
OPERATOR'S MANUAL
FOR THE REFERENCE
4020 SERIES DOCUMENT
THREE AXIS BASE PLATE
(TA3 OEM)

REV. 1
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CHAPTER 1

SECTION 1-1 INTRODUCTION

This manual provides information on the installation and operation of the TA3 OEM 4020 SERIES Three Axis Base Plate.

Included in this manual is information on the set-up and adjustments of the 4020 Servo Amplifier Modules and also information on wiring the Three Axis Base Plate into a system.

One line diagrams on the operational characteristics of each servo amplifier module are also included.

More detailed information, such as "Theory of Operation" is included in supplemental literature which is available upon request.

A description for the operational characteristics of the base plates is given in chapter 2, General Description. Included in this chapter are electrical diagrams and specifications for the three axis base plate.

A detailed description on installation and set-up of the servo modules is given in section 3, Installation and Start-up.

Information on field troubleshooting and general repair is presented in section 4, Troubleshooting and section 5, Service and Repair, respectively.

CHAPTER 2

SECTION 2-1 GENERAL DESCRIPTION

The 4020 SERIES servo amplifier module is a very high gain transconductance amplifier, intended primarily to drive a permanent magnet (PM) DC motor.

Typically, a servo module is used with a motor and a tachometer in a velocity loop configuration (figure 2-1). Here a velocity input command, a voltage between ± 10 volts, is summed with the tachometer output (negative-feedback-phased) to produce a net voltage input to the servo amplifier module. The module provides an output current to the motor, proportional to this net voltage input. For user convenience, there are separate input terminals and individual scale (gain) controls provided for both command and tachometer voltages. Summation takes place with the module itself.

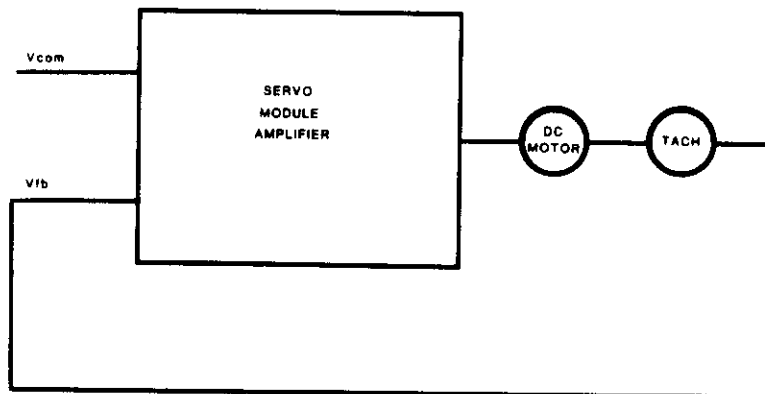


FIGURE 2-1: VELOCITY LOOP CONFIGURATION

The module obtains its high transconductance (ie., voltage in gives current out) through a pre-amplifier/post-amplifier arrangement, wherein the pre-amplifier supplies a voltage gain of 2000 V/V and the post-amplifier supplies a transconductance of 2 amps per volt (A/V).

The pre-amplifier is an operational-amplifier based gain block which provides customer adjustable amplifier compensation. The post-amplifier is a linear voltage amplifier contained within a current feedback loop configuration, internal to the module. No customer adjustment of the post-amplifier is required. The overall transconductance of the pre-amplifier and post-amplifier is 4000 A/V.

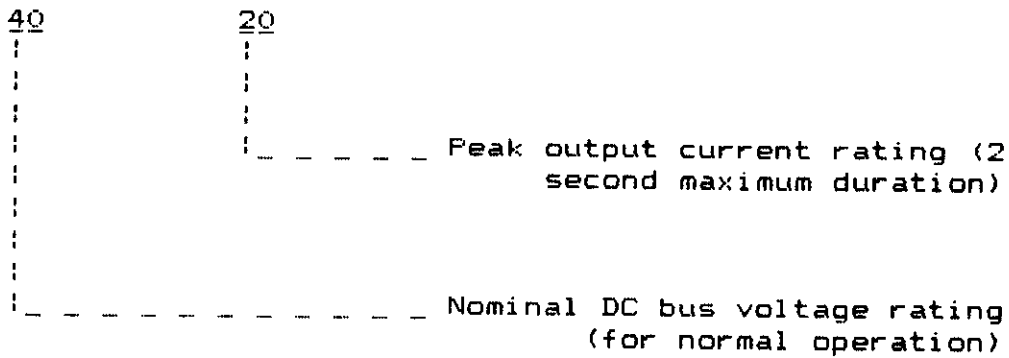
To further explain the arrangement shown in figure 2-1, any difference in magnitude between the scaled input command and the scaled negative-feedback tachometer output results in a proportional current flowing into the motor. This current accelerates or decelerates the motor until the motor speed matches the (scaled) input command, less a small amount due to load friction. This means that the motor torque and acceleration are independent of back emf, resistance, and inductance within the motor, rendering a higher degree of accuracy to the user.

To protect the motor, maximum current to the motor is controlled through self-contained, isolated current feedback clamp circuits. These clamp circuits can be set to deliver minimum and maximum current to a motor load by the adjustment of two current limit potentiometers located on the top of the module.

These and other potentiometer adjustments are described in more detail later in this chapter.

SECTION 2-2 MODEL IDENTIFICATION

The basic part number shown on the label at the top of the module contains the following information:



NOTE: Not shown in this part number is the continuous output current rating of 5 amps.

Figure 2-2 shows the label location for identification of the servo amplifier module

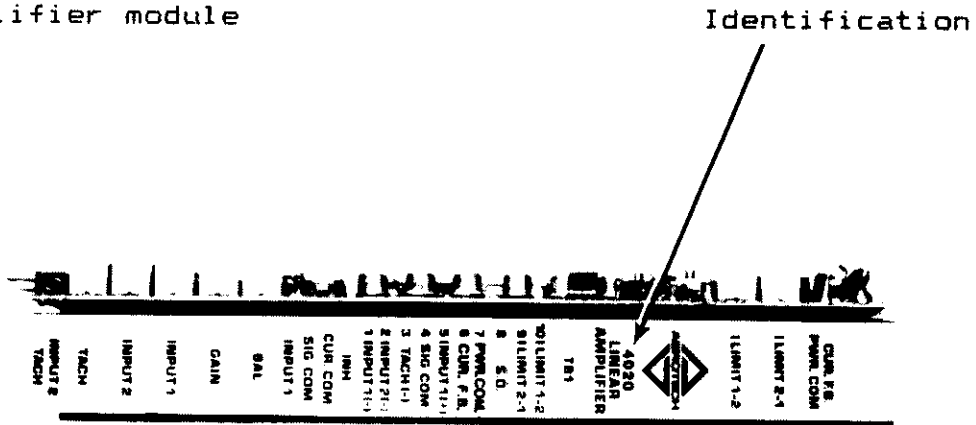


FIGURE 2-2: LOCATION OF IDENTIFICATION LABEL

SECTION 2-3 ELECTRICAL SPECIFICATIONS (SERVO MODULE)

Electrical specifications for the servo amplifier module are shown in table 2-1. These specifications are broken into two headings: Power Stage and Control Stage. More detailed electrical specifications for the 4020 servo module are provided in chapter 3.

TABLE 2-1: ELECTRICAL SPECIFICATIONS

POWER STAGE	4020
Peak output current, (max., amps) - - - - -	20
Continuous output current (max., amps) - -	5
DC bus input voltage (volts)	
maximum - - - - -	45
minimum - - - - -	25 ***
nominal - - - - -	40
Output power (max., watts) **	
peak - - - - -	600
continuous - - - - -	175
Load inductance (min., uH) - - - - -	100
Operating temperature (C degrees) - - - - -	0 to 50
Storage temperature (C degrees) - - - - -	-30 to 80
Power amplifier bandwidth - - - - -	1 KHz
(with 1 mH inductive load, minimum KHz)	

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CONTROL STAGE

CURRENT LOOP (POWER AMPLIFIER)

Current feedback gain (V _{ifb} , amp/volt)	- -	10
Current command gain (V _c , amp/volt)	- - -	2
I Limit 1-2 current limit pot adjustment range (amps)	-	-5 to -20
I Limit 2-1 current limit pot adjustment range (amps)	-	+5 to +20

RATE LOOP (Pre-amplifier)

Voltage gain (open loop, dB)	- - - - -	100
Tach feedback signal (max., volts)	- - - -	+60
Speed command signal (max., volts)	- - - -	+20 ****
Tach feedback signal input impedance (min., K ohms)	- - -	9.5
Speed command signal input impedance (min., K ohms)	- - -	50
Speed command input signal, offset null adjustment (max., + and - mV)	- -	15 *****
Pre-amplifier output drift (nominal, mV/C degrees)	- - - - -	10
Pre-amplifier bandwidth (nominal, Hz)	- - -	100 *

* Measurement taken with Aerotech Model 1075-01 Motor

** Data relative to DC bus input voltage at nominal value

*** Automatic shutdown occurs at this level

**** When using differential inputs, maximum limit is ± 10 volts

***** Offset adjustment via balance pot

SECTION 2-4 DESCRIPTION OF COMPONENTS (SERVO MODULE)

Locations of fuses, potentiometers, test points and other components of the 4020 SERIES Servo Module that are of concern to the user, are identified in figure 2-3. Figure 2-4 illustrates a one-line diagram of the circuitry contained within the servo module. The locations of components illustrated in figure 2-3 are shown in figure 2-4.

General descriptions of the components illustrated in figures 2-3 and 2-4 are provided in figure 2-5.

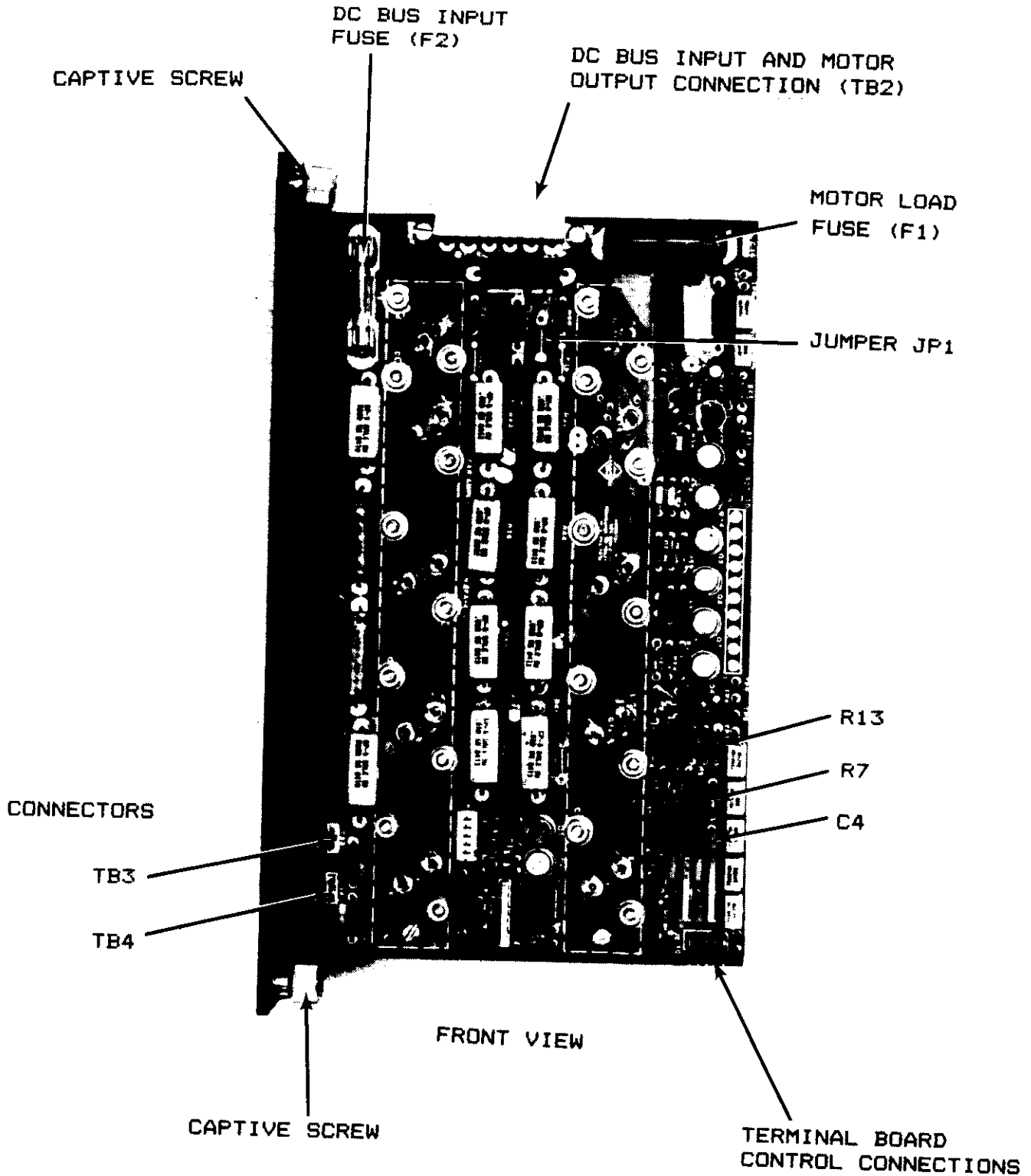


FIGURE 2-3: FRONT AND TOP VIEW OF SERVO AMPLIFIER MODULE

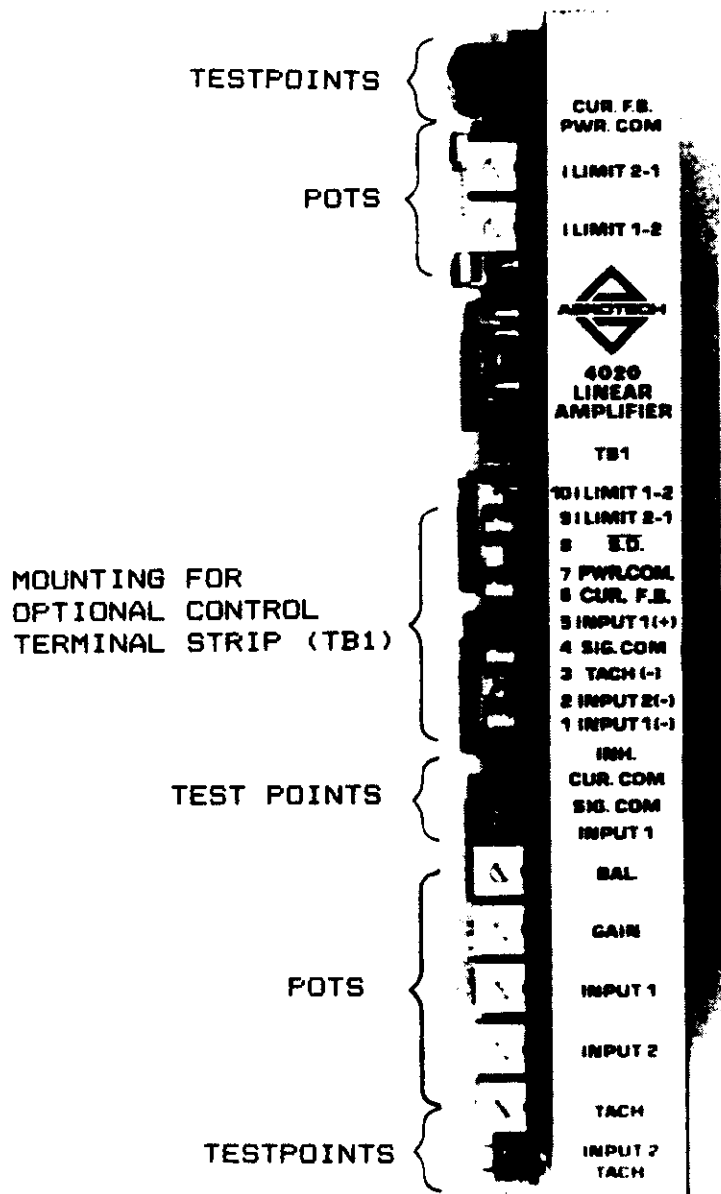
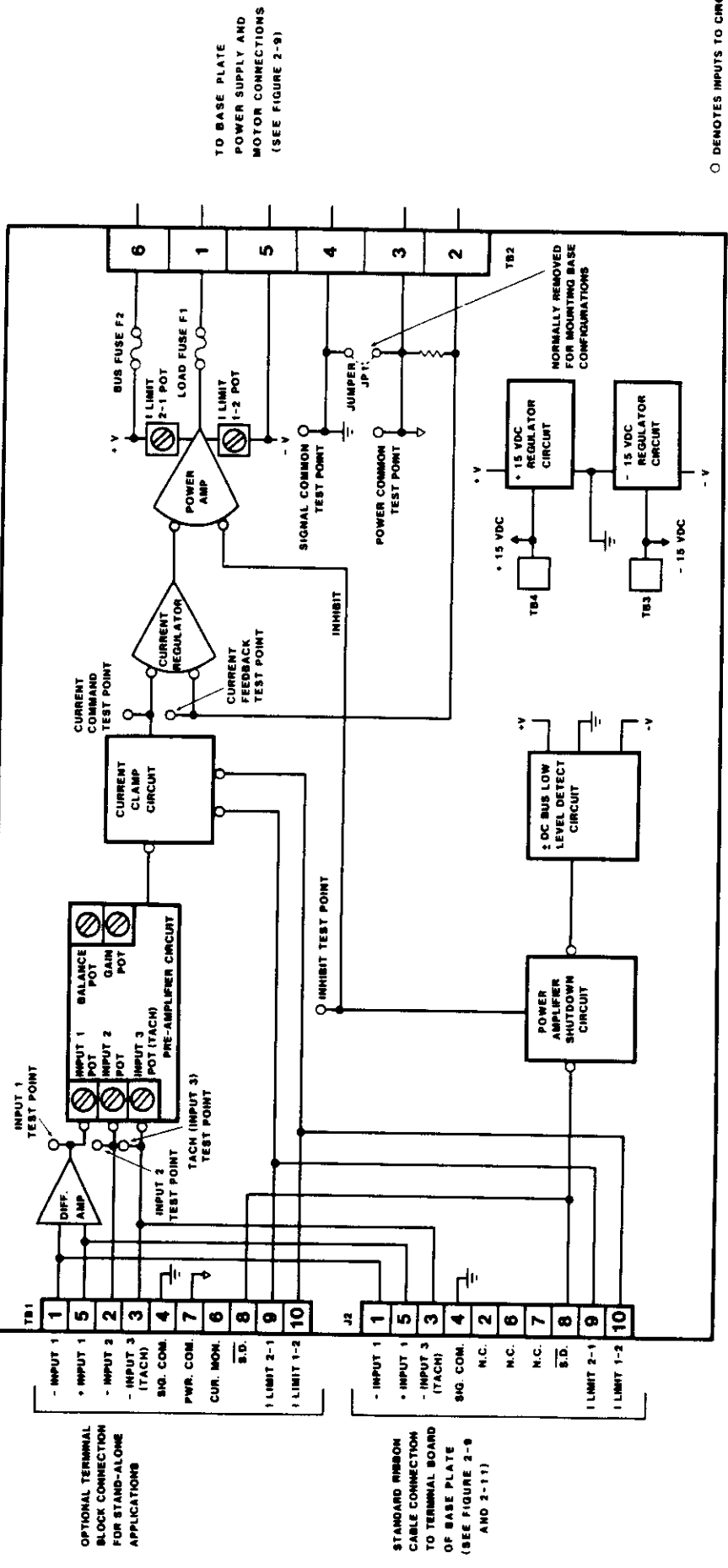


FIGURE 2-3: CONTINUED

CONTROL INPUT CONNECTIONS

POWER CONNECTIONS



OPTIONAL TERMINAL BLOCK CONNECTION FOR STAND-ALONE APPLICATIONS

STANDARD RIBBON CABLE CONNECTION TO TERMINAL BOARD OF BASE PLATE (SEE FIGURE 2-9 AND 2-11)

TO BASE PLATE POWER SUPPLY AND MOTOR CONNECTIONS (SEE FIGURE 2-9)

○ DENOTES INPUTS TO CIRCUIT BLOCK

FIGURE 2-4: GENERAL FUNCTIONAL DIAGRAM OF THE SERVO AMPLIFIER MODULE

FIGURE 2-5: COMPONENT DESCRIPTION

(Items listed below are shown in figure 2-3 and 2-4)

SIG. COM. TEST POINT	Test point for referencing signals on control stage circuitry. <u>NOTE:</u> Signal common (Sig. Com.) and power common (Pwr. Com.) are tied together on the base plate. Jumper JP1 is always removed when module(s) are used in the three axis base plate.
INHIBIT TEST POINT	Test point for indication of a low \pm DC bus voltage inhibit or an external shutdown. The servo module is inhibited when this point shows +.7 volts. Normal operation is present when this test point registers +8 volts.
CUR. COM. TEST POINT	Test point for monitoring the current command signal. The current command gain ratio is approximately 2 amp/volt, referenced to the Sig. Com. test point (see also figure 2-6).
INPUT 1 TEST POINT	Test point for monitoring the differential input (servo command) signal to the pre-amplifier. Signal is referenced to Sig. Com. test point (see also figure 2-6).
INPUT 2 TEST POINT	Test point for monitoring an auxiliary signal to the pre-amplifier. <u>NOTE:</u> This input is not used when the servo module is operated with the three axis base plate (see also figure 2-6).

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TACH (INPUT 3) TEST POINT	Test point for monitoring the tach feedback input signal. Signal is referenced to Sig. Com. test point (see also figure 2-6).
PWR. COM. TEST POINT	Test point for referencing the current feedback signal in the power stage. <u>NOTE:</u> Power common (Pwr. Com.) and signal common (Sig. Com.) are tied together on the base plate. Jumper JP1 is always removed when the module(s) are used in the base plate.
CUR. F.B. TEST POINT	Test point for monitoring the current feedback signal. The current feedback ratio is 10 amp/volt, referenced to the Pwr. Com. test point.
I LIMIT 2-1 POT	Potentiometer used for adjusting the clamp for maximum current flow from motor connection 1TB4 point 2 to point 1 (see figure 3-5). Pot adjustment range is from +5 amps (full CW) to +20 amps (full CCW) DC (see figure 2-7).
I LIMIT 1-2 POT	Potentiometer used for adjusting the clamp for maximum current flow from motor 1TB4 point 1 to point 2 (see figure 3-5). Pot adjustment range is -5 (full CW) to -20 (full CCW) amps DC (see figure 2-7).

BALANCE POT	Potentiometer used for nulling small offsets that may be present on the input 1 control connection (or input 2 control connection if used). The pot is capable of only nulling small offsets of ± 15 mV on either of the two input connections (see also figure 2-6).
GAIN POT	Potentiometer used for adjusting the AC gain of the pre-amplifier circuit. Minimum gain is present when this pot is turned full CW. Maximum gain is present when this pot is turned full CCW (see also figure 2-6).
INPUT 1 POT	Potentiometer used for adjusting the DC/AC gain of input 1 control signal. The full CW position allows maximum gain. Input 1 is usually designated for the input speed command signal (see also figure 2-6).
INPUT 2 POT	Potentiometer used for adjusting the DC/AC gain of input 2 control signal. NOTE: This pot is not used when the servo module is configured on the three axis base plate (see also figure 2-6).
TACH (INPUT 3) POT	Potentiometer used for adjusting the DC/AC gain of input 3 (or tach feedback signal). The full CW position allows maximum gain. Input 3 (tach) is usually designated for the tach feedback signal (see also figure 2-6).

- MOTOR LOAD FUSE (F1) This fuse provides motor overload protection and is sized in the factory to the maximum continuous output current of the servo module (5 amps). If motors with continuous current ratings lower than that of the servo module are used, fuse F1 must be resized accordingly.
- DC BUS INPUT FUSE (F2) This fuse provides protection against short circuits in the power stage that cannot be cleared by fuse F1. Situations of this sort are rare, making this fuse act only as back-up protection to fuse F1.
- DC BUS INPUT AND MOTOR OUTPUT POWER CONNECTOR (TB2) Connections to the DC bus power supply and motor terminal blocks on the three axis base plate are made here. The mate to this connector is a six circuit quick-connect plug found on the base plate.
- TERMINAL BOARD CONTROL CONNECTION (J2) Control connections from the terminal board (located on the base plate) to the servo module are made at this connector through a 10-pin ribbon cable.
- JUMPER (JP1) This jumper allows the power common (Pwr. Com.) and signal common (Sig. Com.) to be tied together on the servo module. Normally these two points are tied together at the neutral point of the \pm DC bus power supply on the base plate. Thus, this jumper should be **REMOVED** when the servo module is used on the base plate and

	CONNECTED when the servo module is used in the stand-alone configuration.
CONTROL TERMINAL STRIP (TB1)	An optional control terminal strip used when the servo module is operated in a stand-alone configuration (not utilized on the three axis base plate).
CONNECTOR (TB3)	Provides a connection for -15 VDC to the terminal board for external use. Maximum external current draw is -20 mA.
CONNECTOR (TB4)	Provides a connection for +15 VDC to the terminal board for external use. Maximum external current draw is +20 mA.
COMPONENTS R13, R7, AND C4	These resistors and capacitor are components associated with the pre-amplifier circuit of the servo module. They are mounted on stand-offs, in order to facilitate replacement in the field (see also figure 2-6).

(Items described below are shown in figure 2-4 only)

The following are input connections on J2 (TB1 connections, if used, are similar). NOTE: All connections from J2 go to the terminal board of the three axis base plate.

-INPUT 1 (PIN 1)	Non-inverting differential input connection for the speed command signal.
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+INPUT 1 (PIN 5)	Inverting differential input connection for the speed command signal.
-INPUT 3 OR TACH (PIN 3)	Non-inverting input connection for the tach feedback signal.
SIG. COM. (PIN 4)	Reference point for -input 1, +input 1, and -input 3 (tach) signals.
SHUTDOWN (PIN 8)	When this input is pulled to signal common (3mA sinking) the servo module is inhibited. A high impedance is placed at the motor output connections (1TB4 on base plate).
I LIMIT 2-1 (PIN 9)	Providing a contact closure between this point and signal common limits current flow to the motor from point 2 to point 1 of 1TB4 on the base plate (ie., power to the motor is limited in its flow from point 2 to point 1 of the given axis - see figure 3-5). When activated, maximum current flow is no more than +3 amps. Current flow through the contact closure is no more than 3 mA (see also figure 2-8).
I LIMIT 1-2 (PIN 10)	Providing a contact closure between this point and signal common limits current flow to the motor from point 1 to point 2 of 1TB4 on the base plate (see figure 3-5). When activated, maximum current flow is no more than -3 amps. Current flow through the contact closure is no more than 3mA. (See figure 2-8.)

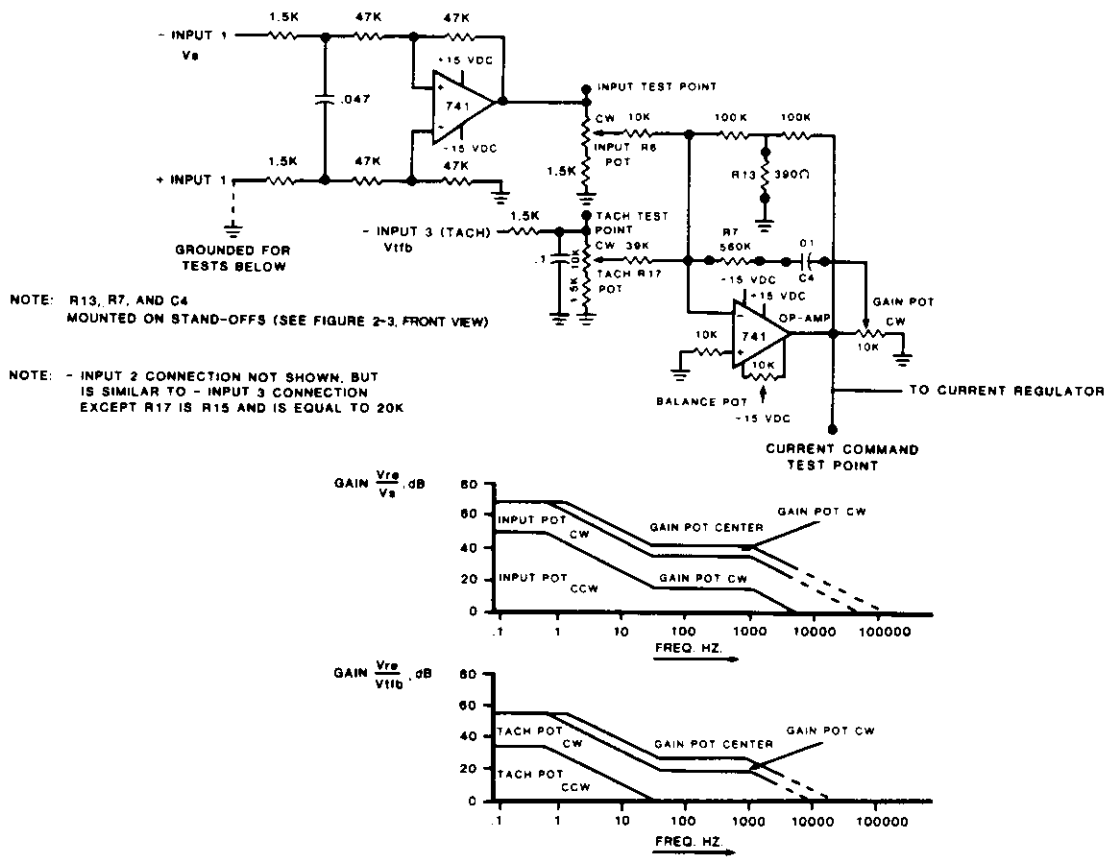


FIGURE 2-6: ELECTRICAL OUTLINE OF PRE-AMPLIFIER CIRCUIT WITH OPEN LOOP GAIN CHARACTERISTICS

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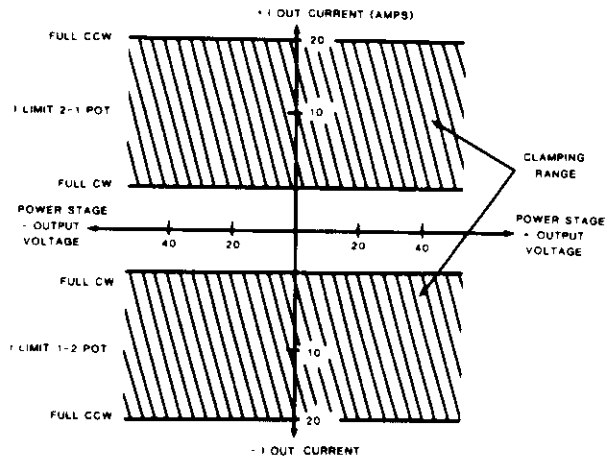


FIGURE 2-7: CURRENT LIMIT POT ADJUSTMENT RANGE

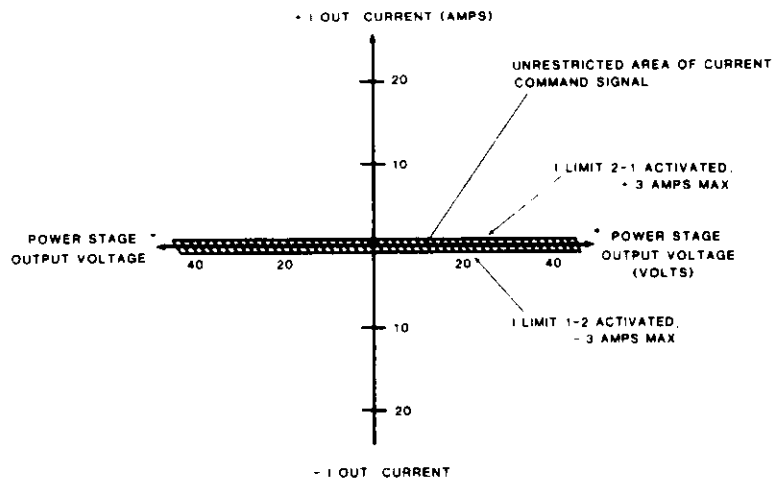


FIGURE 2-8: EFFECTS OF I LIMIT 1-2 AND I LIMIT 2-1 CLAMPS ON OUTPUT CURRENT

SECTION 2-5 DESCRIPTION OF COMPONENTS (3-AXIS BASE PLATE)

Included in this section are diagrams and schematics for the three axis base plate.

The three axis base plate provides the site for internal connections to be made between the servo modules, DC bus power supply and the terminal board. It also provides the site for external connections of AC input power and control connections to the servo modules.

Figure 2-9 illustrates the schematic of the internal wiring on the base plate. Figure 2-10 shows views of the base plate.

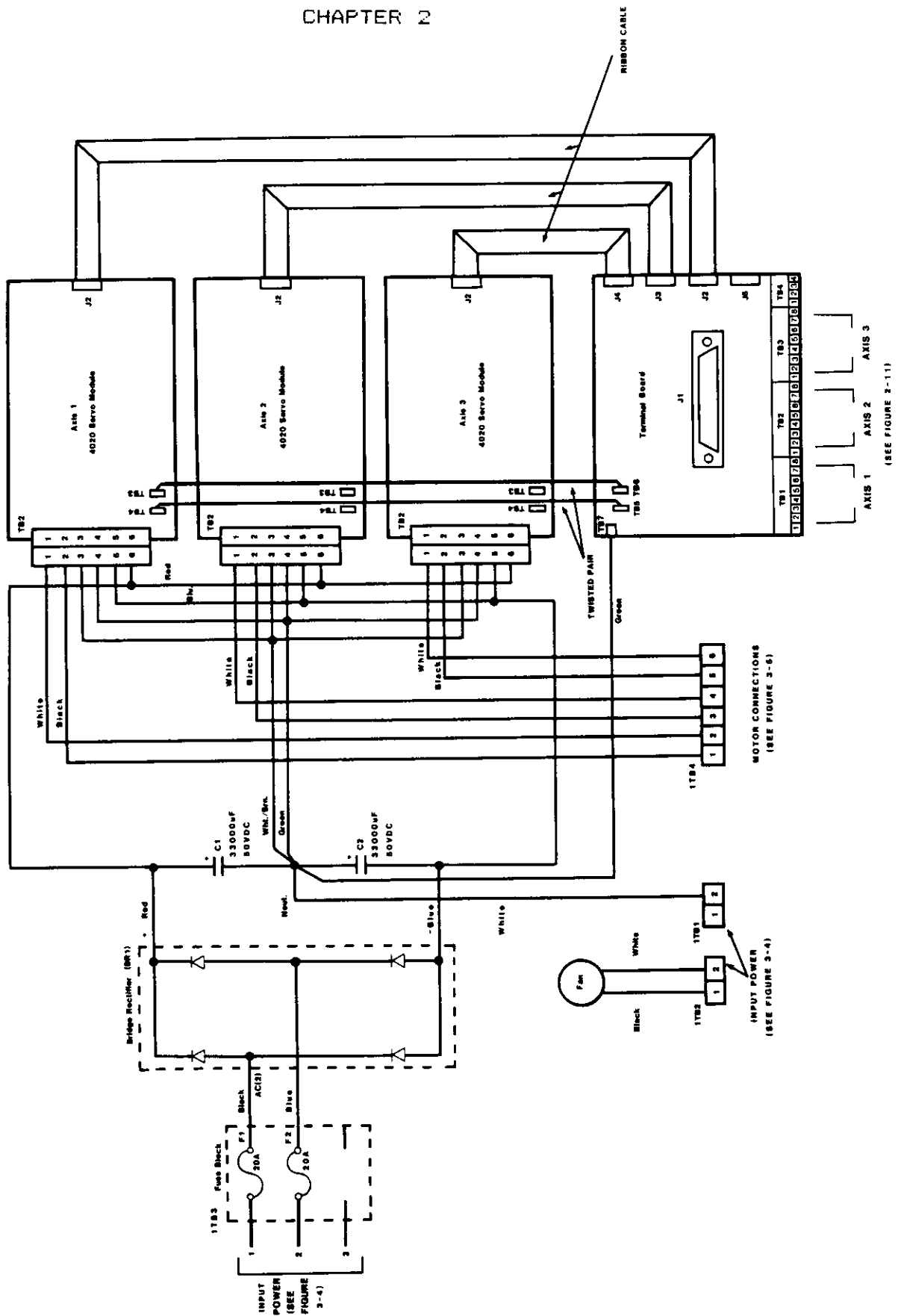


FIGURE 2-9: 4020 SERIES BASEPLATE SCHEMATIC

SERVO MODULES

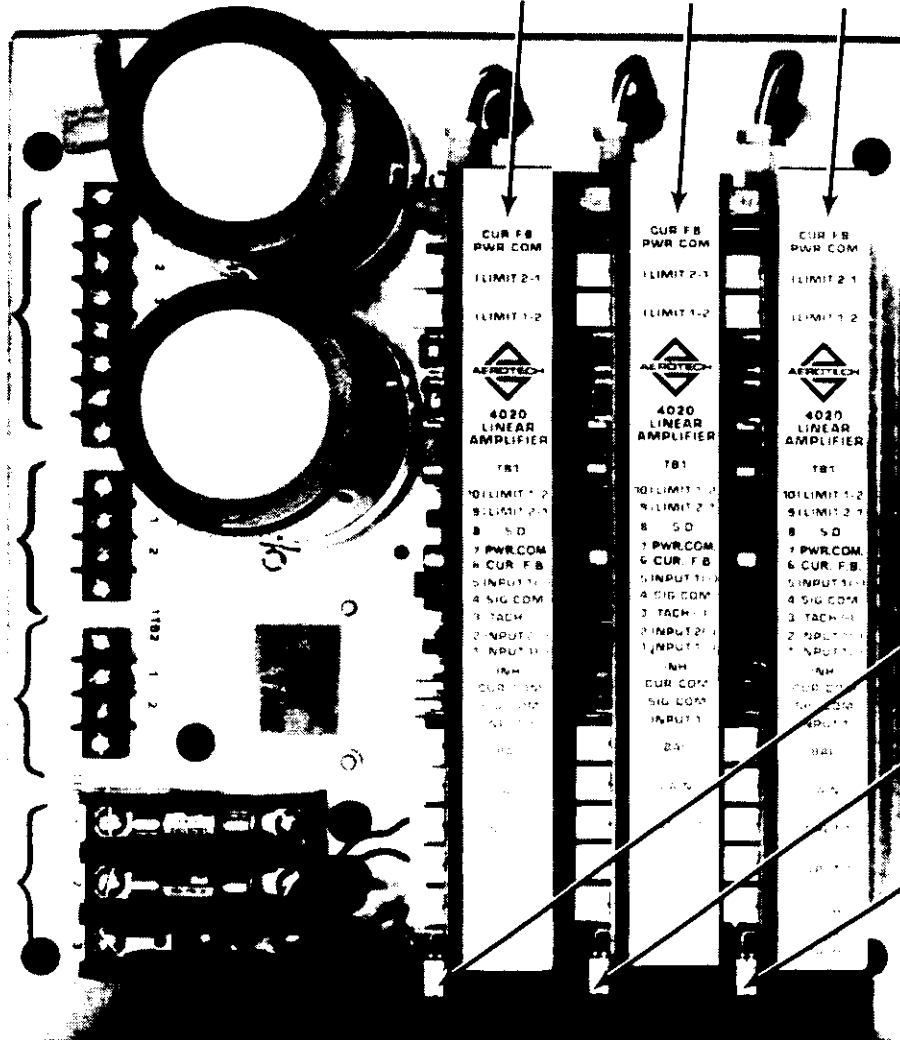
AXIS 1 AXIS 2 AXIS 3

** MOTOR POWER CONNECTIONS 1TB4

** AC INPUT NEUTRAL CONNECTION 1TB1

** 115 VAC FAN CONNECTION 1TB2

** AC INPUT CONNECTION 1TB3

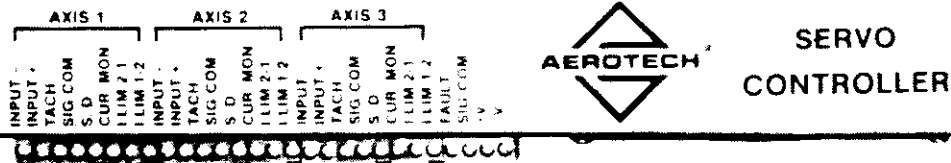


SERVO MODULE CONTROL CONNECTORS (J2)

* TO J2 OF TERMINAL BOARD

* TO J3 OF TERMINAL BOARD

* TO J4 OF TERMINAL BOARD



* SEE FIGURE 2-11

TOP VIEW

** SEE FIGURES 3-4, 3-5

FIGURE 2-10: 4020 SERIES THREE AXIS BASE PLATE

SERVO MODULE
POWER CONNECTORS TB2

TWISTED PAIR
CONNECTION BETWEEN
TB4, TB3 OF AXIS 1
MODULE AND TB5, TB6
OF TERMINAL BOARD
(SEE FIGURE 2-9)

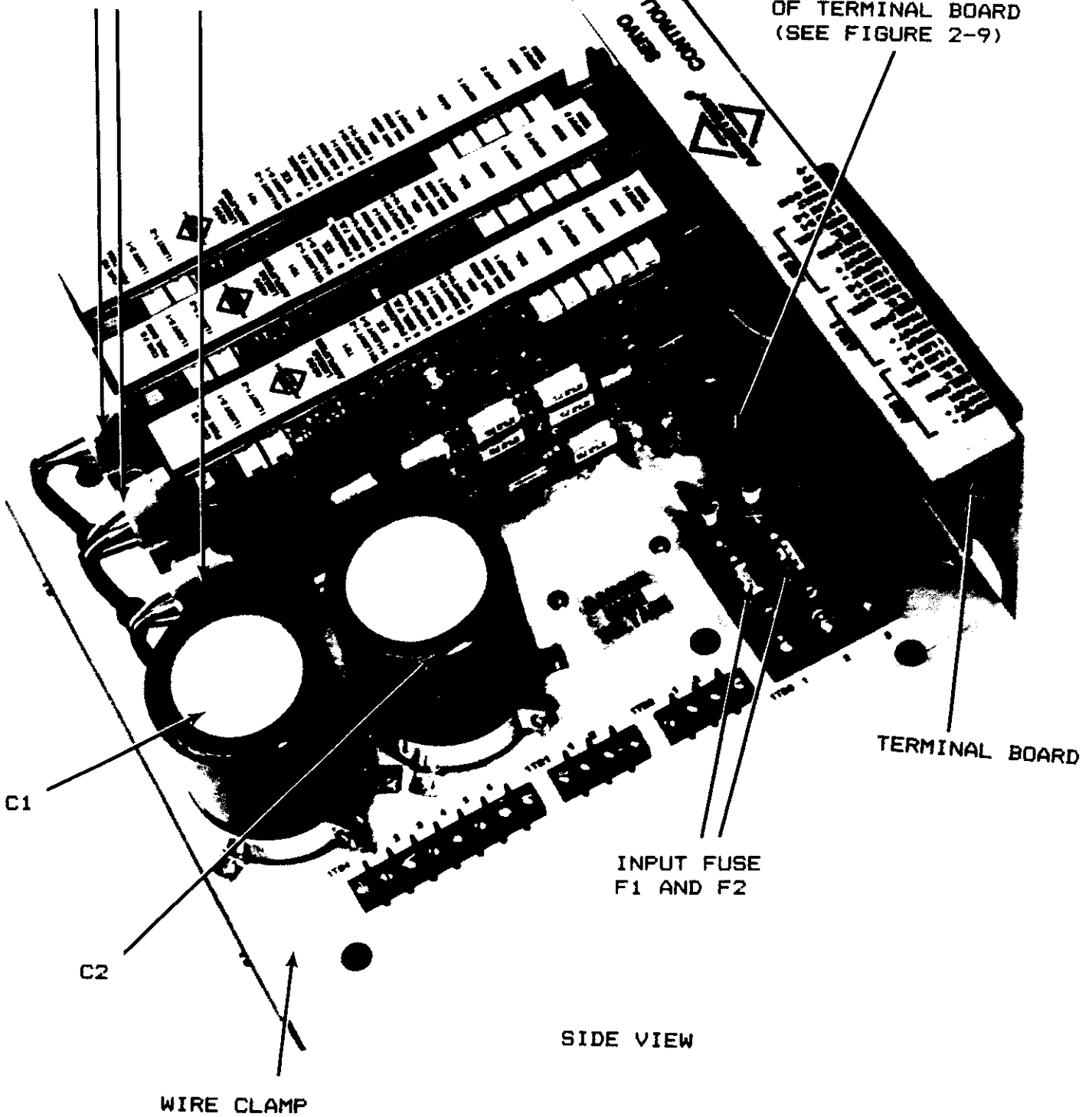


FIGURE 2-10: CONTINUED

TERMINAL BOARD

The 4020 SERIES Three Axis Base Plate utilizes the terminal board as a mechanism for interfacing control connections from an external controller to the 4020 SERIES servo module.

Figure 2-11 shows the schematic of the terminal board. Locations of connections to the terminal board from an external controller is shown in figure 2-12.

Referring to figure 2-11 and 2-12, it is noted that TB1, TB2, TB3 and TB4 are "screw type" connectors, allowing the user to wire to the terminal board with discrete connections. If desired, an optional mass termination of the control connections can be accomplished by utilizing the 50 pin connector, J1. All connections shown for TB1, TB2, TB3 and TB4 are available on connector J1. Using connector J1 for control interfacing instead of TB1, TB2, TB3 and TB4 allows an additional advantage to that of providing mass termination. With connector J1, 4 axis interfacing with a single connector is possible, when a single axis base plate is "mated" with the three axis base plate, as shown in figure 2-13.

The destinations for control wiring from TB1, TB2, TB3, TB4 and J1 of the terminal board to the control modules for axis 1, axis 2 and axis 3 servo amplifiers are shown in figure 2-14. In this figure, control wiring from the terminal board to axis 1 is given as an example. The wiring for axis 2 and axis 3 (TB2 and TB3 respectively) is similar.

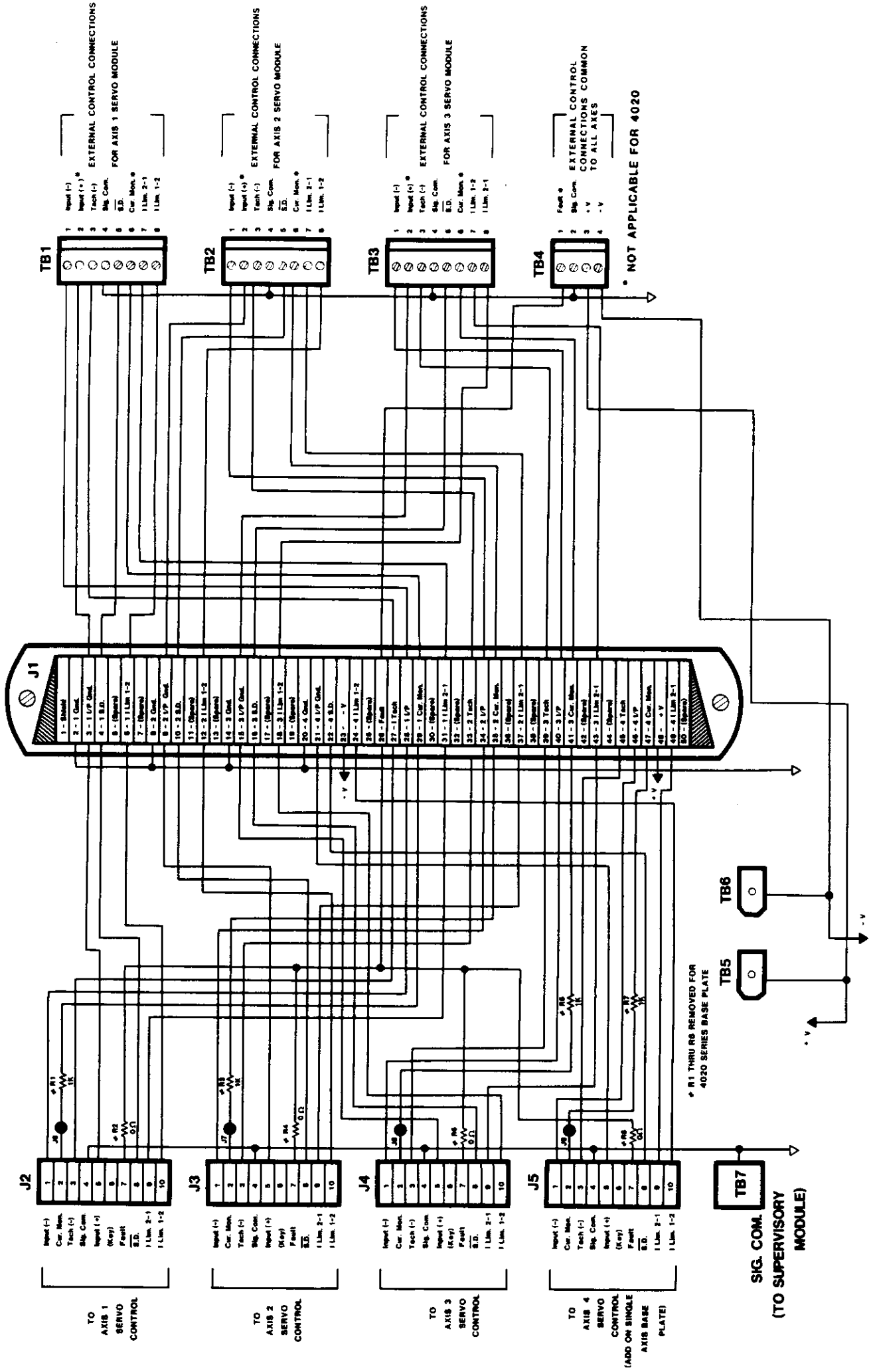


FIGURE 2-11 SCHEMATIC OF TERMINAL BOARD

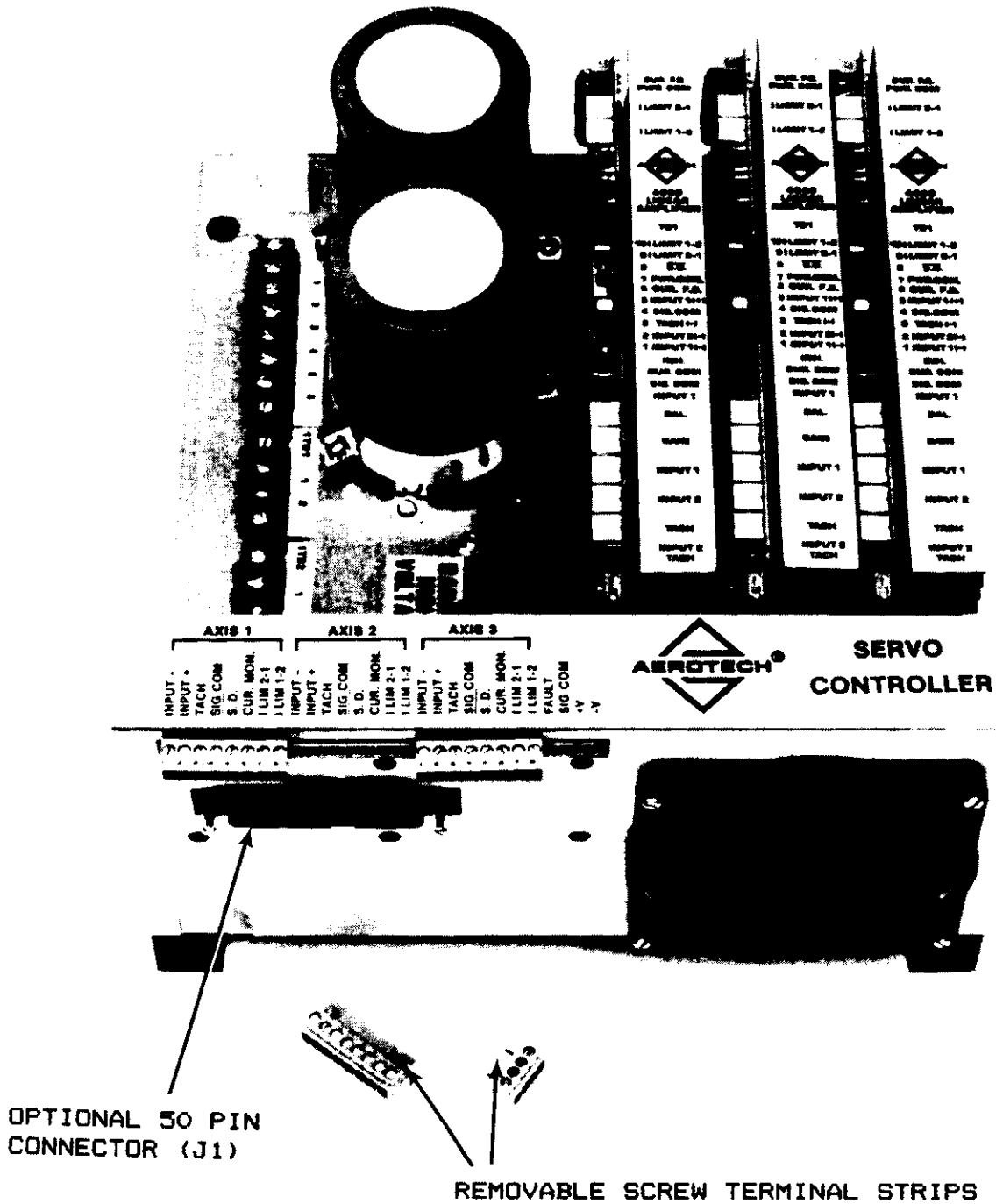


FIGURE 2-12: SIDE VIEW OF THREE AXIS BASE PLATE SHOWING LOCATIONS FOR CONTROL CONNECTIONS

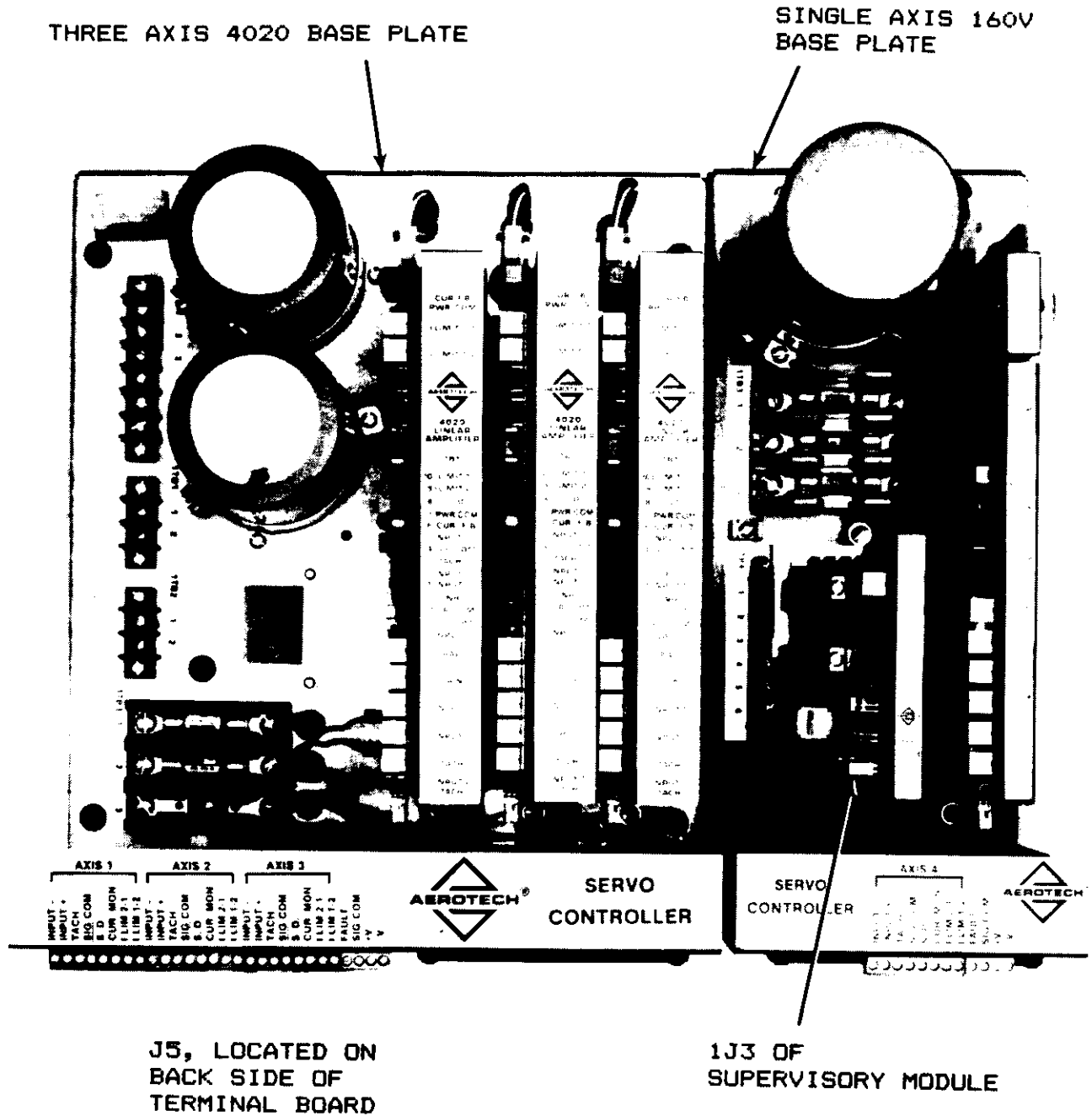


FIGURE 2-13: THREE AXIS BASE PLATE "MATED" WITH A SINGLE AXIS BASE PLATE TO CREATE A 4-AXIS SYSTEM

With J5 of terminal board connected to 1J3 of supervisory module (or J2 of a 4020 SERIES servo module) on the single axis base plate (shown above), J1 (50 pin connector) can be used to control all four axes.

FIGURE 2-15: CONTROL CONNECTIONS DESCRIPTIONS FOR THE TERMINAL BOARD

TB1 (TB2 AND TB3 SIMILAR)

PIN 1, INPUT (-)	Speed command input signal to servo module. Nominal signal is usually between ± 10 volts. This signal can be referenced to pin 2 - input (+) for differential inputs or signal common (pin 4, Sig. Com.). (See also figure 2-6.)
PIN 2, INPUT (+)	Differential reference point for Input (-) connection. If not used, this input should be tied to signal common. (See also figure 2-6.)
PIN 3, TACH (-)	Tach feedback input signal to servo module. Nominal signal is usually between ± 10 volts. However, signal range can be as high as ± 60 volts. (See figure 2-6.)
PIN 4, SIG. COM.	Reference point for input and output signals.
PIN 5, S.D.	Shut down input for servo module. By pulling this input to signal common (1 mA sinking through internal pull-up resistor), the operation of the power stage of the servo module is inhibited.
PIN 6, CUR. MON.	Not used on 4020 servo amplifier module (no connection)

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PIN 7, I LIM 2-1

Directional current limit for servo module. By pulling this input to signal common (contact closure only), power flow to motor from 1TB4 point 2 to point 1 is limited to near zero. See also figures 2-8 and 3-5.

PIN 8, I LIM 1-2

Directional current limit for servo module. By pulling this input to signal common (contact closure only), power flow to motor from 1TB4 point 1 to point 2 is limited to near zero. See also figures 2-8 and 3-5.

TB4
PIN 1, FAULT

Not used on 4020 amplifier module (no connection).

CHAPTER 3

SECTION 3-1 INSTALLATION AND START-UP

CAUTION: HIGH VOLTAGE EXISTS ON ALL TRANSISTOR CASES ASSOCIATED WITH THE POWER STAGE. Before attempting installation or removal of the servo amplifier modules from the three axis base plate, make sure the following steps are taken.

1. All input power to the three axis base plate is TURNED OFF.
2. Disconnect "white" power connectors (TB2) from ALL servo modules.

See figure 3-1 for additional information.

WARNING: Damage to a servo amplifier module due to improper handling during installation or removal voids warranty.

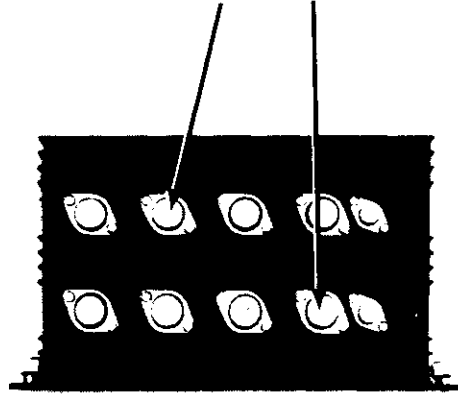
Mounting dimensions for the three axis base plate are shown in figure 3-2. Mounting is accomplished with four #10-32 bolts.

Mounting of the servo modules to the three axis base plate is accomplished with two captive screws located at the bottom of these modules. These captive screws insert into holes located on the mounting surface of the three axis base plate as shown in figure 3-3.

Control connections between the servo modules and the terminal board are made with ribbon cables as shown in figure 2-10 (top view). The location and destination of each ribbon cable can be determined by referring to these figures.

CHAPTER 3

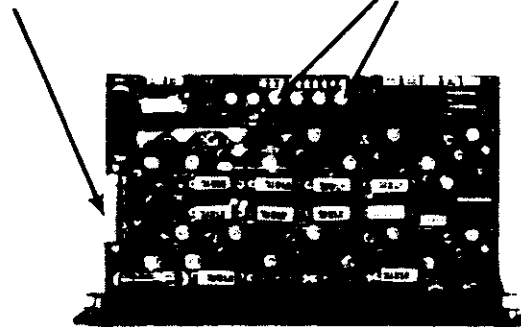
HIGH VOLTAGE (TYPICAL)



BACK VIEW

POWER CONNECTOR TB2

HIGH VOLTAGE (TYPICAL)



FRONT VIEW

FIGURE 3-1: LOCATIONS OF HIGH VOLTAGE ON SERVO MODULE DURING OPERATION

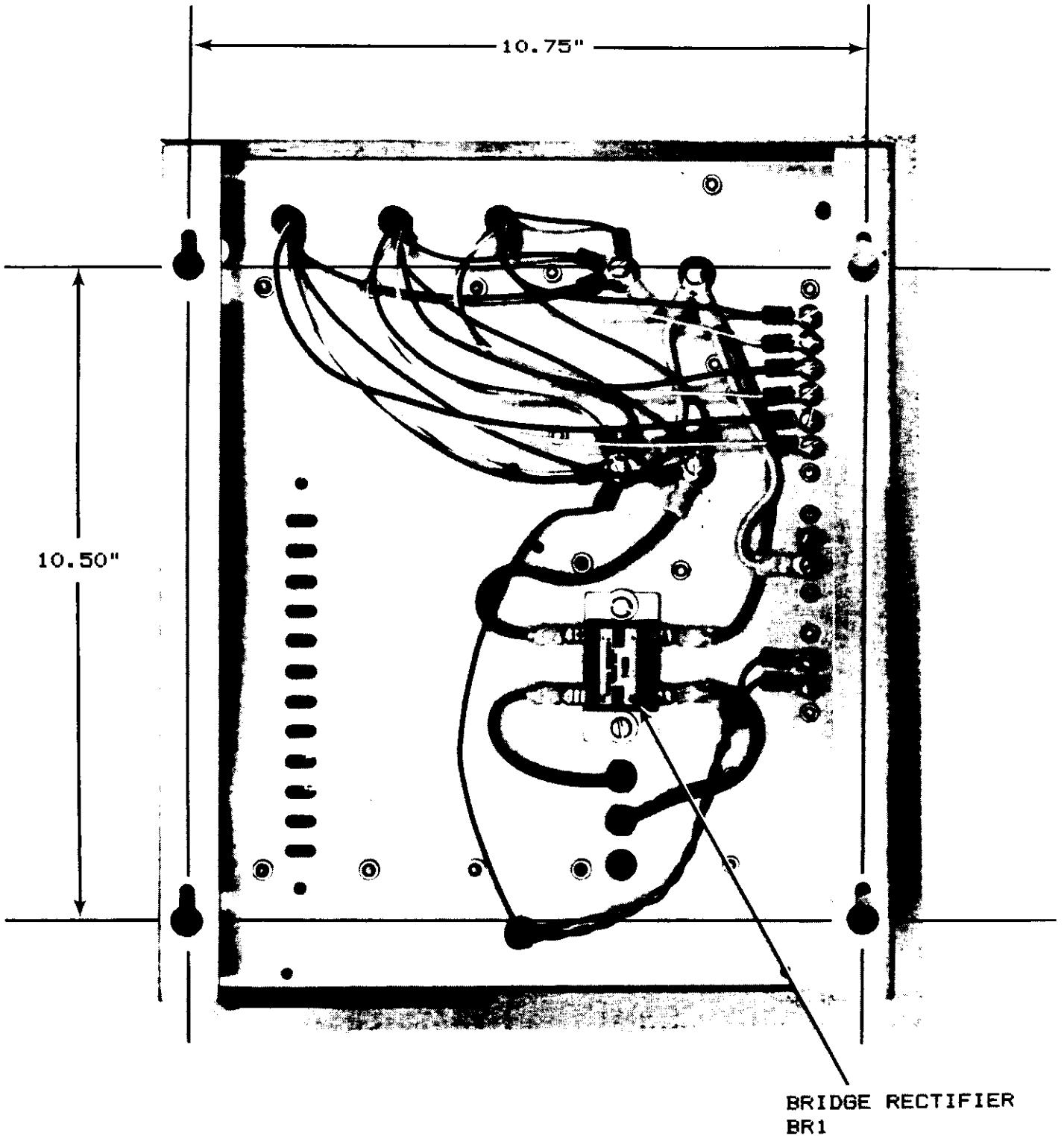


FIGURE 3-2: BACK VIEW OF THREE AXIS BASE PLATE WITH MOUNTING HOLE LOCATIONS

CAPTIVE SCREW
MOUNTING HOLES
FOR AXIS 3
(TYPICAL FOR
AXIS 1 AND
AXIS 2)

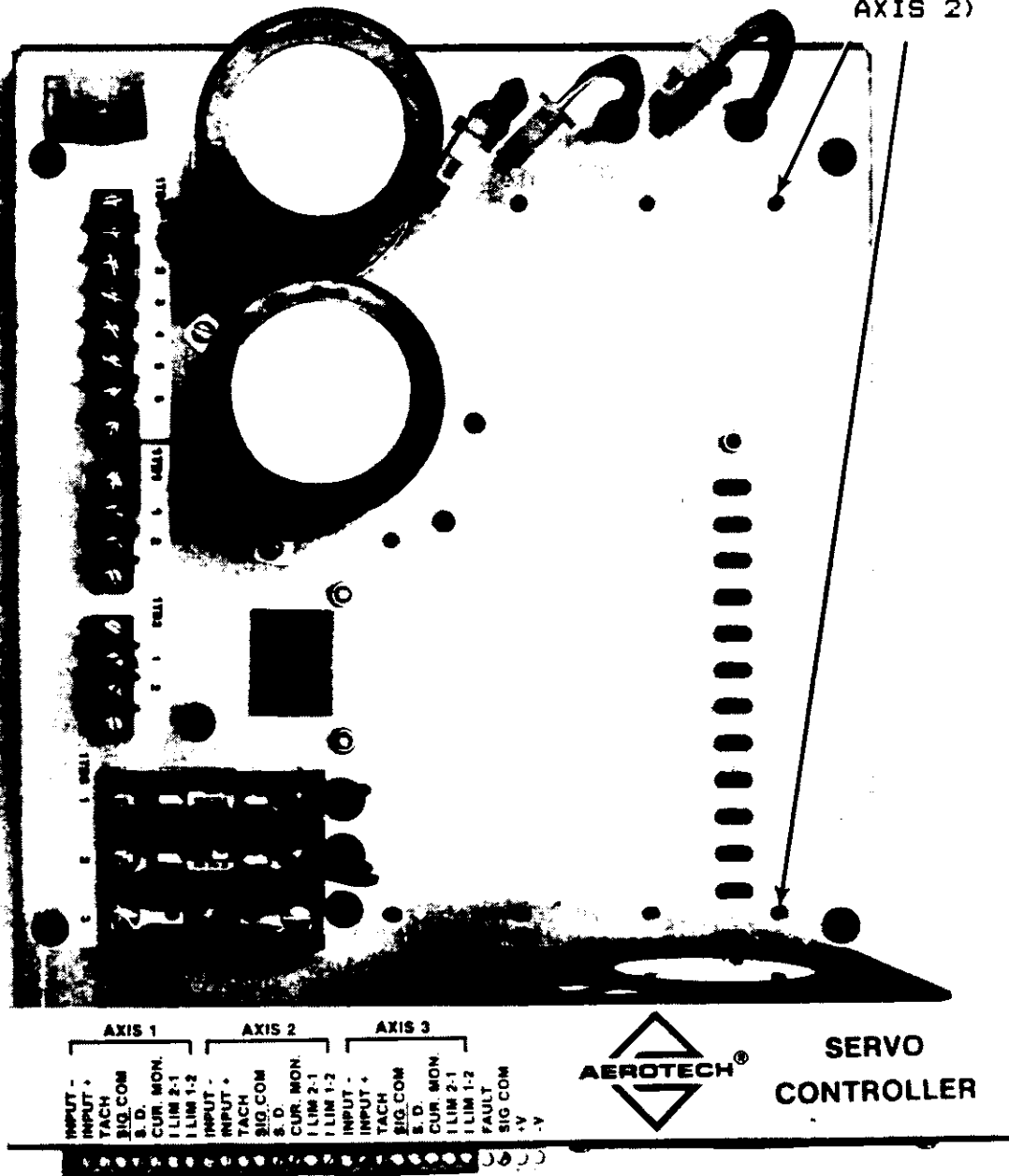


FIGURE 3-3: LOCATION OF HOLES FOR MOUNTING MODULES TO BASE PLATE

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Input power connections to the three axis base plate are made at terminal blocks 1TB1, 1TB2, and 1TB3, as shown in figure 2-10 (top view). Figure 3-4 shows the input power arrangements for the 4020 SERIES Three Axis Base Plate.

The location for the motor power connections for the three axis base plate is shown in figure 3-5. The technique for properly connecting the polarity of the motor power connections and motor tach connections to the 4020 SERIES Base Plate is described below:

1. Spin motor shaft CW (looking into flange). Note the polarities of the motor power leads and tach leads.
2. A minus (-) signal on the Input(-) connection to the terminal board will cause the motor to spin CW (looking into flange) if:
 - a. The "-" lead of the motor is connected to 1TB4 point 2, with the "+" lead connected to point 1.
 - b. The "+" lead of the tach is connected to tach(-), axis 1 (2 or 3) of terminal board, with the "-" lead connected to signal common.

As noted, connections described above are similar for axis 2 and 3.

After being installed in the base plate, the servo module(s) is ready to be adjusted for operation within the system. Note in figure 2-3 the locations of the seven control pots and eight test points. Before connecting TB2 and J2 to the servo module(s), (see figure 2-10) adjust these pots to the following positions, as noted below:

1. Current limit (I Limit 2-1 and I Limit 1-2) pots to be turned completely CW (limiting maximum current flow to ± 5 amps).

CHAPTER 3

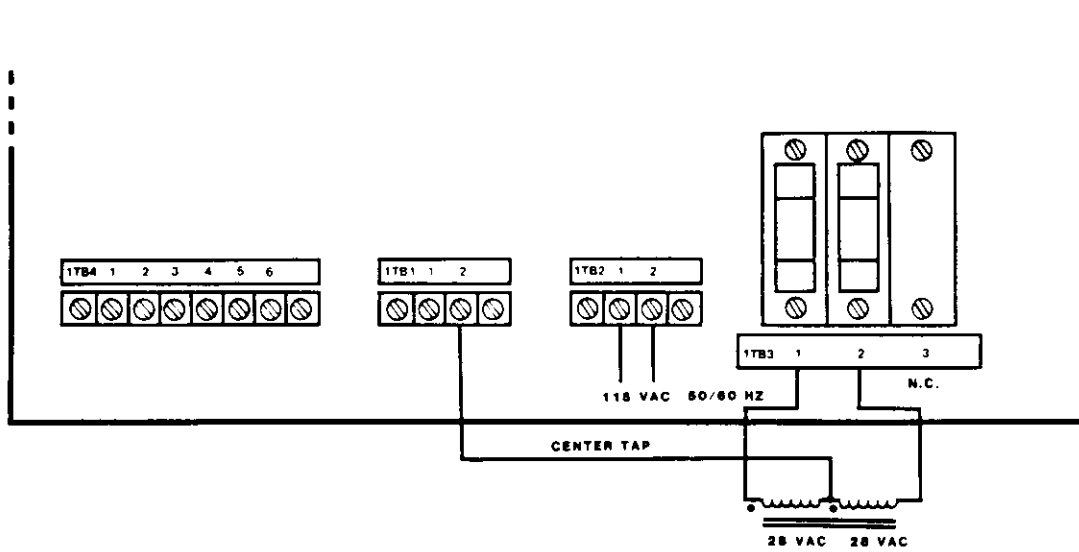


FIGURE 3-4: INPUT POWER CONFIGURATIONS FOR THE 4020 SERIES THREE AXIS BASE PLATE

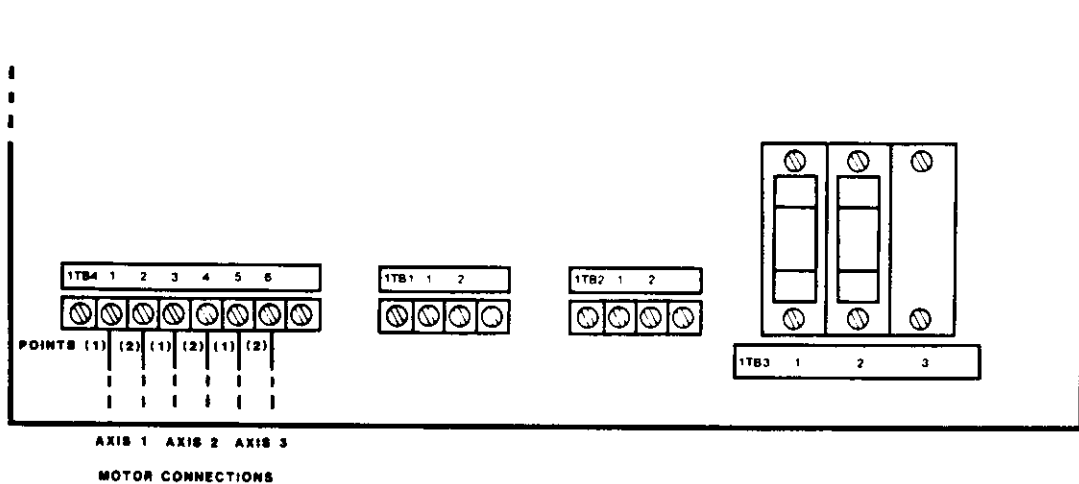


FIGURE 3-5: LOCATIONS FOR MOTOR POWER CONNECTIONS FOR AXIS 1, 2 AND 3

CHAPTER 3

2. Gain (Gain) pot to be turned completely CW.
3. Input (Input 1) pot to be turned completely CW.
4. Tach (Input 3 or Tach) pot to be turned completely CW.
5. Balance (Bal) pot to be adjusted to midway position.

NOTE: Ascertain that the motor shaft is mechanically decoupled from the drive system, hence avoiding possible damage to the system.

If the servo module(s) is being used in a position loop, temporarily disconnect the input signal. This will allow the servo module to work only in the rate loop.

Apply power to the mounting base. If the motor races, disconnect power and reverse the tach connections at the terminal board of the mounting base (see chapter 4, Troubleshooting).

With the power again applied, adjust the balance pot until the motor comes to a complete stop.

Disconnect power, reconnect the input signal and recouple the motor shaft to the drive system. Be sure the input signal is at zero volts (ie., make sure the position loop controller is in "home" position).

Now reapply power. If the position controller indicates that the system is out of "zero" (or "home") position, readjust the balance pot. **NOTE:** The balance pot is capable of cancelling only small offsets (± 15 mV) in the pre-amplifier or on the input signal. If adjusting the balance pot fails to bring the system to the zero position, then the input signal is exhibiting too much offset voltage.

Position commands can now be applied to the system. Program the position controller so that the motor accelerates and decelerates to some position, stops, and then returns to "home" position. Make the cycle time in which this event occurs approximately 2 seconds. With an oscilloscope, monitor the tach test point with respect to signal common (refer to figure 3-6).

SECTION 3-2 INPUT AND TACH POT ADJUSTMENTS

Adjusting the input and tach pots accomplishes position loop stability. This section refers to figure 3-6.

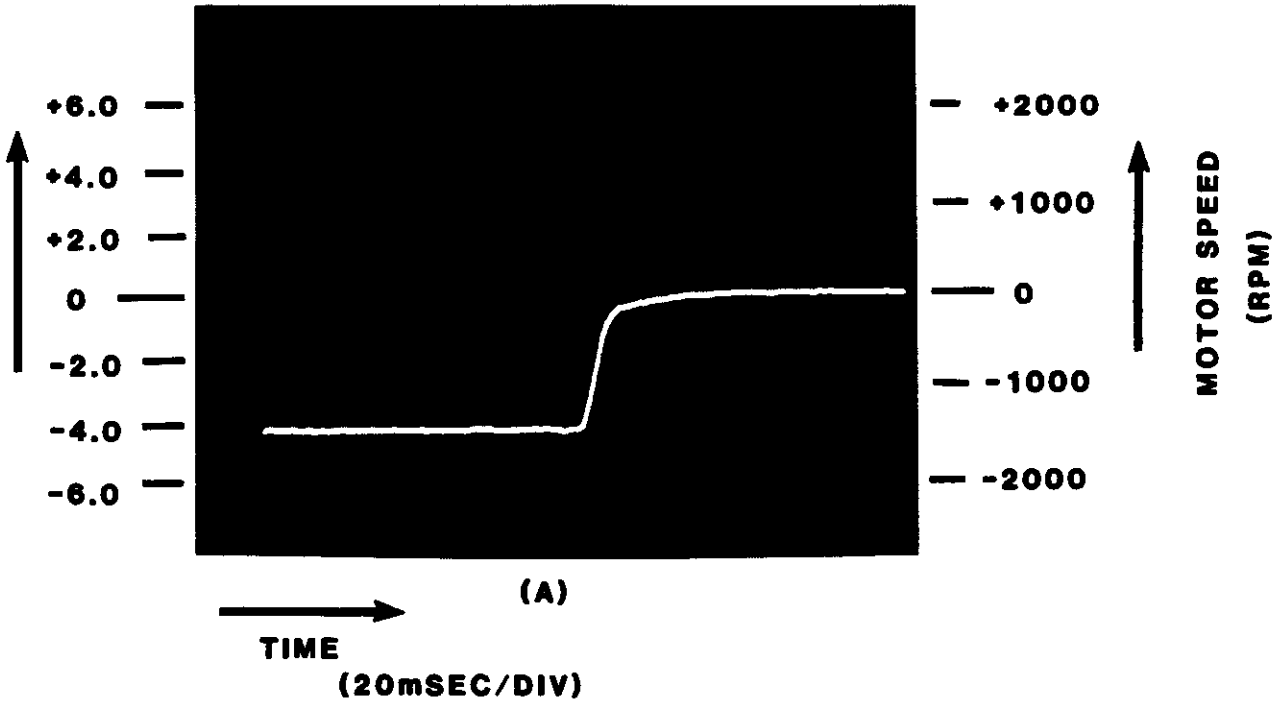
Motor overshoot, when present in a closed position loop system, can be very detrimental to position loop accuracy. Care must be taken in the fine tuning adjustments of the tach, input, and gain pots in order to prevent the problem from occurring.

Photograph A (following page) shows a typical deceleration interval for a motor (in this case, the 1035-01 motor), used with the 4020 servo amplifier module, being commanded to decelerate to zero speed by a position controller. Note that the motor's speed (or tach voltage) ramps smoothly to zero speed, without ever crossing zero. This photograph shows optimum motor response during deceleration.

Photograph B (following page) shows a deceleration interval where the tach gain is set too low (or the input gain is set too high). Note that the tach voltage crosses zero. In this case, the motor "over-shoots" its designated "home" position, but eventually settles into position.

A good rule of thumb for adjusting motor deceleration response, is to initially set the input and tach pots full CW. Then slowly turn the tach pot CCW until minimum motor deceleration time is achieved without over-shooting.

TACH VOLTAGE SIGNAL (VOLTS)
AS VIEWED FROM TACH TESTPOINT



TACH VOLTAGE SIGNAL (VOLTS)
AS VIEWED FROM TACH TESTPOINT

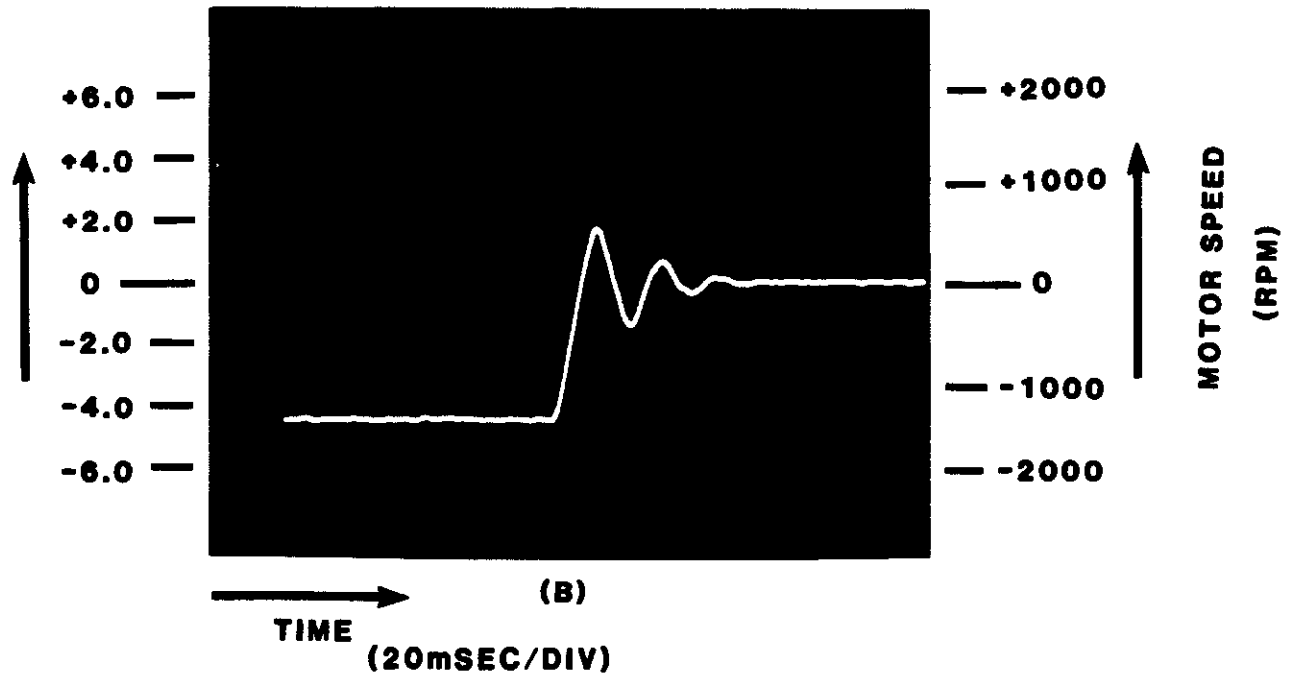


FIGURE 3-6: ADJUSTING INPUT AND TACH POTS FOR POSITION LOOP STABILITY

SECTION 3-3 GAIN POT ADJUSTMENTS

The gain pot is adjusted in order to minimize ripple current in the motor. This section refers to figure 3-7.

The magnitude of ripple current present on the current feedback test point of a linear servo amplifier such as the 4020, when the motor is running at a constant speed, is basically the product of the tach feedback ripple voltage produced by the commutator of the tach. This effect is amplified by the pre-amplifier circuit, contributing to ripple on the current command signal.

It is this ripple from the tach signal on the current command signal that usually contributes to most of the excess I R heating in the motor.

Photograph A (following page) shows an optimum level of peak to peak ripple current for a motor (for example, the Aerotech 1035-01 motor) running unloaded, at constant speed.

Photograph B (following page) shows an excessive level of ripple current, due to the increased gain in the pre-amplifier, for this motor running under the same conditions as in photograph A.

This excessive level of ripple current can usually be minimized by turning either the gain pot in the CW direction or turning the tach pot in the CCW direction. Care must be taken, however, when turning these pots as indicated above. For example, turning the tach pot too far in the CCW direction may result in the undesirable wave form shown in photograph 3-6B.

CURRENT FEEDBACK SIGNAL (VOLTS)
AS VIEWED FROM CURRENT FEEDBACK TESTPOINT

CURRENT FEEDBACK SIGNAL (VOLTS)
AS VIEWED FROM CURRENT FEEDBACK TESTPOINT

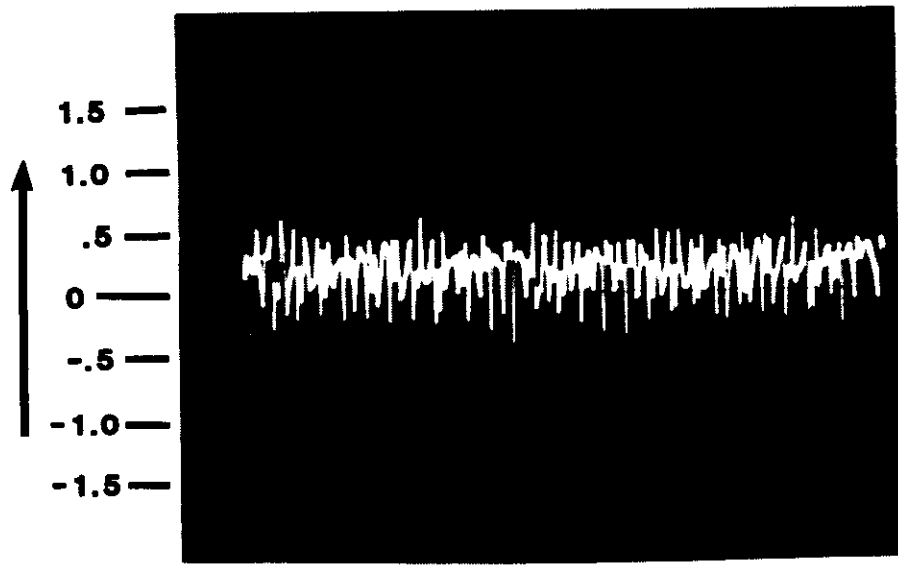
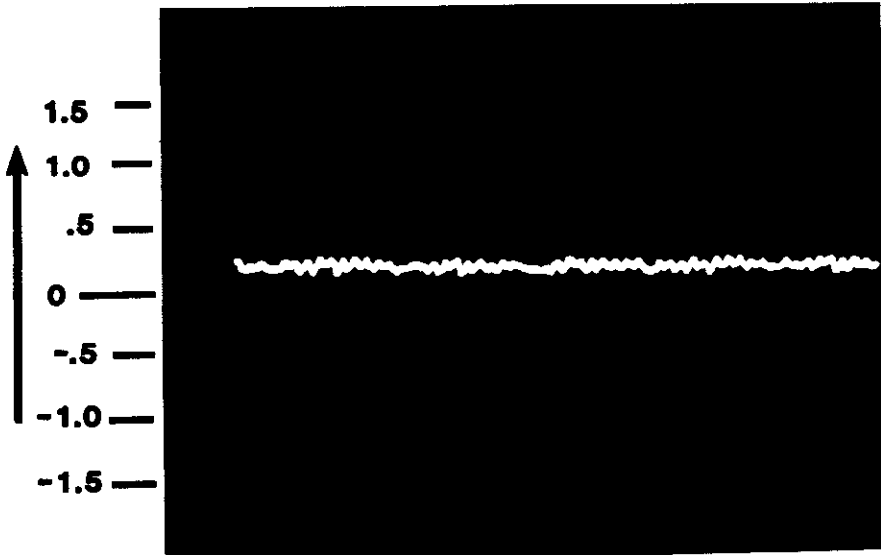


FIGURE 3-7: ADJUSTABLE GAIN POT TO MINIMIZE RIPPLE CURRENT IN MOTOR

CHAPTER 4

SECTION 4-1 TROUBLESHOOTING (THREE AXIS BASE PLATE)

(Unless otherwise noted, refer to figure 2-10 A&B)

WARNING: BEFORE ANY ACTION IS TAKEN, AND UNLESS OTHERWISE SPECIFIED, TURN OFF POWER.

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
Fan does not operate when input power is applied	Improper power connections on 1TB2 of base plate	Check for 115 VAC between 1TB2 terminals 1 and 2 (see also figure 3-4)
DC bus voltages are not at their proper levels	Improper power connections on 1TB1 and 1TB3 of base plate	Refer to figure 3-4 for input power connection arrangement. With an AC voltmeter, verify that these voltages exist
Input power fuse F1 or F2 of 1TB3 of the base plate opens when power is applied	Bridge rectifier, BR1, on the base plate, may be shorted. (See also figures 2-9 and 3-2)	Refer to figures 2-9 and 3-2. Check for shorted diodes in bridge rectifier, BR1

SECTION 4-2 TROUBLESHOOTING (SERVO MODULE)

(Unless otherwise noted, refer to figure 2-3)

WARNING: BEFORE ANY ACTION IS TAKEN, AND UNLESS OTHERWISE SPECIFIED, TURN OFF POWER.

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
No power to motor	Input fuses on base plate are open	See also section 4-1
	Motor fuse (F1) on servo module is open	Remove fuse and check for continuity
	DC bus input fuse (F2) on servo module is open	Remove fuse and check for continuity. <u>NOTE:</u> If F2 is open, <u>DO NOT REPLACE.</u> Return servo module to Aerotech for repair
	Input shut-down (S.D.), located on terminal board of mounting base pulled to signal common	Temporarily remove connection to restore power
	\pm DC bus low level detect circuit (represented in figure 2-4) is inhibiting servo module due to a high or low \pm Vbus condition on the power supply of the base plate	Check Vbus voltage levels on base plate, remove connector TB2 from servo module and check the DC voltages on the cable as follows: - Red wire (+) to wht/brn (-) should be approximately +40 VDC

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<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
Motor is racing	Tach polarities are reversed	<p>- Wht/brn wire (+) to blue wire (-) should be approximately +40 VDC</p> <p>Reverse polarities of tach connections on the terminal board of the base plate</p>
	No connection	<p>Check "tach" testpoint with respect to signal common on the servo module. With motor racing, tach voltage signal should be present at this test point. If no signal is present, check for continuity on tach connection of the ribbon cable between the servo module and the terminal board</p>
Motor is sluggish in response to speed command	<p>I Limit 1-2 or I Limit 2-1 inputs (located on terminal board of mounting base) are activated by limit switches. (See figure 2-5)</p>	<p>Temporarily remove connections to restore power</p>
	<p>I Limit 2-1 and/or I Limit 1-2 (Cur. Lim.) pots set to clamp at too low a value (see figure 2-5)</p>	<p>Turn I Limit 2-1 or I Limit 1-2 pots CCW, to increase the + or - current clamp levels</p>

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
Motor will not lock system in "home" position (position loop control)	Excessive DC offset on input signal to servo module	Adjust balance (Bal.) pot to bring system into "home" position. If system does not respond to this solution, then excessive offset exists on the speed command signal of the position controller
Motor overshoots when coming to rest (position loop control)	Gain not set properly	See figure 3-6 for information on gain control adjustment in a position loop
Motor runs very hot	Gain set too high in servo module, causing excessive ripple current in motor	See figure 3-7 information on gain pot adjustment

CHAPTER 5

SECTION 5-1 SERVICE AND REPAIR

General repair of equipment consists entirely of solutions listed in sections 4-1 and 4-2 on troubleshooting, or the removal and replacement of a servo module, should the need arise. IF UNDER WARRANTY, REPAIR OF DEFECTIVE ELECTRICAL COMPONENTS OF THE BASE PLATE SHOULD NOT BE ATTEMPTED, SINCE TO DO SO WOULD VOID THE ENTIRE WARRANTY. If necessary, any on-site service should be performed by an experienced electronic technician, preferably trained by Aerotech, Inc. It is recommended that the user NOT attempt repair of the servo module, whether or not these units are under warranty.

SECTION 5-2 SHIPMENT

The procedure for shipping equipment back to Aerotech for repair is shown below. This procedure pertains to warranty as well as non-warranty repairs of equipment.

1. Before shipping any equipment back to Aerotech, the person making the return should call ahead for a "Return Authorization Number".
2. The equipment being returned (in this case the three axis base plate or the 4020 servo module) must be encased in a proper cushioning material and enclosed in a cardboard box.
3. Equipment should be sent to:

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238
Phone: (412) 963-7470
Customer Service

WARNING: DAMAGE DUE TO IMPROPER PACKAGING VOIDS WARRANTY.

SECTION 5-3 PARTS LIST (THREE AXIS BASE PLATE)

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>MANUFACTURER</u>
4020 SERIES Base Plate (TA3 OEM) less servo moduel		EFA 451
Fuses F1, F2	FNW-20	Bussman
Ribbon Cables: (set of three) J2, J3, J4 to J2, J2, J2 (terminal board to servo module)	630D1265 (Assembly D)	Aerotech
Blue/brown twisted pair (terminal board to axis 1 servo module)	630D1265 (Assembly D)	Aerotech
Bridge Rectifier (BR1)	ECD110	Aerotech
Filter Capacitor (C1 and C2)	ECC121	Aerotech
Fan Assembly	630D1265 (Assembly A)	Aerotech

SECTION 5-4 PARTS LIST (SERVO MODULE)

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>MANUFACTURER</u>
Motor Load Fuse (F1)	3136.25	Little Fuse
DC Bus Input Fuse (F2)	3136.25	Little Fuse
4020 Servo Module	EFA427	Aerotech

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