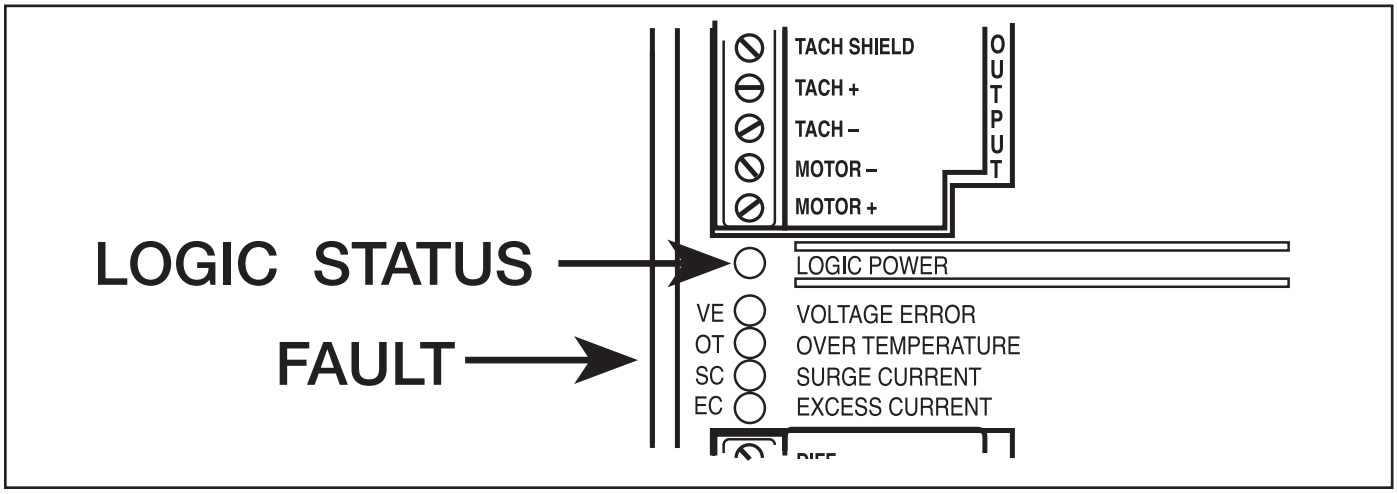
Excess Current (EC) -- Identifies excess RMS current.

Surge Current (SC) -- Identifies a peak current draw which exceeds the rating.

Over Temperature (OT) -- Identifies an unsafe temperature condition.

Status Indicator -- A green status indicator indicates and verifies that the logic power supply is functioning properly.

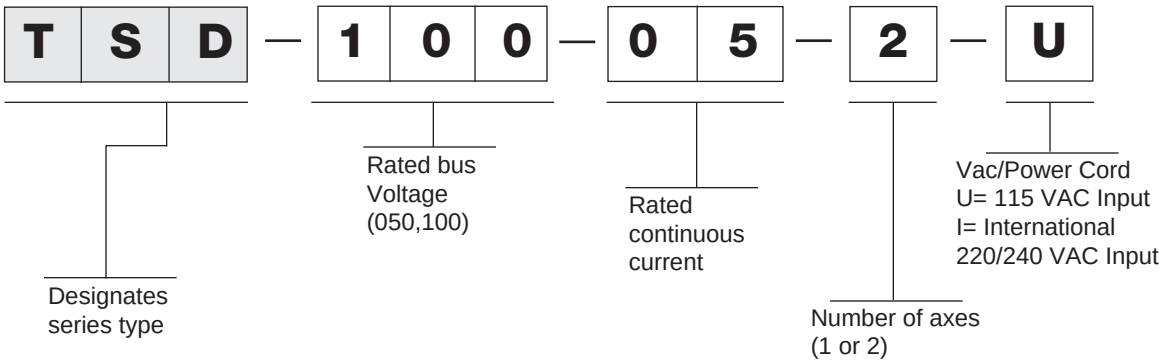
Figure 1-2 TSD INDICATORS



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1.4 MODEL INFORMATION

The “TSD” Series is specified by model numbers that describe key parameters of each unit. An example is listed below.



The “TSD” can be configured with either 50 or 100 VDC bus voltage and either 1 or 2 axis. All models have a switching frequency of 20 KHz and peak and continuous ratings of 10 and 5 amps respectively. Each axis of each unit can be independently configured for either velocity or current (torque) mode.

1.5 REQUIREMENTS TO GET STARTED

1.5.1 Tools

A few basic tools are required (and recommended) to install the “TSD” servo driver.
Other common tools recommended would include solder iron, solder, crimp tools, wire stripper.

REQUIRED	FUNCTION
Slotted screw drivers small size	Screw terminal strips
Slotted screw drivers, very small (pot adjustment tool)	Potentiometer adjustment
VOM meter (highly recommended)	Testing continuity, verifying voltage, current polarity etc.

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1.6 - SPECIFICATIONS

SPECIFICATIONS	TSD-050-05-*-U or I		TSD-100-05-*-U or I	
	-1	-2	-1	-2
GENERAL SPECIFICATIONS				
Operating Temp. (ºC)	0-50	0-50	0-50	0-50
Drift (µV/ºC)	10	10	10	10
Weight (lbs)	14	19	15	21
Footprint (inches)				
Height	12	12	12	12
Width	4.5	4.5	4.5	4.5
Depth	7.5	7.5	7.5	7.5
OUTPUT SPECIFICATIONS				
Rated Bus Voltage (VDC nominal)	50	50	100	100
Continuous Current (A)	5	5	5	5
Current Limit Adjustment (A)	0-5	0-5	0-5	0-5
Peak Current (A)	10	10	10	10
Maximum Time (seconds)	2	2	2	2
Peak Current Adjustment (A)	0-10	0-10	0-10	0-10
Switching Frequency (kHZ)	20	20	20	20
Form Factor	1.01	1.01	1.01	1.01
Minimum Inductance (mH)	1.0	1.0	1.5	1.5
Frequency Response (kHZ)	2.5	2.5	2.5	2.5
Positive Logic 15 VDC (mA)	20	20	20	20
Negative Logic 15 VDC (mA)	20	20	20	20
INPUT SIGNAL SPECIFICATIONS				
Differential Input (± VDC)	5 to 15	5 to 15	5 to 15	5 to 15
Impedance (kΩ)	20	20	20	20

POWER SPECIFICATIONS	VERSION U	VERSION I
AC Input Power (VAC)	115 60 Hz	240 50 Hz
Input Range (VAC) Number of Phases	105-125 1	216-264 1

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Section 2
Installation

2.1 INTRODUCTION

The installation information provided in this section covers general precautions that should be considered, general wiring considerations to be followed, how to unpack the unit, connecting the servo control, mounting the chassis and the wiring instructions.

2.1.1 General Precautions

The "TSD" package should be installed in an environment where: (1) the equipment ambient temperature does not exceed 50ºC; (2) operational altitude does not exceed 10,000 feet above sea level; (3) atmosphere is free of highly flammable or combustible vapors, corrosive chemical fumes, oil vapors, steam, excessive moisture and conductive particles.

WARNING: THE "TSD" SERVO CONTROL EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THE EQUIPMENT. OBSERVE THE FOLLOWING POINTS FOR YOUR SAFETY:

(1) Do not touch any live circuits, voltages up to 115 volts AC may be present when power is applied.

(2) Do not make any adjustments on the equipment or its associated motors unless thoroughly familiar with the equipment

(3) Do not touch or make any adjustments to internal circuits unless all power has been shut off for at least three (3) minutes.

2.2 UNPACKING

Each "TSD" is thoroughly inspected and tested by Baldor. It is shipped in a carton especially designed to protect it from damage in transit and storage. Examine the servo control immediately after receiving it, for transportation damage. Should damage be discovered, immediately notify your forwarding agent and your insurance company.

This equipment should be stored in its original carton in a cool and dry place until it is mounted and connected for its intended use.

1. Open the servo control package carton carefully by cutting away the tape along the top of the box and removing staples.
2. Lift the servo control out of the carton.
3. Place the unit upright on a clean, dry and stable surface.
4. Inspect for damage and verify the contents according to the packing list and assembly drawings located in Appendix A of this manual.

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2.3 MOUNTING THE CHASSIS

1. Select an appropriate mounting location that meets the requirements spelled out in General Precautions in this section.
2. Lay out the hole pattern according to the dimensions of the panel. Refer to Appendix B for dimensions.
3. Cut any wiring openings needed in the cabinet, deburr the edges and bolt the chassis securely within the equipment enclosure. Use one of the mounting bolts to attach a ground strap to earth ground.

2.4 GENERAL WIRING CONSIDERATIONS

Care should be taken to see that all interconnecting wiring is sized and installed in conformance with the National Electrical Code (NEC) or Canadian Electrical Code (CEC) and other applicable local codes.

To minimize electrical interference problems, interconnecting wires should be arranged in groups. As a minimum, two groups should be used; (1) high current, high voltage power wiring such as main power input, 115 VAC for fans, relays, contactors, etc. DC wiring for armature and (2) low level signal wiring such as input velocity command (VCS), tachometer feedback, inhibit/enable signals, etc. It is recommended that wire groups be separated by at least one foot, or run in separate shielded grounded conduits. All wiring should be kept as short as possible. As a general rule, use only wires of adequate size for their length and current being carried. Specific recommendations for each major group follows. For critical applications, finer subdivision into wire groups of like functions is advised.

2.4.1 Power Wiring

All power wiring for the motor (+ and -) connections should be no less than 16 AWG gauge or equivalent rated wire. It is suggested that DC bus power wires be run as twisted pairs, i.e., twist the wire carrying current with the same wire returning the current. Twisting the DC bus (armature) wires will reduce radiated electrical noise. In systems particularly sensitive to electrical noise, use of shielding for the armature wiring might be considered.

2.4.2 Grounding

Proper grounding helps guard against electrical shock to personnel and can reduce the effects of electrical noise interference. Each servo control assembly should be grounded. One mounting bolt can be used to attach a ground wire. The chassis ground wire should have a green or green with yellow stripe insulation. In addition to the chassis grounds, the cabinet which houses the equipment should have a separate connection direct to earth ground on the power distribution panel.

The system ground should be designed with individual ground wires converging to a single earth ground point. Ground wires should be short and large enough to carry the maximum short circuit current rating of the circuit, as determined by the fuse rating on the incoming power. The customer should consult local governing codes for compliance with safety regulations before finalizing the grounding system.

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2.4.3 Input Signal Wiring

All signal wiring and limit circuit wiring need not be larger than 22 AWG gauge. Signal circuits including the tachometer, should employ twisted, shielded pairs. Proper termination of shielded cables is important to avoid creating ground loops or otherwise degrading the noise immunity of the servo control Note that cable shields should be terminated at one end only; the other end should be left floating but insulated by electrical tape or some other means to prevent contact with any metallic part. In most applications, satisfactory noise immunity will be realized with the signal line shields terminated at the respective signal input points.

NOTE: ALWAYS REFERENCE THE SHIELD TO THE LOW SIDE OF THE SIGNAL WIRES WHICH THE SHIELD IS TO PROTECT. EARTHING OR GROUNDING THE SHIELD DOES LITTLE GOOD UNLESS THE SIGNAL IS ALSO REFERENCED TO THE SAME POINT.

It is important to maintain the continuity of cable shields through any intervening connectors and/or terminal blocks. Also attempt to minimize the length of unshielded cable at these interconnections.

2.4.4 Electrical Noise Suppression

Electrical noise suppression requires a thorough system design using a combination of good grounding practices, shielded cable, cable separation and suppressors. The customer must provide suppression of transient voltages in his equipment which may occur when interrupting current to an inductive load.

2.5 WIRING INSTRUCTIONS

Whether a one or two axis “TSD” has been purchased, the wiring procedure is basically the same. When applicable, repeat the following steps to connect the second axis.

2.5.1 Motor/Tachometer Wiring

Wire the unit according to the National Electrical Code (NEC) and local requirements. Armature and AC input wiring should be appropriate for the continuous rated current for the motor being used.

For the following wiring instructions, refer to figure 2-1 before connecting the “TSD” servo control and integrating it into the system.

NOTE: DO NOT CONNECT AC POWER TO THE UNIT YET!

1. First connect the negative (typically black) wire from the motor to the connector marked “MOTOR (-)”.

2. Connect the positive (typically red) wire from the motor to the next terminal down marked “MOTOR (+)”.

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3. Connect the positive lead from the tachometer to the terminal marked “TACH (+)”.

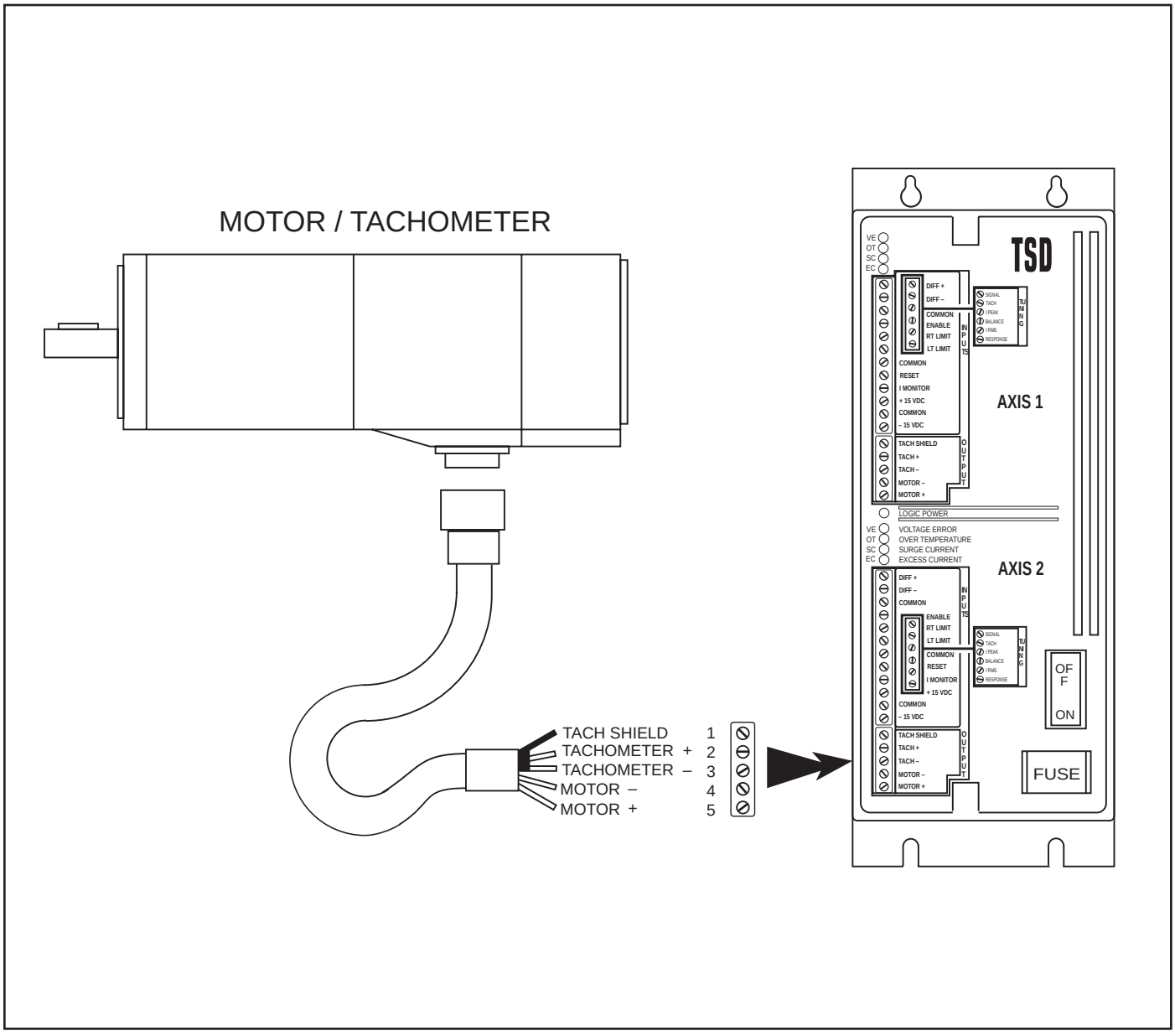
4. Connect the negative tachometer lead to the terminal marked “TACH (-)”.

5. If the motor cable has a shield, connect it to the pin marked “TACH SHIELD”.

6. Verify the first axis tachometer signal by rotating the 1st axis motor shaft by hand while monitoring the tach leads with a VOM. A clockwise motor shaft rotation should produce a positive tach output voltage.

Repeat the above step by step motor/tachometer wiring procedure for the second axis.

Figure 2-1 Motor/Tach Wiring



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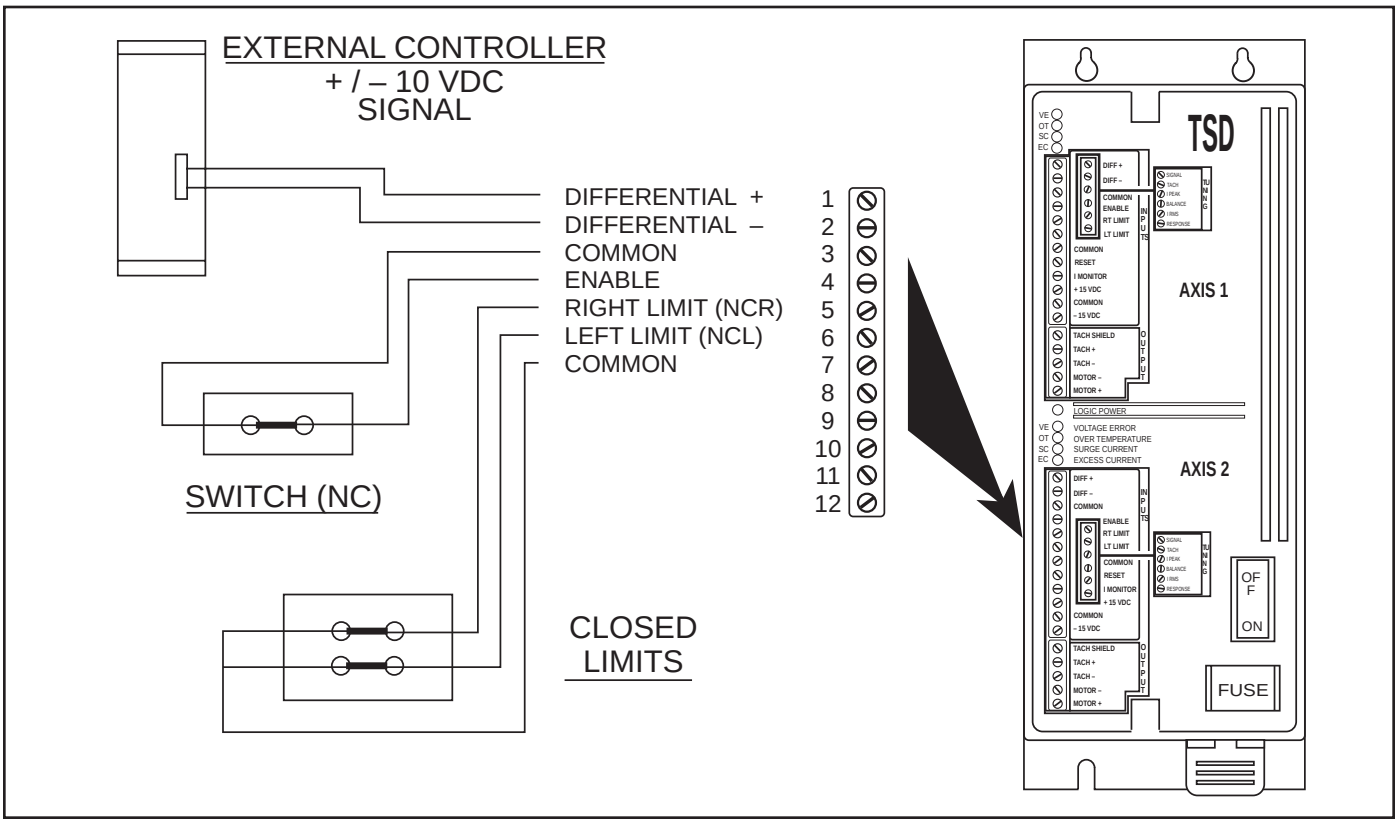
2.5.2 Signal Input Wiring

Refer to Figure 2-2 before connecting “TSD” and integrating it into the system.

NOTE: DO NOT APPLY VOLTAGE AT THIS TIME!

1. Connect the first axis input velocity command signal (VCS) wires to the 1st axis, marked “DIFF (+)” and “DIFF (-)” (pins 1 and 2 respectively); connect the common to pin 3. If a voltage signal is not available from an external controller, refer to Optional Signal Input Wiring in this section.
2. Connect a switch between “ENABLE” (pin 4) and “COMMON” (pin 3). This should be a normally closed switch (i.e. tied to common) for unit operation; opening this switch will disable system operation, and the servo motor will coast to a stop. If the machine control you are using does not have options for a remote enable, then tie ENABLE to common. For some applications, an emergency E-switch would be wired into this circuit. Refer to EMERGENCY STOP in Section 6.4 for additional information.
3. Connect the “RIGHT LIMIT” or “Normally Closed Right” (NCR --pin 5) and “LEFT LIMIT” or “Normally Closed Left” (NCL --pin 6) as illustrated in figure 2.2. Note that one side of these switches should be connected to pin 7 (common). These are normally closed (i.e. tied to common) to assure operation. When opened, the motor will coast to a stop, and it will not be possible to operate in that direction; it is possible however to jog off the closed limit switch. Note that if an application does not call for RIGHT and LEFT LIMITS, it is possible to wire these directly to common.

Figure 2-2 Signal Input Wiring



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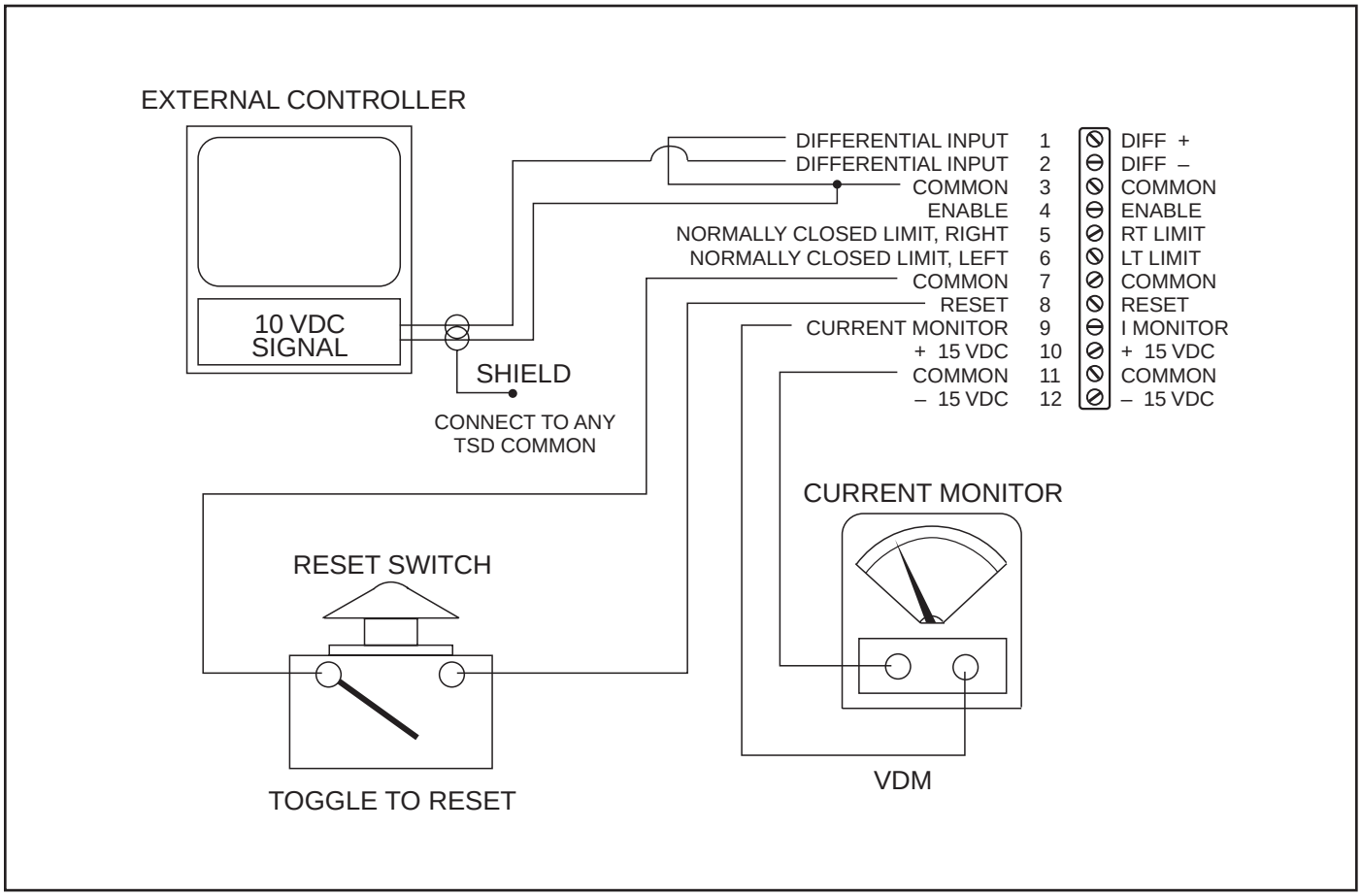
2.5.3 Optional Signal Input Wiring

NOTE: DO NOT APPLY VOLTAGE AT THIS TIME!

Single Ended Input -- The "TSD" Servo control can be configured to operate using a single ended command input signal as illustrated in Figure 2-3.

Current Monitor Interface (I MONITOR --Pin 9) -- This is an analog representation of amplifier current. Using an oscilloscope, the output current can be monitored. An analog output voltage of 1 volt represents approximately 1 amp of current.

Figure 2-3 Optional Wiring



Reset Function (Pin 8) -- This is a normally open switch function which will reset the "TSD" after it has faulted and shut down due to one of the following conditions:

High bus or low bias voltage (VE Indicator ON)
Over Temperature (OT Indicator ON)
Excessive Surge Current (SC Indicator ON)
Excess Current (EC Indicator ON)

After the fault condition is removed, the reset switch can be toggled. This will enable (restart) the "TSD".

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+15 VDC/-15 VDC (Pins 10 & 12) -- This is an available logic power source (20 mA maximum) which can be used to support external devices or can be used with a voltage divider network to provide the signal input to the servo control.

2.5.4 AC Power Wiring

CAUTION: MAKE SURE THAT THE MAIN POWER SWITCH ON THE FRONT PANEL IS IN THE "OFF" POSITION.

Plug the female end of the power cord included into the receptacle on the bottom of the "TSD". The AC input power cord provided has the appropriate gauge for its length and load. For your convenience a cord strain relief has been provided near the receptacle.

Plug the male end of the cord into your wall outlet. If you are connecting to a power strip and need to cut off the end of the cord be sure to keep the wire polarity straight. Use an OHM meter to reconfirm proper wiring polarity.

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Section 3
Start Up

3.1 GENERAL INFORMATION

The start up information provided in this section contains the procedures necessary to get each axis running and properly tuned using the six (6) adjustment potentiometers on the servo control. Each axis should be started up independently to insure that catastrophic problems do not cause damage to the equipment. Make provisions to quickly disconnect power if this should become necessary.

NOTE: FOR POSITIONING APPLICATIONS, THE TSD SHOULD BE CONFIGURED IN CURRENT (TORQUE) MODE. REFER TO SECTION 6.2 FOR CURRENT MODE SETUP AND POTENTIOMETER SETTINGS.

CAUTION: READ THIS ENTIRE SECTION AND BECOME FAMILIAR WITH THE START UP PROCEDURE BEFORE APPLYING POWER.

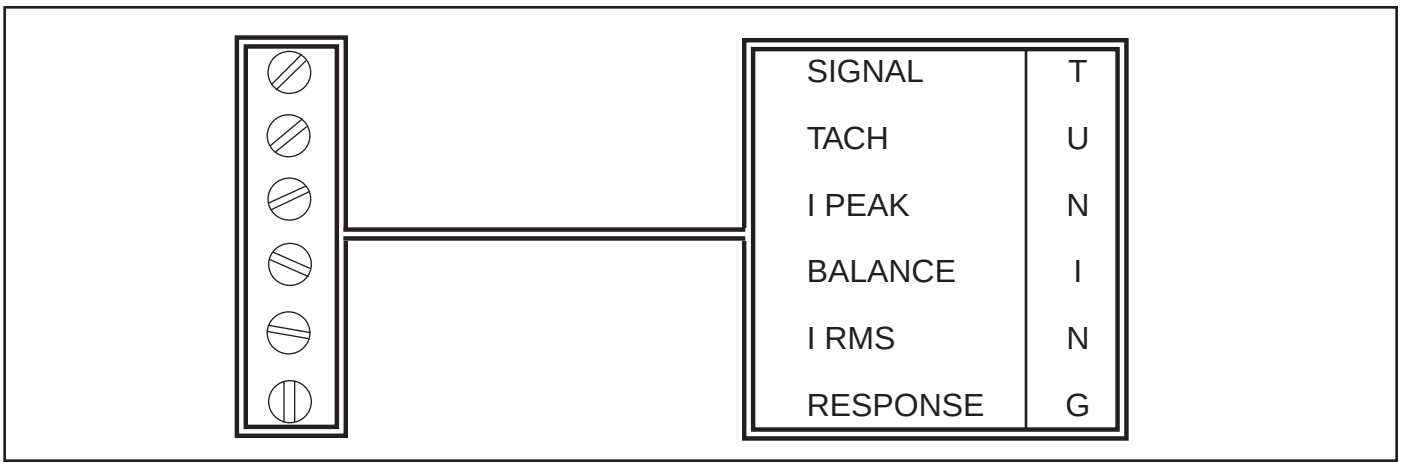
3.2 INITIAL POTENTIOMETER SETTING

Before power is applied to the unit, the potentiometers on each servo control should be set to the following default positions (refer to Figure 3-1):

POTENTIOMETER	POSITION
SIGNAL	Fully counterclockwise
TACH	Fully clockwise
I PEAK	Four turns clockwise
BALANCE	Leave as shipped
I RMS	Four turns clockwise
RESPONSE	Fully counterclockwise

NOTE: ALL POTS ARE 15 TURN AND ARE WITHOUT A HARD STOP. AN AUDIBLE "CLICK" MAY BE HEARD WHEN THE END IS REACHED.

Figure 3-1 Pot Settings



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3.3 START UP (Power On)

It is advised that power is applied and adjustments made with only one motor axis connected at a time. It is further advised, that these adjustments be made on an unloaded motor (i.e. not connected in the equipment or machine). After preliminary adjustments and a familiarization with the "TSD" is acquired, the servo motors may be connected to the load. This will minimize the potential of damage to the machine. Note that the tuning procedure would have to be repeated after the load is connected in order to attain optimum performance.

CAUTION: IT MAY BECOME NECESSARY TO QUICKLY REMOVE POWER. IF THE MOTOR AND/OR TACHOMETER IS IMPROPERLY CONNECTED, A RUNAWAY CONDITION WILL OCCUR.

1. Make sure that the ENABLE and LIMIT connections are in place.

2. Apply the 115 VAC to the AC power input by pushing the "ON" switch located on the "TSD" panel.

3. Observe that the green LED in the center of the front panel labeled "LOGIC POWER" comes on. On some units, fan operation will also be heard.

4. Observe that the servo motor on the first axis did not rotate. If the servo motor runs up to a high speed at an uncontrolled rate, reverse the tachometer or armature leads. By reversing the tach lead polarity the speed loop will be closed in the same direction that the motor is rotating. Switching armature leads will also close the speed loop, but the motor will rotate in the opposite direction.

3.4 ADJUSTMENT PROCEDURE

The following procedure will allow proper potentiometer set up to obtain optimum servo control operation.

1. Apply a signal input command between 0 and 10 VDC at the "DIFF (+)", and "DIFF (-)" on the signal input connector. Suggest using a +5 VDC input voltage. A -5 VDC would result in the opposite motor rotation direction (CCW). If the motor shaft does not rotate, turn the SIGNAL, I PEAK, and I RMS posts four (4) turns clockwise until rotation occurs. If the motor shaft rotates in the wrong direction for a given polarity of the signal input voltage, reverse both the tachometer wires along with the motor's red and black armature wires.

CAUTION: THE MOTOR MAY TEND TO RUN AWAY, OUT OF CONTROL, IF THE TACH WIRES ARE REVERSED. IF THE AXIS MOVES IN THE WRONG DIRECTION, THE MOTOR WIRES ARE REVERSED. IF, HOWEVER, REVERSING THE LEADS DOESN'T STOP A RUNAWAY MOTOR, MAKE SURE THE TACH POTENTIOMETER IS NOT FULL COUNTERCLOCKWISE.

2. Slowly turn the SIGNAL pot four (4) turns in the clockwise direction observing that the motor shaft rotates at a reasonably controlled rate.

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3. Slowly turn the I PEAK pot four (4) turns in the clockwise direction observing that the motor shaft speed may increase and stabilize. If the motor shaft runs to a high or uncontrolled rate, reverse the tach wires coming to the signal input connector.

4. If connected, verify that the LEFT and RIGHT LIMIT switches properly inhibit the axis travel in the direction defined.

5. Slowly turn the SIGNAL pot clockwise to increase the motor speed to full.

6. If a high output voltage tachometer is used, it may be necessary to turn the TACH pot a few turns counterclockwise to adjust and fine tune for exactly the desired speed.

7. Slowly turn the I PEAK pot to the full clockwise position **only** if the servo control's peak current is less than the rated peak current of the motor. If the peak motor current is less than that of the servo control, a reduced current must be maintained, otherwise the motor may burn out. The I PEAK pot is a 15 turn pot which would represent full servo control output current (7 1/2 turns would represent 1/2 output peak current). Adjust I PEAK to the motor's capability.

8. Note that the I RMS pot must also be adjusted to limit current to the motor if the servo control's capability is greater than the motor's capability. This is to prevent the motor from burning out. The I RMS pot is a 15 turn pot; full CW would allow the servo control to output it's full rated current (7 1/2 turns would output 1/2 rated current). Adjust the pot so the servo control output equals the motor's capability.

NOTE: THE FOLLOWING STEPS SHOULD BE REPEATED AFTER THE EQUIPMENT HAS BEEN INSTALLED WITH A LOAD AND CONTROL APPLIED FOR THE FINAL FINE TUNING.

9. If the motor shaft rotates with the signal input voltage at zero, slowly adjust the BALANCE pot to eliminate any motor shaft rotation.

10. The adjustment of the RESPONSE pot may be accomplished by one of two methods:

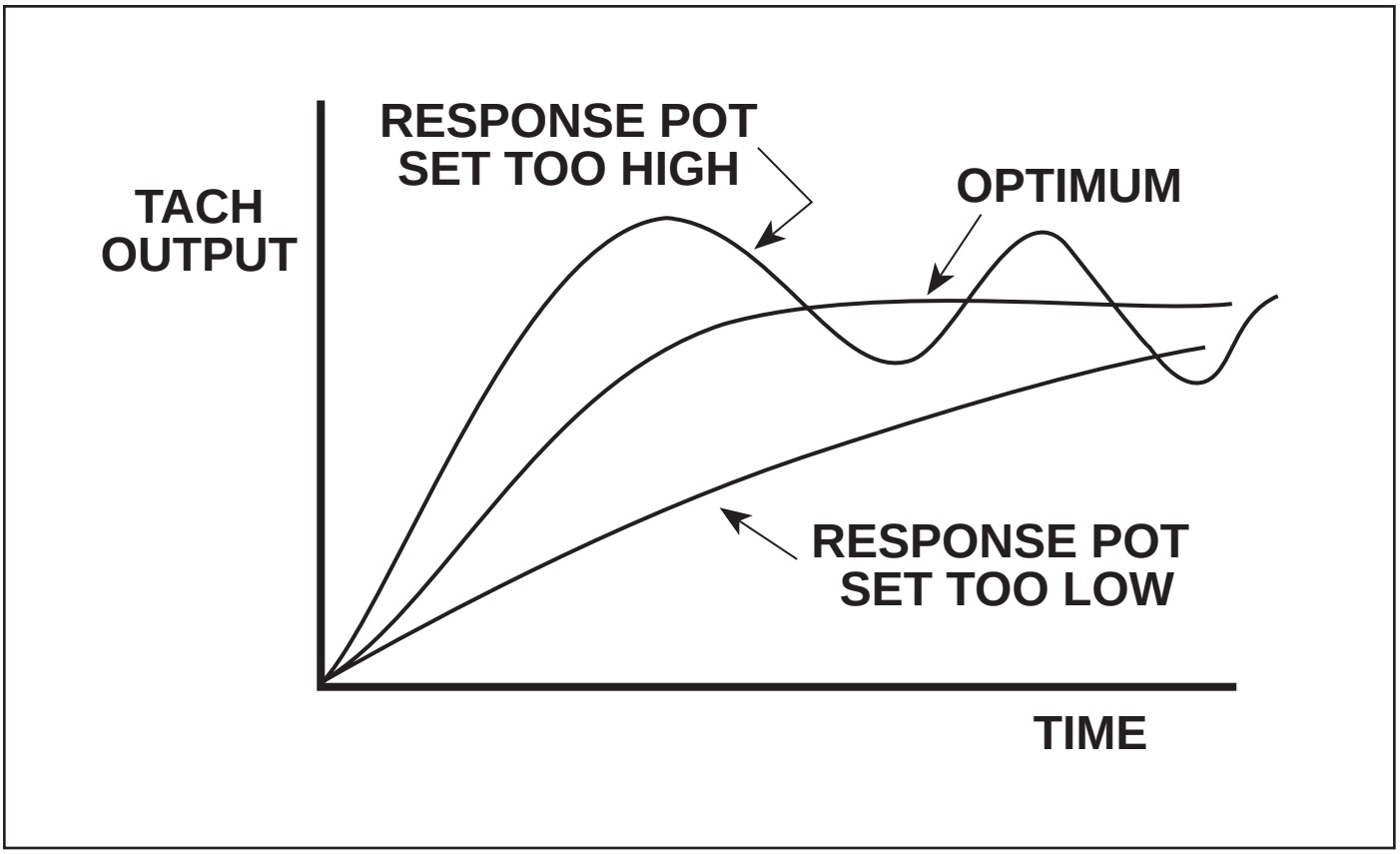
    A). Slowly turn the RESPONSE pot in the clockwise direction until the axis becomes unstable and then turn the pot back one full turn in the counterclockwise direction.

    B). Using a step input command with amplitude of 10% of full desired speed, and a suggested duration of 1 second on/1 second off, adjust the RESPONSE pot in the clockwise direction (while monitoring the tachometer output signal on a scope) until the desired response is obtained. Refer to Figure 3-2 for typical responses.

    Note that if the servo drive system is unstable at all pot settings there is probably a mechanical resonance.

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Figure 3-2 Typical Responses



11. If the motor shaft overshoots when stopping, turn the TACH pot in the counterclockwise direction being careful not to turn to full counterclockwise. Full counterclockwise on the TACH pot may cause the motor shaft speed to become uncontrollable.

12. The SIGNAL pot can now be adjusted to optimize the maximum response for the given signal input voltage range. Note that steps 9 thru 11 may have to be repeated.

Repeat the Wiring Instructions in Section 2.5 of this manual and the Start Up procedure in this section for the second axis if you have a two axis unit.

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Section 4
Troubleshooting

4.1 GENERAL INFORMATION

This troubleshooting section describes the symptoms of possible malfunctions along with information needed to check and correct the causes of a fault. Most of the faults can be identified by using the four LED fault indicators and a VOM.

Unless the cause of a malfunction is obvious and readily correctable, replace the whole “TSD” with a new one. This will get the system running most quickly and reduce the equipment down time.

Under no circumstances should you modify or replace any module components. This could compound the problem as well as void the equipment warranty.

In addition, if a problem develops in a system that was previously operating well, do not make any adjustments without first diagnosing the cause or causes. To arbitrarily readjust the unit will only compound the problem. Work from the four LED indicators and from the troubleshooting table in this section.

WARNING: THE SERVO CONTROL EMPLOYS VOLTAGES THAT ARE DANGEROUS AND CAN CAUSE INJURY TO PERSONNEL OR EQUIPMENT. CAUTION SHOULD BE EXERCISED AND THE FOLLOWING RULES OBSERVED.

4.1.1 Initial Checks

Begin your troubleshooting with a systematic and complete check of power lines and input signals to the servo control.

1. Check the 115 VAC input power (240 V on International units).

2. Check to see if the green logic power LED is lit.

3. Check for an open fuse. Refer to Section 4.1.2.

4. Check input speed command signals. Determine that they reach the servo driver input connector.

5. Check the external EOT limit switches if used, to determine that they are functioning properly.

6. Check for loose or broken terminals.

7. Check for damaged control or equipment wiring.

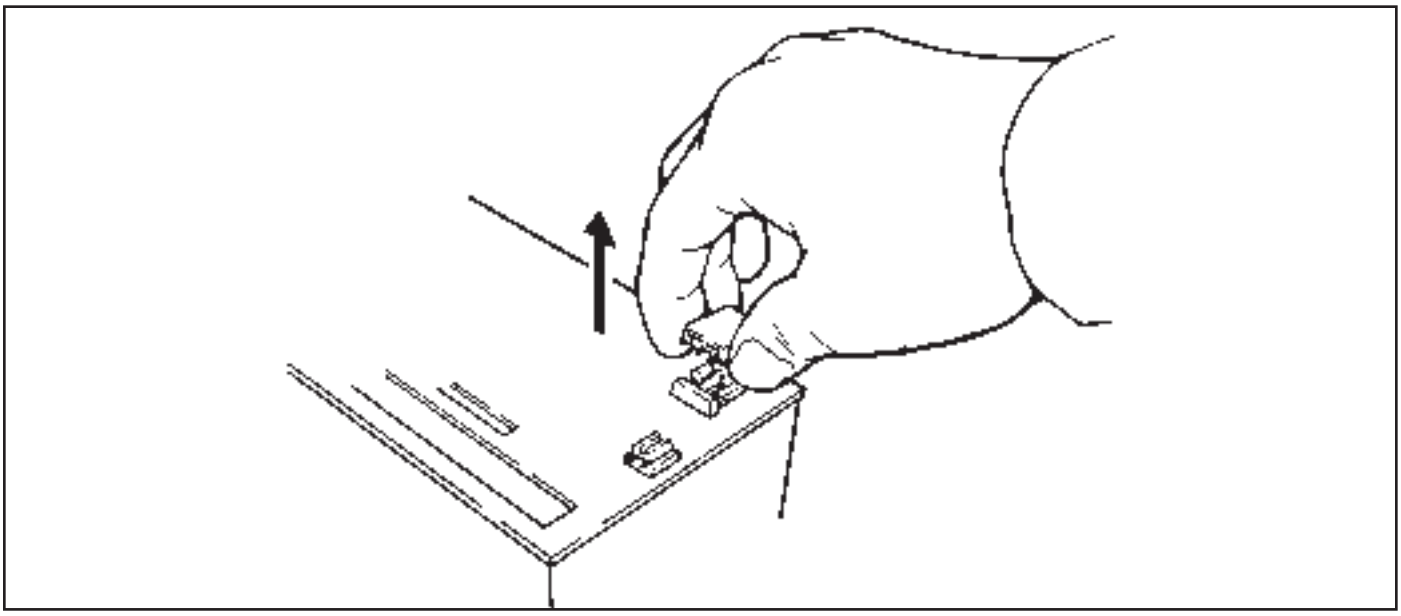
8. Check for the correct jumper positions.

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4.1.2 Checking the Incoming AC Line Fuse

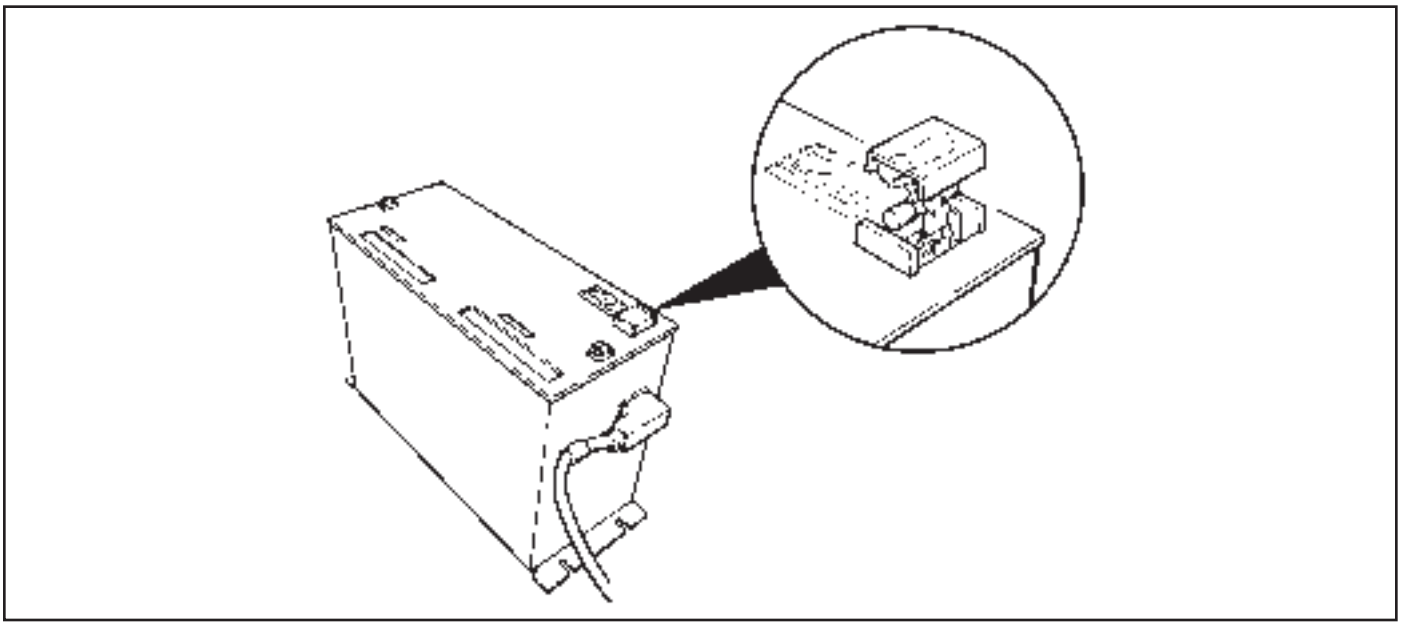
The “TSD” has a line fuse located underneath the front panel fuse-holder cover. To gain access, place your finger on the top of the fuse cover and move it as shown in Figure 4.1. Now grasp the cover and raise it away from the front panel, approximately 3/4 of an inch.

Figure 4.1 Access to AC Line Fuse



As shown in Figure 4.2 you will find 2 fuses inside. The lower one is the main AC fuse and the fuse located just underneath the cover is a spare. Check the fuse with an ohmmeter. If defective, either substitute the spare or replace with an equivalent brand.

Figure 4.2 Fuse Location



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4.1.3. Resetting the Servo Control

In order to reset a servo control with a fault, the following procedure MUST be performed.

1. Check over the servo control and wiring for obvious problems.

2. Review the following troubleshooting table for a possible explanation of the cause and corrective action to be taken.

3. Reset the axis or package by one of two means; remove and reapply logic power to the chassis, or take the reset line on the signal input connector and touch it to common and release. When performing a reset it is a good idea to remove any signal input command (signal = 0 Vdc).

TABLE 4.1. TROUBLESHOOTING

SYMPTOM	CORRECTIVE ACTION
No Torque in one direction.	Check left or right limit switch wires to insure that they are closed, that is, connected to common. Verify that the proper limit switches are used.
No output in either direction.	Check reset wires to insure that they are not tied to common. Perform setup procedure and verify all connections and observe the green LED lit on front. If the green LED is not lit, check the fuse on the front panel. Verify that the personality module is inserted. Check Dual Fault Mode.
Motor runs at uncontrolled speeds.	Verify that servo control is not set for current mode. Verify that TACH pot is not set full CCW. Reverse tach leads and verify that tach voltage is present at signal input connector when motor is running.
Oscillation in motor seen as instability or rocking of motor shaft. Motor may have growling sound.	Refer to Start Up and Adjustment Procedures for proper setting of RESPONSE and TACH pots.
Motor exhibits “dead zone” when responding to a signal input.	Verify that the bus voltage is sufficient for the motor. Refer to Start Up and Adjustment Procedures for proper setting of RESPONSE pot.

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FAULT INDICATOR	SYMPTOM	CORRECTIVE ACTION
VE	Low output voltage from logic power supply.	Check incoming power to logic power supply and verify that it is in specified range. If in range disconnect any external load on logic power and reset servo control. Check to insure TACH pot is not turned too far CCW.
	Over-voltage on bus.	Reset servo control and cycle axis. Watch for VE indicator to light during deceleration of axis. If VE indicator lights, increase the deceleration time rest, and cycle equipment until problem is resolved.
EC	RMS Current output is exceeded.	Check axis for instability (oscillation). Correct by turning response pot CCW. If not instability, look for high tach noise (over 5% p-p) by using an oscilloscope. If present, check tach shielding. Check the actual RMS current to the motor. It might be that the I RMS pot is turned down too far. If overloading is suspected, a larger servo control may be required. Contact your supplier for alternatives.
OT	Over-temperature on servo driver.	Verify that air circulation is present. Check for over-load using oscilloscope on I MONITOR line to determine current to motor. 1 volt is approximately 1 Amp. If not overloaded, unit should be returned for repair.
SC	Rated peak current has been exceeded.	Verify that motor has sufficient inductance. Refer to Specifications in Section 1. Reset servo control and see if problem immediately reappears. If so, check for short in motor or cable. If none, unit has internal short and should be returned for repair. If upon resetting servo control, the unit does not fault, cycle equipment while watching for a fault during acceleration. If fault occurs, increase acceleration time, reset and cycle until problem is eliminated.

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Section 5
Maintenance

5.1 - GENERAL

The servo control is designed for easy and straight forward maintenance. LED indicators provide immediate indication of servo driver status and fault indication.

WARNING: THE SERVO CONTROL EMPLOYS VOLTAGES THAT ARE DANGEROUS AND CAN CAUSE INJURY TO PERSONNEL OR EQUIPMENT. CAUTION SHOULD BE EXERCISED AND THE FOLLOWING RULES OBSERVED.

1. Remove the input power before performing any maintenance work on the servo control or motor. Allow time for the bus capacitor voltage to bleed down (typically 3 minutes).

2. Do not make any adjustments unless thoroughly familiar with the equipment.

5.2 - PERIODIC MAINTENANCE

The only periodic maintenance required on the servo control is an occasional inspection for accumulated dust or dirt on the heat sinks and circuit boards. Heat sinks must be kept clean for maximum cooling efficiency. Also, shop dust in some environments tend to be electrically conductive and can cause servo control malfunction.

WARNING: THE SERVO CONTROL EMPLOYS VOLTAGES THAT ARE DANGEROUS AND CAN CAUSE INJURY TO PERSONNEL OR EQUIPMENT.

1. If cleaning is needed, carefully vacuum loose dirt or use dry compressed air. On units equipped with a cooling fan, periodically clean the wire mesh air filter covering the fan.

2. Remove the input power and ensure that bus capacitor voltage has bled down before checking connections.

3. Periodically check all connections and fasteners for tightness.

5.3 - REPLACEMENT ASSEMBLIES

The following is a list of replacement assemblies and parts for the servo control. Use the Baldor part number when ordering.

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5.4 - ORDERING INFORMATION

Contact your original supplier (OEM/Distributor) for:

Price and availability information of replacement parts.

Information on repair policies and pricing. (All repairs require return authorization number).

REPLACEMENT PARTS

MFG. PART NUMBER	DESCRIPTION
WS01320A-00	AC Power Cord with Plug 120 VAC - 1 PH
WS00013B-00	AC Power Cord with Leads 240 VAC - 1 PH
HF01319A-00	Front Panel Fuse Holder
HF00179A-00	AC Incoming Line Fuse (Qty-2) 10 AMP - 250 VAC - SLOBLO 5 x 20 mm - Type T, Little Fuse #218010 or Equivalent
SW00924A-00	AC Power On/Off Switch
CB07310B-00	Personality Module - One per Axis (Located inside cover)
HY01175A-00	Printed Circuit Board Jumper or Shunt (Internal - Qty 3)
KM06502A-00	Screw Terminal Connector Kit Includes: Motor, 5 Pin Plug, 1 per axis, CL65001A-05 Signal, 12 Pin Plug, 1 per axis, CL65001A-12

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Section 6
Special Functions

6.1 CURRENT (TORQUE) MODE

The “TSD” servo control can be configured for current (torque) mode operation which is useful in applications where commanded motor torque must be proportional to a voltage at the signal input, or if a host position controller (like the Baldor PMC) is precisely controlling the velocity loop. The current mode operation differs from standard operation in that the velocity loop is basically disabled (gain is reduced from 6000 A /V to approximately. 6 A /V).

If the “TSD” is configured to operate in the current mode, then tachometer feedback to the “TSD” is not required. However, **feedback of some form is required**. In circumstances when the host position controller (such as the Baldor PMC) would be closing the velocity and position loops, the control would require feedback compatible with its design scheme.

Jumper “P1” on the “TSD” personality module (refer to Figure 6-1) allows you to select either velocity or current mode. The personality module is a small PC board, located under the cover of the “TSD”. To access, rotate the snap locks (located on the top and bottom of the front cover) and lift the cover.

WARNING: REMOVE ALL POWER BEFORE OPENING UNIT.

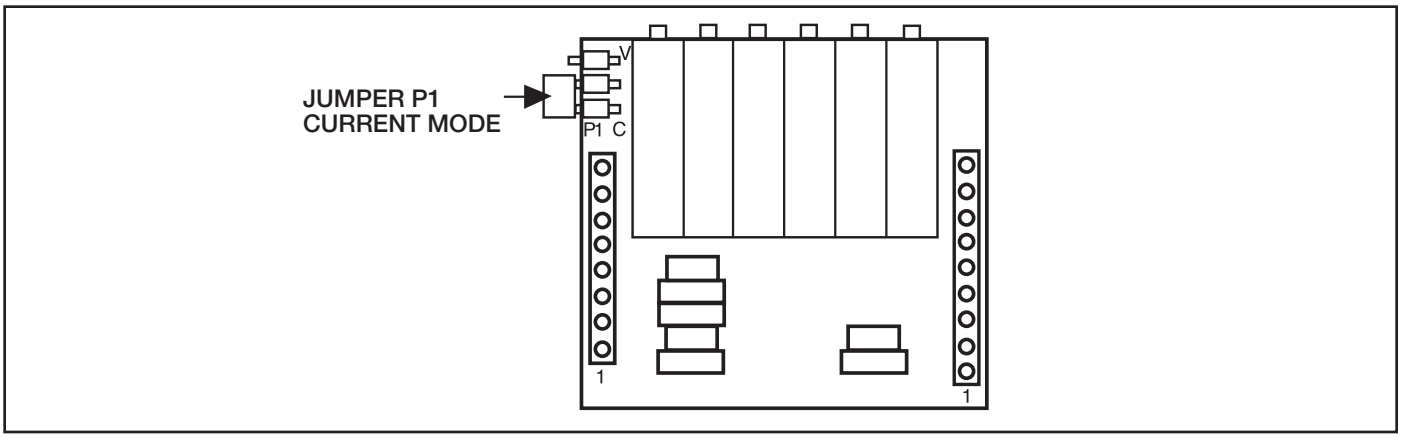
The personality module is a small PC board, mounted on pins which connect it to the main PC board, and can be identified easily since the pot adjustments are mounted on it (along with other components) including the “P1” jumper.

To convert a velocity control amplifier to a current amplifier (Refer to Figure 6.1):

1. Move the P1 jumper *on the personality module* onto the bottom pin (marked “C”) and the middle pin. The unit is shipped with the jumper (in velocity mode) located on the top pin (marked “V”) and the middle pin.
2. The TACH pot must be rotated fully counterclockwise.
3. The SIGNAL pot should be set fully clockwise.

If it should become necessary to remove the personality module, firmly grasp the small PC board by it’s edges, apply pressure, and lift away from the main PC board to remove it from the mounting pins.

Figure 6.1 - Jumper P1 Location



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6.2 - EXCESS CURRENT LATCH VS. FOLDBACK

The “TSD” can be configured to foldback to approximately 50% of rated continuous current when an excess current condition is detected. The factory configures the drive to trip (latch). This feature must be configured for each axis. These jumpers are located on the main PC board See Figure 6.2).

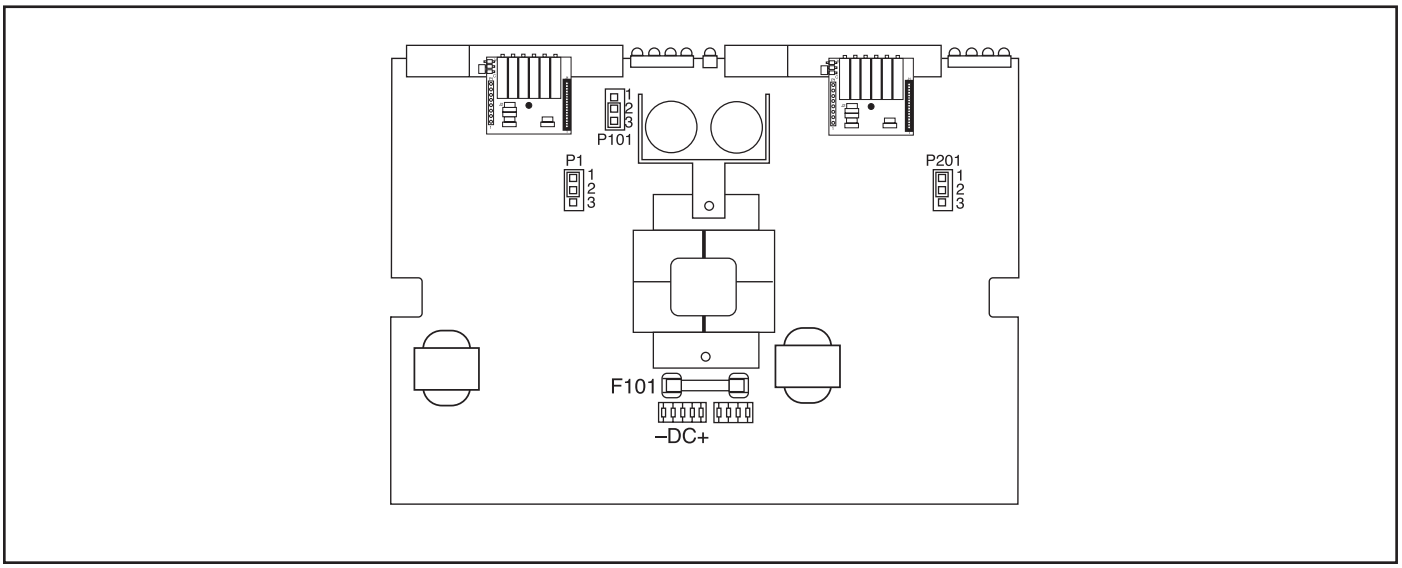
	Jumper #	Latch	Foldback
Twin Axis Unit			
Axis 1 (upper)	P201	1 to 2	2 to 3
Axis 2 (lower)	P1	1 to 2	2 to 3
Single Axis Unit			
Single (lower)	P1	1 to 2	2 to 3

CAUTION: DO NOT CONFUSE P1 ON THE PERSONALITY MODULE WITH THE P1 ON THE MAIN PC BOARD

6.3 - DUAL FAULT MODE (Two Axis Only)

The “TSD” is factory configured to disable both axes when a fault occurs (P101 factory setting 2-3). See Figure 6-2. A LED fault indicator only lights on the axis that has the fault. If independent operation is desired, place jumper P101 (on the main PC board) between pins 1 and 2. This jumper is on the main (large) PC board.

Figure 6-2 Optional Adjustments



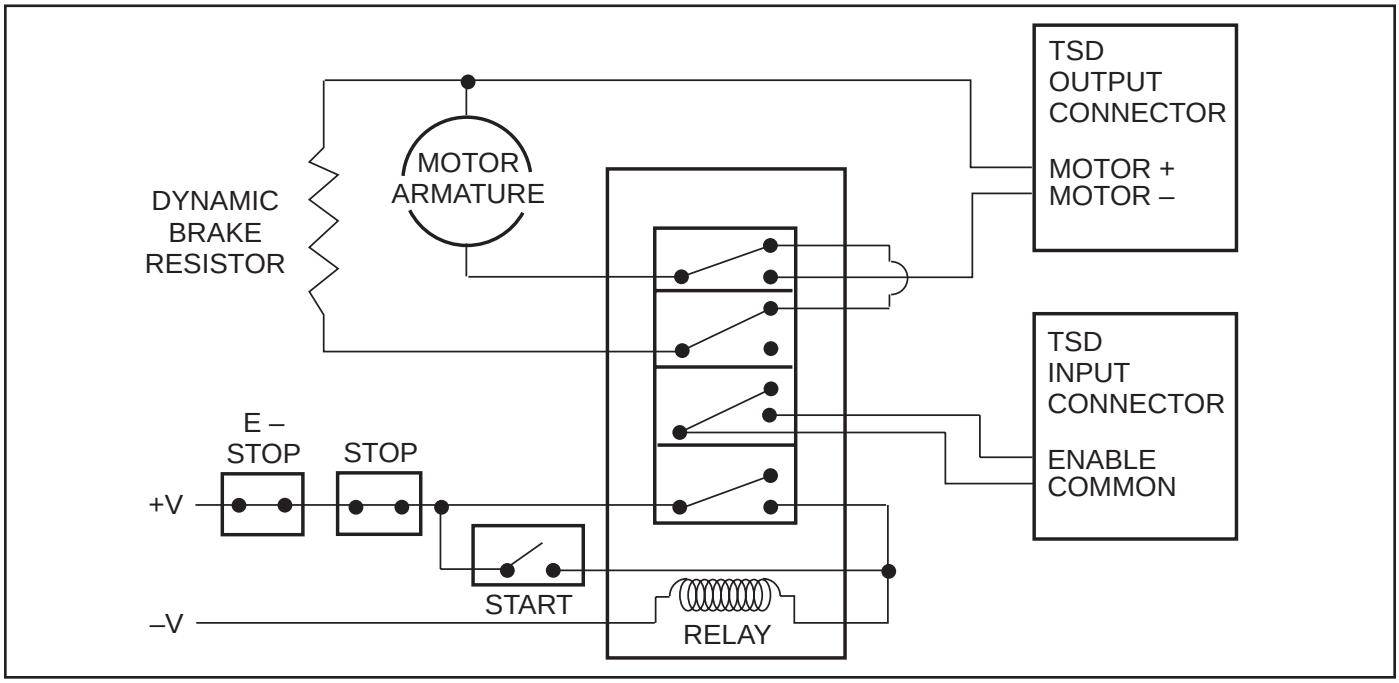
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6.4 - EMERGENCY STOP

In some applications, a requirement may exist to positively disconnect a motor in the event of an emergency (E) stop.

A suggested approach using a relay with 4 sets of contacts could be applied as shown in Figure 6-3, providing a power disconnect of motor and servo control in the event of E stop.

Figure 6-3 Power Contactor For Positive Disconnect



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Appendix A
Condensed Installation Instructions

A-CONDENSED INSTALLATION INSTRUCTIONS

STEP 1: COMPONENTS

Familiarize yourself with the equipment. You should have:

A. The "TSD" of the type and quantity you have ordered.
B. Accessories which also include:
   - AC power cord
   - Signal Input Connector (two for 2 axis)
   - Motor power connector (two for 2 axis)
C. Installation and Operating Manual

STEP 2: READ THE INSTALLATION AND OPERATING MANUAL

It contains detailed installation and start up procedures and drawings pertaining to your equipment. Specific CAUTIONS must be adhered to so that the equipment or personnel are not damaged or injured.

STEP 3: MOUNT THE MODULE

WARNING: DO NOT APPLY POWER UNTIL ALL CONNECTIONS ARE MADE AND CHECKED AND THE SAFETY PRECAUTIONS IN THE INSTALLATION AND START UP SECTIONS OF THE INSTALLATION AND OPERATING MANUAL ARE READ AND UNDERSTOOD.

STEP 4: WIRING

A. Connect motor armature and tach leads to the motor power connector(s). Plug these into the front panel.
B. Connect the input signal command, including enable, CW & CCW limits, to the signal connector(s) and plug these into the front panel.
C. Connect to the VAC power source with the power cord provided.

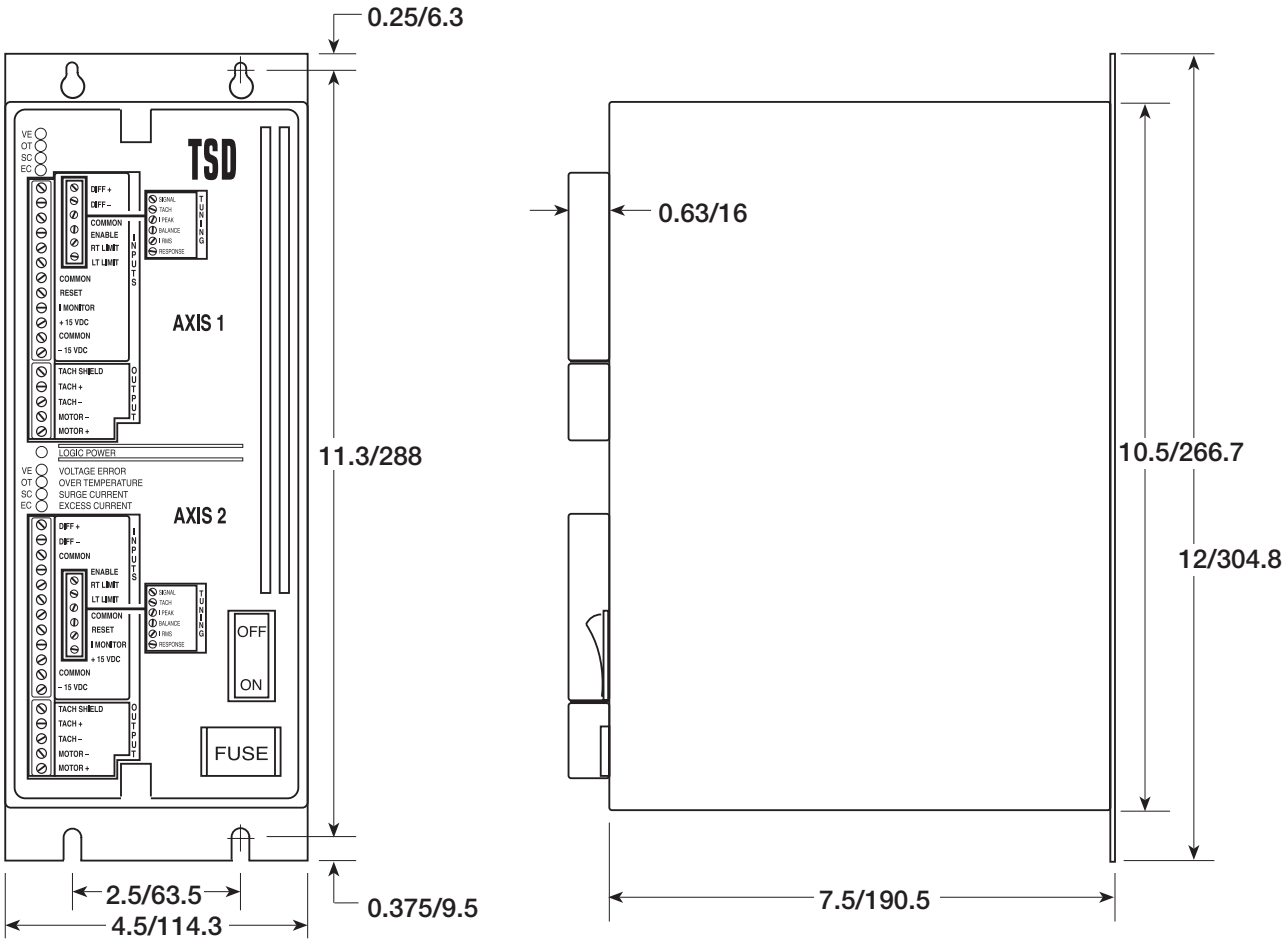
STEP 5: START UP AND ADJUSTMENT

A. Refer to the Installation and Operating Manual for detailed Start Up and Adjustment instructions.
B. Set potentiometers for default parameters.
C. Apply power.
D. Adjust potentiometers to obtain optimum operation.

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Appendix B
Outline Drawing

B- OUTLINE DRAWING



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