INSTRUCTION MANUAL

WESTAMP A529 SERIES

This is a general manual describing a whole series of amplifiers and may be used in conjunction with drawings pertaining to various specific models.

CAUTION

The maintenance procedure described herein should be attempted only by highly skilled technicians using proper test equipment. Read your warranty provisions before starting, to avoid voiding your warranty.

WESTAMP®

TABLE OF CONTENTS

FORWARD:

This manual is a general purpose manual covering the theory and application of the A529 Series of Linear Servo Amplifiers.

This manual does not necessarily apply specifically to any individual amplifier. However, the information is presented in a general way so that it may be applied to a specific amplifier in conjunction with its associated drawings and parts list.

The A529 Series of Linear Servo Amplifiers consists of three basic sections.

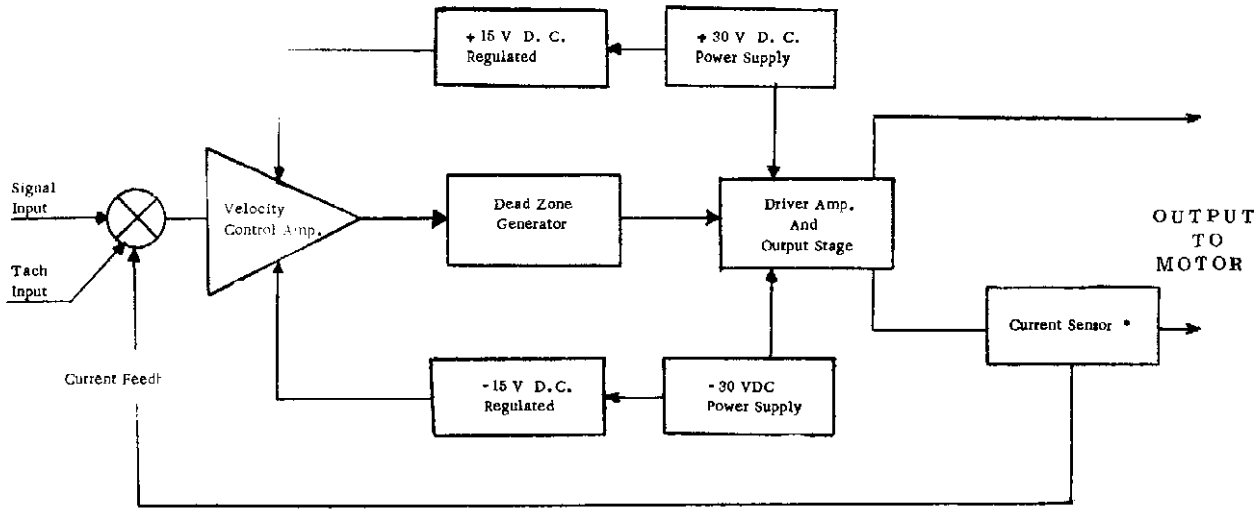
1. The main chassis contains the power transformer, DC rectifier bridge, line fuse, storage capacitor, terminal block with wiring and connectors needed for connecting either 1 or 2 amplifier modules.
2. Either 1 or 2 amplifier modules are mounted on the A529 Series main chassis. These modules are identical in all respects and are interchangeable.

BLOCK DIAGRAM:

Figure 1 is a Block Diagram showing the direction of signal flow and power through the amplifier. The flow of signals starts at the signal and tachometer inputs and proceeds through the velocity control amplifier. The output of the velocity control amplifier is fed to the optional dead zone generator, and to the driver amplifiers. Then the signal is fed directly to the output transistors. The output current is sampled by the current sensor and is fed to the current feedback potentiometer. The output of the current feedback potentiometer is used as a feedback signal for the amplifier.

The plus and minus 30 volt power supplies are on the chassis of the unit. These supplies are connected to the P.C. Cards by Plug P-2.

The plus and minus 15 volt regulated power supplies are made on the P.C. Card from the unregulated plus and minus 30 volt supplies.



BLOCK DIAGRAM Fig No. 1

SPECIFICATIONS: A5292 LINEAR AMPLIFIER

Specifications are for each amplifier acting independently.

1.	Peak Current	± 20 Amps	13.	Input Impedance	10 K
2.	Peak Voltage	± 30 Volts	14.	Input Voltage Max	± 50 Volt
3.	Power Dissipation Max	120 Watts @ 50°C	15.	Drift (Refer To Input)	10 u V/°C/Input
4.	Continuous Output Power	180 Watts	16.	Current Limit	Fixed
5.	Continuous Current	± 8 Amps	17.	Balance	Adjustable
6.	Continuous Voltage	± 30 Volts	18.	Ambient Temp.	0 - 50°C
7.	Horsepower Rating	1/3 HP	19.	Form Factor	Pure DC 1.000
8.	Input Power	120/240 50/60 Hz	20.	Auxiltary Mode	Current feedback with output
9.	Frequency Response	1000 Hz Min.			impedance greater than 100 ohms
10.	Dead Band	None	21.	Protection	Current limit, primary power
11.	Output Impedance	Less than .1 ohm			fuse, output fuse.
12.	Gain (Adjustable)		22.	Cooling	Blower
	Input 1	1000 Volts/Volt	23.	Weight	18 lbs.
	Input 2	1000 Volts/Volt	24.	Mounting	Panel (Vert. or Horiz.)

NOTES:

1. Maximum peak current is limited to a 25% duty cycle.
2. Frequency response is typical of units with no compensation. Servo compensation networks in practical applications usually reduce the response to a few cycles.
3. For short circuit proof operation or continuous operation into a very low load resistance, the current limit must be set so as not to exceed the allowable dissipation.
4. When amplifier is used with current feedback, the pre-amplification, velocity signal summing, plus compensation, may be done external to the amplifier.
5. The output impedance with current feedback depends upon the amount of feedback applied. The maximum practical amount of current feedback is 30 db with 20 to 30 db being adequate for many servo applications.
6. Amplifier can be made with a dead band in the output. The dead band is measured after the first op amp with ± .7 volts dead zone.

MODEL A5292-002 Standard Unit

Typical Values For Setting Current Limit Resistors R26 and R27

Value of R26 and R27 Must Be	Current Limit For Decel of Motor
OHMS	PEAK AMPS
0	7
1	7.5
2	8
3	9
4	9.5
5	10
6	11
7	12
8	12.5
9	13
10	13.5
11	14
12	15
15 (Factory Std.)	16

FOR LOWER CURRENTS SEE SUPPLEMENTAL INFORMATION IN BACK OF MANUAL

NOTE:

The amplifier's current limit should not be set any higher than is necessary because you may exceed the allowable dissipation for the unit.

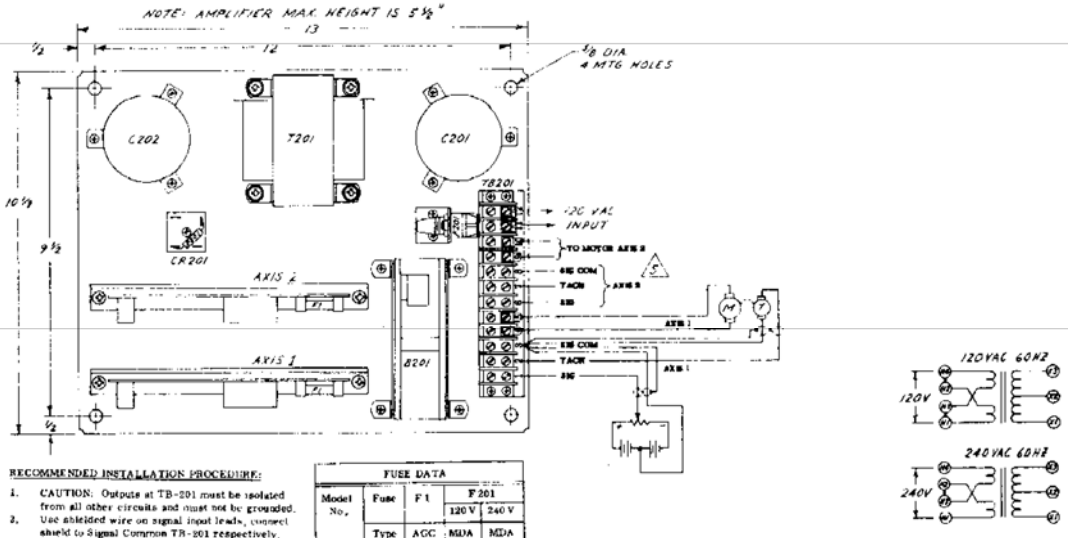
INSTALLATION

Each amplifier in the A529 Series comes with an individual installation drawing showing where to make the various connections for power input, signal input, and output to the motor or other load. While this manual may show in a general way how to make connections to amplifiers, follow the specific instructions applicable to your amplifier. Always be certain to apply the correct input power voltage and frequency. Some amplifiers may have dual voltage power transformers and, in such cases, make certain that the jumpers are on the correct transformer terminals. On all amplifiers the output is taken from separate terminals mounted on TB 201. CAUTION: DO NOT USE GROUNDED TEST EQUIPMENT ON THE OUTPUT CIRCUITS AND DO NOT CONNECT EITHER OF THE OUTPUTS TO GROUND.

The signal input is usually applied directly to Terminal 1 of TB-201 and the signal common is usually applied to Terminal 3 of TB-201. The tachometer signal is usually applied to Terminal 2 of TB-201 and the tachometer return is applied to Terminal 3 of TB-201. Use shielded wire for signal and tachometer inputs to prevent stray pickup and noise from being introduced into the amplifier input. The amplifier may have a bandwidth anywhere from 1000 Hz (no compensation) to a much lower frequency, depending upon the setting of the TC (Time Constant) potentiometer and the components in the servo compensation network. Figure 2 below shows a typical installation drawing that could be utilized to test an amplifier-motor combination. This is a specific example but the connections have general application. When testing with a motor-tach, adjustments will have to be made to the TC (Time Constant Potentiometer) and tachometer gain potentiometer to assure that the system is not oscillatory. The application of a positive signal from the signal source must result in a negative signal from the tachometer, otherwise the motor will run away when the loop is closed.

Typical Amplifier Connections at TB-201

Amp No 1		Amp No 2			
1)	Signal Input	6)	Signal Input	11)	Input Power
2)	Tach Input	7)	Tach Input	12)	Input Power
3)	Signal Common	8)	Signal Common		
4)	Output (Hi)	9)	Output (Hi)		
5)	Output (Lo)	10)	Output (Lo)		



RECOMMENDED INSTALLATION PROCEDURE:

1. CAUTION: Outputs at TB-201 must be isolated from all other circuits and must not be grounded.
2. Use shielded wire on signal input leads, connect shield to Signal Common TB-201 respectively.
3. Output at TB-201-5 is plus w.r.t. TB-201-4 when TB 201-1 is plus w.r.t. TB-201-3.
4. Motor case must be terminated to Signal Common TB-201 respectively.
5. Installation of Axis 2 is typical to Axis 1, however, on a One Axis unit Axis 2 is not used.

FUSE DATA				
Model No.	Fuse	F1	F201	
			120 V	240 V
	Type	AGC	MDA	MDA
A5292-002		8	5	5

Fig No. 2

ADJUSTMENTS:

There are 5 adjustments on the circuit board. They are as follows: Ref Fig No. 3

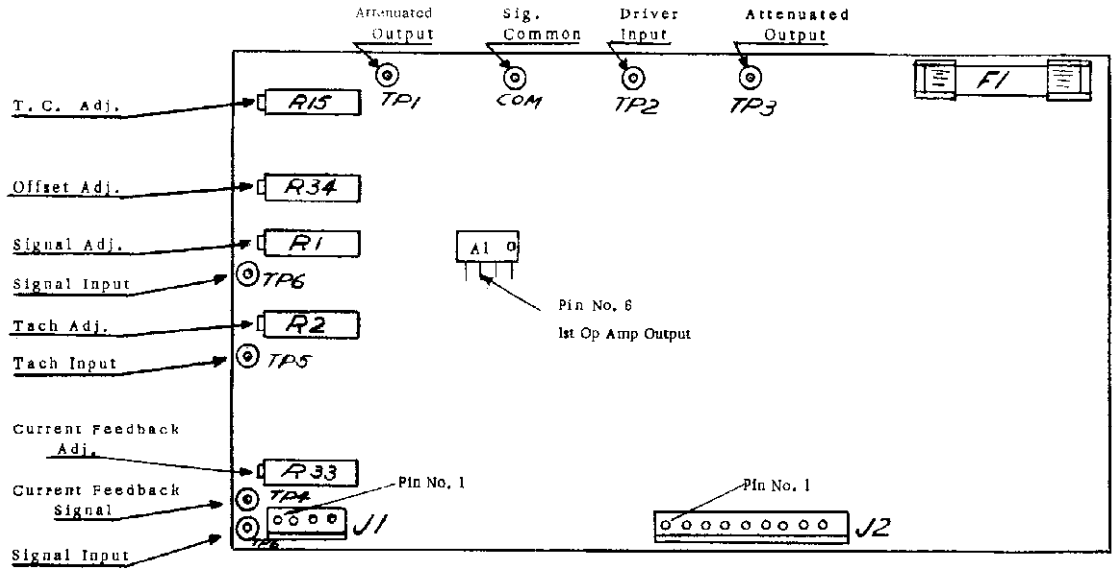
Sig Gain	The signal gain is used to scale the signal input to the previously set tach gain.
Tach Gain	The tach gain should be adjusted first to set the stability of the tachometer loop, and to adjust the amount of tach feedback in the closed loop system.
Balance	After the gains have been set, it may be necessary to adjust the BAL for zero output when zero input is applied.
T.C.	The TC (Time Constant) potentiometer is used to help stabilize the closed loop system. CW rotation increases the bandwidth.
CUR F.B.	The current feedback potentiometer is used to change the effective output impedance of the amplifier, thereby changing the motor transfer function.

Pin Connection J-1

Pin No.	
1	Signal Input
2	Tachometer Input
3	Com. (Signal)
4	Not Used

Pin Connection J-2

Pin No.			
1	Com. (Power)	6	Not Used
2	Not Used	7	-30 V Power Supply
3	Output	8	Not Used
4	Not Used	9	+ 30 V Power Supply
5	Output	10	Not Used



STANDARD UNIT ADJUSTMENTS AND TEST POINTS

Fig No. 3

SERVO SYSTEM COMPENSATION:

It is possible to compensate a servo system empirically without any theoretical evaluation of the system, provided that the specifications are not too stringent. For most applications the procedure as outlined in the Short Form "Set Up Procedure" will result in adequate servo performance. The A529 Series of servo amplifiers were designed to operate with "state of the art" characteristics in modern performance oriented systems. Therefore, matching amplifier-motor-tachometer combinations are recommended. However, the A5292 Series Amplifiers will provide good performance with many DC motor-tach combinations. This is accomplished by merely adjusting the TC and the tach gain potentiometers. Figure 4 titled "Helpful Hints" indicates the type of tachometer pictures that should be seen for optimum results.

SHORT FORM SET UP PROCEDURE: A5292 Amplifier

CAUTION: Please read entire Set Up Procedure before applying power.

1. Check input voltage for proper transformer connections.
2. Connect in accordance with proper Installation Drawing.

   Note: All adjustment pots are 20 turns.
3. Before turning power on, adjust these pots as follows and read Steps 4 and 5.
   a) "TC" pot - mid-range 10 turns from either end.
   b) Tach pot - turn fully "ccw".
   c) Signal gain pot - turn approx. mid-range, 10 turns from either end.
   d) Current feedback pot - turn fully "ccw".
4. Select the proper value of R26 and R27 for desired current -- See Specification section.

   Note: If you use decade boxes, be careful the contacts do not open circuit when selecting resistor, otherwise excessive currents will result and damage the transistors.
5. Select the appropriate output fuse F1 for your application. Do not exceed the 8 amp AGC type in the unit.
6. Apply AC power.
7. Apply a small DC signal to signal input.
8. Motor tach phasing.
   a) If motor tach phasing is incorrect, the motor will oscillate back and forth at a rapid rate (do not let the unit operate long under these conditions).
   b) If phasing is correct, motor will rotate at some slow RPM and be controllable by varying signal level.
9. Applicable only under 8 (a) condition.

   Turn power off and reverse either the motor armature wires or tach wires.

   Note: Either pair of wires, not both pair.
10. Repeat Step 8.
11. Apply a zero input command motor should stop. If motor rotates slowly or drifts, adjust signal balance pot either way until shaft stops turning.

12. Apply a small signal input, then turn tach pot "cw" 3 times, (make sure motor shaft is turning at this point) then turn "TC" pot "cw" until motor starts to oscillate at high frequency (audible noise) then back off "ccw" "TC" pot one full turn.

    Note: Do not let motor oscillate very long (one second max) or you may damage amplifier.

    Note: Normally, the "TC" pot is turned "ccw" only far enough to stop high frequency oscillation. However, this bandwidth should be above 30 cps, and if there is any noise from the tachometer, then it is very easy to exceed the dissipation of the unit due to normal servo correction.

13. If you have a high frequency oscillation and have to TC pot all the way ccw. Refer to Notes at end

14. Apply small step inputs and observe the tachometer output on an oscilloscope. (Refer to Helpful Hints, attached).

15. If the tach loop is overdamped, turn tach pot "cw" until one overshoot appears. The system is now set up for a conservative bandwidth in tach loop and dissipation from tach noise should be acceptable.

16. If you don't want an overshoot in your tach loop, turn tach pot "ccw" until the overshoot disappears.

    Note: One overshoot in tach loop does not necessarily mean the position loop will overshoot.

17. After you have made these adjustments, you will have to re-calibrate signal gain pot to obtain proper output voltage to input signal.

18. Also, if motor drifts, it may be necessary to re-adjust signal balance pot until motor stops.

19. Note: It is also possible to use the current feedback pot to stabilize a servo loop. In fact, in some applications, this may actually be preferred.

    In some applications of the A529 Series of amplifiers, the TC pot is not used. In these cases, increasing the current feedback pot "cw" can stabilize the loop.

20. All other adjustments are factory set and do not require any further adjusting.

21. Note: On some models of the A529 Series a dead zone generator is used.

    In this case, the output of A-1 at Pin 6 is set to null by the signal balance potentiometer after the signal and tachometer gains have been set.

22. End of Set Up Procedure.

CAUTION: MAKE SURE POWER IS OFF WHEN SOLDERING ON CIRCUIT BOARDS.

Notes:

1) If the system is highly inertial or you are using a large motor, it may be necessary to change capacitor C * to a value of .22 ufd.

2) If your system needs more DC gain, then C * should be increased in value. Then you can turn tach pot further cw for more gain and still stabilize tach loop.

   Std value of C * = .068 ufd.

3) If it is necessary to change C * then it will be necessary to re-adjust system. Mainly turn TC ccw.

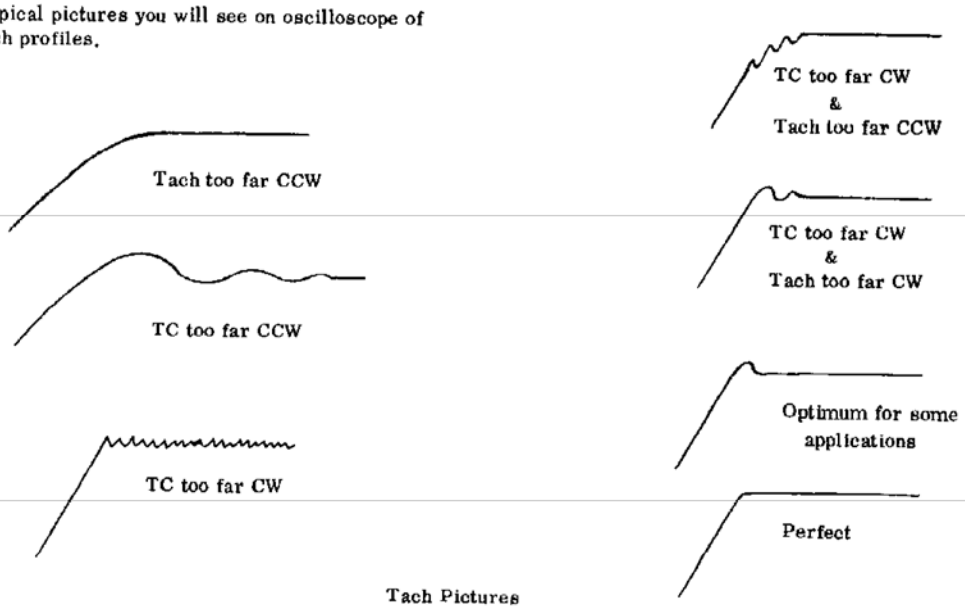
C * = C_2 is component on A529 circuit boards.

HELPFUL HINTS:

1. Tachometer should be observed on an oscilloscope where sweep speed is set at .1 seconds/centimeter and adjust the vertical attenuator to provide a convenient displacement in response to the signal input.

2. Small step input commands may be provided with a DC simulator (battery box) while observing the tach response on the oscilloscope.

3. Typical pictures you will see on oscilloscope of tach profiles.



Tach Pictures

TROUBLE SHOOTING AIDS: Ref Installation Dwg. Fig No. 2 and Fig No. 3

If the unit fails to operate -

1. Examine the unit visually for loose connections, broken wires and damaged components.
2. Check the wiring to the motor-tachometer.
3. Check the incoming power.
4. Check input power fuse F-201 .
5. Check output fuse F-1 .
6. Disconnect P2 from J2 .
7. Measure + 30 VDC at P2 and Pin 9 with respect to P2-1 .
8. Measure - 30 VDC at P2 Pin 7 with respect to P2-1 .
9. Re-connect P2 to J2 .
10. Measure + 15 VDC at the cathode of ZR-2 .
11. Measure - 15 VDC at the cathode of ZR-1 .
12. Observe input signal at TP-6 . If there is an input signal at TP-6 then
13. Observe velocity control amplifier output at A1-6. If signal appeared at TP-6 but is not seen at A1-6 then A-1 is not operating properly. If an amplified signal is seen at A1-6 then
14. Observe TP-2 which is the input of the driver amplifier. If there is a signal at TP-2 then
15. Observe TP-3 which is the attenuated output of the unit. If there is no output seen here, the output stage is damaged and the unit should be returned for repair.

SPECIAL UNITS

The amplifier modules for both the mirror and drum servos are identical and interchangeable. The differences required between the mirror and drum are accomplished in the wiring of the amplifier chassis. The current feedback is only used in the mirror drive servo to provide servo compensation. The drum servo does not use the current feedback feature which is eliminated by not wiring the motor return to J2-1, 2, but rather to J2-3, 4.

The TC potentiometer R-15, capacitors C-1, resistors R-3, R-4 and R-13 are not used in either the mirror or drum drive servos and are therefore eliminated from the P.C. board.

PIN CONNECTIONS

J 2 Connector

AXIS # 1

Pin # 1	=	Not used.
Pin 2	=	Not used.
Pin 3	=	Not used.
Pin 4	=	Not used.
Pin 5 & 6	=	Motor output.
Pin 7 & 8	=	30 V power supply.
Pin 9 & 10	=	30 V power supply.

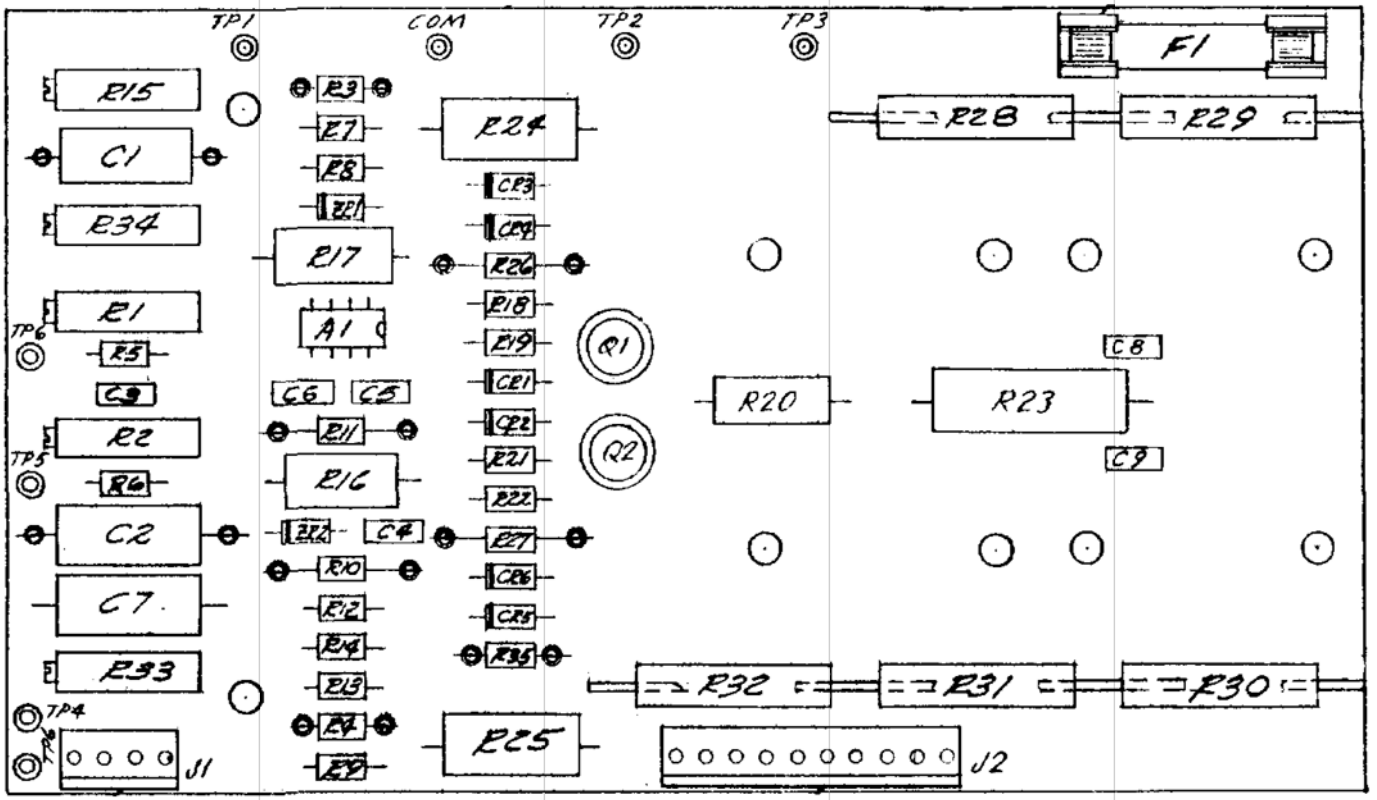
AXIS # 2

Pin # 1	=	Com. (Power)
Pin 2	=	Com. (Power)
Pin 3 & 4	=	Motor output
Pin 5 & 6	=	Motor output
Pin 7 & 8	=	- 30 V power supply
Pin 9 & 10	=	+ 30 V power supply

TROUBLE SHOOTING:

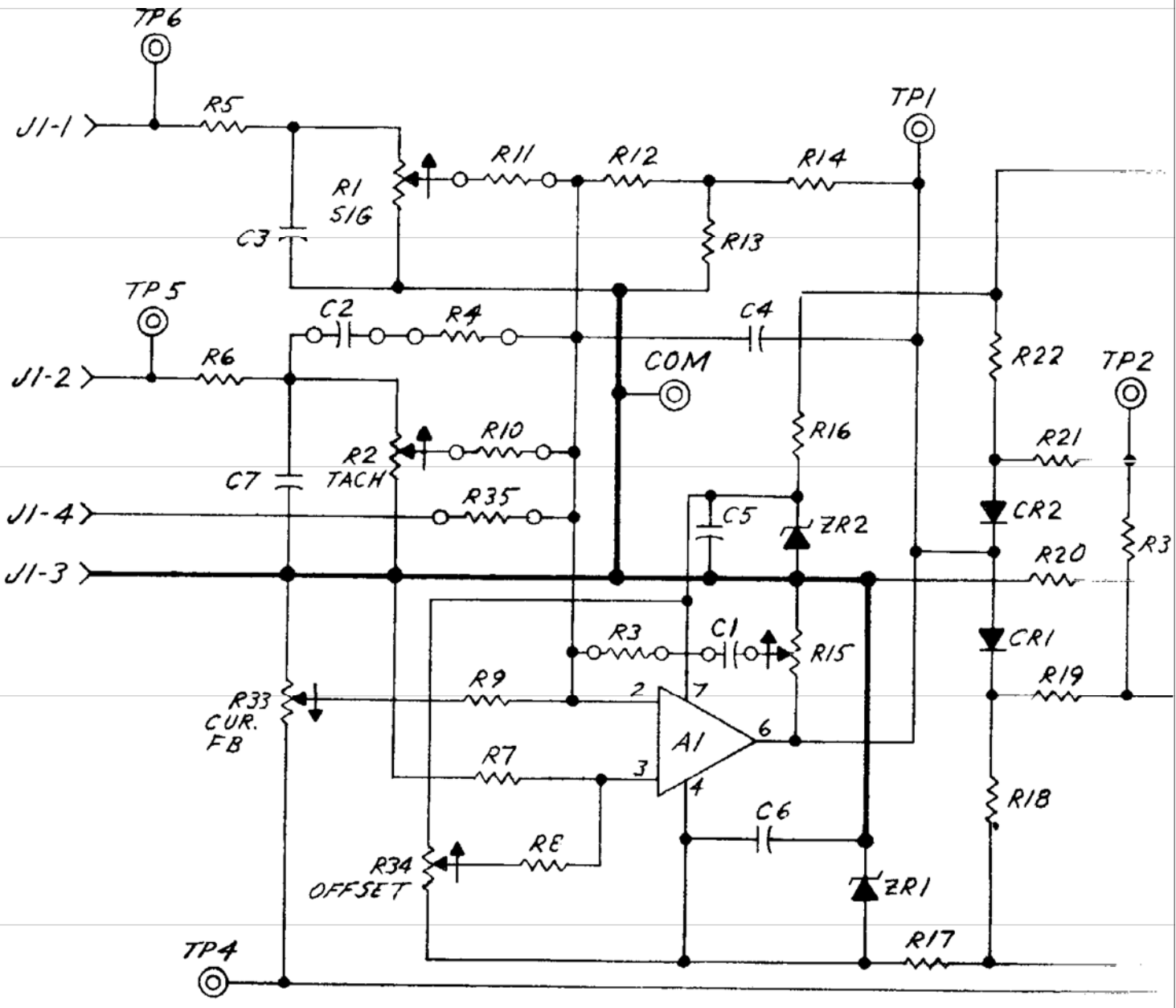
Refer to Standard Trouble Shooting section with the exception of Step #13 which reads as follows:

Step # 13 Observe velocity control amplifier output at TP-1. If signal appeared at TP-6 but is not seen at TP-1, then A-1 is not operating properly. If an amplified signal is seen at TP-1, then proceed thru Standard Trouble Shooting section.

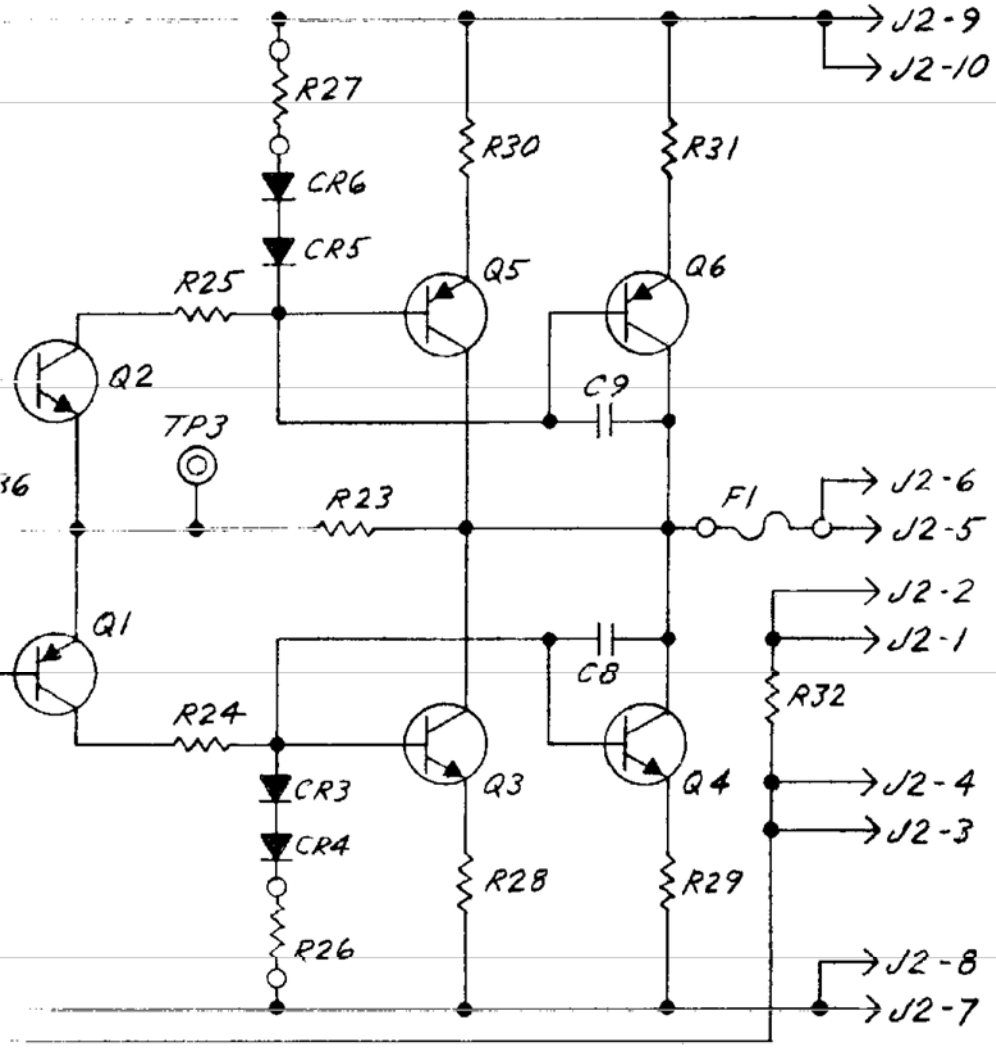


CIRCUIT BOARD LAYOUT

Fig No. 4


TP6
J1-1
R5
R1
SIG
C3
R11
R12
R14
TP1
R13
TP5
C2
R4
C4
J1-2
R6
COM
R22
TP2
R10
R16
R21
R2
TACH
C7
R35
CR2
J1-4
C5
ZR2
R3
R20
J1-3
R3
C1
R15
CR1
R9
R19
R33
CUR.
FB
2
7
A1
6
R7
3
4
R18
C6
R8
R34
OFFSET
ZR1
TP4
R17

REVISIONS			
LTR	DESCRIPTION	BY	DATE APPR
A	PER EO 105011	[illegible]	[illegible] 10-7-75
B	PER EO 125005	[illegible]	[illegible] 12-24-75



PART NO.	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED:
TOLERANCES: FRACTIONS ± 1/64
.XX ± .01 .XXX ± .005 ANGLES ±2°
BEND RADII
BREAK SHARP EDGES .005 – .010

FINISH

SCHEMATIC
D.C. BOARD

MODEL
A529X

DWN [illegible] CHK [illegible] APP. [illegible] 9-25-75

DATE 9-10-75 SCALE [illegible]

WESTAMP®
INCORPORATED
1542 15TH STREET
SANTA MONICA, CAL.

DWG NO. 28326

REV. B

SHEET 1 OF 2

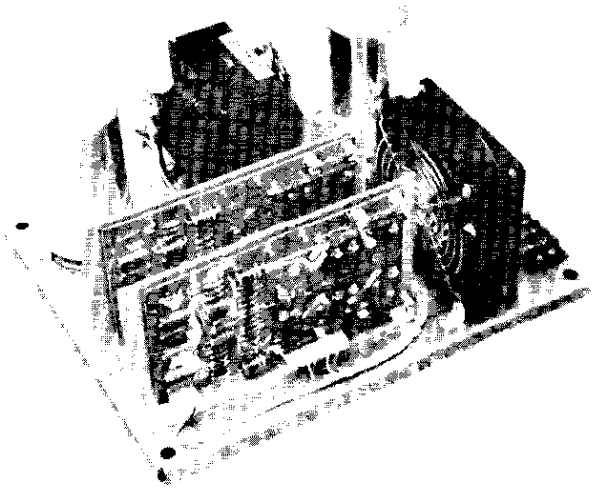
SUPPLEMENTAL INFORMATION

If currents less than the minimum value are required follow rules below.

Change R28, R29, R30, R31 to (RS-2B .5 Ohms - 3 Watt)

Typical values for current limit resistors R26 & R27

Values of R26 & R27 Ohms	Current Limit Peak Amps	
	Accel	Dccel
0	1.5	2
1	1.8	2.5
2	2.2	2.8
3	2.5	3.2
4	2.8	3.5
5	3.1	3.8
6	3.6	4.2
7	3.8	4.4
8	4	4.8
9	4.2	5.5
10	4.4	5.8
11	4.8	6.0
12	5.0	6.2
15 (Factory Std.)	5.8	7



A5292

GEMINI SERIES

WESTAMP®