INSTRUCTION MANUAL

A613 SERIES

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

CAUTION

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

WESTAMP INC.

1542 15th Street, Santa Monica, California 90404 (213) 393-0401 TLX # 71 3720078

REV. A

WARRANTY PROVISIONS

WARRANTY - The Seller warrants that the articles delivered will be free from defects in material and workmanship under normal use and service. Seller's Obligations under this warranty are limited to replacing or repairing, at its option, at its factory, any of said articles which shall within one (1) year after shipment be returned to the Seller's factory of origin, transportation charges prepaid, and which are, after examination, disclosed to the Seller's satisfaction to be thus defective. THIS WARRANTY IS EXPRESSED IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE SELLER'S PART AND IT NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR THE SELLER ANY OTHER LIABILITIES IN CONNECTION WITH THE SALE OF THE SAID ARTICLES.

This warranty shall not apply to any of such articles which shall have been repaired or altered, except by Seller, or which shall have been subjected to misuse, negligence, or accident. The aforementioned provisions do not extend the original warranty period of any article which has either been repaired or replaced by Seller.

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FOREWARD

This is a general purpose manual, covering the theory and application of the A613 Series of Current Feedback Linear DC Servo-Amplifier.

Each A613 Linear Amplifier consists of a chassis which contains the following:

A) The Module which is made up of :
   1) Control Circuit Board
   2) RMS Circuit Board
   3) Optional Compensation Circuit Board
   4) Output Transistor Heat-Sink Assembly

B) The main chassis which is made up of :
   1) Step Down Transformer
   2) Power I/O Terminal Block
   3) Protective Fusing
   4) Blower (UL Listed)

General Theory

Referring to the block diagram, the input amplifier A1A has a gain of 1 (one) and may be connected differentially or single ended. The output of A1A is connected directly to the SIG (SIGNAL POT) potentiometer which is used to adjust the input signal gain. The input signal and the tachometer signals are of opposite polarity and are almost equal in magnitude. The difference between the input signal, from A1A, and the tachometer signal from the motor, is the error signal which is applied to the input of A1B. The bandwith shaping components close the voltage feedback loop around the amplifier to keep the amplifier and tachometer loops stable. The output of A1B is connected directly to a potentiometer used to control the current command signal (CLM POT).

The output of amplifier A1B is a current command signal which is summed with a current feedback signal at the input summing junction of A1C. The current loop derives its signal from the current sensing resistor and is directly proportional to the motor armature current. The difference between the current command signal, from A1B, and the current feedback signal, from the current sensor, is the current error signal. The current error signal is then amplified at A1C. There are bandwith shaping components around amplifier A1C which are used to set the stability and bandwith of the current loop.

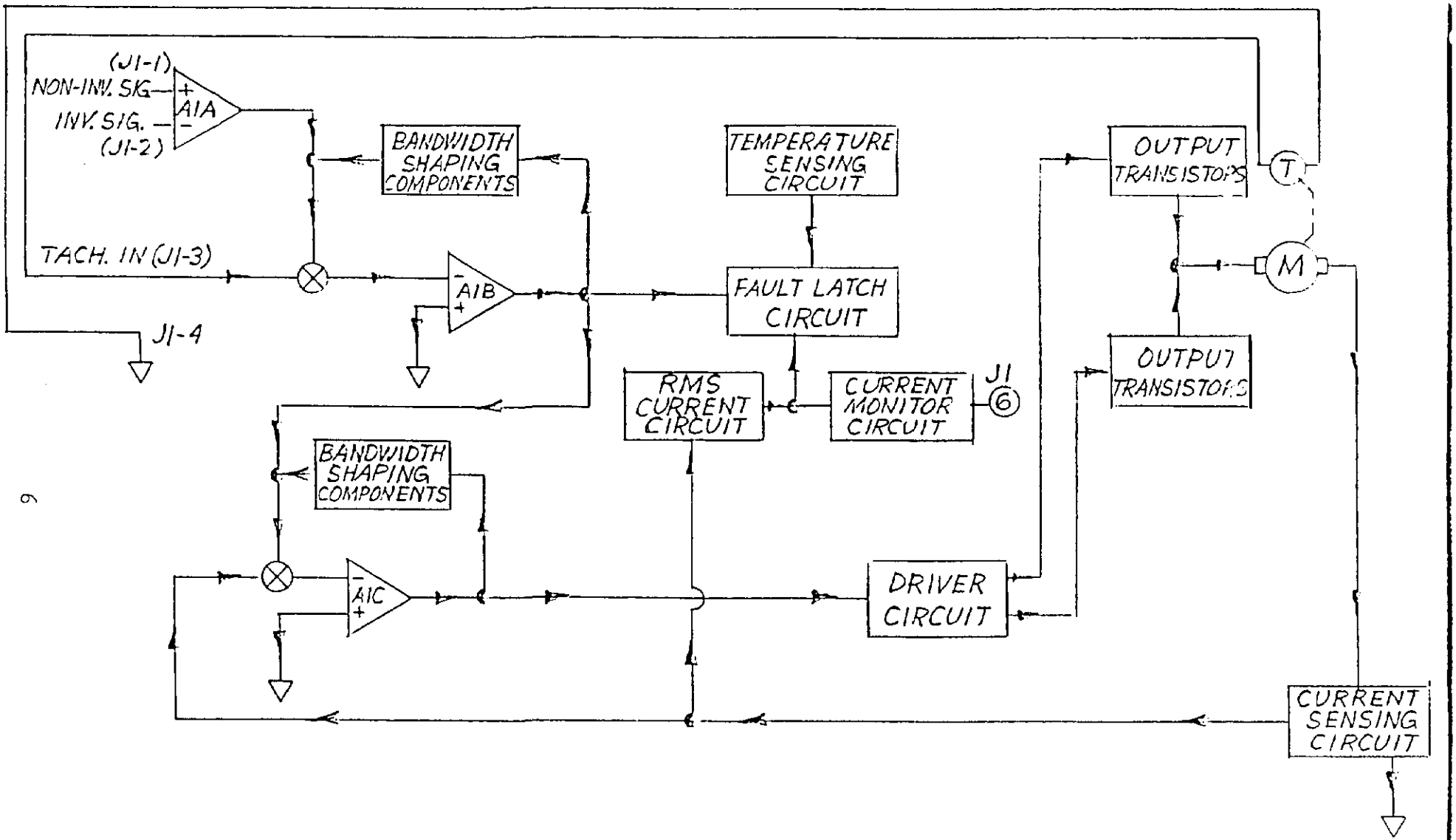
The output of amplifier A1C is applied to the driver circuit and depending on the polarity of the signal, turns on either the upper or the lower set of transistors.

The RMS current circuit derives the current signal from the sampling resistors in series with the motor armature. The RMS current level is adjustable with R36. If the RMS current level is reached, a signal is applied to the input of A1D, which latches down the output of A1D and shuts down the amplifier causing a FAULT LIGHT condition.

The temperature sensing circuit senses heatsink temperature and at a specified temperature, sends a signal to the input of A1D causing a FAULT LIGHT as explained in the previous paragraph.

The +/- 15 VDC necessary for the IC's is derived from the +/- 45 VDC supply via a zener regulator circuit.

REVISIONS				
TR	DESCRIPTION	BY	DATE	APPR



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

BLOCK DIAGRAM

MODEL A613

DWN | CHK | APP.

DATE 11/24/88 | SCALE

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

DWG NO. | REV.

SHEET 1 OF 1

SPECIFICATIONS

1. peak current (available for 1-2 sec.)	+/- 20 amperes dc
2. peak voltage	+/- 45 vdc
3. continuous current	+/- 6.1 amperes dc
4. continuous power	250 watts (.33 hp)
5. continuous voltage	40.5 vdc
6. input voltage for bus supply	120/240 vac
7. gain (typical)	
differential input	0-6000 amperes/volt
single ended	0-6000 amperes/volt
tach input	0-6000 amperes/volt
8. current loop frequency response	500 hz (minimum)
9. signal input voltage	+/- 10 vdc
10. signal input impedance	46K ohms (minimum)
11. tachometer input impedance	6K ohms (minimum)
12. drift	10 uvolts/deg. C (typical)
13. operating temperature	0-50 deg. C

INSTALLATION

Each amplifier in the A613X/614X series comes with individual installation drawings, which shows where the various connections for input power, signal input, tachometer input, fan and motor output must be made. While this manual may show in a general way how to make connections to the amplifier, it is imperative that the specific instructions that apply to your amplifier be followed with no exceptions. Always be certain to apply the correct input voltage and frequency. The input power transformers for all of the amplifiers in the A613X/614X series are mounted on the amplifier chassis. These transformers have dual voltage primaries and it is imperative that the jumpers are on the correct transformer terminals for the input AC power source. The motor output is available on seperate terminals mounted on TB-201.

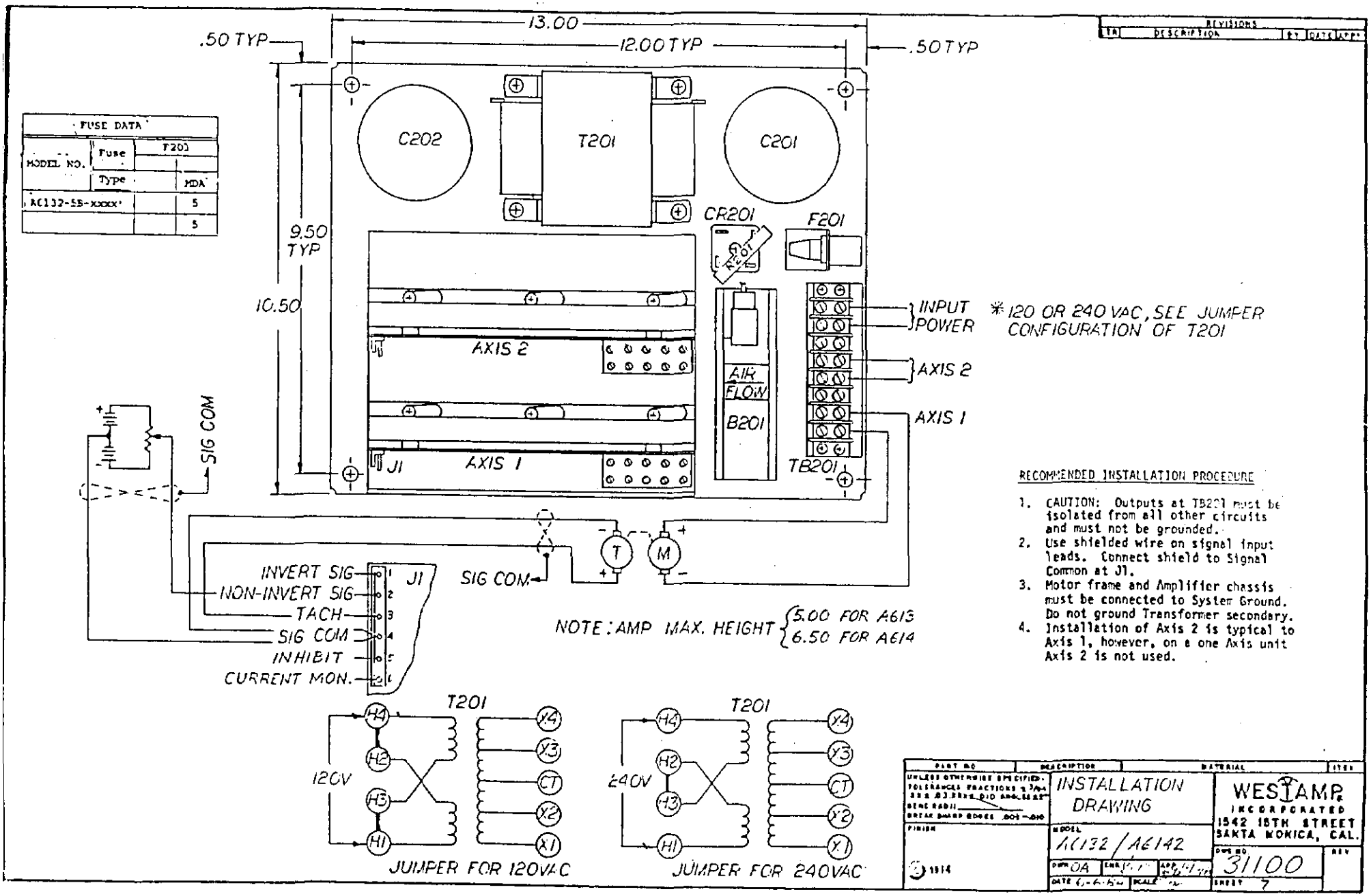
CAUTION: DO NOT USE GROUNDED TEST EQUIPMENT. DO NOT CONNECT EITHER OF THE OUTPUTS TO GROUND.

The signal input is usually applied directly to pin 2 of J1 and the input signal return is usually applied to pin 1 of J1. The signal input may be connected differentially or single ended. To connect the unit differentially remove the shorting plug at J4. If the shorting plug is connected at J4, then the input to the amplifier is single ended and J1 pin 1 is connected to signal common.

The tachometer signal is applied to pin 3 of J1 and the tachometer return is connected to pin 4 of J1. The tachometer signal gain is adjustable. Use shielded wires for signal and tachometer inputs to prevent stray pickup and noise from being introduced into the amplifier. The amplifier bandwidth will be anywhere from 1000 hertz (no compensation) to a much lower frequency, depending on the setting of the TC (time constant) potentiometer and the components in the servo compensation network. Typical installation drawings, illustrated on page 9 may be used to wire up an amplifier motor combination.

The amplifiers in this series require 68 VAC, 6 amperes from the secondary of the stepdown transformer during peak current delivery.

PLEASE CHECK ALL CONNECTIONS BEFORE POWER IS APPLIED.



FUSE DATA

MODEL NO.	Fuse	T201
	Type	MDA
AC132-SS-XXXX		5
		5

REVISIONS

LTR	DESCRIPTION	BY	DATE APP'D

RECOMMENDED INSTALLATION PROCEDURE

1. CAUTION: Outputs at TB201 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 at J1.
3. Motor frame and Amplifier chassis must be connected to System Ground. Do not ground Transformer secondary.
4. Installation of Axis 2 is typical to Axis 1, however, on a one Axis unit Axis 2 is not used.

PART NO	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED TOLERANCES FRACTIONS ± .XXX .03 .XX ± .01 ANGLES ± 1° BEND RADII BREAK SHARP EDGES .005 – .010

FINISH

© 1974

INSTALLATION DRAWING

MODEL AC132 / AE142

DWN OA CHK APP'D

DATE 6-6-84 SCALE

WESTAMP INCORPORATED 1542 18TH STREET SANTA MONICA, CAL.

DWG NO 31100 REV

SHEET 7

ADJUSTMENTS

The A613X/614X series of amplifiers have several different compensation boards available. The unit may be operated with any of these compensation boards or with compensation components mounted directly on the control board. In all cases there are always certain customer adjustments on the control board. Page 17 - shows the location of the various adjustments. These adjustments are as follows:

SIG Signal gain: Potentiometer R5 adjusts the signal gain. turning R5 in a CW direction increases the signal gain.

BAL Balance:Potentiometer R23 is the balance control. It may be necessary to adjust the balance for zero output when zero input is applied. This should be adjusted after the tach and signal gains have been set.

ADJUSTABLE COMPENSATION BOARD

Page 19 - shows the various adjustments available on the adjustable compensation board. These adjustments are as follows:

TACH Tachometer gain: Potentiometer R12 adjust the tachometer loop gain. Turning R12 in a CW direction increases the tach loop gain.

TC Time Constant: Potentiometer R15 is the Time Constant potentiometer. The TC potentiometer is used to stabilize the closed loop system. Turning R15 CW increases the velocity loop bandwidth.

CLM Peak Current Limit: Potentiometer R28 adjusts the peak current output of the amplifier. With the potentiometer at a maximum CW position the amplifier outputs its maximum peak rated current. The peak output current is decreased by turning potentiometer R28 in a CCW direction.

NOTE---R29 & R30 are factory adjustments and altering these components will result in voiding your warranty.

NOTE: On all Westamp servoamplifiers, turning potentiometers in a CW (clockwise) direction increases the parameter that is being adjusted. Turning potentiometers in a CCW direction decreases the parameter being adjusted.

ADJUSTMENT PROCEDURE:

It is possible to compensate a servo system empirically without any theoretical evaluation of the system, provided that the system specifications are not stringent. For most applications, the procedure outlined in the Short Form "Set Up Procedure" will result in adequate servo performance. The A613X/614X series of servoamplifiers were designed to operate in very high performance servo systems. In order to achieve optimum servo performance, matching amplifier - motor - tachometer combinations are recommended. However, the A613X/614X series of amplifiers will provide good performance with many DC motor-tachometer combinations, by merely adjusting the TC and the TACH gain potentiometers.

SHORT FORM SET-UP PROCEDURE

1. Check input voltages and determine proper transformer connections.

2. Measure the voltages before applying power to the amplifier chassis.

3. Connect in accordance with the proper installation drawing.

   NOTE: All multi-turn pots are 20 turns nominal.

   THE FOLLOWING PROCEDURE IS WRITTEN FOR 20 TURN NOMINAL POTENTIOMETERS--YOU MUST READ THE SECTION IN THE BACK OF THIS MANUAL ON POTENTIOMETERS TO VERIFY THE TYPE OF POTENTIOMETERS (# OF TURNS) YOUR UNIT HAS.

4. Before applying power, adjust all potentiometers as follows:

   a) Current limit pot (CLM) - fully CCW
   b) "TC" pot - mid range (10 turns from either end)
   c) "TACH" pot - turn fully CCW then turn CW 5 turns.
   d) "SIG" pot - mid range (10 turns from either end)

5. Apply power but DO NOT apply an input signal

6. To check for proper phasing of the tachometer and motor: turn the "CLM" pot CW very slowly. If the motor starts to run away, shut off the power and reverse the leads of either the motor or tachometer.

7. Turn the power back on and repeat item 6. The motor should not rotate or may rotate very slowly (do not adjust the BAL pot at this time). Turn CLM pot to desired current.

   CLM pot setting allows amplifier to deliver peak currents as shown in following example:

   Example:

20 Turn Pot	12 Turn Pot
3 Turns CW = 30% Peak Current	1.8 Turns CW = 30% I Peak
6 Turns CW = 60% " "	3.6 Turns CW = 60% " "
10 Turns CW = 85% " "	6.0 Turns CW = 85% " "
14 Turns CW = 95% " "	8.5 Turns CW = 95% " "

8. If the motor shaft rotates slowly with no signal applied, adjust the balance (BAL) pot until the motor stops.

9. With zero input signal, turn "TC" pot CW until the motor shaft starts to oscillate at high frequency. Turn CCW until The oscillation stops. Turn 1/2 turn additional in a CCW direction.

   IMPORTANT--IF TC IS FULLY CCW AND THE SYSTEM IS STILL OSCILLATING AT HIGH FREQUENCY, SEE NOTES ON PAGE 13.

10. Apply a small signal and observe motor shaft.

11. Increase or decrease tach gain pot for desired results.

    a) Increasing TACH (turning pot CW) provides quicker settling time (higher bandwidth).

    b) Decreasing TACH (turning pot CCW) provides slower settling time (lower bandwidth).

12. When the tachometer response is proper, do not change the TACH pot further.

13. If the motor drifts after the SIG and TACH pots have been set it may be necessary to re-adjust the BAL balance pot.

14. Run the motor at a higher speed. If it runs smoothly, the system is adjusted properly. A rough sound indicates either the TC or the TACH is too far CW.

15. Set the required speed of the system by adjusting the SIG potentiometer. Turning the pot CW will increase the motor speed.

16. This completes the short form setup. It is recommended that the adjustments be recorded on the form on page 23.

DETAILED SET-UP PROCEDURE

If your system requires a more accurate TACH adjustment, the following procedure should be followed:

1. Perform Steps 1-10 on the previous pages.
2. Apply a small signal until the motor rotates. Observe the tachometer signal on an oscilloscope.

   NOTE: Refer to Helpful Hints Section.

3. If the tach loop is overdamped, turn the TACH pot CW until one overshoot appears. The system is now set up for maximum bandwidth in the tachometer loop.

4. If overshoot in the tachometer loop is objectionable, then adjust the TACH pot CCW until the overshoot is eliminated.

   NOTE : One overshoot in the tachometer loop does not necessarily mean the position loop will overshoot.

5. IF THE SYSTEM IS NOT PERFORMING PROPERLY AND IS MECHANICALLY SOUND, SEE NOTES AT THE END OF THIS SECTION.

6. If motor shaft rotates slowly with no signal input, it may be necessary to re-adjust the BAL pot until the motor stops.

7. Recalibrate the SIG signal gain pot to obtain the proper output speed.

8. All other adjustments are factory set and should not be altered.

CAUTION: POWER MUST BE OFF WHEN REMOVING MODULES OR CHANGING COMPONENTS

NOTES:

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

   AFTER PERFORMING ANY OF THE FOLLOWING CHANGES, REPEAT THE SET-UP PROCEDURE - START WITH STEP 4 ON PAGE 11.

2. If the system exhibits a high frequency oscillation even though the TC pot is fully CCW (this may be due to motor resonance) increase C7 . It may be necessary to add C3 = 2mfd. and C5= .22mfd.

3. If the system requires more DC gain:

   a) Increase C6 to approximately .1 mfd. and decrease R11 to approximately 2K ohms. You might have to increase C7 as shown in note 2.

   b) Reduce value of R16. Caution! The balance adjustment will become more sensitive.

4. If the system has high inertia, or a high inertia motor is being used, it may be necessary to change C6 and R11. Reference Note 3a above.

SET-UP PROCEDURE USING RESISTIVE MEASUREMENTS

This setup procedure is used only after the desired settings for the SIG, TACH, TC and CLM potentiometers have been established. Use either the Short Form or Detailed set-up procedure to determine these settings. **DO NOT USE GROUNDED TEST EQUIPMENT**

1. Remove all power. Measure and record the resistance values as indicated in the following steps. The ohm meter common should be connected to the wire hoop common on the upper left hand corner of the main control board.

2. SIG Potentiometer: Measure and record the resistance from J5 pin 2 to the wire hoop common (4.47K to 4.93K Ohms). _____

3. TACH Potentiometer: Measure and record the resistance from TP1 on the interface board to common (0.0 to 14K Ohms). _____

4. TC Potentiometer: Measure and record the resistance from TP2 on the interface board to common (100.0 to 2.0K Ohms). _____

5. CLM Potentiometer: Measure and record the resistance from TP3 on the interface board to TP1 of the Main Control board (100.0 to 2.0K Ohms). _____

6. To adjust a new board, set the potentiometers to the values determined in steps 2 through 5. NOTE! The TC and CLM adjustments interact and must be adjusted several times to achieve the desired results.

7 Remove the ohm meter and turn CLM fully CCW. Apply power and slowly turn CLM clockwise. If the motor starts to run away, turn off power and reverse either the motor or the tach leads. Turn power back on to verify that the motor does not run away.

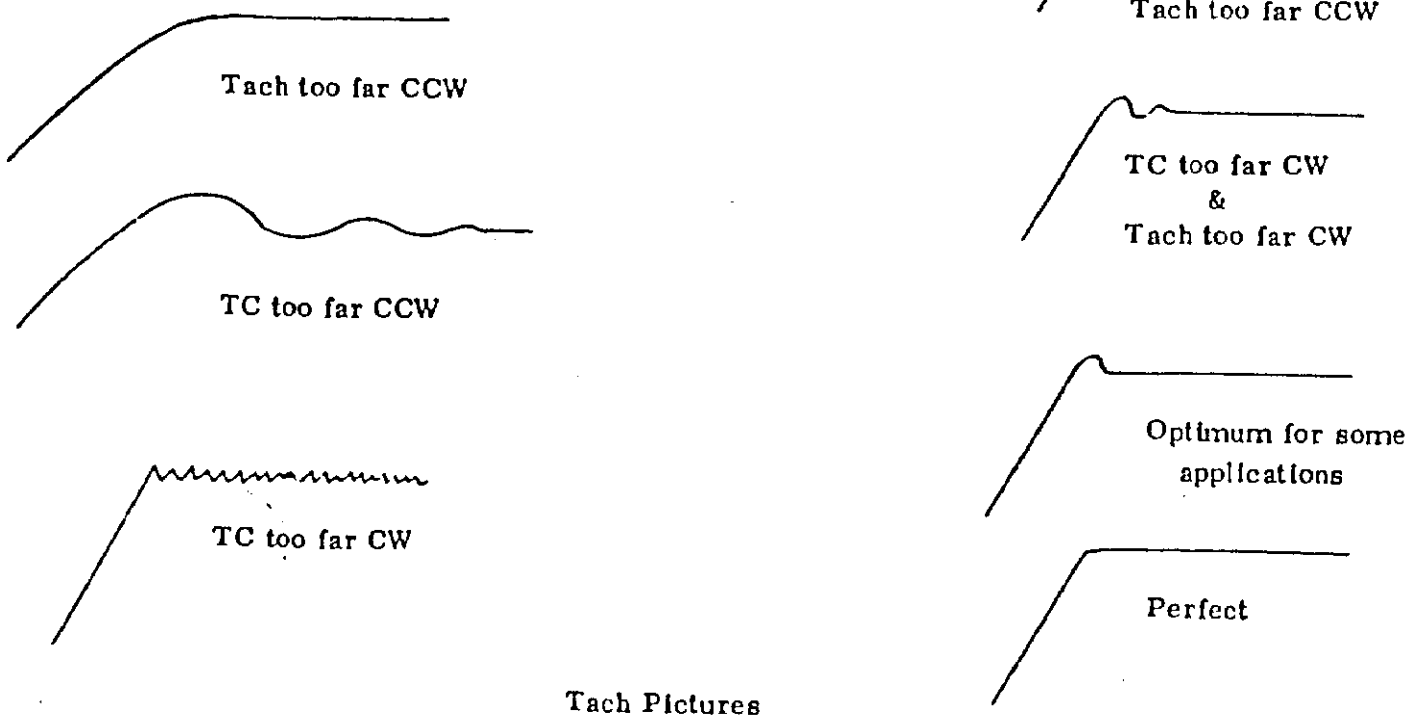
8. Turn power off and re-adjust the CLM potentiometer as in step 5. Remove the ohm meter and apply power. If the motor shaft rotates slowly with no signal applied, adjust the BAL potentiometer until the motor stops. Remove power and repeat step 6 to insure TC and CLM are set at the proper values.

HELPFUL HINTS:

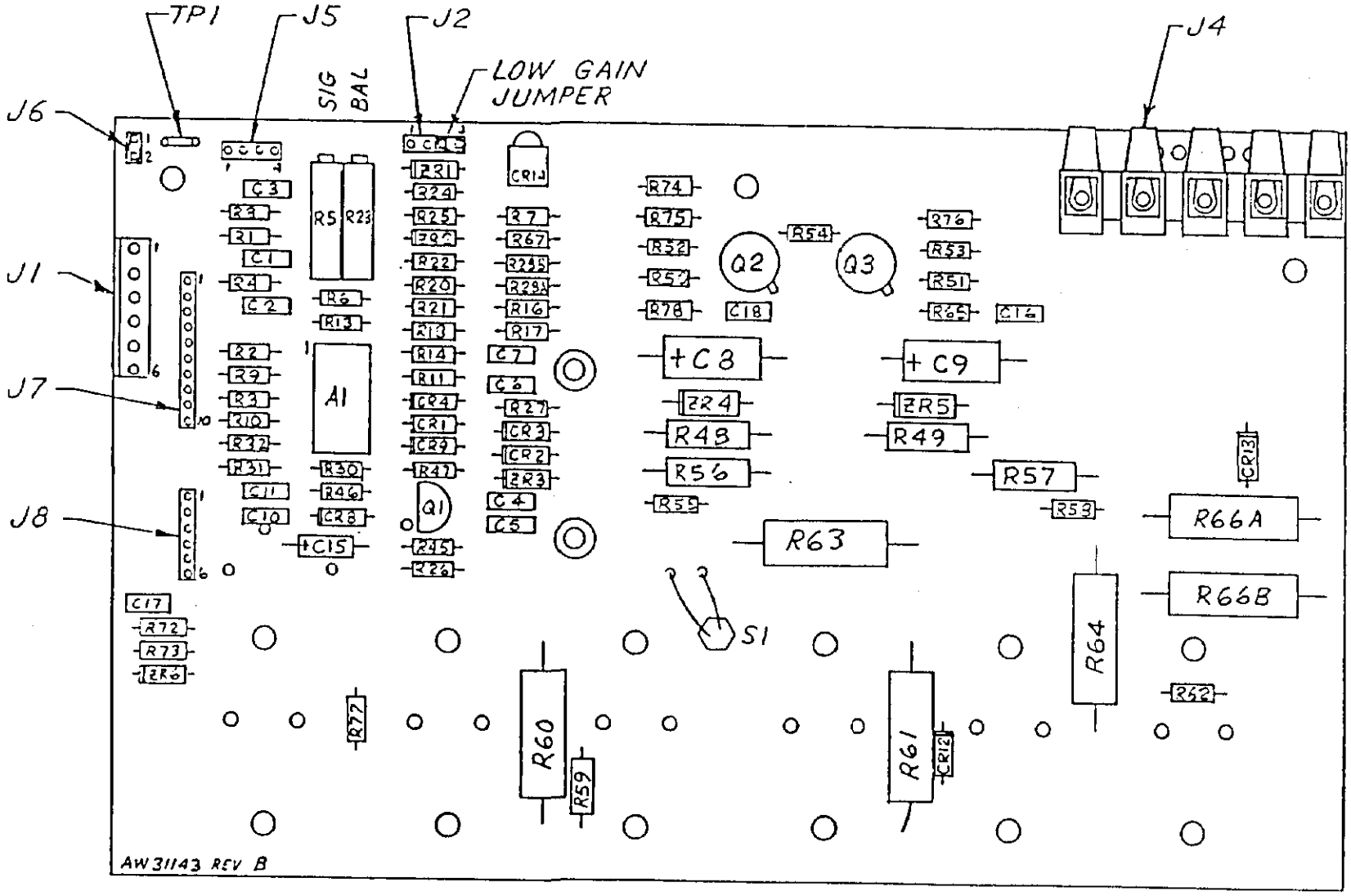
1. Tachometer should be observed on an oscilloscope where sweep speed is set at .1 seconds/centimeter and adjust the vertical attenuator to provide a convenient displacement in response to the signal input.

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

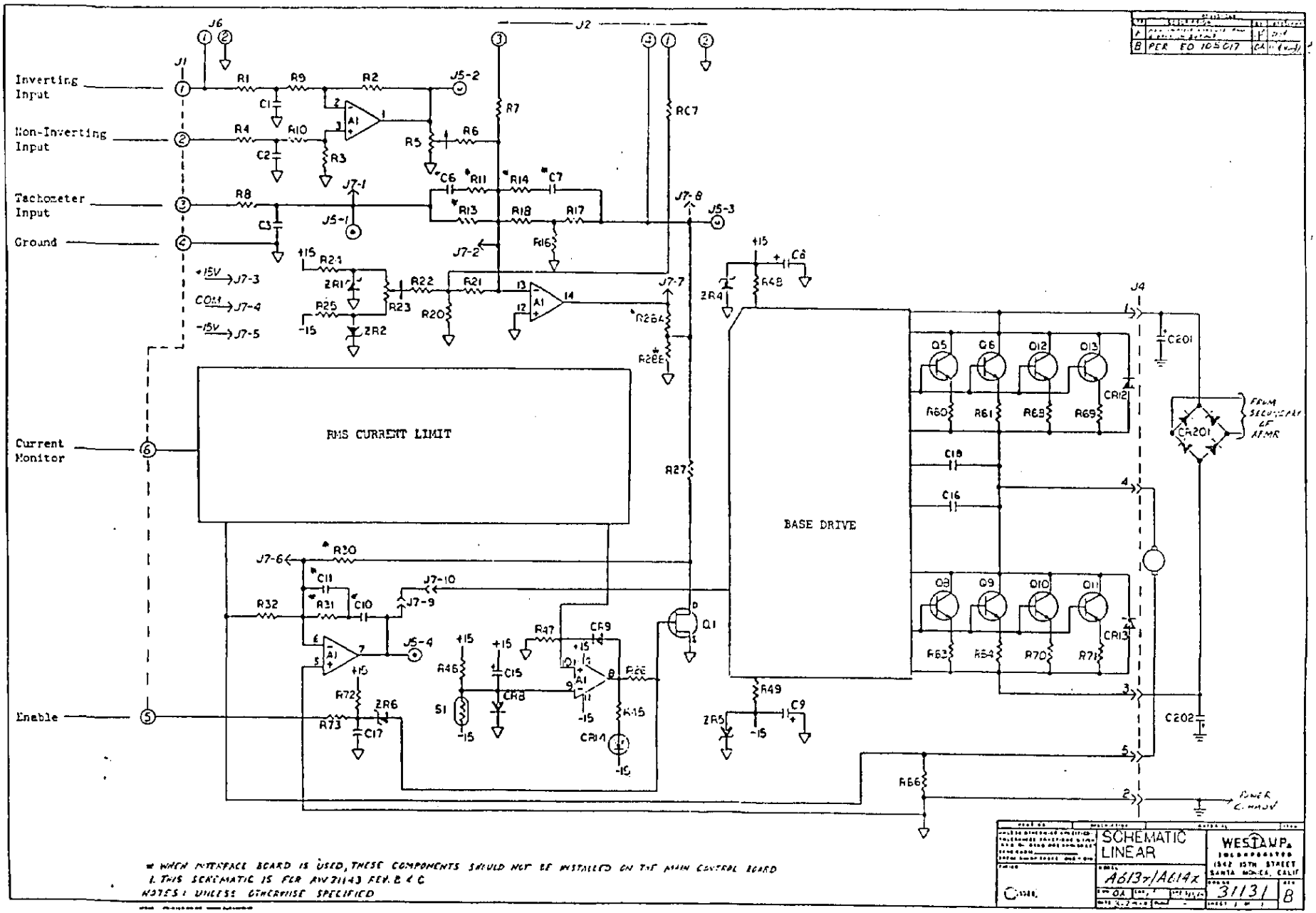
3. Typical pictures you will see on oscilloscope of tach profiles.



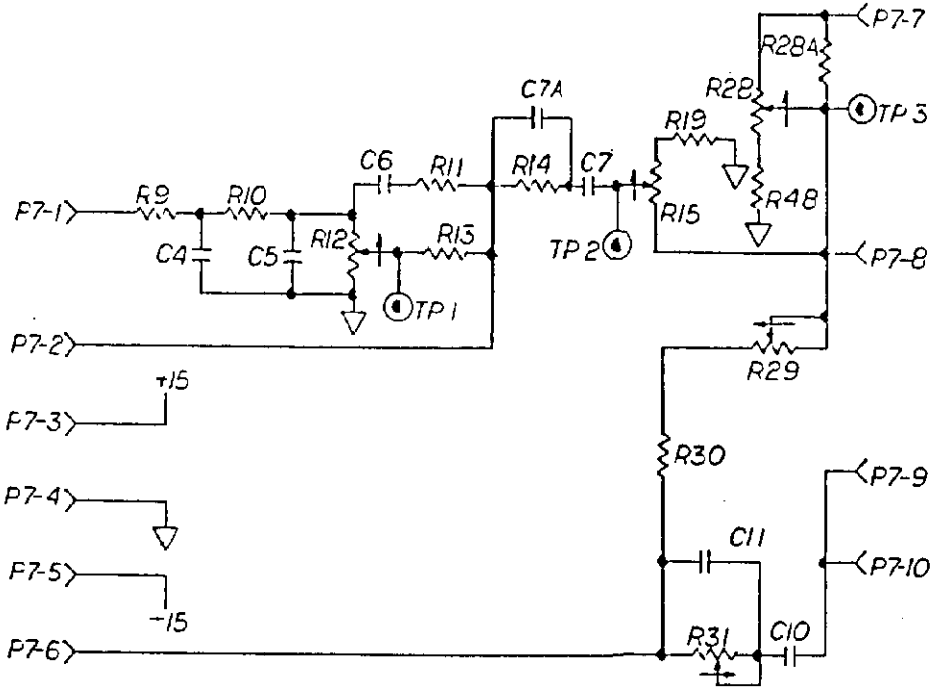
Tach Pictures

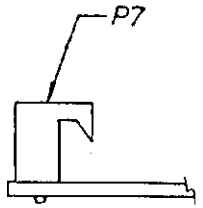


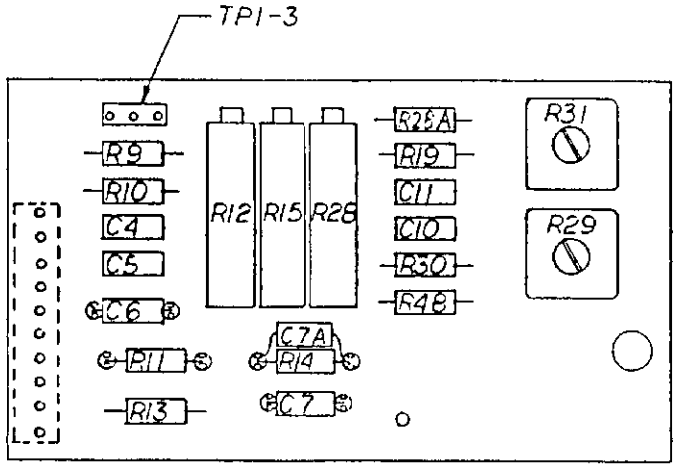
CONTROL BOARD			WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.
MODULE			DWG NO. FIG. 1
DWN	CHK	APP.	REV.
DATE	SCALE		SHEET


Inverting Input
Non-Inverting Input
Tachometer Input
Ground
Current Monitor
Enable
RMS CURRENT LIMIT
BASE DRIVE
+15V → J7-3
COM → J7-4
-15V → J7-5
FROM SECONDARY OF ARMR
POWER COMMON
* WHEN INTERFACE BOARD IS USED, THESE COMPONENTS SHOULD NOT BE INSTALLED ON THE MAIN CONTROL BOARD
1. THIS SCHEMATIC IS PER AW21143 REV. B & C
NOTES: UNLESS OTHERWISE SPECIFIED
SCHEMATIC LINEAR
A613r/A614x
3113 1
B
WESTAMP INCORPORATED
1542 15TH STREET
SANTA MONICA, CALIF

REVISIONS			
LTR	DESCRIPTION	BY	CHECKED
A	ADDED R28A	J.K.	5-6-74
B	PER ED 105006	JK	10-6-76







FOR ELECTRICAL PARTS LIST SEE EPL 33030

PART NO	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± 1/64 .X ± .03 .XX ± .010 .XXX ± .005 ANGLES ± 1° BREAK SHARP EDGES .005 - .010 FINISH

ADJUSTABLE COMPENSATION BOARD

MODEL A72/X

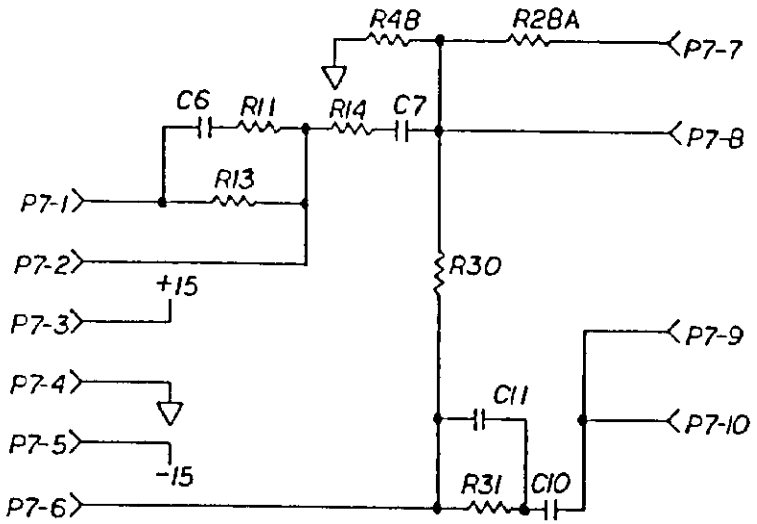
DWN OA CHK [illegible] APP [illegible]

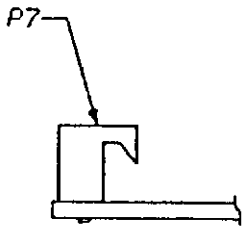
DATE 4-15-74 SCALE 2:1

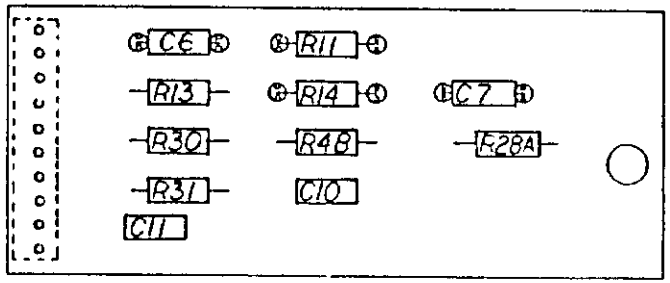
WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.

DWG NO. 33030 REV B

SHEET 1 OF 1







FOR ELECTRICAL PARTS LIST SEE EPL 33035

FIXED COMPENSATION BOARD	WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.	
A 721x	33035	
DR OA		
DATE 9-15-83	SCALE 2:1	SHEET 1 OF 1

RMS CURRENT ADJUSTMENT BY RESISTANCE MEASUREMENT

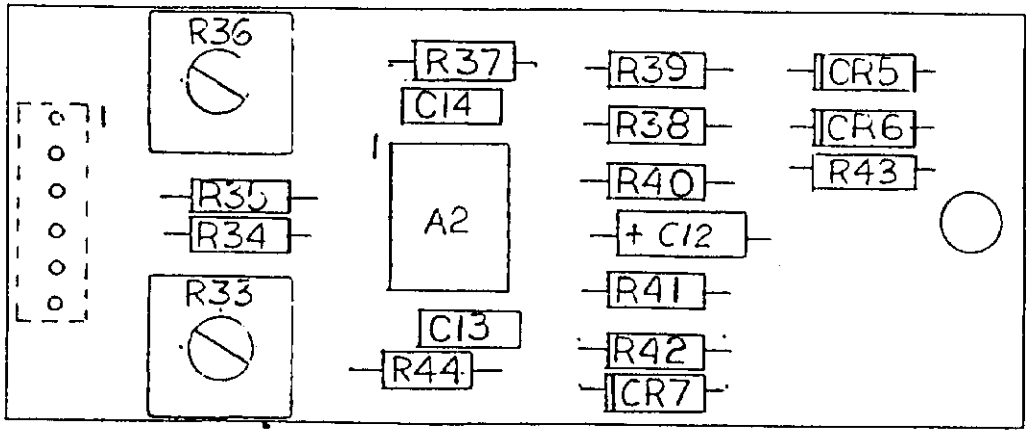
For many applications, the rated RMS current of the amplifier is greater then the motor it is driving. If motor protection, external to the amplifier, is not provided, it is recommended that the RMS current limit be adjusted to equal the motor rating. Adjust R36* on the RMS board to the values indicated in the table. Connect the ohm meter to the left side of R37 and the cathode of CR5 to make the measurements.

A613X 6.0 AMPERES RATED

Current	Resistance
6.0	7.1K
5.5	7.4K
5.0	7.9K
4.5	8.1K

NOTE! Due to circuit tolerances, the minimum value of current may not be achievable! R36 is a factory adjustment and is sealed. The seal must be broken to perform the adjustment. CAUTION! The rating of the amplifier can be exceeded if this adjustment is not performed properly.

*Refer to page 21 for the location of R36.



FOR ELECTRICAL PARTS LIST SEE EPL 31140

PART NO.	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED:
TOLERANCES: FRACTIONS ± 3/64
.XX ± .03, .XXX ± .010 ANGLES ±2°
BEND RADII _____
BREAK SHARP EDGES .005 – .010

FINISH

RMS CIRCUIT BOARD ASSY

MODEL A6132, A6142

DWN OA | CHK | APP. | DATE 4-30-84 | SCALE 2/1

WESTAMP INCORPORATED
1542 15TH STREET
SANTA MONICA, CAL.

DWG NO. 31140 | REV. B

SHEET 1 OF 1

MULTI-TURN POTENTIOMETERS

Various manufacturers' potentiometers may be used in the amplifier.

Please refer to the following chart:

MANUFACTURER	POT COLOR	NOMINAL # OF TURNS	OVERTRAVEL DEAD-ZONE
Weston	Light Green	12	0
Beckman	Light Gray	20	0
VRN	Dark Green	20	0
Spectrol	Tan	20	4 - 5 Turns

Set-up procedures are often established based on counting the number of turns from the counter clockwise end to the set point. Spectrol potentiometers have a 4 to 5 inactive section at the end.

If your amplifier has a tan Spectrol pot, you must turn the potentiometer adjustment screw 4 to 5 turns from the counter clockwise end before any resistance change will occur.