
**OPERATOR'S MANUAL FOR THE
3010B LINEAR SERVO
CONTROLLER
(3010-LS)**

PN: EDA104

*PRODUCT IS
BFA 400*



**AEROTECH, INC., 101 Zeta Drive, Pittsburgh, PA 15238
(412) 963-7470 • TWX 710-795-3125 • FAX(412)963-7459**

NOTICE

AEROTECH'S DESIGNATION OF THE "3010" SERVO CONTROLLER DESCRIBED IN THIS MANUAL HAS BEEN CHANGED TO "3010-LS". WHEN ORDERING OR WHEN REQUESTING TECHNICAL INFORMATION, PLEASE REFER TO THE "3010-LS" SERVO CONTROLLER.

TABLE OF CONTENTS

CHAPTER 1:	DESCRIPTION.....	1-1
CHAPTER 2:	SPECIFICATIONS.....	2-1
SECTION 2-1	MAXIMUM RATINGS (25 C UNLESS OTHERWISE.....)	2-1
SECTION 2-2	ELECTRICAL CHARACTERISTICS.....	2-1
SECTION 2-3	MECHANICAL CHARACTERISTICS.....	2-2
CHAPTER 3:	INSTALLATION AND OPERATION.....	3-1
SECTION 3-1	INPUT/OUTPUT CONNECTIONS.....	3-1
A.	115/230 VAC INPUT.....	3-1
B.	INPUT COMMANDS.....	3-1
C.	DIRECTIONAL CURRENT LIMITS.....	3-1
D.	LOAD CONNECTIONS.....	3-1
E.	SUPPLIES FOR EXTERNAL USE.....	3-2
SECTION 3-2	COMPENSATION.....	3-2
SECTION 3-3	ADJUSTMENTS.....	3-2
A.	CURRENT LIMIT ADJUSTMENTS.....	3-2
B.	GAIN AND SCALE FACTOR ADJUSTMENTS	3-3
C.	BALANCE ADJUSTMENT.....	3-3
CHAPTER 4:	MAINTENANCE	4-1
CHAPTER 5:	TROUBLESHOOTING.....	5-1
SECTION 5-1	MOTOR RUNS AWAY.....	5-1
A.	OPEN TACHOMETER.....	5-1
B.	TACH PHASING.....	5-1
C.	POWER AMPLIFIER LATCHED-UP.....	5-1
D.	PRE-AMPLIFIER LATCH-UP.....	5-1
SECTION 5-2	FUSE BLOWS.....	5-2
A.	AC FUSE OPEN.....	5-2
B.	F1 OPEN.....	5-3
SECTION 5-3	POOR SERVO RESPONSE OR REGULATION.....	5-3
SECTION 5-4	SYSTEM OSCILLATION.....	5-3
CHAPTER 6:	PHYSICAL SPECIFICATIONS.....	6-1
SECTION 6-1	MOUNTING DIMENSIONS.....	6-1

LIST OF ILLUSTRATIONS

1: (A) SIDE VIEW OF THE 3010 SERVO MODULE.....6-2
2: PREAMPLIFIER CHARACTERISTICS.....6-4
3: MOUNTING SPECIFICATIONS.....6-5

CHAPTER 1: DESCRIPTION

The Aerotech Model 3010B (30-volt, 10-amp) linear servo controller provides a unique combination of high reliability, compact design, high output power, high power dissipation, noiseless performance and ease of operation. This model is comprised of a 741-type pre-amplifier with rate and position loop compensation, driving a power amplifier configured in a current feedback mode.

The pre-amplifier has three inverting inputs, two of which have adjustable scale factors, a balance adjustment and a gain adjustment for the lag-lead compensation. The lag-lead network, along with the three inverting input resistors, are mounted on standoffs for quick, easy replacement.

The power output stage contains all hermetically sealed, NPN, single-diffused power transistors for reliable, second breakdown-free operation. The power stage is operated in the linear mode (class B) for wide bandwidth and quiet, reliable operation.

Adjustable current limiting prevents motor demagnetization, and output current fusing (3 amp slow blow) protects the amplifier against short circuits at high output currents. Directional current limits, initiated by limit switch or relay closures, decrease the torque available in only one direction for limited-travel motor loads.

The isolated, internal power supply operates from 115 VAC or 230 VAC, 50/60 Hz and provides all necessary operating voltages in addition to regulated ± 15 volts for external use.

CHAPTER 2: SPECIFICATIONS

SECTION 2-1 MAXIMUM RATINGS (25 C UNLESS OTHERWISE SPECIFIED)

Peak output current (2 secs)	± 10 amps
Continuous output current	± 3 amps
Peak output voltage	± 30 amps

POWER OUTPUT:

Peak	350 watts
Continuous	70 watts*
Continuous mounted in Aerotech chassis	80 watts**
Operating temperature	0° to 50° C
Storage temperature	-30° to 85° C
AC line voltage	125 VAC, 50/60 Hz 240 VAC, 50/60 Hz

SECTION 2-2 ELECTRICAL CHARACTERISTICS

PREAMPLIFIER:

Voltage gain	100 db, open loop
Offset	Adjustable to zero
Drift	10 microvolts/C , referred to input

POWER AMPLIFIER:

Gain	1.2 amps/volt
Current limit	0-10 amps
Bandwidth	2 KHz
Power output:	
Peak	215 watts
Continuous	73 watts
Torque limits***	Limits to 1 amp
Remote shutdown***	Limits to 1/2 amp

POWER SUPPLY:

AC input voltage	100-125 VAC/ 200-240 VAC
Frequency	50 or 60 Hz
External ± 15 VDC	30 mA
(For external use)	

SECTION 2-3 MECHANICAL CHARACTERISTICS

Weight	8 1/2 lbs.
Dimensions	4 3/4" wide x
	6 3/4" long x
	5 7/8" high

- * Derate 0.4 watts per degree C above 25 C.
- ** Derate 0.46 watts per degree C above 25 C.
- *** Requires a closure with current-handling capability of 20 mA.

CHAPTER 3: INSTALLATION AND OPERATION

SECTION 3-1 INPUT/OUTPUT CONNECTIONS

A. 115/230 VAC INPUT

The input power required is 115 VAC, 1 amp or 230 VAC, .5 amp. Connect AC power directly to the power transformer terminal strip, as shown in figure 1. Use a 1 amp or .5 amp slow blow fuse in series with the power input line.

B. INPUT COMMANDS

Three inputs are available for input and feedback signals. Input terminal strip J3, pins 1, 2 and 3 sum to the inverting input of the pre-amplifier (see figure 1). Any of these inputs can be used for command or feedback signals. Aerotech drive systems usually connect tachometer feedback to 3 and velocity commands or position feedback to input 1. The input resistance ranges from 5K to 20K ohms. Input signal commons should be connected to J3-4, signal common.

C. DIRECTIONAL CURRENT LIMITS

J3, pins 4, 5 and 6 are available to inhibit current flow of a specific polarity for limited travel motor loads. If J3 pin 4 is connected to J3 pin 5, current flow is inhibited from load high (-) to load low (+) but not from load low (+) to load high (-). If J3 pin 5 is connected to J3 pin 6, current flow is inhibited from load low (+) to load high (-) but not from load high (-) to load low (+). If J3 pin 4 is connected to J3 pin 6, all current flow (in either direction) is inhibited.

D. LOAD CONNECTIONS

The load is connected from LOAD HI (-) to LOAD LO (+). Connecting either LOAD HI or LOAD LO to ground can damage the power stage.

E. SUPPLIES FOR EXTERNAL USE

Regulated + and - 15VDC at .03 amp is available for customer use. +15V common is the "SIG. COM" terminal J3, pin 8 between the "+15V" (J3 pin 7) and "-15V" (J3 pin 9) terminals.

SECTION 3-2 COMPENSATION

The preamplifier compensation consists of a lag-lead network (refer to figure 2). The lag is caused by C2 and the lead results from R8. An additional lag at about 1000 Hz results from the 1.5K/.1uf input filter on input 3. The DC gain is determined by the input resistance and potentiometer setting (R2 and pot R1 for input 1) along with R7. For example, with R1 maximum CW, the preamplifier DC gain would be about 2000 V/V (66 DB). Since the power amplifier is 1.2 amp/volt, overall DC gain is 2400 amp/volt. The overall AC gain is provided by the R1 and R9 potentiometer setting.

SECTION 3-3 ADJUSTMENTS

A. CURRENT LIMIT ADJUSTMENTS

The current can be measured by monitoring LOAD LO (J3, pin 13) with respect to SIG. COM. (10 amps/volt) with an oscilloscope. Turn R12 maximum CW (zero current limit). Connect a DC motor to the load terminals and connect its tachometer between J3 pin 3 and J3 pin 4. Since there is a continuous output current limit of 3 amps, apply a square wave input command between J3 pin 1 and J3 pin 4 and command peak currents above the continuous rating. Adjust R12 until the desired current limit is obtained. R12 adjusts the current limit in both the positive and negative directions.

B. GAIN AND SCALE FACTOR ADJUSTMENTS

Scale factor adjustments are pots R1 and R5 for inputs 1 and 3 respectively. The GAIN adjustment pot is R9. To increase gain, remove R7. Connect the tachometer to input 3 (J3 pin 3), turn R5 and R9 maximum CW, connect the motor and apply AC power. If the system runs away when AC power is applied, reverse the motor or tach connections. If the motor rotates slowly in either direction, adjust the balance, R11. Adjust R9 CCW until the motor oscillates, (it will make an audible noise) then adjust CW until oscillation ceases, continue 1/8 to 1/16 turn further. Apply velocity commands or position feedback to input 1 (J3 pin 1) or 2 (J3 pin 2) and adjust scale factor for that input to obtain proper speed or response.

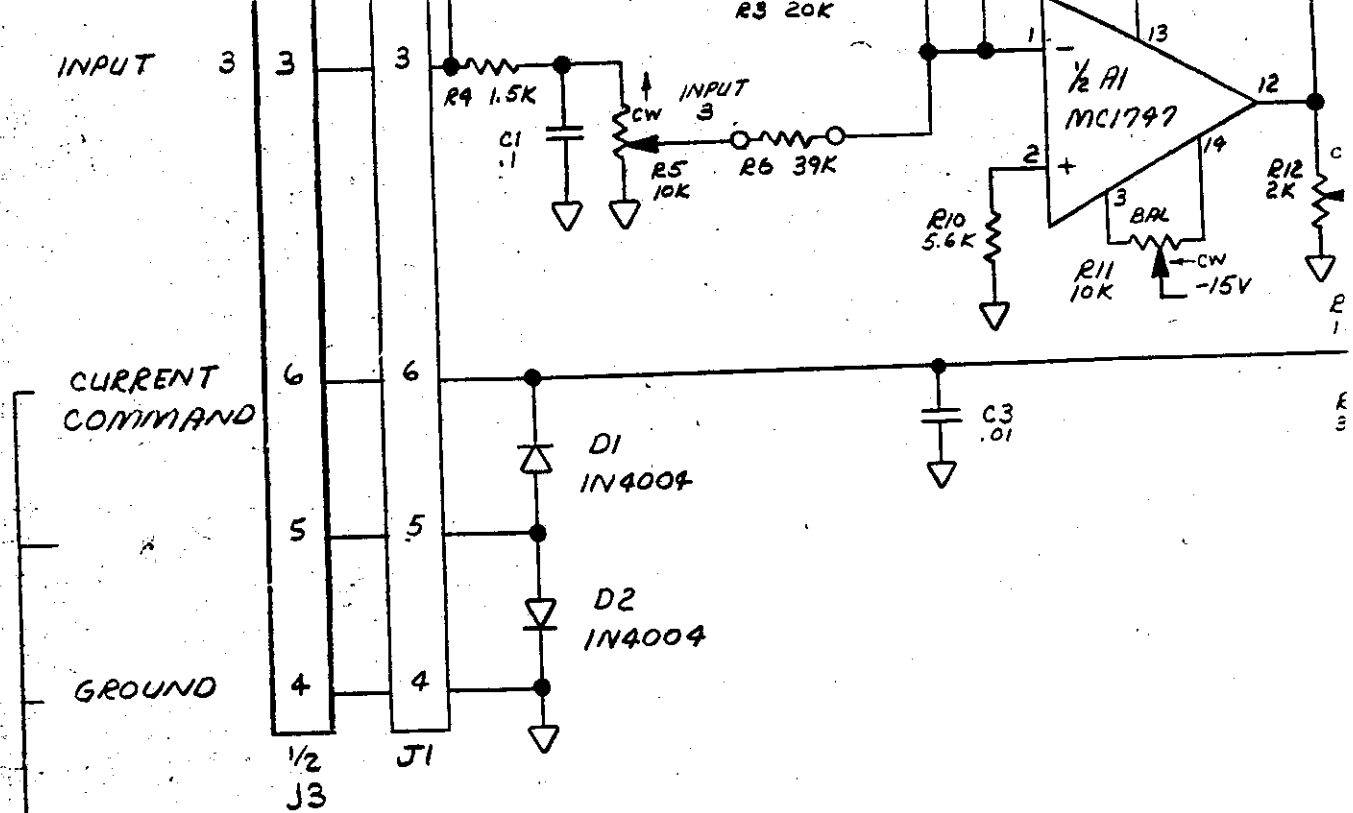
Input 1 will command greater speed than input 2 because R2 is smaller than R3. On input 1, if the speed is too fast with the scale factor most of the way CCW, increase R2. If the speed is too slow with the scale factor full CW, R5 can be adjusted CCW - if R5 is adjusted, R9 will require readjustments. Adjust the input #2 scale factor by changing R3.

C. BALANCE ADJUSTMENT

The pre-amplifier balance (R11) should be adjusted so that with zero input command, the tach voltage or current monitor voltage is minimum. Or visually observe the motor and adjust R11 until the motor does not rotate. If it is determined that the balance is difficult to adjust and DC gain can be sacrificed, R7 can be decreased.

CHAPTER 4: MAINTENANCE

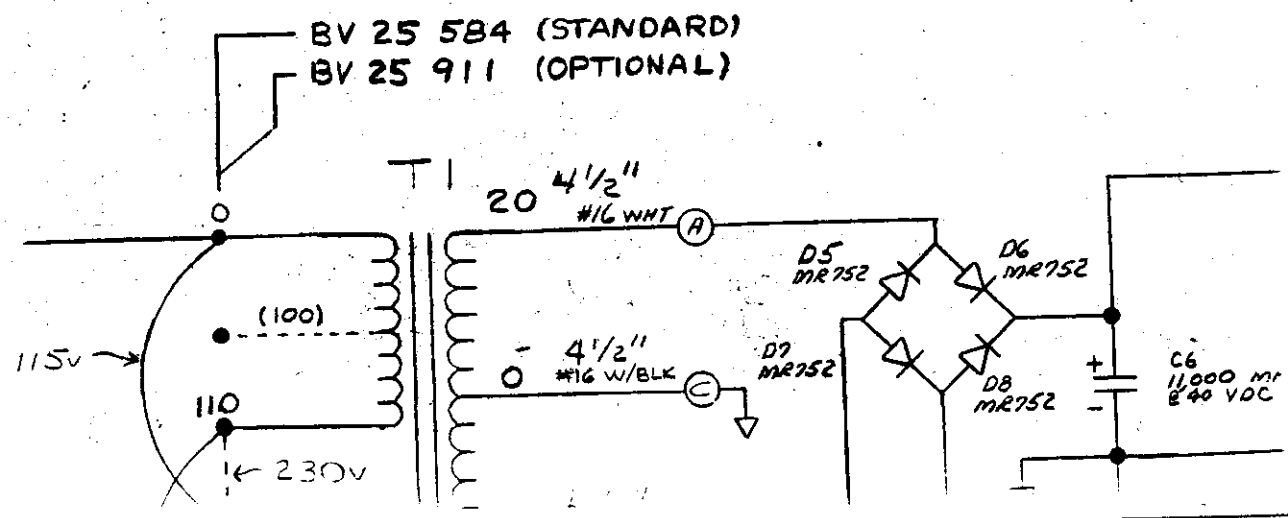
This solid state servo controller requires no maintenance. If it is desired, the balance can be checked as in section 3-3C at 3 or 6 month intervals. The PC card and heat sinks can be checked for an accumulation of dirt if operated in a dirty environment.



- CONNECT 4 TO 5 TO LIMIT CURRENT FROM LOAD HI TO LOAD LO.
- CONNECT 5 TO 6 TO LIMIT CURRENT FROM LOAD LO TO LOAD HI.
- CONNECT 4 TO 6 TO STOP ALL OUTPUT CURRENT.

NOTE: 1) TRANSISTORS Q3-8 AND TRANSFORMER T1 ARE MOUNTED ON L-BRACKET PART NUMBER 640-1118.

2) ALL RESISTORS ARE 1/2 W ±5% UNLESS NOTED.



CHAPTER 5: TROUBLESHOOTING

Troubleshooting will be aimed at determining whether the unit is defective and needs to be returned to the factory for repair. The symptoms will be those for a motor/tach system.

SECTION 5-1 MOTOR RUNS AWAY

If the motor runs at maximum speed with no input commands, the problem can be open tach, wrong tach phasing, or power amplifier failure.

A. OPEN TACHOMETER

Measure the tachometer input terminals and verify that the tachometer feedback voltage is returned.

B. TACH PHASING

If the tachometer phasing is questionable, the simplest check is to reverse motor or tach leads.

C. POWER AMPLIFIER LATCHED-UP

To verify that the 3010 power stage is not latched-up, short J3 pin 4 to J3 pin 6. This will command zero current out and load high output should be near 0 volts with a load connected; if load high output is near +30 or -30 volts, the power stage has failed.

D. PRE-AMPLIFIER LATCH-UP

To verify that the pre-amplifier is not at fault, remove all input signals and connect a 50K resistor in parallel with R7 (this places the preamplifier in a low DC gain). The voltage at J3, pin 6 should be less than a volt.

SECTION 5-2 FUSE BLOWS

If the AC fuse (not supplied with amplifier) blows, see section 5-2A.

If the DC fuse (F1) blows, see section 5-2B

A. AC FUSE OPEN

The AC fuse open usually indicates a power supply failure or power stage short. To test for a short in the power stage, remove AC power, the load, and ohmmeter the power stage. Follow this procedure:

1. Replace F1 if it is open.
2. Place the + lead of the ohmmeter (X1 scale) on +30 volts (cathode D6) and the - lead to load high.
3. Place the - lead on -30 volts (anode D5) and the + lead to load high.
4. Neither of the two readings should be less than 100 ohms.

NOTE: If ohmmeter polarities are not observed, low resistance readings will be measured even for a good power stage.

5. If the above readings fail, check the load for a short to ground.

B. F1 OPEN

The load fuse opening usually indicates a shorted (to ground) load or a current demand greater than the continuous capability. Check for motor shorts to ground. Before replacing the fuse, remove AC power and the load, replace F1 and check the power stage with an ohmmeter by performing steps 1 through 4 in section 5-2A.

SECTION 5-3 POOR SERVO RESPONSE OR REGULATION

Poor servo response usually results from improper servo compensation (not enough gain) or adjustment (see sections 3-2 and 3-3)

SECTION 5-4 SYSTEM OSCILLATION

An unstable system usually results from too much loop gain or mechanical resonances. Scope the tach and observe the frequency of oscillation. If mechanical resonances are suspected, remove the tach feedback, connect a 20K resistor in parallel with R7, turn R9 full CCW, and apply a variable frequency sine wave to a command input. The sine wave magnitude should be low enough so that the current capability of the amplifier is not exceeded. Vary the sine wave frequency through the range of the oscillation that was observed with the tach connected. A mechanical resonance will be indicated by a sizeable increase (factor of 10) in tach voltage as the frequency is increased.

CHAPTER 6: PHYSICAL SPECIFICATIONS

SECTION 6-1 MOUNTING DIMENSIONS

Mounting dimensions and other physical specifications are shown in figure 3.

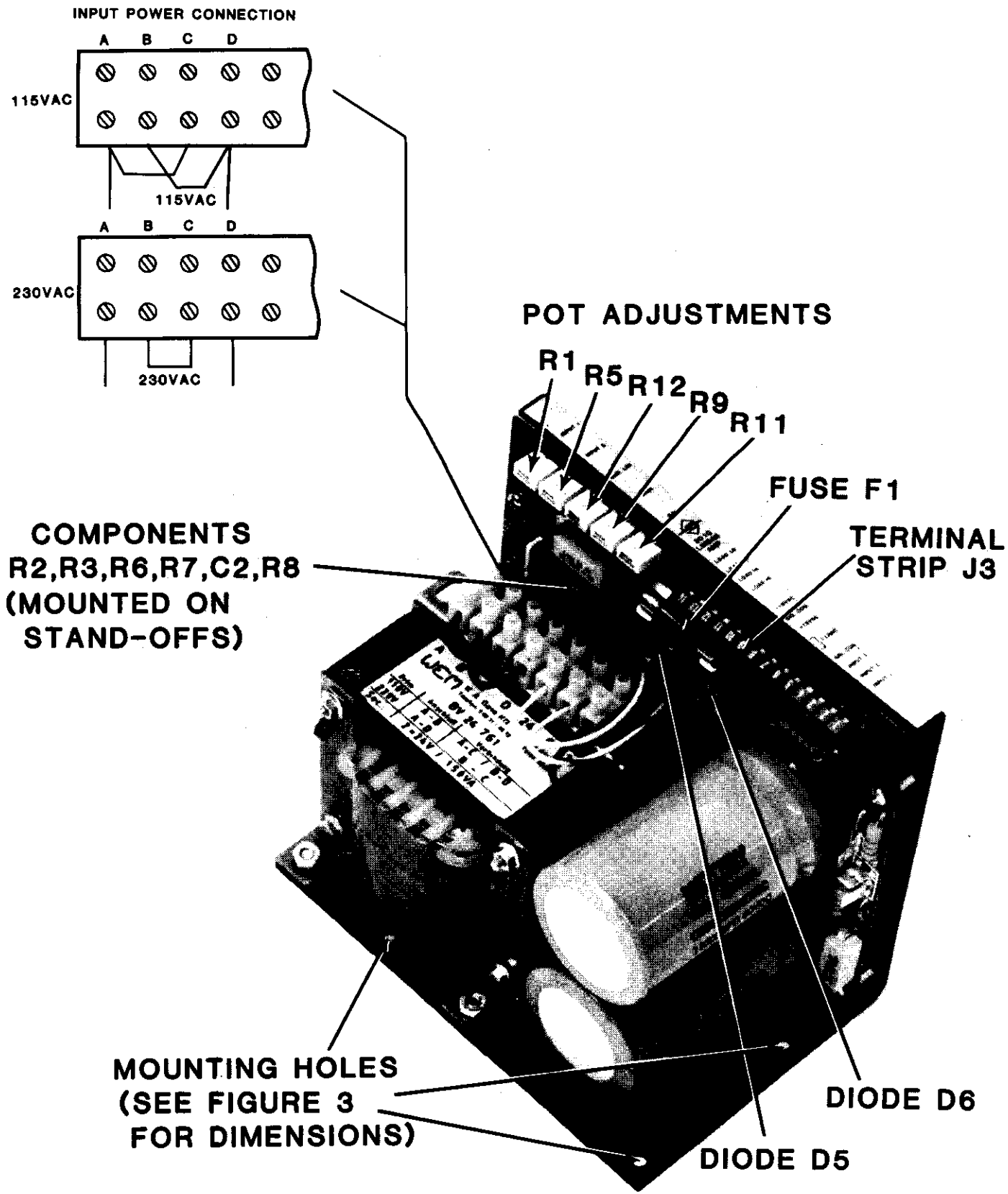
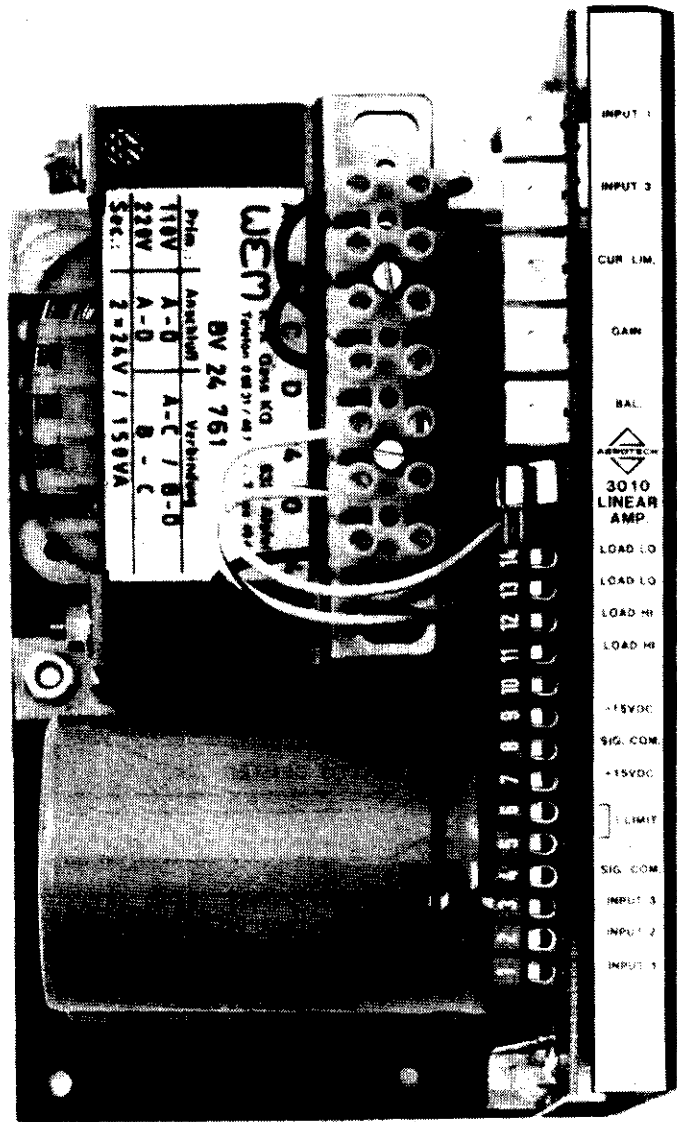
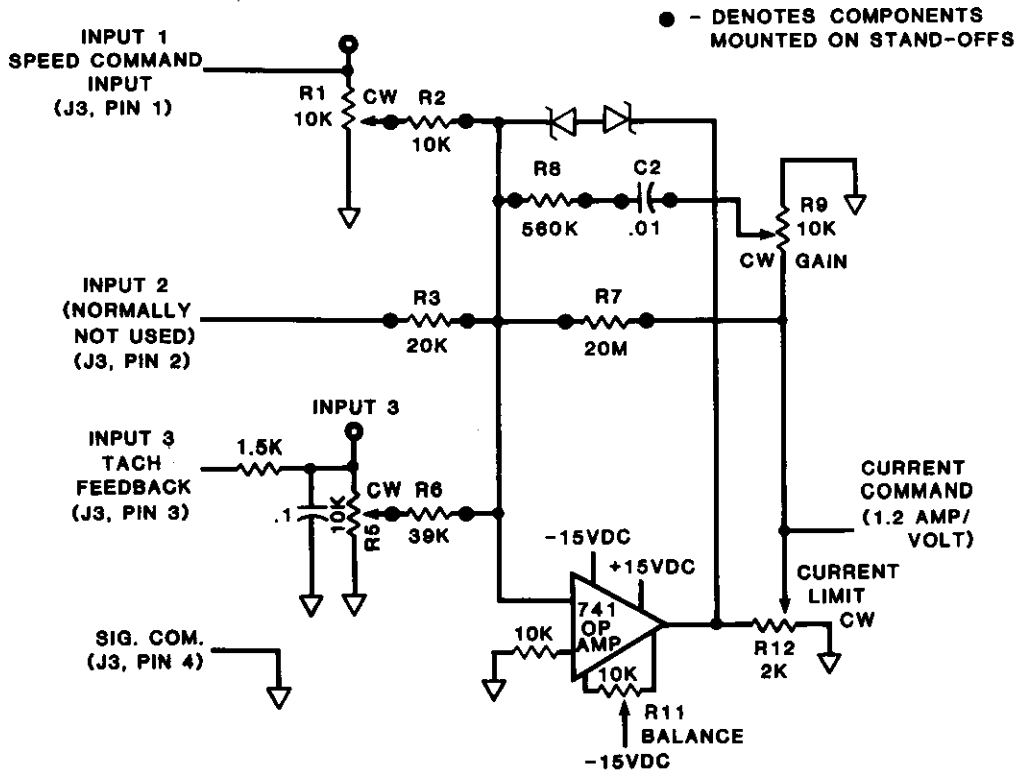


FIGURE 1: (A) SIDE VIEW OF THE 3010 SERVO MODULE



(B) TOP VIEW

PREAMPLIFIER SCHEMATIC



PREAMPLIFIER TRANSFER FUNCTIONS (CURRENT COMMAND POT FULL CW)

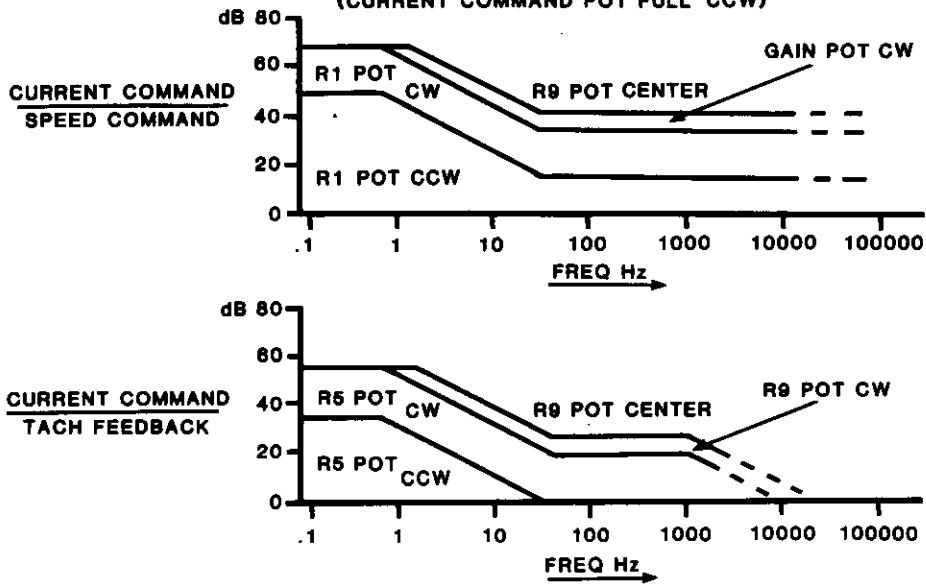
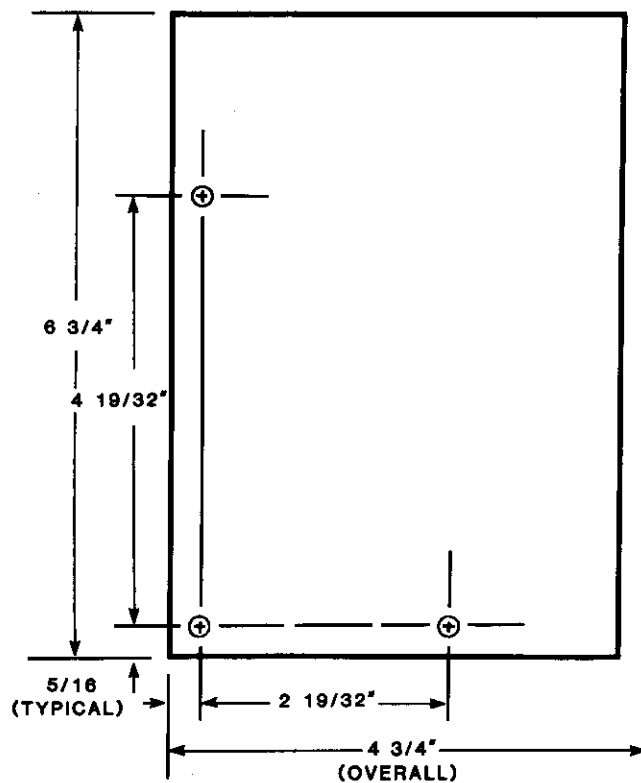


FIGURE 2: PREAMPLIFIER CHARACTERISTICS



MECHANICAL CHARACTERISTICS:

- HEIGHT - $5 \frac{7}{8}''$
- WIDTH - $4 \frac{3}{4}''$
- LENGTH - $6 \frac{3}{4}''$
- WEIGHT - 8 1/2 LBS.
- MOUNTING SCREWS - #10

FIGURE 3: MOUNTING SPECIFICATIONS

A

AC fuse, 5-2
Adjustments, 3-2

B

Balance adjustment, 3-3

C

Compensation, 3-2
Current limit adjustments, 3-2
Current limits, 3-1

E

Electrical characteristics, 2-1

F

Fuses, 5-2

G

Gain adjustment, 3-3

I

Input/output connections, 3-1
Installation, 3-1

L

Load connections, 3-1

M

Maximum ratings, 2-1
Mechanical characteristics, 2-2

O

Operation, 3-1

S

Scale factor adjustment, 3-3
Servo response, 5-3
System oscillation, 5-3



Warranty and Field Service Policy

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a period of one year from date of shipment from Aerotech. Seller's liability is limited to replacing, repairing or issuing credit, at its option, for any products which are returned by the original purchaser during the one-year period. Seller makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to seller in specifications or drawings previously or subsequently provided seller, and whether or not seller's products are specifically designed and/or manufactured by seller for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Returning Goods Procedure

Claims for incorrect or defective materials must be filed within thirty (30) days from delivery at buyer's place of business. No units or systems may be returned, in or out of warranty, without first obtaining approval from the seller, and no claim will be allowed nor credit given for units or systems returned without such approval.

Returned Goods Warranty Determination

If possible, after approval from Aerotech, the defective unit or system is to be returned to the factory with statement of problem and transportation prepaid (no c.o.d. or collect freight shipments will be accepted). After Aerotech's in-plant examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination of such unit or system, warranted defects exist, then the unit or system will be repaired at no charge and shipped, prepaid, back to the buyer. If an out-of-warranty situation exists, the buyer shall be

notified of the repair cost immediately. At such time, the buyer must issue a purchase order to cover the cost of the repair or authorize the unit or system to be shipped back as is, at the buyer's expense.

On-Site Warranty Repair

If the system or unit cannot be made functional by telephone assistance or by sending and having customer install replacement parts, and cannot be returned to the Aerotech factory for repair, and if it is determined that the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a bona-fide purchase order to Aerotech covering all transportation and subsistence costs. For warranty repairs, customer will not be charged for cost of labor and material.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-Site Non-Warranty Repair

If system or unit cannot be made functional by no-charge telephone assistance or purchased replacement parts cannot be returned to the Aerotech factory for repair, then the following field service policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a bona-fide purchase order to Aerotech covering all transportation and subsistence costs and the prevailing cost per hour including travel time necessary to complete the repair.

AEROTECH, INC., 101 Zeta Drive, Pittsburgh, Pennsylvania 15238 • (412) 963-7470
TWX 710-795-3125 • FAX 412-963-7459