INSTRUCTION MANUAL

WESTAMP A611 SERIES

REV. A

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®

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FOREWORD:

This manual is a general purpose manual covering the theory and specification of the A611 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 lists.

The A611 Series of Linear Servo Amplifiers consist 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 A611 Series main chassis. These modules are identical in all respects and are interchangeable.

FUSE DATA		
Model No.	Fuse	F201
	Type	MDA
A6111- A6112-		5
A6113- A6114-		10

SPECIFICATIONS: Model A 6112-5B

Specifications are for each amplifier acting independently.

1.	**Peak Current**	±12A
2.	**Peak Voltage**	±45VDC or ±30VDC *
3.	**Power Dissipation Max**	120 Watts @50°C
4.	**Continuous Current**	±6A
5.	**Continuous Voltage**	±40VDC or ±25VDC *
6.	**Continuous Horsepower**	1/3 HP
7.	**Form Factor**	1.000
8.	**Input Power**	120/240VAC, 50/60 Hz
9.	**Frequency Response**	1000 Hz Min
10.	**Dead Band**	None
11.	**Output Impedance**	Less than .1 Ohm
12.	**Gain (adj.) (22 turn pot)**	
	Input 1	0 to 6000 V/V
	Input 2	0 to 6000 V/V
	Input 3	0 to 6000 V/V
13.	**Signal Input Impedance**	20K Min
14.	**Signal Input Voltage**	
	Typical	±10 Volts
	Max	±50 Volts
15.	**Drift (Refer to Input)**	10 u V/°C
16.	**Current Limit (22 turn pot)**	Adjustable
17.	**Signal Balance (22 turn pot)**	Adjustable
18.	**Ambient Temp (Operating)**	0 - 50°C
19.	**Auxiliary Inputs**	Gain reduction
		Limit switch overtravel
		Remote on off (electronic)
20.	**Auxiliary Outputs**	Fault indication
		±15 VDC @ 50 MA
21.	**System Compensation**	Adjustable and built in

22. Protection
    a) Shorts to ground either leg
    b) Shorts across output (See Note 3)
    c) RMS overload protection (electronic)
    d) Bias fault protection
    e) Overtemperature shutdown
    f) Current limit
    g) Input AC power fuse

23.	Cooling	Blower
24.	Weight	25 lbs
25.	Mounting	Panel (Vert./Horiz.)
26. *	Options	30 VDC

27. Unit also has differential front end for 1 signal input.

NOTES:

1. Max peak current is for 50 millsec.
2. Frequency response is typical of units with no compensation. Servo compensation networks in practical applications usually reduce the response.
3. For continuous operation into a very low load resistance, the current limit must be set so as to not exceed the allowable dissipation.
4. If red light is on, this indicates trip of fault logic. Unit will restart if fault has cleared after interrupting power.
5. Dynamic braking on motor when fault trip occurs.

BLOCK DIAGRAM DESCRIPTION:

The A611 Series DC Linear Servo Amplifier has three inputs. See Fig. 1. The three inputs are:

1. Signal Input
2. Tachometer Input
3. Auxiliary Input

Each input has a potentiometer for gain adjustment. The three input signals are summed at the input of the velocity control amplifier (VCA). The output of the VCA drives the output bridge transistors through a gated FET. The output return is current sensed and clamps the output of the VCA if the output current exceeds the pre-set value of the current clamp. In the current clamped mode the output drive is reduced to a safe operating level below the rated RMS current of the unit.

In the event of a fault, (low bias voltages, a short at the output drive stage, or overheated heatsink) the fault logic turns off the bridge gate and activates the dynamic brake circuitry.

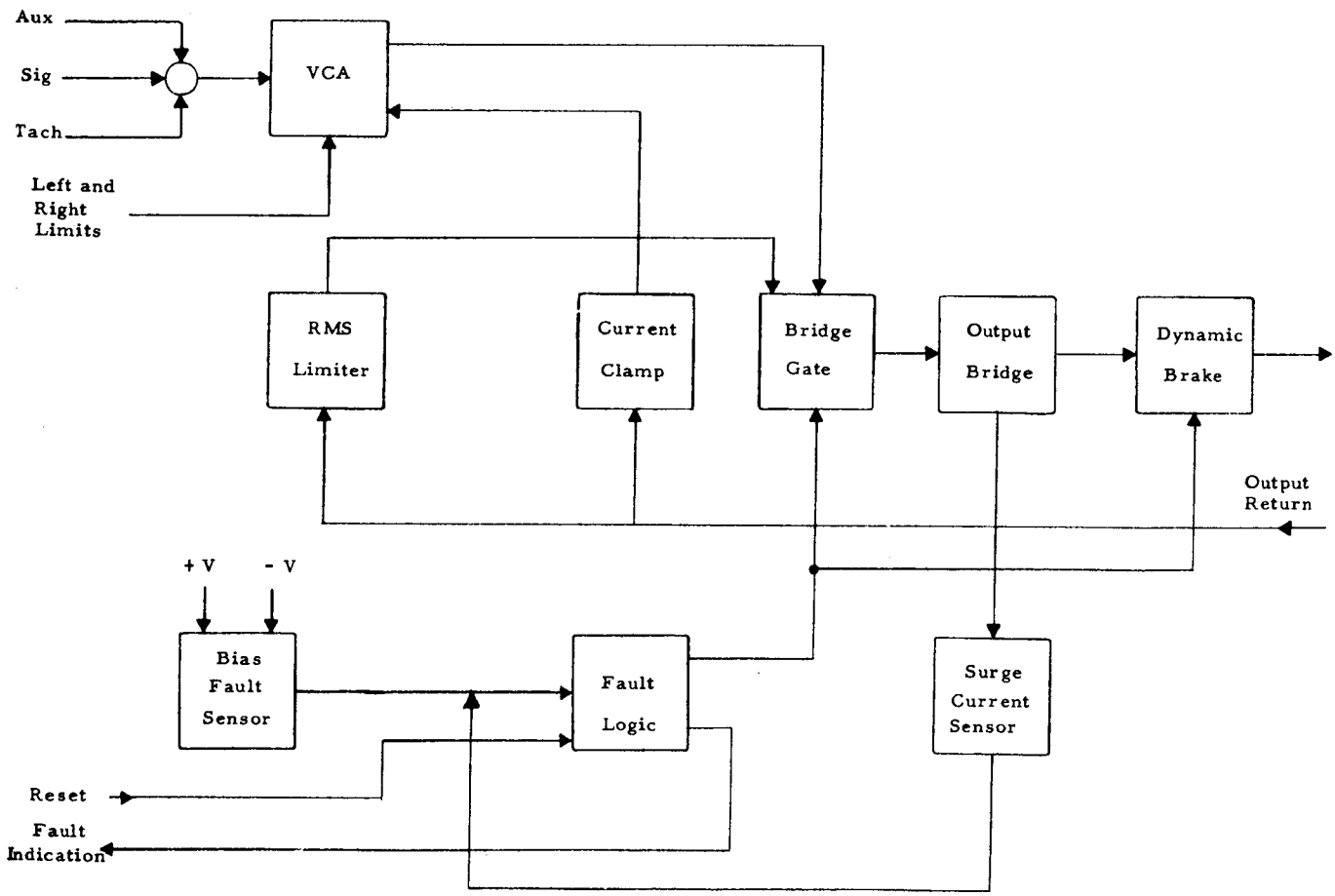


Fig. 1 BLOCK DIAGRAM

PROTECTIVE FEATURES:

The A611 unit is the most advanced linear amplifier today in the marketplace.

These safety features help protect personnel, machinery and the amplifier from accidental damage.

A) Amplifier will shut off and turn on red light if:

1) Motor short of either side of armature to ground for high current shorts.

2) Low power line.

Note: This occurs when power is removed from unit.

3) If the sum of the bias voltages is less than approximately 28 volts.

4) Overheating of unit.

5) Excessive fault currents which could damage the output power transistors.

NOTE: When amplifier shuts off a triac is triggered in the unit so as to provide dynamic braking for the motor.

B) Amplifier will not shut off but is protected for the following:

Excessive rms current under normal operation and oscillatory condition. Amplifier will put out reduced power and return automatically to full power so as to keep unit within rating.

NOTE: Under all conditions when unit shuts off - with light indication, it is necessary to remove power, wait until red light turns off, then re-apply power.

OTHER FEATURES: Fig No. 3

Connector J1

Pin 1 - Signal Input (Auxiliary)

Pin 2 - Signal Input (Standard)

Pin 3 - Signal Input (Tach)

Pin 4 - Signal Common

Pin 5 & 6 - Limit Switch Overtravel - These circuits are used to prevent the amplifier from producing more than 12% of rated current when grounded to Pin No. 7 usually used in conjunction with machine limit switches.

Pin 5 - Clamps the negative output.

Pin 6 - Clamps the positive output.

Outputs are with respect to signal common.

Pin 7 - Common for Pins 5 & 6.

Pin 8 - Fault Light - Can be used for external LED trip indication. Return line for this pin is Pin 10 (+V).

Pin 9 - Electronic shut down.

The bridge is disabled by grounding this pin to Pin 7.

Pin 10 - +15 VDC bias power

50 MA is available for external use.

Pin 11 Common for bias power.

Pin 12 -15 VDC bias power.

50 MA is available for external use.

NOTE: Pins 10, 11, 12 - - If more than 50 MA is taken from these pins the bias power will sag and the amplifier may turn off.

Connector J2

Pin 1 & Pin 2 may be connected together to reduce the gain around the velocity control amplifier.

Pin 1 & Pin 2 can also be used as an external remote gain control.

Pin 1 can be used as an additional input with respect to Pin 3 or signal common.

Connector J3

Pin 1 + 15 VDC bias power

Pin 2 common for bias power

Pin 3 - 15 VDC bias power

Connector J4

Input power ± 45 VDC or ± 30 VDC and output to motor.

Connector J5

Pin 1 & Pin 2 - Differential input.

Pin 2 - Signal Input

Pin 1 - Signal Return

These inputs are normally used to eliminate ground currents on the return line of Pin 4 of J1.

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.

INSTALLATION:

Each amplifier in the A611 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 TB201.

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 Pin 2 of J1 and the signal common is usually applied to Pin 4. The tachometer signal is usually applied to Pin 3 and the tachometer return is applied to Pin 4. 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 (Page 5) 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.

* NOTE: Don't change the secondary voltage taps without consulting factory. The ±15 volt zeners will become damaged if a 30 volt model is changed to the 45 volt model. If you change the 45 volt model to 30 volt taps the logic will not operate properly and drive will destroy itself.

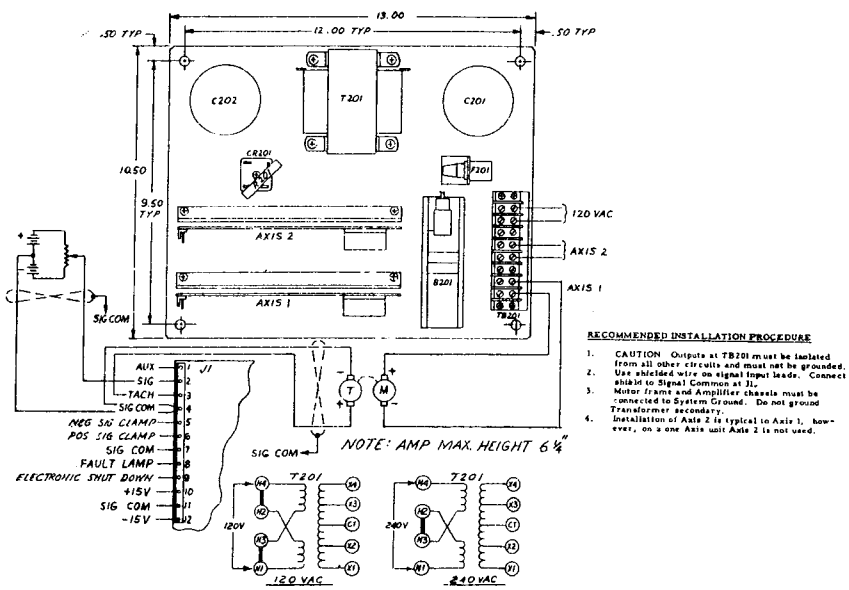


Fig. 2

ADJUSTMENTS:

Figure 3 shows the location of various adjustments on the circuit board. These adjustments are as follows:

Aux Gain - Potentiometer R-2 adjusts the auxiliary gain in the event that this input is used. If this input is not used, the auxiliary potentiometer R-2 should be turned to the fully "ccw" position.

Sig Gain - The signal gain potentiometer R-5 is used to set the signal gain of the system. Turning R-5 in a "cw" direction increases the signal gain.

Tach Gain - The tach gain should be adjusted to set the stability of the tachometer loop, and to adjust the amount of tach feedback in the closed loop system. R-12 is the tach potentiometer. Turning R-12 in a "cw" direction increases the tachometer gain.

Balance - Potentiometer R-23 is the balance control. It may be necessary to adjust the balance for zero output when zero input is applied. This should be done after the tach and signal gains have been adjusted.

TC - The TC (time constant) potentiometer is R-15. The TC potentiometer is used to help stabilize the closed loop system. "CW" rotation increases the bandwidth.

Cur Lim - The current limit potentiometer is R-28. If the current limit potentiometer is at the maximum "cw" position then the unit puts out its maximum rated peak current. If it is desired to decrease the peak output current of the amplifier, turn the Cur Lim potentiometer in a "ccw" direction to reduce the peak output current.

The proper procedure to be followed in setting up this unit in your servo system will be explained in a Short Form Set Up Procedure which follows:

Pin Connection J-1

Pin No.	
1	Aux Input
2	Signal Input
3	Tachometer Input
4	Signal Common
5	Negative Signal Clamp
6	Positive Signal Clamp
7	Common for Pins 5 & 6
8	Fault Light
9	ESD (Electronic Shut Down)
10	+ 15 VDC
11	Common for Bias Power
12	- 15 VDC

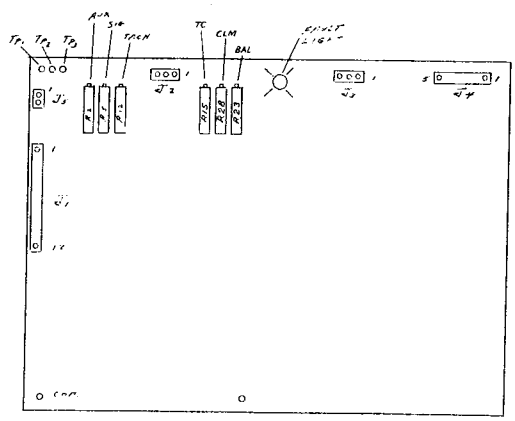


Fig 3

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 A611 Series of servo amplifiers is designed to operate with "state-of-the-art" characteristics in modern performance oriented systems. Therefore, matching amplifier-motor-tachometer combinations are recommended. However, the A611 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: A611 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 22 turns nominal.
3. Before turning power on, adjust these pots as follows:
   a) "TC" pot - mid-range 11 turns from either end.
   b) Tach pot - turn fully "CCW". Then turn "CW" 5 turns.
   c) Signal gain pot - turn "CCW". Then turn "CW" about 5 turns.
   d) Current limit pot - turn fully "CCW".
4. Apply AC power, but do not apply an input signal.
5. To check motor tach phasing turn current limit pot "CW" very slowly.
   a) If motor tach phasing is incorrect the motor will run away

      or

   b) The motor will oscillate back and forth at some rate. (Do not let the motor operate too long under condition).
6. If tach phasing incorrect remove power and reverse either the motor armature wires or tach wires.

   Note: Either pair of wires, not both pair.
7. Turn power back on.
8. If motor-tach phasing is correct motor may rotate slowly and be controllable by varying signal input level.
9. If motor rotates slowly or drifts adjust signal balance pot either way until shaft stops turning.
10. Set current limit to desired setting -

    Note: First 4 turns produces zero current.

    Example:

5 turns	approx.	1.5 Amps
10 turns	"	4.5 Amps
15 turns	"	7 Amps
20 turns	"	10 Amps

11. Apply a small signal input, (make sure 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: Oscillation will start and stop if you exceed 6 amps rms capability.

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.

12. Apply small step inputs and observe the tachometer output on an oscilloscope. (Refer to "Helpful Hints", attached). Figure No. 4

13. 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.

14. 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.

15. Run the motor at some higher speed and watch and listen to it. If it runs smoothly, the system is OK. A rough sound means either TC is still too far "CW" or tach is too far "CW".

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

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

18. Set the appropriate speed of the system by turning signal gain pot. "CW" will make system go faster for same voltage into unit.

19. No further adjustments are necessary. (STOP)

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

Notes:

1) Check system for backlash, wind up lost motion, misalignment, bad coupling or any other mechanical problems.

AFTER YOU MAKE ANY OF THE CHANGES BELOW, REPEAT SET UP PROCEDURE - START WITH STEP 3.

2) High frequency oscillation even though TC pot fully "CCW" (high frequency oscillation probably motor resonance). Increase C7 to approximately .033 mfd and add C3 = 2 mfd and C5 = .022 mfd.

3) If system requires more DC gain

a) Increase C6 to approximately .1 mfd and decrease R11 to approximately 2K. You might have to increase C7 to approximately .033 mfd - Reference Note 2 above.

OR b) Reduce value of R16 - However, balance adjust will become more sensitive.

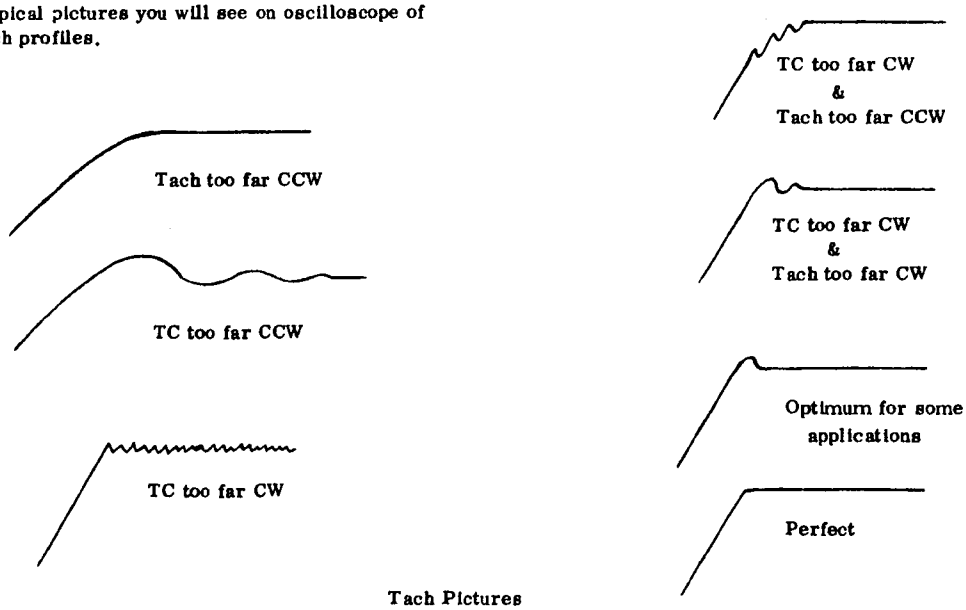
4) If the system is highly inertial, or a highly inertial motor is used, it may be necessary to change C6 and R11 - Reference Note 3 above.

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.



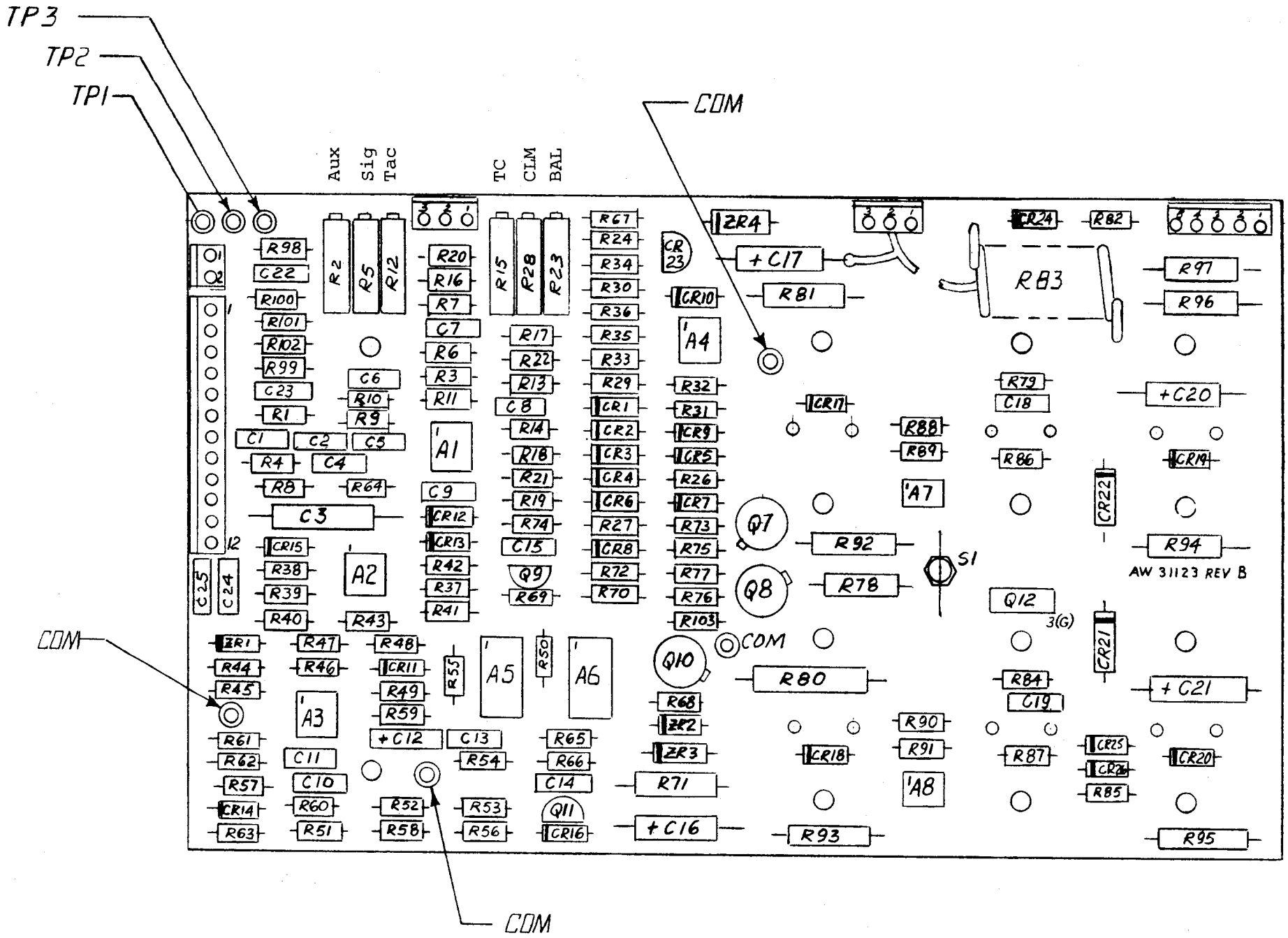
Tach Pictures

Fig. 4

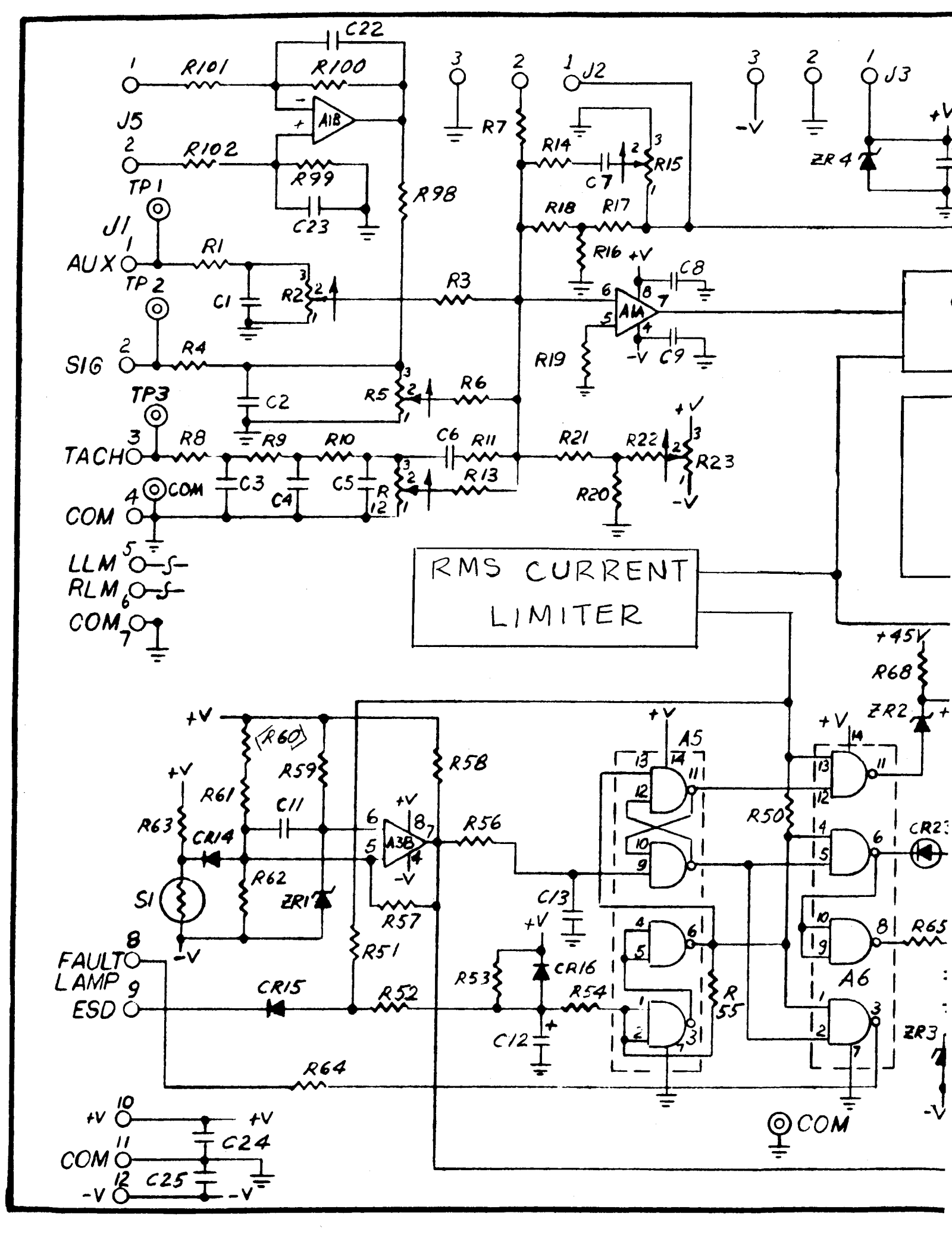
TROUBLE SHOOTING AIDS: Ref. Installation Dwg. Fig. No. 2 and Fig. No. 5

If the unit fails to operate -

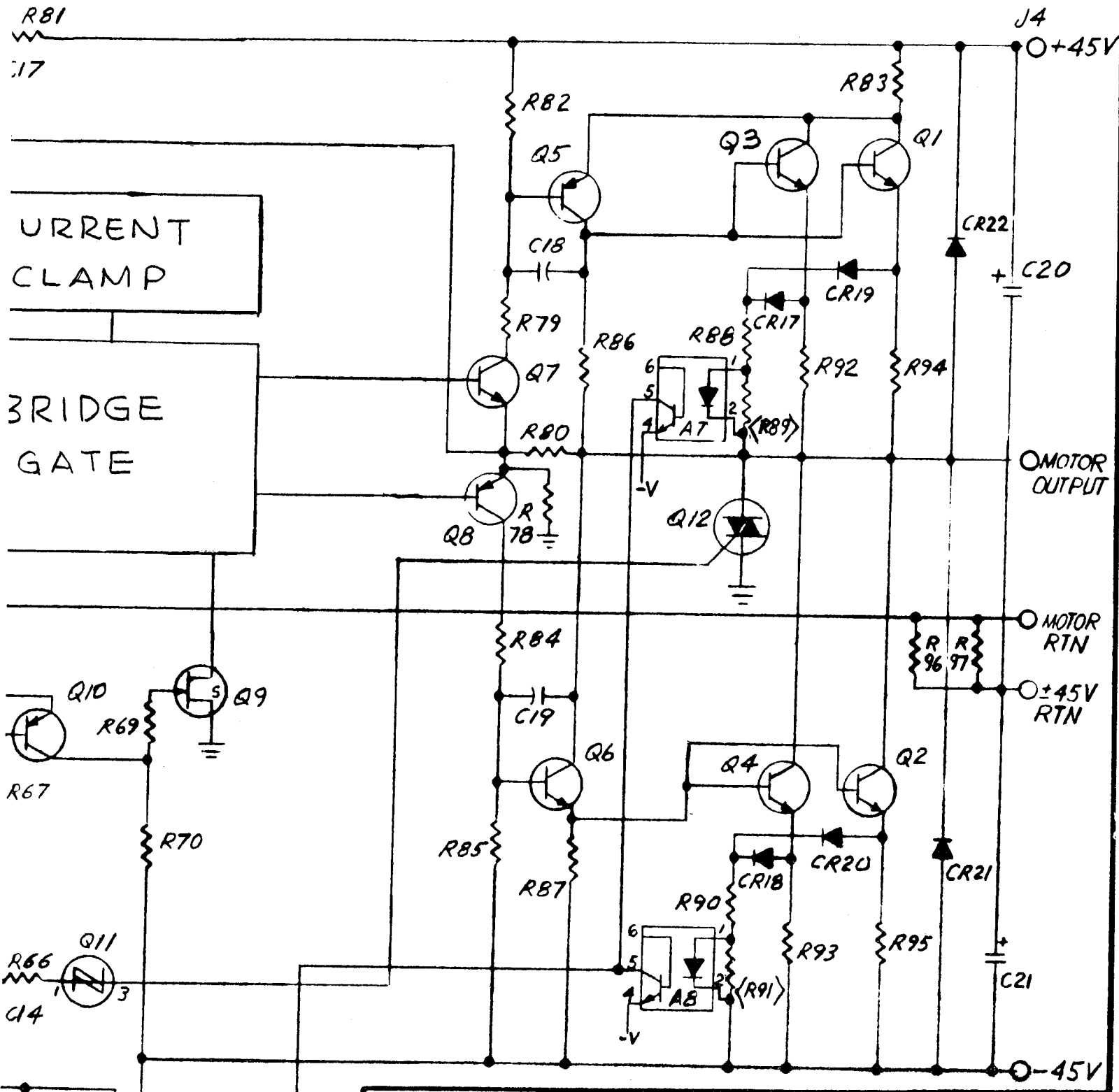
1. Examine the unit visually for loose connections, broken wires and damaged components.
2. Check the wiring to the motor-tachometer.
3. Check the incoming power.
4. Check input power fuse F-201 on panel.
5. Disconnect P4 from J4.
6. Measure +45 VDC or 30 VDC at P4 Pin 5 with respect to P4 Pin 4.
7. Measure - 45 VDC or 30 VDC at P4 Pin 3 with respect to P4 Pin 4.
8. Re-connect P4 to J4.
9. Measure + 15 VDC at the cathode of ZR-2.
10. Measure - 15 VDC at the anode of ZR-3.
11. Observe input signal at TP-2. If there is an input signal at TP-2 then
12. Observe velocity control amplifier output at A1-7. If signal appeared at TP-2 but is not seen at A1-7, then A-1 is not operating properly. If an amplified signal is seen at A1-7 then
13. Observe the source of FET Q9. If Q9 is gated OFF.
14. Check: (a) Bias Fault Sensor amplifier A3B
    (b) RMS Limiter amplifier A3A.
15. If Q9 is gated on, the output drive stage is damaged and should be returned for repair.



PC BOARD LAYOUT Figure No. 5


C22
R101
R100
J5
R102
R99
C23
TP1
J1
AUX
R1
TP2
C1
R2
SIG
R4
TP3
C2
R5
TACH
R8
R9
R10
C6
R11
R21
R22
R23
C3
C4
C5
R13
R20
COM
LLM
RLM
COM
A1B
R98
R7
J2
R14
C7
R15
R18
R17
R16
+V
C8
R3
A1A
R19
-V
C9
RMS CURRENT LIMITER
+45V
R68
ZR2
+V
A5
R50
CR23
A6
R65
ZR3
-V
COM
R60
R59
R61
C11
R63
CR14
R62
S1
ZR1
R58
R56
A1B
R57
R51
R52
CR15
FAULT LAMP
ESD
C13
R53
CR16
R54
C12
R55
R64
+V
COM
-V
C24
C25

REVISIONS			
SYM	DESCRIPTION	BY	DATE/APPR



CURRENT CLAMP

BRIDGE GATE

PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± 1/64 .XX ± .03 .XXX ± .010 ANGLES ± 2° DEBUR AND BREAK SHARP EDGES .005"-.010" FINISH			

SCHEMATIC
LINEAR AMPLIFIER
BOARD

SIZE A611X

DWG NO R0

DATE 12-16-77

SCALE —

WESTAMR
INCORPORATED
1642 15TH STREET
SANTA MONICA, CAL.

DWG NO.

REV.

SHEET 1 OF 1