INSTRUCTION MANUAL

FOR THE

A82x SERIES (R)

AC PM BRUSHLESS

SERVO AMPLIFIERS

REV A DATE: 08-26-91

THIS IS A GENERAL PURPOSE MANUAL DESCRIBING A SERIES OF AMPLIFIERS AND SHOULD BE USED IN CONJUNCTION WITH DRAWINGS PERTAINING TO YOUR SPECIFIC AMPLIFIER.

CAUTION

THE MAINTENANCE PROCEDURES DESCRIBED IN THIS MANUAL SHOULD BE ATTEMPTED ONLY BY HIGHLY SKILLED TECHNICIANS USING PROPER TEST EQUIPMENT. READ YOUR WARRANTY PROVISIONS BEFORE STARTING TO PREVENT VOIDING YOUR WARRANTY.

WESTAMP, INCORPORATED (R)

1542 15th STREET
SANTA MONICA, CA 90404
(213) 393 - 0401

FAX # (213) 451 - 1058

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WARRANTY PROVISIONS

WARRANTY - The Seller warrants that the article 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, 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 have been repaired or altered, except by seller, or which have been subject to misuse, negligence or accident. The aforementioned provisions do not extend the original warranty period of any article which has been repaired or replaced by the seller.

FOREWORD

This is a general purpose manual covering the theory and application of the A82x Series of pulse width modulated, AC, Permanent Magnet, Brushless motor servo amplifiers.

Each A82x pulse width modulated amplifier consists of a chassis which contains the following:

A) The drive module(s) which is/are made up of:
   1) Control/Drive Board
   2) Compensation Board
   3) Output Transistor Heatsink Assembly
   4) Optional Commutation and Velocity Feedback Board

B) The main chassis which is made up of:

   1) Logic Supply, +/- 12 VDC
   2) Main Bus Power Supply
   3) Power I/O Terminal Block
   4) Protective Fusing
   5) Blower (UL Listed)
   6) Optional Shunt Regulator

SPECIFICATION

Westamp Models	A821, A822 and A826 Series
Continuous Voltage	+/- 310 Volts DC
Input Voltage for Bus Supply (10% allowable overvoltage)	30-230 Volts AC, 3 Phase
Input Voltage for Fan & Logic Supply	120 Volts AC*
Signal Input Voltages	+/- 10 Volts DC (typical)
Drift	10 Uv/deg.C (typical)
Operating Temperature	0-50 deg.C Max Ambient

* NOTE: For some models/applications, the logic supply voltage may be derived from the bus supply.

	A821		A822		A826	
Peak Current Ampere	15	30	50	75	100	125
Continuous Current Amperes	7.5	15	25	37.5	50	70

NOTE: Peak current and continuous rating are maximum for that model. Specific values less than maximum ratings are possible. In a sinusoidal application:

$$\frac{\text{Torque Required}}{\text{Kt}} * \text{Square Root of 2}$$

FEATURES

AUXILIARY INPUTS:
(with jumper selectable logic polarity)
Remote Disable/Enable
External Reset
Right Overtravel Limit Switch (A limit)
Left Overtravel Limit Switch (B limit)

AUXILIARY OUTPUTS:

Current Monitor (0-12.5 A/V)
+/- 12 VDC
Fault Sense

PROTECTION

With individual LED indication
- Motor shorts to ground
- Motor winding short-surge protection
- Under logic voltage
- Over bus voltage
- Peak current limit
- RMS current limit
- Over temperature

Fused 120 VAC for fan & bias power
Shunt regulator

NOTES

1. Peak current is available for 1 to 2 seconds.

2. Frequency response is typical for the amplifier with NO COMPENSATION around the velocity loop. Servo compensation networks for most practical applications usually reduce the response of the amplifier.

3. 115 VAC is for blower and logic power. In certain applications it is possible to eliminate the power input transformer and derive the bus power directly *from the line*.

4. Maximum output voltage for the amplifier depends on the AC line voltage for the bus power supply. The DC bus voltage is approximately 1.4 times the AC (RMS) applied to the bus power supply.

5. The output current monitor is capable of driving a zero center 3 milliampere ammeter. The scale factor for this output is 10 volts equals the rated peak current of the amplifier.

6. Fault conditions cause a red light emitting diode (LED) to illuminate and the amplifier to shut down.

CHASSIS DIMENSIONS

DIMENSIONS-INCHES (cm)

MODEL	AXIS	LENGTH	WIDTH	HEIGHT
A8211 A8221	1 1	18.2 (46.2) 18.2 (46.2)	5.0 (12.7) 7.3 (18.5)	11.5 (29.2) 11.5 (29.2)
A8212 A8222	2 2	18.2 (46.2) 18.2 (46.2)	7.3 (18.5) 12.0 (30.5)	11.5 (29.2) 11.5 (29.2)
A8214 A8224	4 4	18.2 (46.2) 18.2 (46.2)	13.0 (33.0) 17.5 (44.5)	11.5 (29.2) 11.5 (29.2)
A8216 A8226	6 6	18.2 (46.2) 18.2 (46.2)	18.0 (45.7) 24.0 (61.0)	11.5 (29.2) 11.5 (29.2)
A8261	1	18.2 (46.2)	7.3 (18.5)	11.5 (29.2)
A8262	2	18.2 (46.2)	12.0 (30.5)	11.5 (29.2)

THEORY OF OPERATION

The A82x series of servo amplifiers are pulse width modulated, brushless, sinusoidal output amplifiers. The amplifiers in this series all produce sine wave outputs for driving permanent magnet brushless motors irrespective of whether a tachsyn(R) or resolver is used for commutation.

Referring to the block diagram (see appendix A), the input to the amplifier may be applied single ended or differentially. The input signal first passes through the limit switch clamping circuit that, when utilized, has the effect of regeneratively braking the motor. The circuit clamps the signals applied to the input of the amplifier thus, emulating the removal of the signal previously commanding speed or torque. After the limit switch clamping circuit, the signal is summed with a velocity signal at the input of operational amplifier A1.

The signal is processed and amplified by A1 and used to develop two sine wave current command signals, one being the sine and the other being the sine plus 120^0. The sine wave frequency is based upon the motor's rotational speed, while the amplitude is current command dependant. The third phase of the three phase motor is assumed to be the summation of the first two, therefore, it is not necessary to close a third current loop.

The signals produced by the commutation decoder circuit are summed with the armature current feedback signals. The signals produced from the summation are current error signals appropriate for each winding and based upon the current command signal. The signals are then amplified and compensated by A2, A3 and the associated bandpass shaping components.

The resulting signals are used with the triangle wave generator circuit to develop six sine-weighted pulse trains appropriate for driving the base drive circuits.

Any fault that is detected is collected by fault logic circuit and shuts down the amplifier. The only way to restart the amplifier is by using the "Reset" input or removal and reapplication of logic power.

PROTECTIVE FEATURES

The A82x amplifiers provide many advanced safety features. These safety features help protect personnel, machinery, motors and the amplifiers themselves.

THE AMPLIFIER WILL SHUT OFF AND THE APPROPRIATE LED WILL ILLUMINATE IF ANY OF THE FOLLOWING OCCURS:

1. Motor stator windings shorted or grounded.
2. The output leads of the amplifier are shorted together.
3. Any output lead is shorted to ground.
4. The bus power supply exceeds safe levels. High bus voltage levels can result from either high AC line or excessive motor regeneration.
5. RMS current exceeds the amplifier's rating.
6. Excessive heatsink temperature.
7. The sum of the logic supplies is less than 24 volts.
8. Low bus voltage.
9. Internal fault (surge).
10. Logic supply failure.

NOTE: The amplifier will shut down and a **RED LED** will illuminate under all of the above conditions. Connecting the external reset line (J1-13) to signal common with a momentary contact will reset the amplifier. The amplifier may also be reset by removal and reapplication of logic power.

CONNECTORS AND TEST POINTS

Connector J1 (19 pin)

PIN 1 - Signal input (inverted with jumper at J4 removed and pin 2 connected to common) with jumper at J4 installed, pin 1 is connected to the signal common.

PIN 2 - Signal input (non-inverted). Connecting the signal input to both pin 1 and 2 with the jumper at J4 removed, allows for differential signal input.

PIN 3 - Tachometer input

PIN 4 - Signal common

PIN 5 - Auxiliary Input

PIN 6 - Left limit over travel limit switch (negative signal clamp) *

PIN 7 - Right limit over travel limit switch (positive signal clamp) *

CONNECTORS AND TEST POINTS
(CONTINUED)

PIN 8 - Enable/Remote shut-down. Connecting this pin to the signal common shuts-down the amplifier. *

PIN 9 - Fault indication

PIN 10 - (+) 12 VDC

PIN 11 - Common

PIN 12 - (-) 12 VDC

PIN 13 - External amplifier fault reset. Momentarily connecting this pin to signal common resets any faults. *

PIN 14 - Optional Extenal programmable current limit. The external programmable current limt allows the peak current of the amplifier to be controlled by varying the voltage on pin J1-14 and repositioning the jumper on J17. THIS OPTION REQUIRES A CURRENT LIMIT COMPENSATION BOARD, AND MUST BE SPECIFIED AT THE TIME OF PURCHASE.

PIN 15 - Current monitor output (10VDC = Peak current of the amplifier)

PIN 16 - No connection

PIN 17 - Common

PIN 18 - Common

PIN 19 - Common

* see description of connectors J12, J14, J15, & J16

Connector J2 (4 pin)

This connector is provided with a two pin jumper. Connecting pins 1 & 2 with the jumper places the amplifier in the high gain mode for velocity loop applications.

Connecting pins 3 & 4 with the jumper lowers the gain of the velocity loop by a factor of 1000. The amplifier may be used as a current source power amplifier by installing the jumper on these pins. With the signal gain potentiometer set fully CW, the gain is approximately 2000. If more balancing range with the balance potentiometer is required in the high gain mode, remove the jumper.

CONNECTORS AND TEST POINTS
(CONTINUED)

Connector J3 (4 pin)

PIN 1 - (-) 12 VDC

PIN 2 - Common

PIN 3 - (+) 12 VDC

PIN 4 - No connection

Connetor J4 Not used

Connector J5 (11 pin)

The J5 connector is an open collector fault output, capable of pulling down an external pull up component. The outputs are normally at zero volts, and require an external pull up resistor connected to a positive voltage source (40 Vmax).

PIN 1 - High if either over travel or Enable/Remote Shut down limit is activated.

PIN 2 - High if a temperature fault exists.

PIN 3 - High if a RMS fault exists.

PIN 4 - high if a bus over-voltage or logic-voltage fault exist.

PIN 5 - High if a motor ground fault exists.

PIN 6 - High if a surge current fault exists.

PIN 7 - High if any fault on the board exists.

PIN 8 - This pin provides an "OR" of the above pins 1 through 7. In other words, if any of the above pins are high this pin is also high.

PIN 9 - This pin serves as a logic common.

PIN 10 - Not used

PIN 11 - Not used

Connector J6 For Factory use only.. Leave jumper om pins 2 & 3.

CONNECTORS AND TEST POINTS
(CONTINUED)

Connector J7 Non-user interface for the compensation board

Connector J8 Tachsyn/Resolver Interface (see Tachsyn or Resolver section)

Connector J9 For Factory use only. Leave jumper on pins 2 & 3

Connector J10 (3 pin)

This connector is supplied with a jumper. When the jumper is connected between pins 1 & 2 the INVERTED signal input (J1 pin 1) is connected to the signal common. If the jumper is between pins 2 & 3 the NON-INVERTED signal input (J1 pin 2) is connected to the signal common. If differential input is required then remove the jumper completely.

Connector J11 & J12 (3 pin)

These connectors work in unison and have jumpers provided. If the jumpers at J11 and J12 are between pins 2 & 3 then the tachometer input is connected directly across to the input of the velocity loop. If, however, the jumpers at J11 and J12 are between pins 1 & 2 then the tachometer input is inverted. THESE PINS MUST MOVE TOGETHER.

Connector J13, J14, J15 & J16 (3 pin)

These jumpers control the interface for: "A" and "B Limit", "Reset" and "Enable." If the jumper on connector J13, for example, is between pins 2 & 3 then the input at J1 pin 6 must be connected to the common potential to limit the amplifier in that direction (ideal for normally open limit switches). However, if the jumper is between pins 1 & 2 then the input at J1 pin 6 must be released when a limit is desired (ideal for normally closed limit switches). There are internal pull-up resistors at each of the inputs, therefore, it is not necessary to drive the inputs to the high level. J14, J15 and J16 all work in the same fashion as J13.

J13 - Jumper for "A" limit (J1-6)

J14 - Jumper for "B" limit (J1-7)

J15 - Jumper for Reset (J1-13)

J16 - Jumper for Enable (J1-8)

CONNECTORS AND TEST POINTS
(CONTINUED)

Connector 17 (3 pin)

This connector is used to connect J1 pin 14 to the programmable current limit circuit. If operation of this circuit is desired and the option has been specified, then by connecting the jumper at J17 between pins 1 and 2 the user may program a specific peak current limit by varying the voltage applied to J1 pin 14. See the section on this option for further information.

Connector J18 Non-user interface connector for the commutation board

Connector J19, J20, J21 & J22 Non-user interface for commutation set-up

Connector J23 Non-user interface for bus over-voltage inputs

Connector J24 Non-user interface for current feedback inputs

Connector J25 (4 pin)

PIN 1 - The summation of the absolute value of the current in all windings multiplied by a negative one.

PIN 2 - Logic common test point connection.

PIN 3 - Sine test point connection.

PIN 4 - Current command signal test point.

Connector J26 (10 pin)

PIN 1 - Triangle wave.

PIN 2 - Feedback loop analog common.

PIN 3 - The sine current command signal.

PIN 4 - The amplified sine current error signal.

PIN 5 - The amplified sine plus 120^0 current error signal.

PIN 6 - The sine plus 120^0 signal.

PIN 7 - The sine plus 120^0 current command signal.

CONNECTORS AND TEST POINTS
(CONTINUED)

PIN 8 - The surge current threshold signal.

PIN 9 - The modulator/demodulator feedback oscillator.

PIN 10 - The summation of the sine and the sine plus 120^0.

Connector J27 Non-user interface connector for the base drive signals.

Connector J28 Non-user interface connector for the heatsink thermistor.

Connector J29 (6 pin)

PIN 1 - The base drive signal for channel 1.

PIN 2 - The base drive signal for channel 2.

PIN 3 - The base drive signal for channel 3.

PIN 4 - The base drive signal for channel 4.

PIN 5 - The base drive signal for channel 5.

PIN 6 - The base drive signal for channel 6.

INSTALLATION

Each amplifier in the A82x series comes with an individual installation drawing which shows where the various connections for power input, signal input, tachometer input, fan and logic power input and motor outputs must be made. **CAUTION:** 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 **WITHOUT EXCEPTIONS.** Always make certain that the input voltages and frequencies are correct for the specific model number amplifier you have.

The input power transformers for all amplifier in the A82x series are mounted externally to the amplifier. It is possible to use one power transformer for several amplifiers given that the transformer is sized properly. Westamp transformers have dual voltage primaries and it is imperative for one to make certain that the jumpers are on the correct transformer terminals for the input AC power source. The motor output connections are on each of the modules on the chassis.

CAUTION: USE DIFFERENTIAL SCOPE MEASUREMENTS ON THE OUTPUT!
DO NOT CONNECT ANY OF THE OUTPUTS TO GROUND!!

The signal input is usually applied directly to pin 2 of J1 and the signal input return is usually applied to pin 1 of J1. The signal input to the amplifier may be applied differentially or single ended. The above mentioned method is single ended. To connect the signal inputs to the amplifier differentially, remove the jumper installed at J10. If the jumper at J10 is connected between any two of the three pins then the signal input is applied single ended.

The tachometer signal is applied to pin 3 of J1 and the tachometer return is applied to pin 4 of J1. The tachometer signal gain is fixed to a predetermined point. If an adjustable tachometer input is required then the optional adjustable compensation board must be used. In the brushless series of amplifiers, the tachometer signals are derived from the commutation circuitry, therefore, for most applications no external tachometer is required.

Use shielded, twisted wire to prevent stray pickup and noise from being introduced into the system. Be sure to ground only one end of the shield in order to prevent the shield from creating a ground loop.

The amplifier bandwidth will be anywhere from 2.5 Khz (no compensation) to a much lower frequency depending on the setting of the TC (time constant) potentiometer, and the components in the velocity loop compensation network. Typical installation drawings (see appendix A) may be used to wire an amplifier-motor combination. The amplifiers in this series require 115 VAC at 2 amperes for the fan and logic supply. The AC input power for the bus power supply may range from 80 to 240 VAC.

CAUTION: CHECK ALL CONNECTIONS BEFORE POWER IS APPLIED!!

POWER SUPPLY - SHUNT REGULATOR

When a motor slows down or stops (decelerates), a portion of the energy stored in the inertia of the armature is returned to the amplifier. This energy "pumps-up" the bus power supply since the rectifiers will not allow it to return to the AC line. If the bus voltage exceeds a predetermined safe operating area, the fault circuitry shuts-down the amplifier and a RED LED is illuminated. If the system performance mandates operation of the amplifier under conditions which produce excessive regeneration, then it may be necessary to install an optional bus voltage shunt regulator.

ADJUSTMENTS:

The A82x 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 on the main control card. In most cases, there may be certain customer adjustments on the main control card. The board layout diagram (see appendix A) illustrates the location of various adjustments, most of which are factory set and must not be tampered with. Some of the customer adjustable potentiometers are as follows:

SIG - Signal gain:	Potentiometer R5 adjusts 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 tachometer and signal gains have been set.

NOTE: On all Westamp amplifiers, turning a potentiometer in a clockwise direction increases the parameter being adjusted.

Adjustable Compensation with Auxiliary Input Board

The component layout drawing for the adjustable compensation board (see appendix A) shows the various adjustments available for the adjustable compensation board. These adjustments are as follows:

TACH - Tachometer gain:	Potentiometer R12 adjusts the tachometer loop gain.
TC - Time Constant:	Potentiometer R14 is used to stabilize the velocity loop. Turning the potentiometer clockwise produce higher bandwidth in the velocity loop.
S1 - TAC Lag	S1 is a hexadecimal switch used to select the TAC lag capacitor that is used in conjunction with the TC pot in selecting the bandwidth of the velocity loop. The higher the alpha-numeric valuer, the lower the response.

Auxiliary - Aux Gain: Potentiometer R2 adjusts the auxiliary gain of the amplifier

R11 & S2 - TAC Lead: Potentiometer R11 along with S2 adjusts the TAC lead. For any setting of S2 turning R11 clockwise increases the TAC lead.

S2 is a hexadecimal switch used to select the lead capacitor. Increasing the alpha-numeric number, increases the TAC lead. If S2 is set at zero, the TAC lead components are disconnected from the system.

CLM - Current Limit: Potentiometer R28 adjusts the peak current output of the amplifier. With the potentiometer at the maximum CW position the amplifier will output its maximum rated current.

ADJUSTMENT PROCEDURES

It is possible to compensate a servo system by trial and error without theoretical evaluation of the system, provided that the system performance requirements are not critical. If the procedure outlined in the "Short Form Set-up" section provides adequate system performance then this procedure is all that is needed. The A82x series of amplifiers were designed to operate in VERY high performance applications requiring low positioning tolerances. In order to achieve maximum system performance, matching amplifier-motor-commutation device combinations are recommended. However, the A82x series of amplifiers will provide better than average performance with a variety of brushless motors coupled with the appropriate commutation device.

THE MULTI-FUNCTION RESOLVER BOARD

The multi-function resolver board accepts resolver sine and cosine positional inputs from a resolver mounted to the motor shaft and processes these inputs into velocity and digital position information. Outputs of the multi-function resolver are a simulated tachometer (motor speed), Sine and Sine + 120 (motor position information), simulated encoder output signals, and a 12 bit digital output word. Digital commutation (hall) outputs are also generated by the resolver board; which in the case of the sine wave amplifiers, are used for the commutation L.E.D.s (and for factory alignments).

The multi-function resolver board mounts to the amplifier by the non user interface J18 and P601 connectors. Customer interface connectors consist of the J8 connector (resolver interface), J600 (digital output), and J602 (synthesized encoder outputs). The J8 connector is on the main control board. The J600 and J602 connectors are on the multi-function resolver board.

The ratiometric tracking conversion technique used by the multi-function resolver board allows continuous output position data without conversion delay. For positional information, it is insensitive to absolute signal levels. The electronically derived tach proportional to motor (resolver) velocity is accurate within typically one percent. If tach accuracy is required, input signal levels must be properly scaled (see tach section).

The multi-function resolver can be factory selected to meet the needs of your particular resolver or system. Simulated encoder outputs are available and field selectable for up to 1024 counts per revolution. The resolver reference excitation signal can be supplied either externally or from an internal reference generator. The internal reference can be scaled to any frequency from 50 Hz to 20,000 Hz, and any amplitude up to 20V peak to peak. If needed, line drivers capable of driving up to 100ma are available (consult factory). The board inputs can be differential or single ended. Bandwidth, maximum tracking rate, and velocity scaling can be factory set to match the customers requirements.

RESOLVER CONNECTORS

J8 Connector:

The customer interface between the motor and the amplifier is the J8 connector. The J8 connector is a loop going through the multi-function resolver board via the J18 non user interface connector. The motor mounted resolver windings would connect to the J8 connector in the following order:

J8-1	COS HI	S2 resolver stator winding
J8-2	COS LOW	S4 resolver stator winding
J8-3	SIN HI	S1 resolver stator winding
J8-4	SIN LOW	S3 resolver stator winding
J8-5	REFERENCE HI	R1 resolver rotor winding
J8-6	REFERENCE LOW	R2 resolver rotor winding
J8-7	SHIELD	

The rotor connections listed above may be reversed for some resolvers. For normal operation a positive command to the J1-2 (control board) velocity signal input should result in a counter clockwise rotation of the motor shaft when viewed from the front of the motor; and should result in a negative simulated tach signal being developed by the multi-function resolver board.

The Reference can be factory configured as either an input or an output. If The reference excitation signal is generated within the multifunction resolver board, the reference hi is an output pin (the excitation signal goes from the multi-function resolver board to the resolver transducer on the motor) and the reference low will be at signal common. If the reference excitation signal is generated outside the Multi-function resolver board (within the controller, computer, etc), the reference low becomes an input pin (the reference signal is simultaneously sent to both the resolver and the multi-function resolver board.), and the reference low can be configured either differentially or single ended (tied to signal common).

J18 Connector:

Non user interface between the main control board and the Multi-function resolver board.

RESOLVER CONNECTORS
(continued)

J600 Connector:

The resolver shaft position is represented at the J600 output as a binary parallel digital word. Because the conversion depends on the ratio of the input signals, the digital outputs are very tolerant of input amplitude and frequency variations (including the encoder outputs: J601 connector). The inclusion of a phase sensitive detector in the conversion loop ensures a very high immunity to signals that are not coherent or are in quadrature with the reference signal. If desired, the digital outputs can be disabled (see J600-13 below).

The pin out of the J600 connector is:

J600-1 MSB - most significant bit, bit 12
J601-2 MSB-1, bit 11
J601-3 MSB-2, bit 10
J601-11 LSB +1, bit 2
J601-12 LSB - least significant bit, bit 1
J601-13 - Digital Output Enable

The state of the digital output can be controlled by external logic if desired, by applying logic commands to J1-13. This function will only work If the J604 jumper on the multi-function resolver board is removed. If J600-13 is held at a logic high (and J604 is removed), the digital outputs will be disabled, and there will be no outputs from J600. If J600-13 is held at a logic low, the digital outputs will be enabled, and J600 will supply output signals. With J604 installed, the board is permanently enabled. Normal factory setting is J604 installed (digital outputs working).

J601-14 Signal common
P601 Non user interface for connecting the sine and sine+120 current commands to the main board.

J602 Connector:

It is a synthesized encoder output connector. The J602 connector supplies all the functions normally found on an incremental encoder. This can be very cost effective for systems that require an encoder for motion control information, yet require the resolver for brushless motor position information (the resolver and multi-function resolver board can supply both signals). In addition, a Busy (data changing), Dir (direction), and analog Tach output are supplied through this connector.

RESOLVER CONNECTORS
(continued)

The pin out of the J602 connector is as follows:

J602-1 - BUSY: The busy pulse indicates that the output data is changing. It will go to a logic high when position output data is about to change. The timing is a positive going edge 50 nanoseconds before the change in position data occurs. The width of the pulse is between 300 to 600 nanoseconds.

J602-2 - DIR: (Direction) The direction signal is a logic indication of the direction of direction of rotation of the resolver. Electronically, it will be at a logic high when counting up, and a logic low when counting down. It changes, if required, at the start of the output position data cycle. For normal operation the DIR signal is at a logic hi for clockwise (CW) movement of the motor shaft (when viewed from the front of the motor.), and at a logic low for counter-clockwise (CCW) movements of the motor shaft.

J602-3 - ZR: Simulated encoder Zero reference signal

J602-4 - $\overline{ZR}$: Simulated encoder $\overline{Zero}$ reference signal

J602-5 - Tach: The tach is an electronically derived analog signal and its direction is dependent upon motor direction, and its amplitude is proportional to speed. The tach signal will be positive for clockwise rotation of the motor shaft, and negative for counterclockwise rotation of the motor shaft (when viewed from the front of the motor.) Normal tach scaling would be approximately 1.5V per thousand rpm.

Please note that this tach output is for external reference use only, and does not need to be tied back into the amplifier to close the velocity loop. The same signal is brought into the amplifier through the interface and does not require any customer configuration.

J602-6 Common Signal common.

J602-7 B Simulated encoder B output

J602-8 $\overline{B}$ Simulated encoder $\overline{B}$ output

J602-9 A Simulated encoder A output

J602-10 $\overline{A}$ Simulated encoder $\overline{A}$ output
(See encoder configuration for more details)

RESOLVER CONNECTORS
(continued

J603 Connector:

Three pin connector used for encoder configuration (see encoder configuration below)

J604 DIGITAL OUTPUT ENCODER JUMPER

A two pin connector used to enable the digital encoder outputs. If the jumper is installed, the digital outputs are permanently enabled. If the jumper is removed the state of the digital outputs will depend upon the logic level at J600-13 (see J600 connector). Normal factory configuration is J604 jumper installed (digital outputs working).

J605 AND J606 Connectors:

J605 and J606 are two pin connectors used as test points for the resolver signals. These pins are used in factory alignment of the resolver/board configuration. See tach configuration for more details.

J605-1 Scaled Reference Signal

This is the resolver reference signal at the input to the resolver to digital conversion circuitry.

J605-2 Scaled Cos Signal

This is the resolver cosine signal at the input to the resolver to digital conversion circuitry.

J606-1 Signal Common

J606-2 Scaled Sin Signal

This is the resolver sine signal at the input to the resolver to digital conversion circuitry.

J607, J608, J609, & J610 Connector:

They are three pin connectors used for encoder configuration (see encoder configurations for details).

ENCODER CONFIGURATION

The synthesized encoder output may be configured for up to 1024 lines (4096 counts) per revolution. Configuration is accomplished by the use of jumpers on the J603, J607, J608, J609, and J610 connectors. The following list covers the possible jumper configurations.

Output	Jumper Configuration
1024 counts / rev J610 pins 1&2	J609 pins 2&3 (others blank)
512 counts / rev J609 pins 1&2	J608 pins 2&3 (others blank)
256 counts / rev J608 pins 1&2	J607 pins 2&3 (others blank)
128 counts / rev J607 pins 1&2	J603 pins 2&3 (others blank)

Please note that only two of the connectors will have jumpers installed. the other three connectors will be blank. Normal factory configuration would be 1024 lines per revolution (jumpers on J610 pins 1&2, J609 pins 2&3).

For normal operation, with a clockwise (CW) rotation of the motor shaft (when viewed from the front of the motor), the A encoder signal would lead the B encoder by 90 degrees. The ZR pulse would occur once per revolution and be locked to the trailing edge of the A pulse. With a counter clock wise (CCW) rotation of the motor shaft (when viewed from the front of the motor), the A encoder signal would lag the B encoder pulse by 90 degrees. The ZR pulse would occur once per revolution and be locked to the trailing edge of the A pulse.

TACH SCALING

The tach signal is an analog signal proportional to velocity and can be made linear to typically one percent. In most applications this is used in place of an external tach to provide loop stabilization and velocity feedback data. The tach is internally applied to the amplifier and does not require any customer configuration. An external reference of approximately 1.5V per thousand RPM is supplied through the J602 jumper.

If the motor/ amplifier combination is supplied by WESTAMP, all circuit scaling was performed at the factory. If the customer is supplying his own motor/ resolver and wishes to use the amplifier in the velocity mode, best performance can be obtained by insuring that the levels are proper.

The following checks will insure that the tach circuit is properly scaled.

The reference: J605-1

This is the rererence signal applied to the conversion circuitry. The amplitude here is not critical. The signal should be a sine wave of the proper frequency (determined by the resolver specifications) and should not be clipped or distorted. A four to twelve volt peak to peak signal at this point is acceptable. All analog inputs are diode protected and if the reference level at J605-1 exceeds 15V peak to peak, clipping could occur. Check the signal at TP3. This is the same point, except on the other side of a dropping resistor. It should be the same as the signal at J605-1 in both amplitude, frequency, and phase. If it is not, the reference is probably clipping.

Sine and Cosine: (J606-2 = sin, J605-2 = cos)

The signal levels of the sin and the cos inputs to the converter circuitry should be set at 2V RMS (5.7V peak to peak). It is essential that the signal amplitude of the Sine and Cosine inputs be maintained within 5 percent of this value if full performance is required from the velocity (tach) signal.

If needed these levels can be scaled by the buffer / input circuitry of the multifunction resolver board. It is recommended that this be accomplished by the factory. If this is not practical, consult WESTAMP before attempting modifications.

THE TACHSYN BOARD

The tachsyn is a system consisting of a magnetic sensing device, mounted to the motor, and a signal processing board mounted to the amplifier. The two would connect with a cable that would run from the motor mounted transducer to the J8 connector on the amplifier control board.

The tachsyn transducer mounted to the motor consists of a rotor mounted to the motor shaft, and a pancake stator attached to the motor frame. For increased reliability, the output windings, field winding, and permanent magnet are all located in the stator. A large through hole makes the rear shaft of the motor available for other rear mounted devices.

Four (4), six (6) and eight (8) pole versions of the tachsyn transducer are available. The tachsyn transducer must be matched to the poles of the motor. The tachsyn processing board (mounted to the amplifier) is the same for all units (only the motor/transducer will be different from one system to the next).

The tachsyn board senses and processes both speed and position information. These consist of a simulated tach signal (relative to motor speed); and the sine, and sine + 120 degree signals used by the amplifiers commutation logic circuits to develop the proper output currents. Hall outputs are also developed by the tachsyn board which, in the case of the sine wave amplifiers, are used for the commutation L.E.D.s (and for factory troubleshooting and alignment). The tachsyn board mounts to the amplifier by the non-user interface J18 and P601 connectors.

TACSYN CONNECTORS

J8 Connector

The customer interface between the motor and the amplifier is the J8 connector. The J8 connector is a loop through to the tachsyn board via the J18 non-user interface connector. The motor mounted transducer windings would connect to the J8 connector in the following order:

J8-1 Tachsyn phase 1: pin 1 or brown wire on the tachsyn transducer

J8-2 Tachsyn phase 2: pin 2 or yellow wire on the tachsyn transducer

J8-3 Tachsyn phase 3: pin 3 or green wire on the tachsyn transducer

J8-4 Do not connect: pin 4 do not connect

J8-5 Reference: Pin 5 or red wire on the tachsyn transducer (excitation signal)

J8-6 Reference return: Pin 6 or black wire on the tachsyn transducer (signal common)

J8-7 Shield: Connect on amplifier side only.

J8-8 Do not use

If you are connecting directly to the tachsyn transducer, note that there are two types of transducers. One would consist of 6 pins mounted to the stator (pin 4 not used). The other would consist of 5 wires leaving the stator. If your transducer uses pins, pin 1 would be the far counterclockwise pin (when viewed from the back of the motor and increase in a clockwise direction. If your transducer uses wires, follow the color pattern listed above. Both transducers are electrically the same.

A dual shielded cable should be used between the transducer and the J8 connector. One shield should be around the reference and reference return and a separate shield should be around the three "phase" windings: One shield should be around the brown(1), yellow (2) and green (3) wires and the other shield should be around the red (5) and black (6) reference / excitation wires.

For normal installation the two cable shields should be tied together at both ends; terminated at the transducer end and connected to J8 pin 7 at the amplifier end.

For proper operation applying a positive command to J1-2 of the main control board, with respect to J1-1, results in a counter clockwise rotation of the motor shaft (when viewed from the front of the motor) and results in a negative simulated tach signal being developed in the tachsyn board.

The tachsyn system is dependent upon analog levels of the particular system and may differ between different tachsyn transducers, tachsyn processing modules, or wiring interface configurations. If you are considering a new system, the multi-function resolver system would be the recommended choice (see multi-function resolver section). If the sine wave is being retrofitted into an older system using a tachsyn transducer, the following procedure should insure that the amplifier characteristics are within the factory specifications. These steps should be performed before applying the three phase bus power.

1. Complete the normal installation of the amplifier. Connect all interface cables/connectors from the motor tachsyn transducers to the amplifier.

2. Apply logic voltage only. Do not apply the bus voltage.

3. Connect the probe of an oscilloscope to J601 pin 1 of the tachsyn board. Insure that the trace is perfectly centered by grounding the oscilloscope probe and centering the trace.

4. Slowly rotate the motor by hand. The level of the signal at J601 pin 1 on the tachsyn board will vary as the motor shaft rotates. It should have an amplitude of 8V peak to peak and be perfectly centered around zero (the amplitude of the negative going peak should be exactly the same as the positive going peak). If the wave form is not perfectly centered, the variable resistor on top of A1 can be used to correct any offsets. If the waveform amplitude is not within ten percent of 8V peak to peak, R11 can be reselected to correct the amplitude.

5. Connect the probe of an oscilloscope to J601 pin 2 of the tachsyn board. Again, insure that the trace is perfectly centered by grounding the oscilloscope probe and centering the trace.

6. Slowly rotate the motor by hand. The level of the signal at J601 pin 2 on the tachsyn board will once again vary as the motor shaft rotates. It should have an amplitude of 8V peak to peak and be perfectly centered around zero (the amplitude of the negative going peak should be exactly the same as the positive going peak). If the wave from is not perfectly centered, the variable resistor on top of A2 can be used to correct any offsets. If the waveform amplitude is not within ten percent of 8V peak to peak, R11 can be reselected to correct the amplitude.

7. If it was necessary to reselect R11, then recheck the amplitude of both waveforms once again. Both waveforms should be within the specified range. If not, recheck the tachsyn transducer and its wiring.

8. Continue your setup procedure as you would normally do.

SHORT FORM SET-UP PROCEDURE

1. Check input voltages and implement proper transformer connections.

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

3. Be sure to make **ALL** connections in accordance with the appropriate installation diagram.

4. Before applying power, adjust all potentiometers as follows:
NOTE: All multi-turn potentiometers are 20-turns. nominal.

   a) Set the Current Limit potentiometer (CLM), fully CCW.
   b) Set the Time Constant potentiometer (TC), mid-range from either end.
   c) Set the tachometer potentiometer (TACH), 10 turns from either end.
   d) Set the Signal potentiometer (SIG), 10 turns from either end.
   e) Set S1 at position #8
   f) Set S2 to position zero

5 Apply power but **DO NOT** apply an input signal to the amplifier.

6. If the motor runs away or operates erratically after step five (5) above has been completed, turn off the power to the amplifier and check the wiring. The wiring from the commutation device and the motor output leads should be scrutinized for accuracy and integrity. It is imperative that these wires be connected to the amplifier in accordance with the amplifier's installation diagram. If all of the above avenues have been pursued and the symptoms described above persist, contact the Westamp Service Department for further advice and assistance.

7. CLM SET-UP: Set the CLM potentiometer to deliver peak currents as shown in the following:

   3 turns CW = 30% of peak current
   6 turns CW = 60% of peak current
   10 turns CW = 80% of peak current
   14 turns CW = 95% of peak current

8. If the motor's shaft rotates slowly with no signal applied, adjust the balance potentiometer (BAL) until the motor stops. If necessary, remove the jumper at J2 to obtain more balance range.

9. With no signal input to the amplifier, turn the Time constant potentiometer (TC) until the motor shaft starts to oscillate at high frequency. After oscillation occurs, turn the potentiometer CCW until the oscillation subsides. After the oscillation has stopped, continue to turn the potentiometer an additional one eighth (1/8) to one fourth (1/4) of a turn CCW.

SHORT FORM SET-UP PROCEDURE
(continued)

IMPORTANT: IF THE TC POTENTIOMETER IS FULLY CCW AND THE SYSTEM IS STILL OSCILLATORY, SEE THE NOTES AT THE END OF THE "DETAILED SET-UP" PROCEDURE IN THIS WRITING.

10. Apply a small signal input and observe the motor's shaft.

11. Increase or decrease the tachometer gain potentiometer for desired results.
    a) Increasing the tachometer potentiometer (turning CW) provides quicker settling time or higher system bandwidth.
    b) Decreasing the tachometer potentiometer (turning CCW) provides slower settling time or lower bandwidth.

12. When the tachometer response provides adequate system performance, do not adjust the tachometer potentiometer further.

13. If the motor starts to drift after the signal and tachometer potentiometers have been adjusted, it may be necessary to re-adjust the balance potentiometer (BAL).

14. Run the motor at higher speed. If it runs smoothly, the system is adjusted.

15. To calibrate the system for the correct speed, adjust the signal gain potentiometer (SIG). Turning the potentiometer CW will increase the speed with respect to a fixed signal input, while turning the potentiometer CCW will decrease the speed with respect to the same signal input.

16. This completes the "Short Form Set-Up" procedure. It is recommended that the adjustments be recorded on the form at the end of this manual for future reference.

DETAILED SET-UP PROCEDURE

If your system requires a more accurate tachometer loop or higher performance than that observed with the "Short Form Set-Up" procedure, the following procedure should be used:

1. Perform steps 1-10 of the "Short Form Set-Up" procedure.

2. Apply a small signal to achieve motor rotation. Observe the tachometer signal with a differentially connected oscilloscope.

NOTE: Refer to the "Helpful Compensation Hints" section.

DETAILED SET-UP PROCEDURE
(continued)

3. If the tachometer loop is over-damped (no over-shoots are observed), turn the tachometer potentiometer until an over-shoot is observed (under-damped). The system is now set-up for maximum bandwidth in the tachometer loop.

4. If an under-damped (over-shoots are observed) tachometer loop is objectionable, adjust the tachometer potentiometer until the over-shoot is eliminated.

NOTE: One over-shoot in the tachometer loop will not necessarily result in position loop over-shoots.

5. If the system is performing properly and is mechanically sound, see the notes at the end of this section.

6. If the motor rotates slowly with no signal input, it may be necessary to readjust the balance potentiometer (BAL) until the motor stops rotating

7. Recalibrate the signal potentiometer (SIG) to obtain the desired output speed versus a particular input voltage.

8. All other adjustments are factory set and should not be altered. Adjusting, altering or otherwise tampering with potentiometers other than those described in this manual as being for customer use may damage the amplifier and/or motor and may void any applicable warranties.

DANGER: POWER MUST BE OFF BEFORE REMOVING MODULES OR CHANGING COMPONENTS!!!

NOTES:

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

AFTER PERFORMING ANY OF THE FOLLOWING CHANGES, REPEAT THE SET-UP PROCEDURES. START WITH STEP FOUR (4) OF THE "SHORT FORM SET-UP" PROCEDURE.

2. If the system exhibits a high frequency oscillation even though the Time Constant potentiometer (TC) is fully CCW, then motor resonance is possible. It may be necessary to increase the value of capacitor C7.

3. If the system is over-damped (under-shoots are observed) with the tachometer potentiometer fully CW, it may be necessary to decrease C6 if there is one on the compensation board. If there is not a C6 on the board, reduce the value of resistor R13 to obtain more tachometer gain.

4. If the system exhibits a servo oscillation despite the fact that the Time Constant potentiometer (TC) is fully CCW, reduce the R14 resistance and/or increase the C7 capacitance.

5. If the system is not positioning near zero speed or the axis following error is significant, more DC gain may be required. To obtain more DC gain decrease the R13 resistance, after which, it may be necessary to readjust the balance potentiometer (BAL).

6. If the system has high inertial loads or a high inertia motor is being used, it may be necessary to change the C6-R11 combination to eliminate over-shoots (see step 3 in the notes).

NOTE: C7 will be selectable with switch S1. To increase the value of C7, rotate the switch to a higher alpha-numeric number.

C6 will be selectable with switch S2. Decreasing the alpha-numeric number of S2 will decrease the value of C6. If C6 is set to the zero position, C6 will be removed from the system.

SET-UP PROCEDURES USING RESISTIVE MEASUREMENTS

This set-up procedure is used only after the desired settings for the signal, time constant, and current limit potentiometers have been established. Use either the short form or the detailed set-up procedures to establish these values.

CAUTION: DO NOT USE GROUNDED TEST EQUIPMENT!!!

1. Turn off all power to the servo amplifier. Measure and record the resistance values as indicated in the following steps. The Ohmmeter common should be connected to the wire loop common in the upper right hand corner of the main control board.

2. SIGNAL POTENTIOMETER: (SIG) Measure and record the resistance value from the right side of R59 to the wire loop common. Make this measurement with the compensation board off the main control board.

3. TACHOMETER POTENTIOMETER: (TACH) Measure and record the resistance value from TP1 on the compensation board to the wire loop common.

4. TIME CONSTANT POTENTIOMETER: (TC) Measure and record the resistance from TP2 on the interface board to the wire loop common.

5. CURRENT LIMIT POTENTIOMETER: (CLM) Measure and record the resistance value from TP1 of the main control board to the wire loop common.

6. To adjust a new board, set the potentiometers to the values recorded in steps two through five (2-5) above. NOTE: The Time Constant (TC) and the Current Limit (CLM) potentiometer adjustments interact and often must be readjusted several times to achieve desired results.

7. Remove the Ohmmeter and turn the Current Limit potentiometer (CLM) fully CCW. Apply power and slowly turn the potentiometer CW. If the motor starts to run-away or operate erratically, turn off the power and refer to step six (6) of the "Short Form Set-Up" procedure.

8. Turn the power off and readjust the Current Limit potentiometer (CLM) as in step 5 above. Remove the Ohmmeter and apply power to the amplifier. If the motor shaft rotates slowly without any signal input applied, adjust the Balance potentiometer (BAL) until the motor stops. Remove the power and repeat step six (6) to insure the Time Constant (TC) and Current Limit (CLM) are set at the proper values.

RMS CURRENT ADJUSTMENT

For many applications, the rated RMS current of the amplifier surpasses the rating that the motor can safely handle. If motor protection, external to the amplifier, is not provided, it may be necessary to adjust the RMS current fault circuit on the amplifier to avoid damaging the motor.

The A82x series of amplifiers employs a unique method for adjusting the RMS current fault rating. This method will NOT allow an individual to set the RMS rating of the amplifier to a higher value than the setting when the amplifier was shipped.

There are two (2) potentiometers for the RMS setting on the main control board. One setting is the factory set and the other is the customer set potentiometer. Altering the factory set potentiometer (R3) may will any applicable warranties for the amplifier. The customer set potentiometer (R4) is shipped such that it can achieve 100% of the factory set value. Therefore, there is no way to surpass the amplifier's rated RMS value using this potentiometer.

R4 is a single turn potentiometer. Turning the potentiometer CCW reduces the RMS current fault level, linearly to zero. Mid-range of the potentiometer will allow approximately 50% of the amplifier's rated RMS current.

SINUSOIDAL OUTPUT CURRENT

When sizing a system for use with a brushless, sinusoidal output amplifier, consideration should be given to the output torque required versus the rated RMS current of the amplifier.

An A82x amplifier with a rated continuous and peak of 30 and 60 amperes, will produce 21A RMS and 42A RMS peak in a sinusoidal application. The confusion results from how the amplifier and motor are rated.

For an application requiring 30 in-lb of torque and uses a motor with a K_t of 3 in-lb/amp RMS, the RMS rating of the amplifier would be:

$$\frac{\text{Torque required}}{Kt} * \text{Square Root of } 2 = \frac{30}{3} * 1.1414 = 14.14$$

This application would require an A821 with a continuous current rating of 15 amperes

TROUBLE SHOOTING

Refer to the appropriate installation drawings, board layout drawings and schematics contained in this manual and supplied with the amplifier upon shipment.

1. Examine the entire amplifier chassis for loose connections, broken wires or damaged components.
2. Verify that no external limit is being activated.
3. If a fault indicator LED is on, read over the protective features section of this manual. Determine the reason for the fault condition.

CAUTION: DO NOT SIMPLY RESET THE AMPLIFIER!!!
Permanent damage to the amplifier may result.

The following is a list of typical conditions for a fault to exist:

a) +/- 12 VDC logic supply is not supplying adequate voltage.
b) High bus voltage.
c) Defective output transistors.
d) Defective motor.

The following steps provide a systematic check of each of the potential faults.

A low or defective logic supply may be the result of one of the following:

a) No 115 VAC supply for the fan and logic.
b) Blown logic supply/fan fuse.

c) Defective logic supply.
d) Excessive load on +/- 12 VDC logic supply.

Check the logic supply fuse and measure the 120 VAC input. If the input voltage and the fuse are okay, but the output voltage is low, measure the load current on each of the outputs (check the model number of your specific logic supply).

MODEL #: 31550-1	1.25 amperes maximum
MODEL #: 31546-1	2.25 amperes maximum

If the load currents are within specification and the output voltages remain low, return the supply to the factory for repair. If the load currents are excessive, determine the cause by disconnecting the logic supply connectors from the amplifier modules while monitoring the load current.

Problems with the bus voltage are attributable to:

a) Incorrect transformer wiring.
b) Defective transformer.
c) Defective rectifiers.
d) High line voltage.

Verify that the transformer is wired properly.

CAUTION: TAKE PROPER PRECAUTIONS TO AVOID ELECTRIC SHOCK WHEN TAKING VOLTAGE MEASUREMENTS!!!

Measure the voltage and the input bus power supply including the transformer primary to verify that the transformer is operating properly. Make certain that all three phases of a three phase input are checked line to line. If one phase is low it can reduce the bus voltage considerably and, if the system is operated under these conditions, cause permanent damage to the rectifiers.

OVER-VOLTAGE FAULT OCCURS

The system may be producing regenerative energy that is being returned to the amplifier during the deceleration phase of motion. The fault circuitry may be protecting the amplifier by shutting it off in order to discontinue any further regeneration.

If you do not have a Shunt Regulator with your amplifier it may be necessary to add one (see the section on shunt regulation in this manual). If you do have a shunt regulator and the problem persists, it is possible that shunt regulator is defective or the external dumping resistors have not been installed.

DEFECTIVE OUTPUT TRANSISTORS

If you have defective output transistors the surge LED will illuminate the moment that power is applied. If this occurs disconnect the output leads from the motor and reapply power to the amplifier. If the surge LED does not reappear, then it is possible that a short in the wiring exists external to the amplifier. Measure the resistance between the leads extending to the motor to find the short. If, on the other hand, the surge LED persists, return the module to Westamp for repair.

MOTOR FAILURE

If you are experiencing erratic or unexplainable faults, although the system seems to perform well in every other aspect, it is possible that the problem is in the motor. If faults occur only occasionally or during power-up only, verify that the motor has not shorted to ground or that they are not intermittently shorting together.

TROUBLE SHOOTING MULTI-AXIS SYSTEMS

Trouble shooting multi-axis systems can create some unique situations since over-voltage bus and low logic voltage faults may cause one or more axes to fault simultaneously. When one or more modules fault or random modules fault, check the shunt regulator or the logic supply as outlined previously. If they appear to be operating normally, remove each module until the module causing the fault has been removed. Replace removed modules to verify that they have not been damaged.

TYPICAL INSTALLATION AND FIELD PROBLEMS

SYMPTOM	CAUSE
High bus voltage	- Defective shunt regulator - Wrong transformer tap - Incorrect Shunt Regulator - High line voltage - Defective transformer
Surge current faults	- Motor winding is grounded - Output leads are shorted - Defective output transistors
RMS current faults	- Extreme duty cycle - Increase in machine friction - Binding or defective - mechanical component - Defective motor - Loop compensation required
Over-temperature faults	- Fan obstructed or defective - Ambient temperature too high
Low logic supply fault	- Overload on logic supply - Low line supplying the logic supply - Defective logic supply

All of the above conditions will result in the protective circuitry to shut off the output and turn on the appropriate LED.

RESETTING THE AMPLIFIER

Momentarily changing the logical state of the input at J1 pin 13 will reset the amplifier's protective circuits. In addition, removal followed by a 3-5 second delay, followed by reapplication of the power supplying the logic supply will reset all circuits within the amplifier.

CAUTION: ARBITRARILY RESETTING THE AMPLIFIER WITHOUT INVESTIGATING THE REASON FOR WHICH THE FAULT OCCURRED, CAN CAUSE PERMANENT AMPLIFIER AND/OR MOTOR DAMAGE. FURTHERMORE, THIS COULD VOID ANY APPLICABLE WARRANTIES FOR THE AMPLIFIER AND/OR MOTOR.

Customer: _____ **Amplifier Model:** _____

Machine: _____

AMPLIFIER SETTINGS

Axis	#1	#2	#3	#4
Module P/N if known				
Potentiometer Settings from fully CCW position				
Differential Input Yes/No				
TACH Pot				
TC Pot				
Current Limit				

SPECIAL NOTES: Here you might want to indicate the overall number of the pots. see Application Note section on pots.

You might want to copy this note and put it with the machine. Date:_____

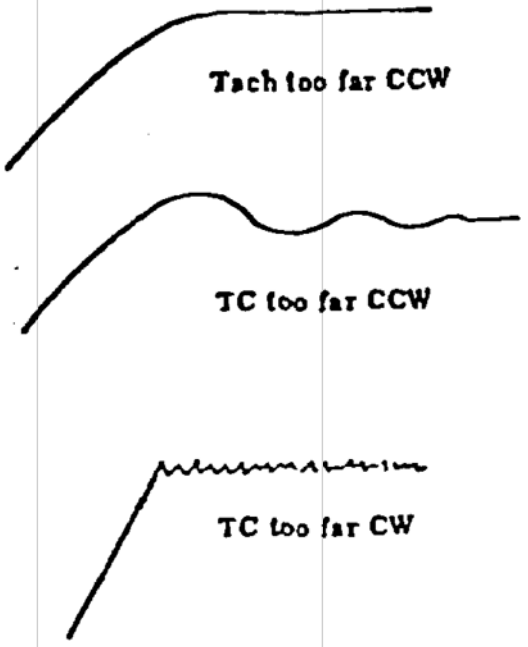
APPENDIX

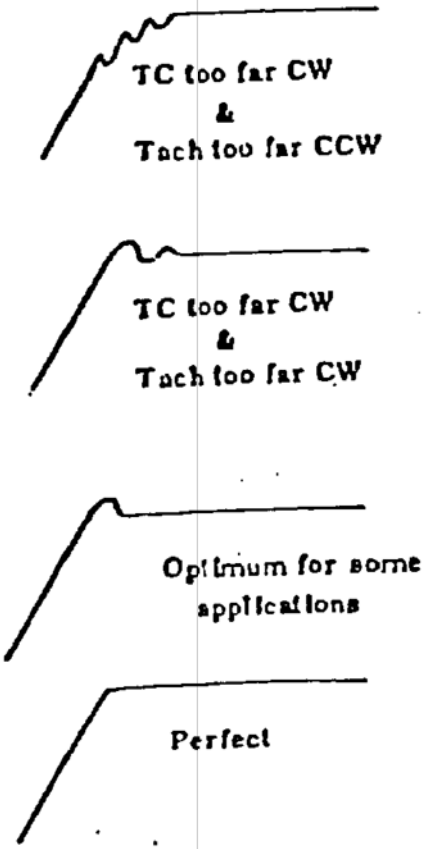
HELPFUL HINTS:

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.

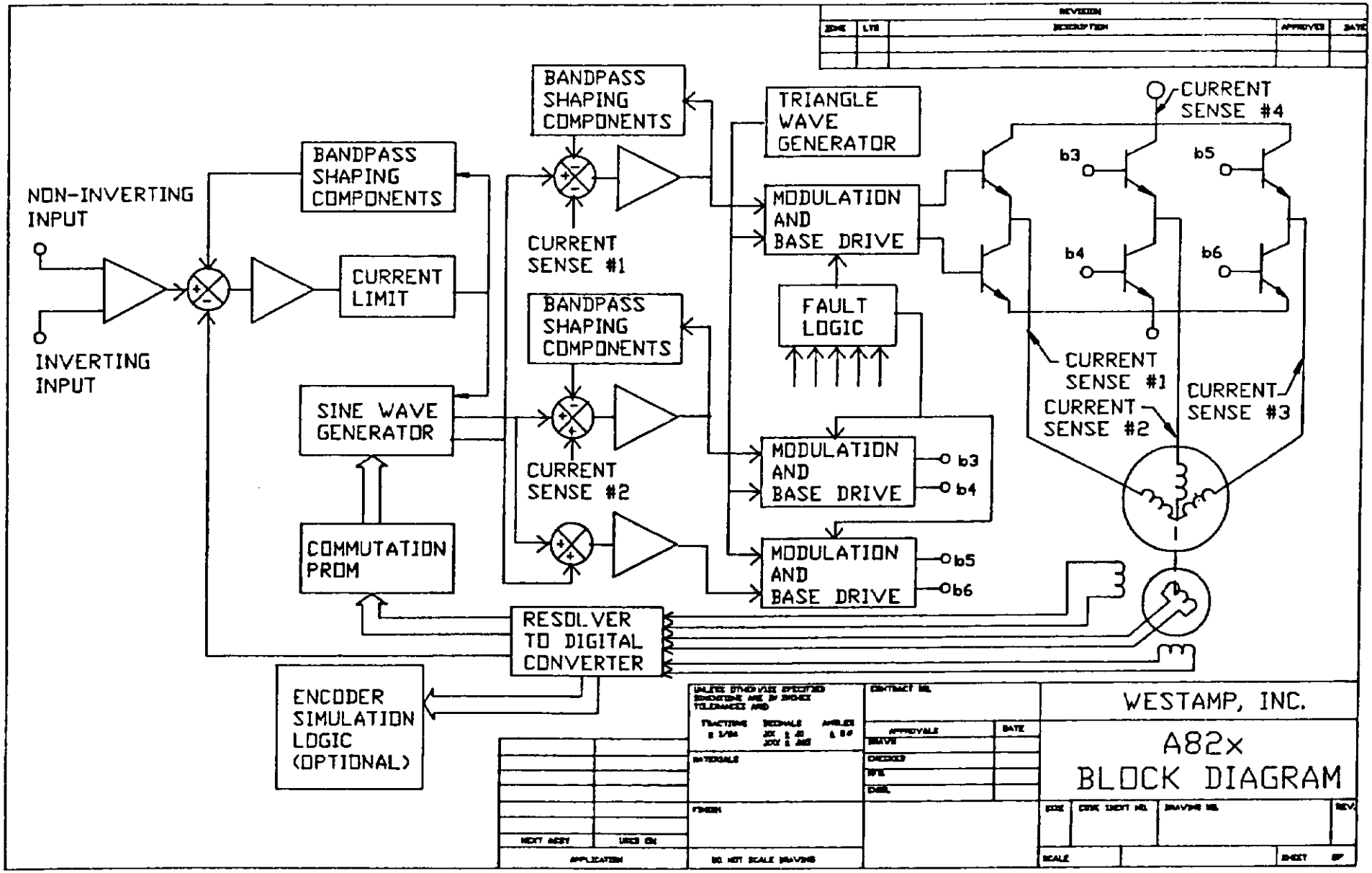
2. Small step input commands may be provided with a DC simulator (battery box) while observing the tach response on the oscilloscope.

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

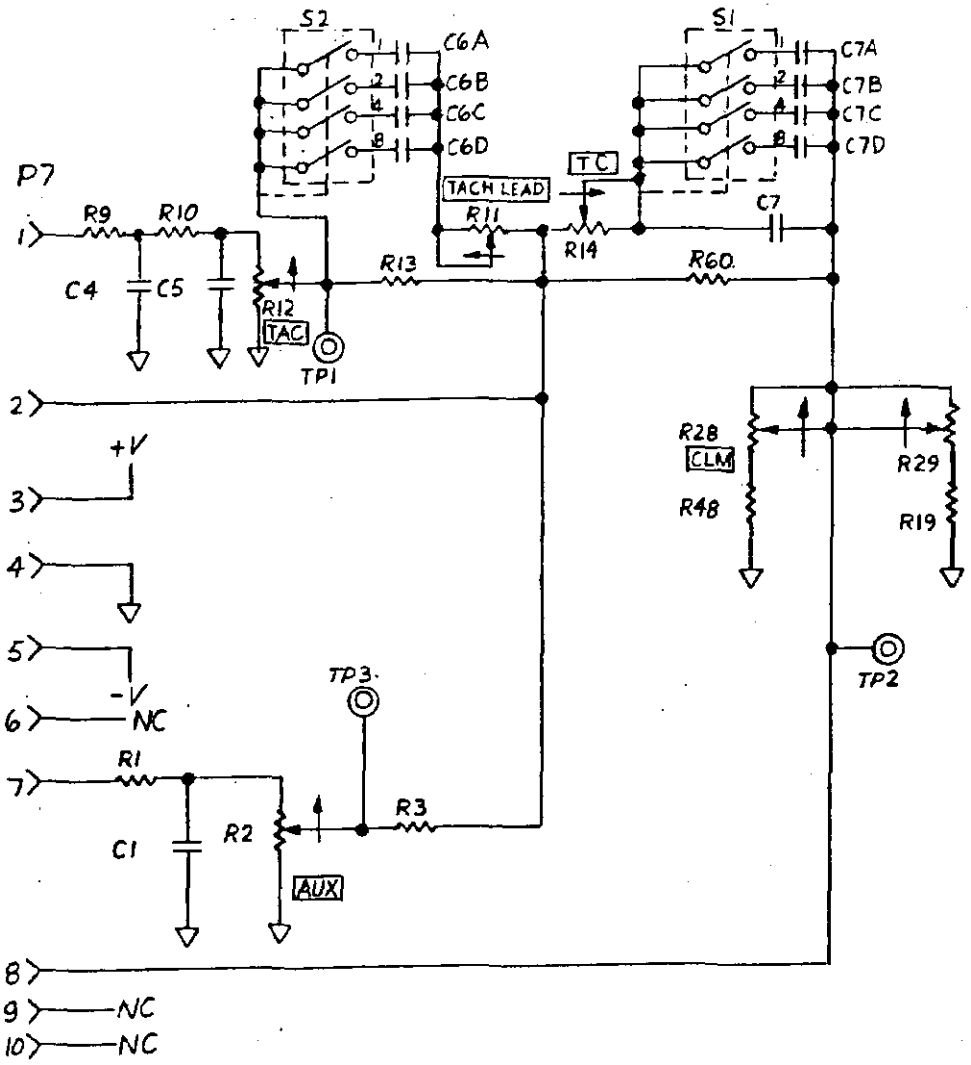


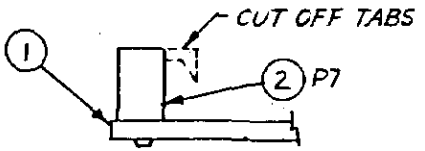


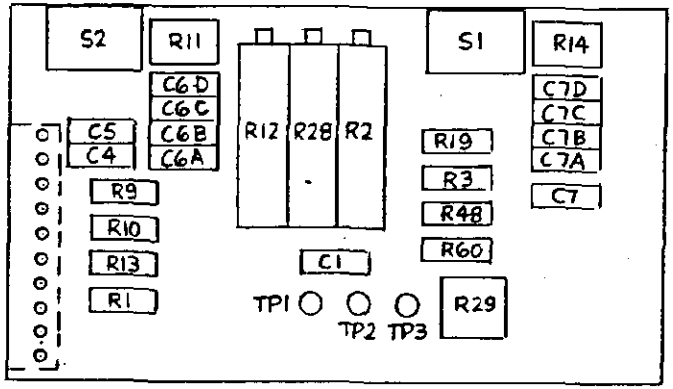
Tach Pictures


NON-INVERTING INPUT
INVERTING INPUT
BANDPASS SHAPING COMPONENTS
CURRENT LIMIT
SINE WAVE GENERATOR
COMMUTATION PROM
ENCODER SIMULATION LOGIC (OPTIONAL)
BANDPASS SHAPING COMPONENTS
CURRENT SENSE #1
BANDPASS SHAPING COMPONENTS
CURRENT SENSE #2
RESOLVER TO DIGITAL CONVERTER
TRIANGLE WAVE GENERATOR
MODULATION AND BASE DRIVE
FAULT LOGIC
MODULATION AND BASE DRIVE
MODULATION AND BASE DRIVE
b3
b4
b5
b6
CURRENT SENSE #4
CURRENT SENSE #1
CURRENT SENSE #2
CURRENT SENSE #3
WESTAMP, INC.
A82x
BLOCK DIAGRAM

REVISIONS			
LTR	DESCRIPTION	BY	DATE/APPD
A	OFFICIAL RELEASE	J.K.	12-19-87







FOR ELECTRICAL PARTS LIST, SEE EPL 33730
FOR MECHANICAL PARTS LIST, SEE MPL 33730

PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± .XXX .XX ± .XXX ANGLES ± BEND RADII BREAK SHARP EDGES .005 MAX			
FINISH			

ADJUSTABLE COMPENSATION w/AUX INPUT

MODEL A822x

DWN J.K. CHK [illegible] APP [illegible]

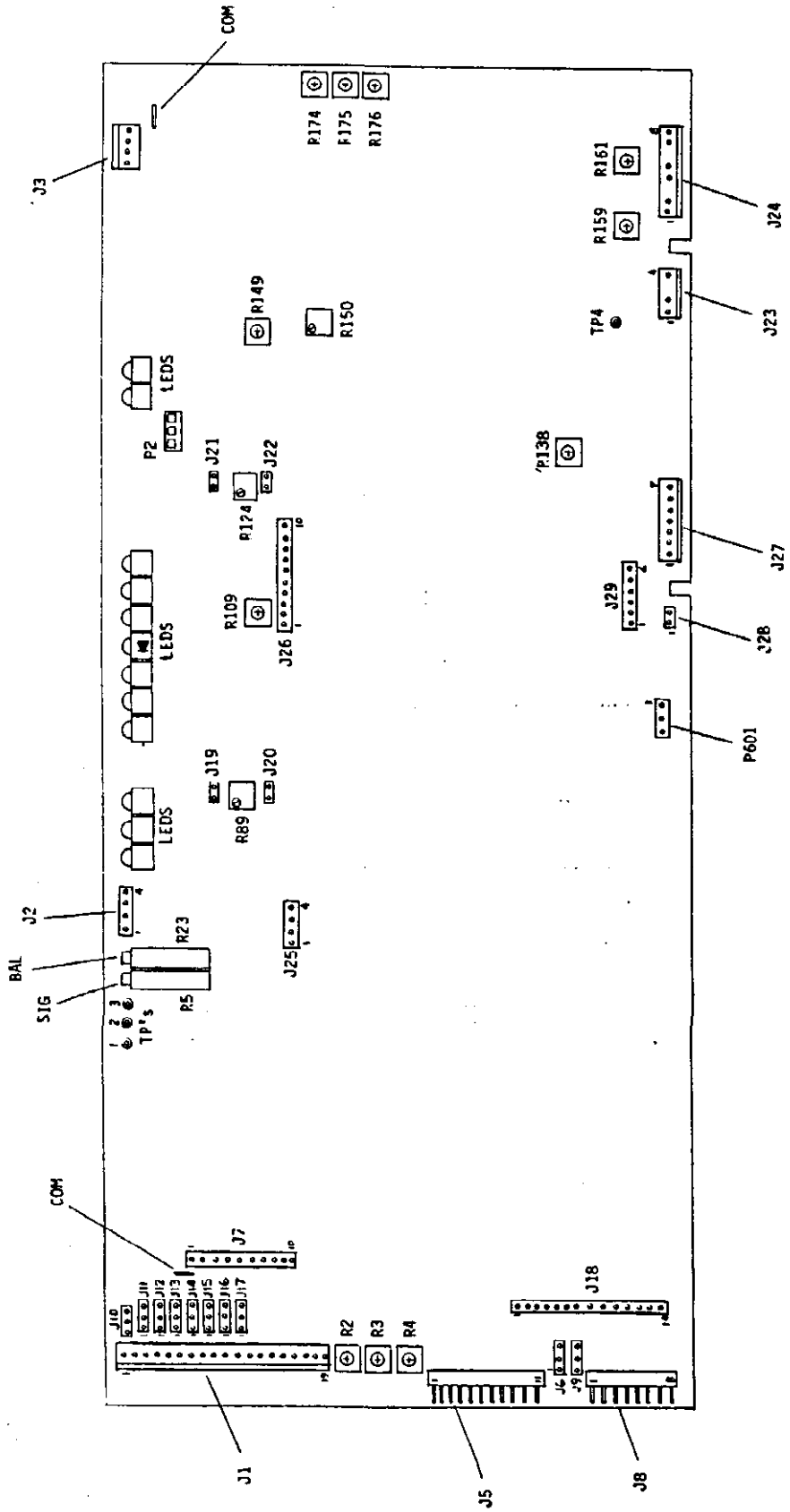
DATE 12-18-87 SCALE 2/1

WESTAMP INCORPORATED
1542 15TH STREET
SANTA MONICA, CAL.

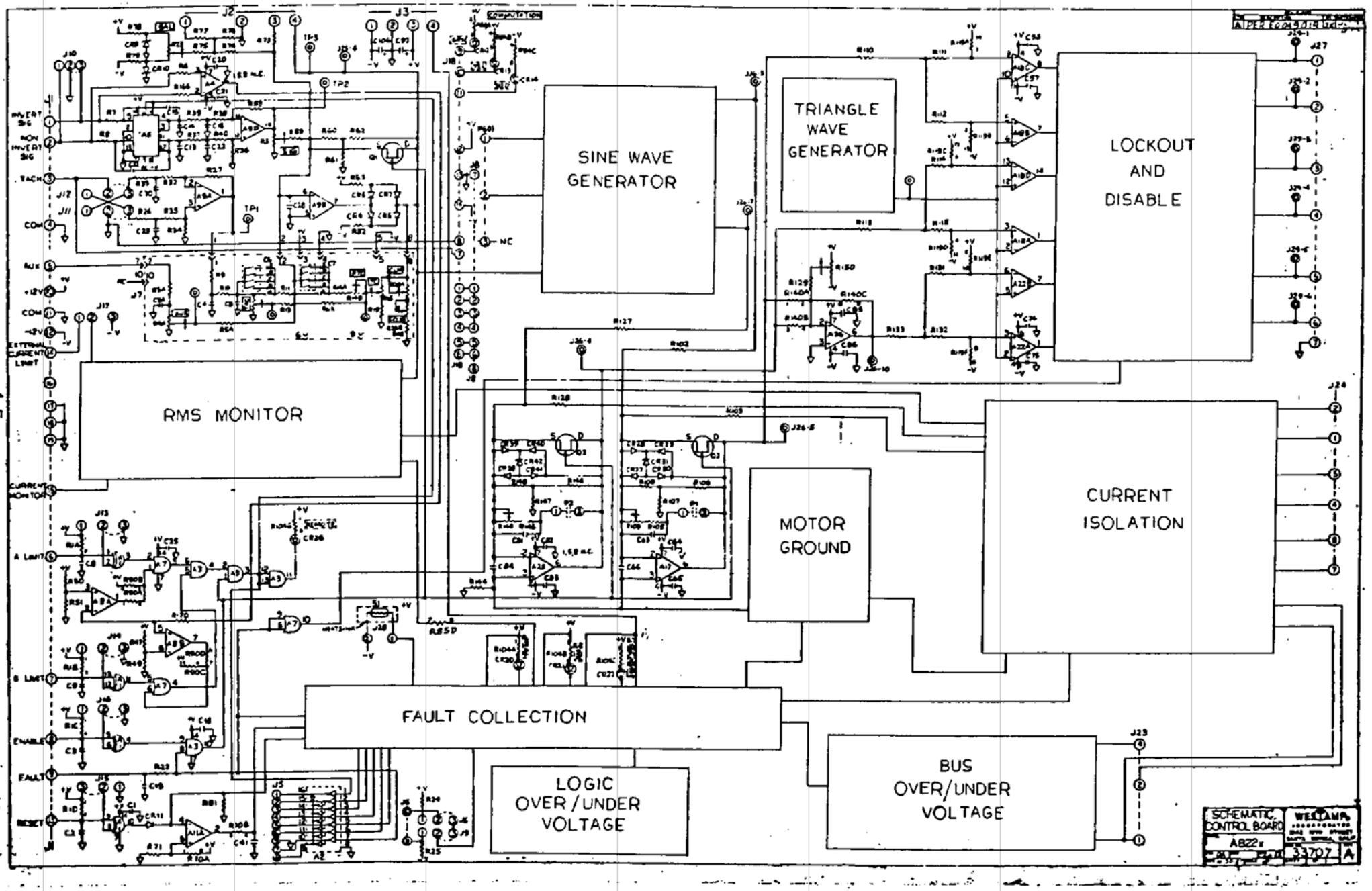
DWG NO. 33730 REV. A

SHEET 1 OF 1

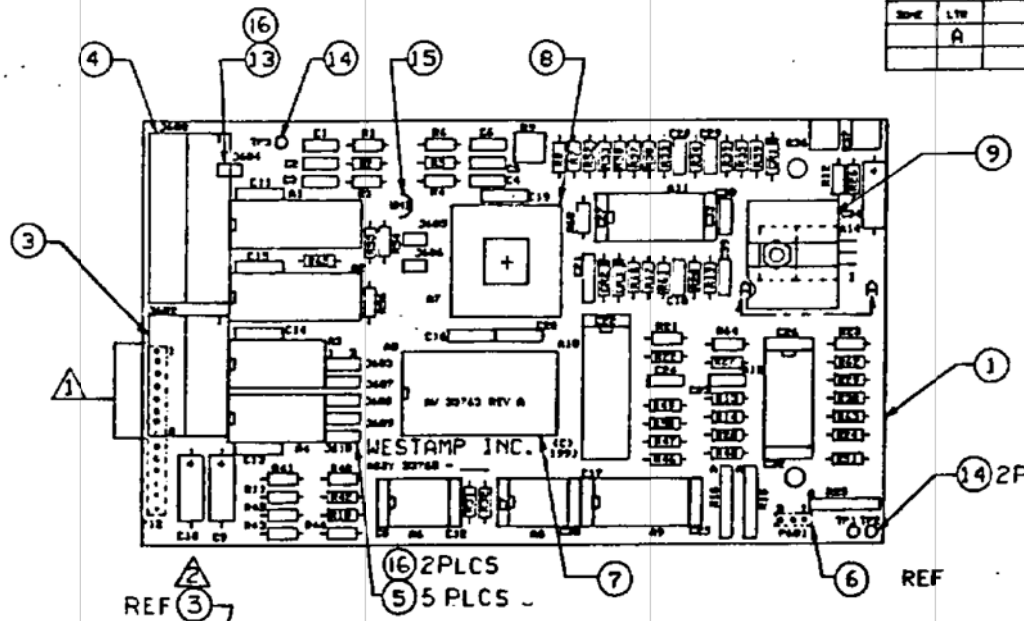
A3

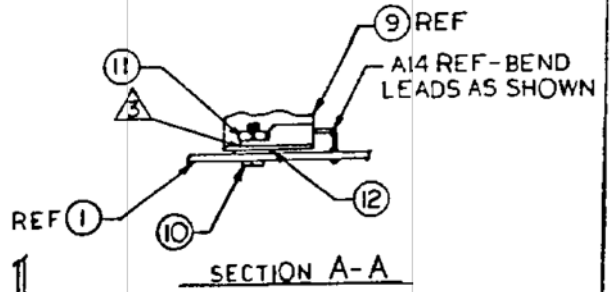


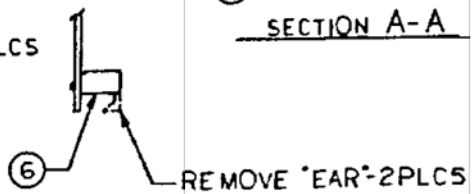
A822 SIMPLIFIED CONTROL /DRIVE BOARD

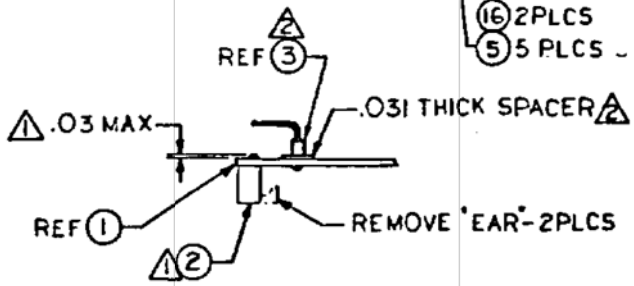

SINE WAVE GENERATOR
TRIANGLE WAVE GENERATOR
LOCKOUT AND DISABLE
RMS MONITOR
MOTOR GROUND
CURRENT ISOLATION
FAULT COLLECTION
LOGIC OVER/UNDER VOLTAGE
BUS OVER/UNDER VOLTAGE
SCHEMATIC, CONTROL BOARD
A822
33707
A

ZONE	LTR	DESCRIPTION	APPROVED	DATE
	A	OFFICIAL RELEASE	SKP	7-21-91









FOR ELECTRICAL PARTS LIST SEE EPL 33765
FOR MECHANICAL PARTS LIST SEE MPL 33765

CONTRACT NO.		WESTAMP INC.
APPROVALS	DATE	
DRAWN D. APPIAH	9-23-91	R/D INTERFACE BOARD ASSEMBLY
CHECKED		
ENG.		
QUAL.		
MATERIALS		MULTI
FINISH		SIZE B; CODE IDENT NO.; DRAWING NO. 33765; REV. A
NEXT ASSY / USED ON		SCALE 1/1; SHEET 1 OF 1
APPLICATION / DO NOT SCALE DRAWING		

NOTES: UNLESS OTHERWISE SPECIFIED

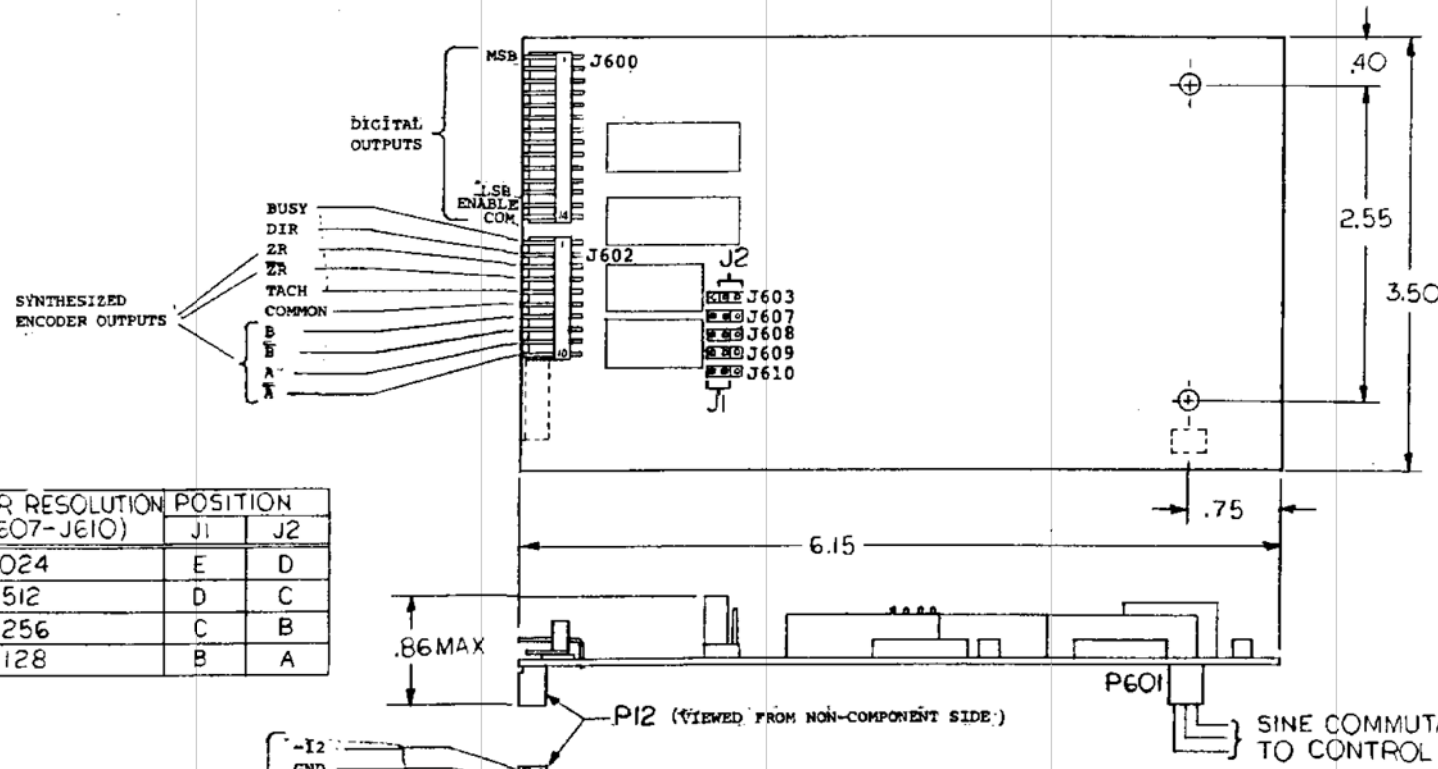
2 APPLY THERMAL COMPOUND BETWEEN A14 & ITEM 9.

3 BEFORE SOLDERING ITEM 3, INSTALL SPACER AS SHOWN.

1 CLIP LEADS OF ITEM 2 TO DIM. SHOWN (PINS 1 THRU 8 ONLY).

A6

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPR

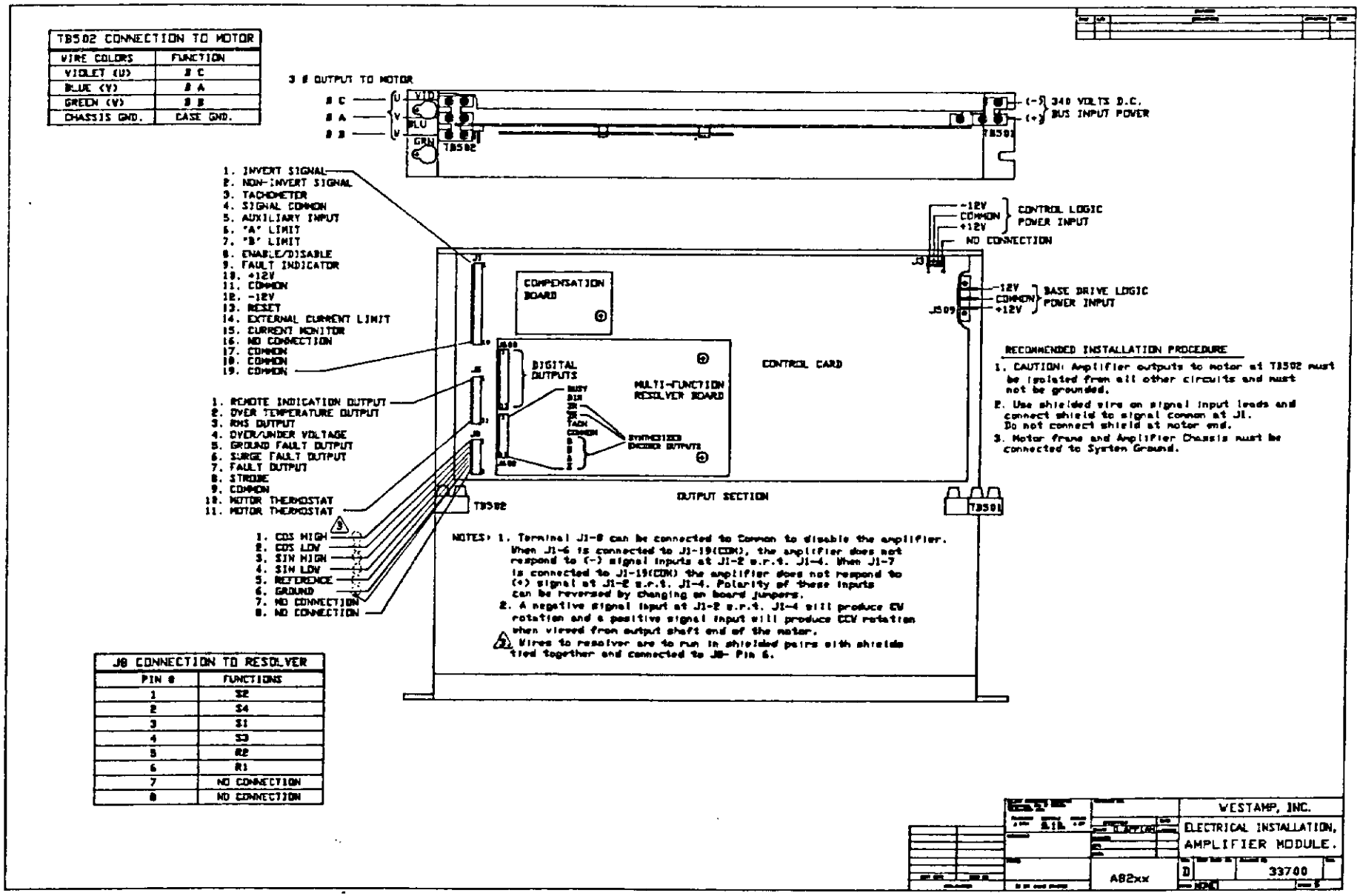


ENCODER RESOLUTION (JE03, JE07-JE10)	POSITION J1	POSITION J2
1024	E	D
512	D	C
256	C	B
128	B	A

CONNECTOR TABLE			
JACK	PIN	FUNCTION	MATING P/N
J600	1-14	NOTED @ LEFT	22-01-3147 (MOLEX)
P601	1-3	NOTED @ RIGHT	MATE TO CONTROL BD.
J602	1-10	NOTED @ LEFT	22-01-3107 (MOLEX)
J603, J607-J610	1-3	NOTED @ LEFT	JUMPER, 15-38-1024 (MOLEX)
P12	1-14	NOTED @ LEFT	MATE TO CONTROL BD.

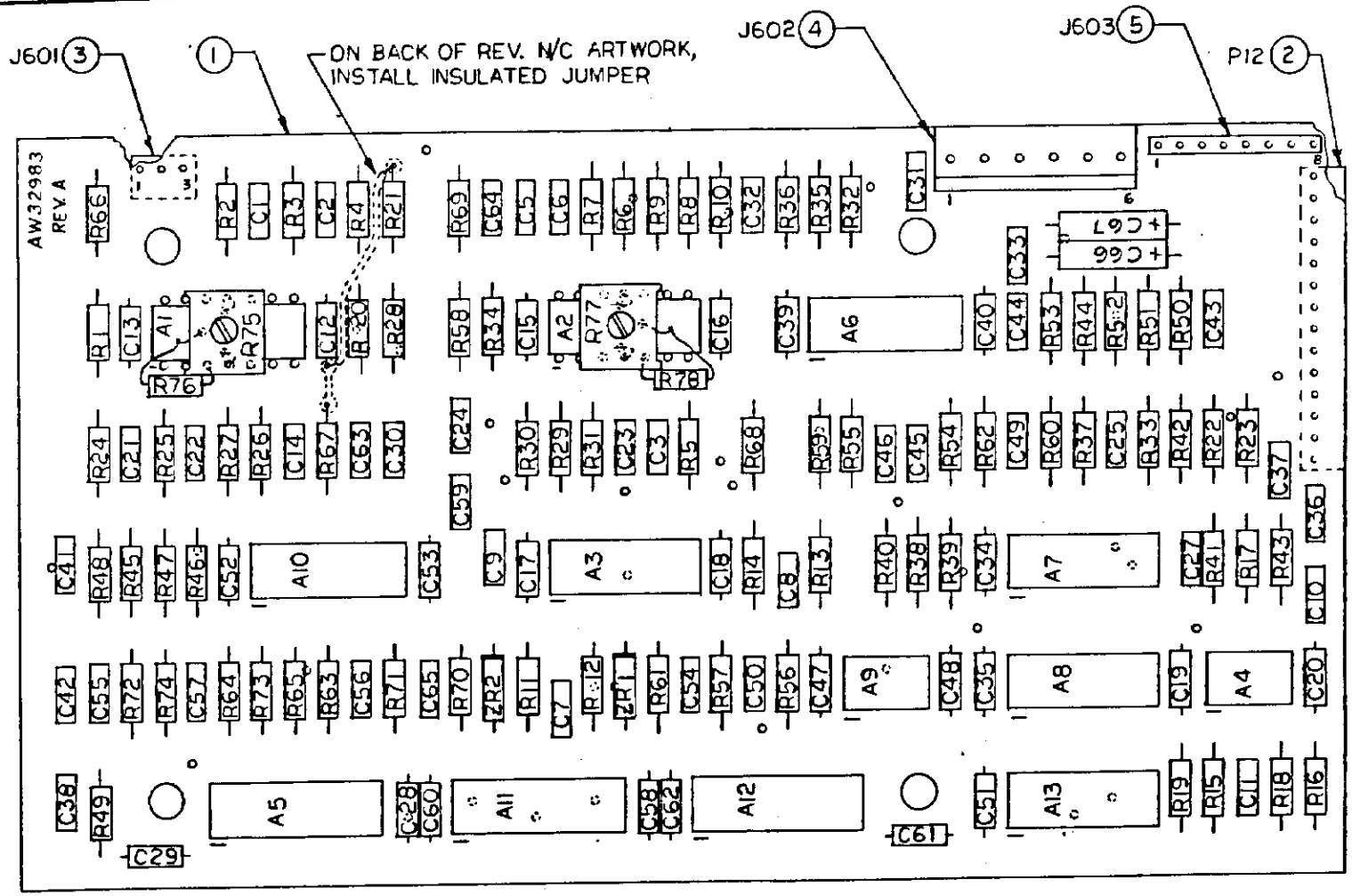
PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ±1/64 .XX ± .03 .XXX ± .010 ANGLES ±2° BEND RADII BREAK SHARP EDGES .005 – .010 FINISH	INSTALLATION, MULTI-FUNCTION RESOLVER BOARD		
	MODEL MULTI.	WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.	
	DWN OA CHK APP. DATE 10-31-89 SCALE 1/1	DWG NO. 33700 SHEET 6	REV.

TB502 CONNECTION TO MOTOR	
WIRE COLORS	FUNCTION
VIOLET (U)	Ø C
BLUE (V)	Ø A
GREEN (V)	Ø B
CHASSIS GND.	CASE GND.

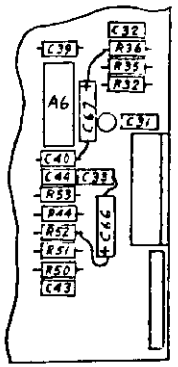


J8 CONNECTION TO RESOLVER	
PIN #	FUNCTIONS
1	S2
2	S4
3	S1
4	S3
5	R2
6	R1
7	NO CONNECTION
8	NO CONNECTION

WESTAMP, INC.
ELECTRICAL INSTALLATION, AMPLIFIER MODULE.
A82xx
D 33700



REVISIONS			
LTR	DESCRIPTION	BY	DATE/APPR.
A	PER EO 085009	J.K.	1/16/86 JLL
B	PER EO 125009	MH	4/4/86 MH
C	PER EO 056031	DA	4/16/86 JLL
D	PER EO 096003	MH	9/9/86 JLL
E	PER EO 126001	MH	12/2/86 JLL
F	PER EO 086013	MM	8/9/88 JLL
G	PER EO 029007	MH	4/6/89 JLL
H	PER EO 081016	DA	

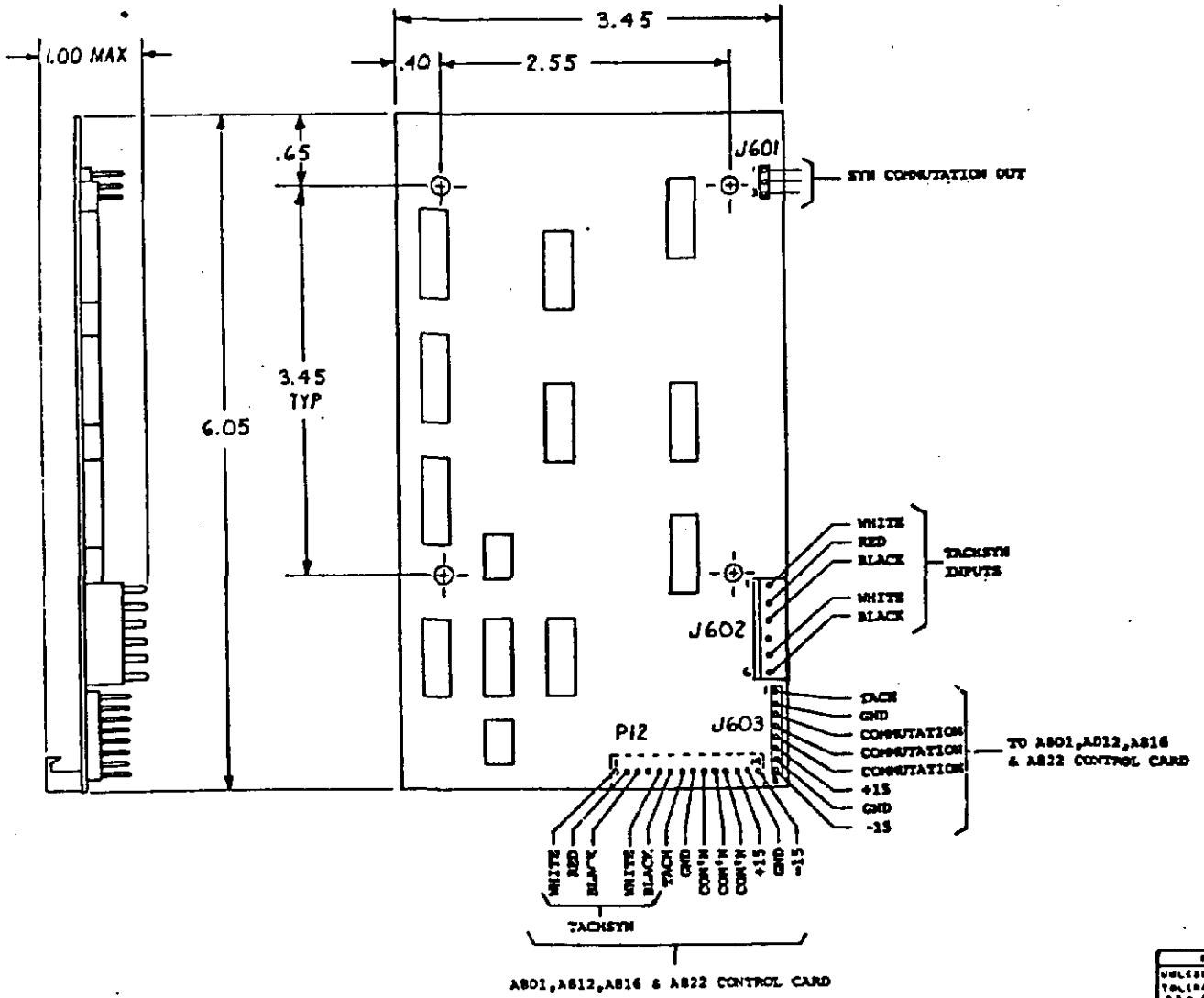


CONFIGURATION FOR AW 32983 REV. N/C

FOR ELECTRICAL PARTS LIST SEE EPL 32985
FOR MECHANICAL PARTS LIST SEE MPL 32985

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	TACHSYN BOARD ASSEMBLY		WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.
FINISH	MODEL A801x, A81xx		DWG NO. 32985 REV. H
© 1985	DWN DA CHK APP		SHEET 1 OF 1
	DATE 7-3-85 SCALE 2/1		

NOTES: UNLESS OTHERWISE SPECIFIED
1. FOR SCHEMATIC SEE DWG 32986.



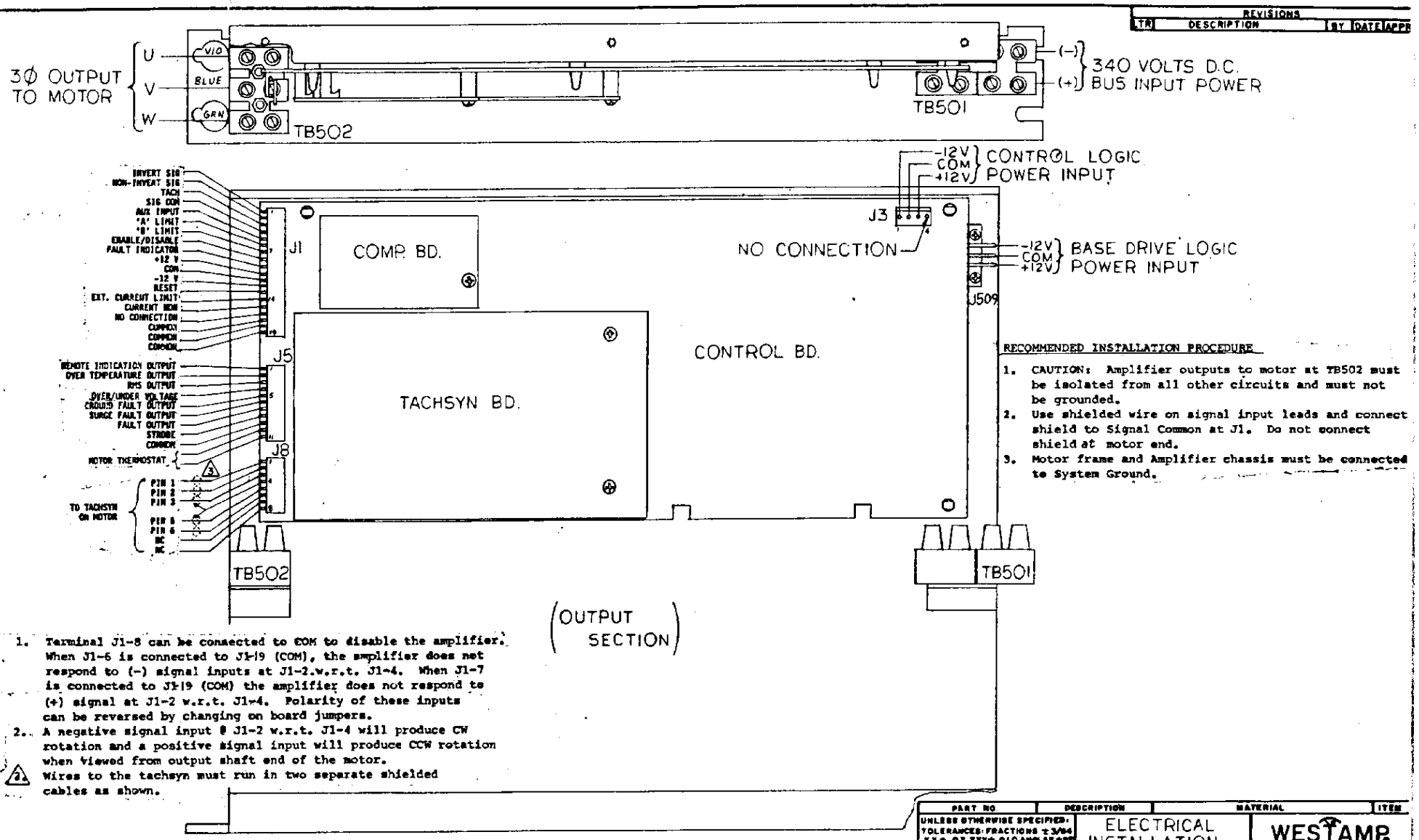
REVISIONS

LTR	DESCRIPTION	BY	DATE	APPR

PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ±1/64 .XX ±.03 .XXX ±.010 ANGLES ±2° BEND RADII _____ BREAK SHARP EDGES .005-.015 FINISH	INSTALLATION TACHSYN BOARD		
	MODEL A801,12,16 & 22		
	DRAWN MR, 1 CHKD APPR. DATE 8-12-88 SCALE FULL		

WESTAMP INCORPORATED
1542 15TH STREET
SANTA MONICA, CAL

DWG NO. REV
SHEET 1 OF 1



RECOMMENDED INSTALLATION PROCEDURE

1. CAUTION: Amplifier outputs to motor at TB502 must be isolated from all other circuits and must not be grounded.
2. Use shielded wire on signal input leads and connect shield to Signal Common at J1. Do not connect shield at motor end.
3. Motor frame and Amplifier chassis must be connected to System Ground.

NOTES: 1. Terminal J1-8 can be connected to COM to disable the amplifier. When J1-6 is connected to J1-19 (COM), the amplifier does not respond to (-) signal inputs at J1-2.w.r.t. J1-4. When J1-7 is connected to J1-19 (COM) the amplifier does not respond to (+) signal at J1-2 w.r.t. J1-4. Polarity of these inputs can be reversed by changing on board jumpers.

2. A negative signal input @ J1-2 w.r.t. J1-4 will produce CW rotation and a positive signal input will produce CCW rotation when viewed from output shaft end of the motor.

⚠2 Wires to the tachsyn must run in two separate shielded cables as shown.

PART NO	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± 3/64 XX ± .03 XXX ± .010 ANGLES ±1° BEND RADII BREAK SHARP EDGES .006-.010

FINISH

ELECTRICAL INSTALLATION, AMPLIFIER MODULE

MODEL A82xx

DWN DA CHK APP

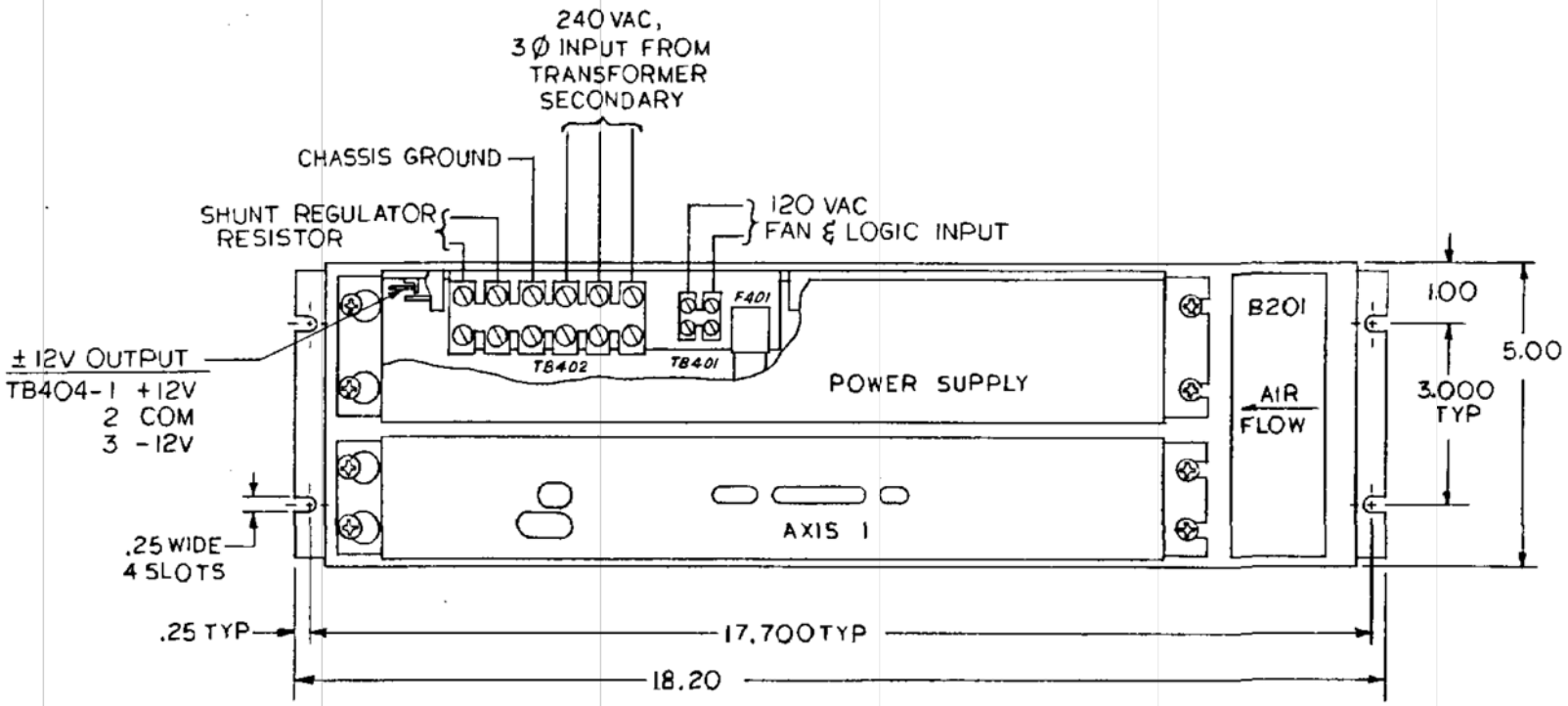
DATE 2-9-89 SCALE

WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.

DWG NO. 33700 REV.

SHEET 4

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPR



NOTE: AMPLIFIER MAX HEIGHT IS 11.45

FUSE DATA		
MODEL NO.	FUSE	F401
	TYPE	MDA
A8211 SERIES		3AMP

PART NO.	DESCRIPTION	MATERIAL	ITEM

UNLESS OTHERWISE SPECIFIED:
TOLERANCES: FRACTIONS ± 1/64
.XX ± .03 .XXX ± .010 ANGLES ±2°
BEND RADII
BREAK SHARP EDGES .005–.010
FINISH

AMPLIFIER INSTALLATION

MODEL A8211

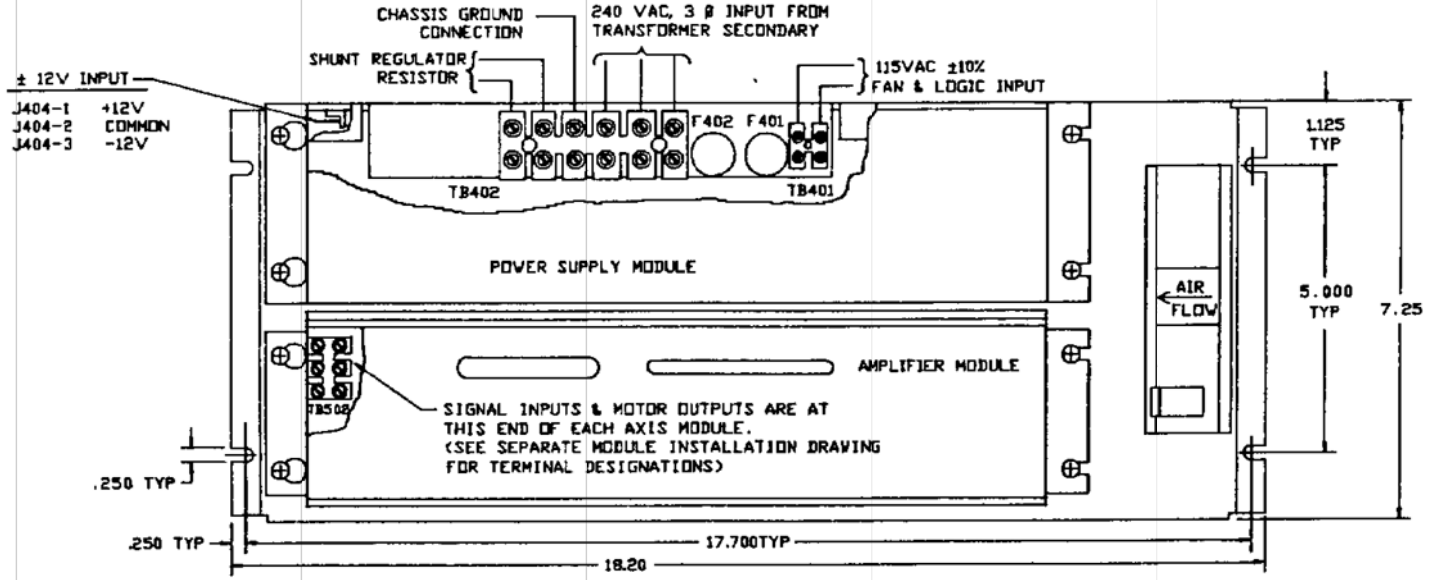
DWN OA CHK APP

DATE 4-5-89 SCALE

WESTAMP INCORPORATED
1542 15TH STREET
SANTA MONICA, CAL.

DWG NO. 33700 REV.

SHEET 1



NOTE : AMPLIFIER MAX. HEIGHT IS 11.45 INCHES.

FUSE DATA			
MODEL NO.	FUSE TYPE	F401 MDA	F402 MDA
A82x1 SERIES		3AMP	5AMP

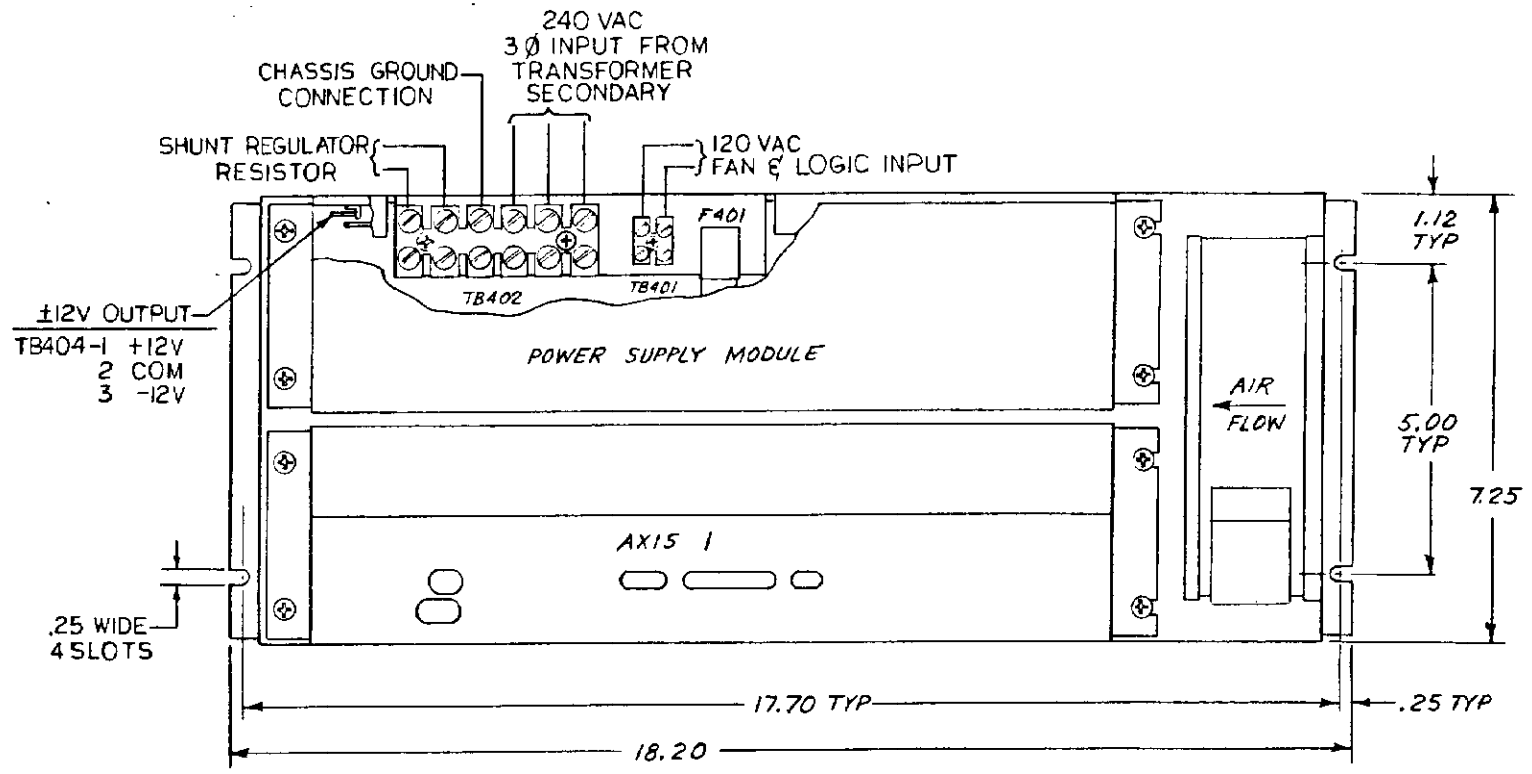
WESTAMP, INC.

INSTALLATION DRAWING

A8221

D 33700

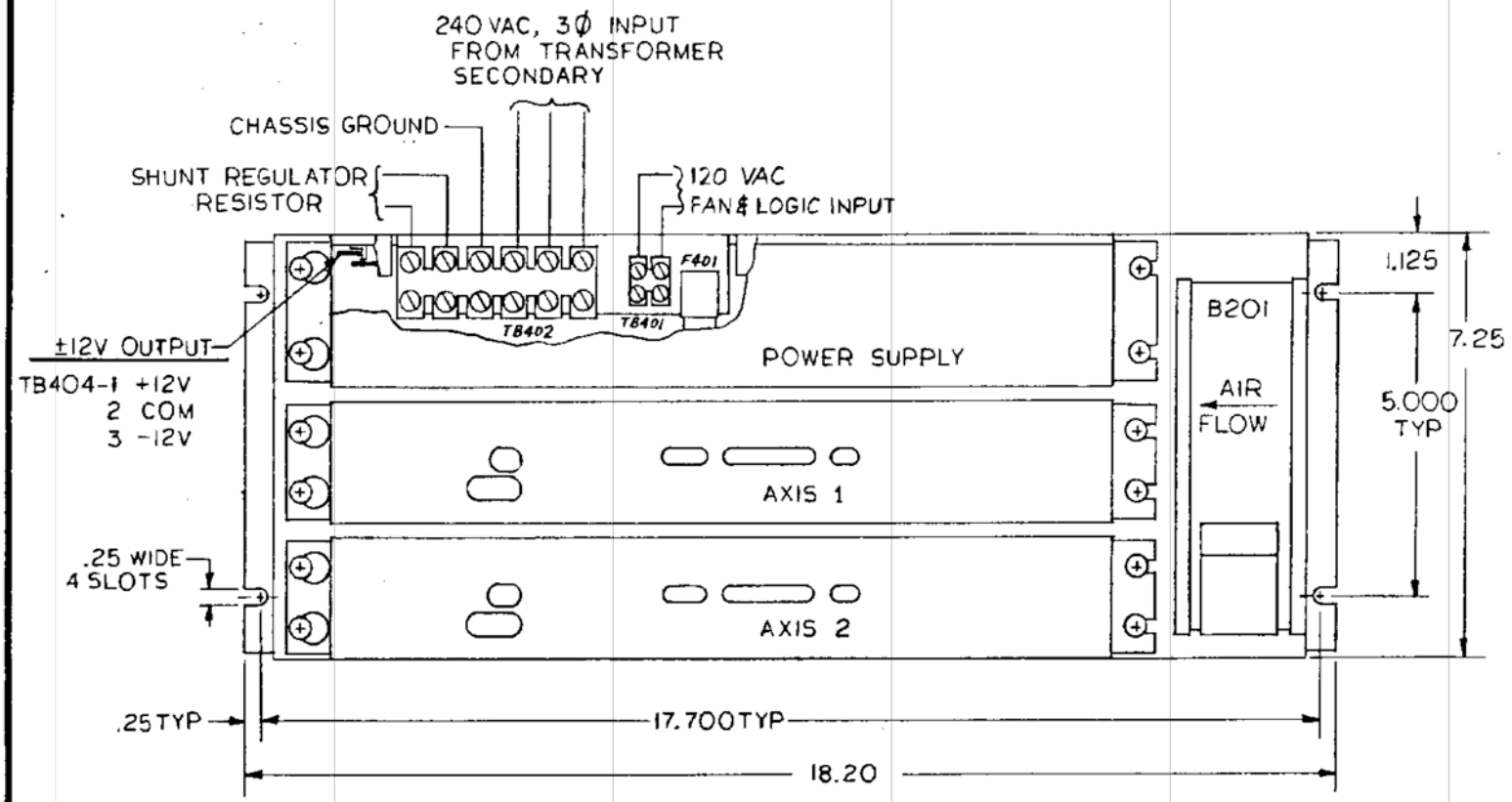
REVISIONS			
LTR	DESCRIPTION	BY	DATE/APPD
A	ADDED CHASSIS GROUND CONNECTION & TB404	SA	11-22-85



NOTE: AMPLIFIER MAX. HEIGHT IS 11.45

PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± 1/64 .XX ± .03 .XXX ± .010 ANGLES ± 2° BEND RADII BREAK SHARP EDGES .005 – .040	INSTALLATION DRAWING		
FINISH	MODEL FIRST USED ON: A8161 / A8261	WESTAMP INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.	
© 1966	DWN [illegible] CHK APP [illegible] DATE 10-21-85 SCALE	DWG NO. 32800 REV. A SHEET 3	

REVISIONS			
LTR	DESCRIPTION	BY	DATE APP'D



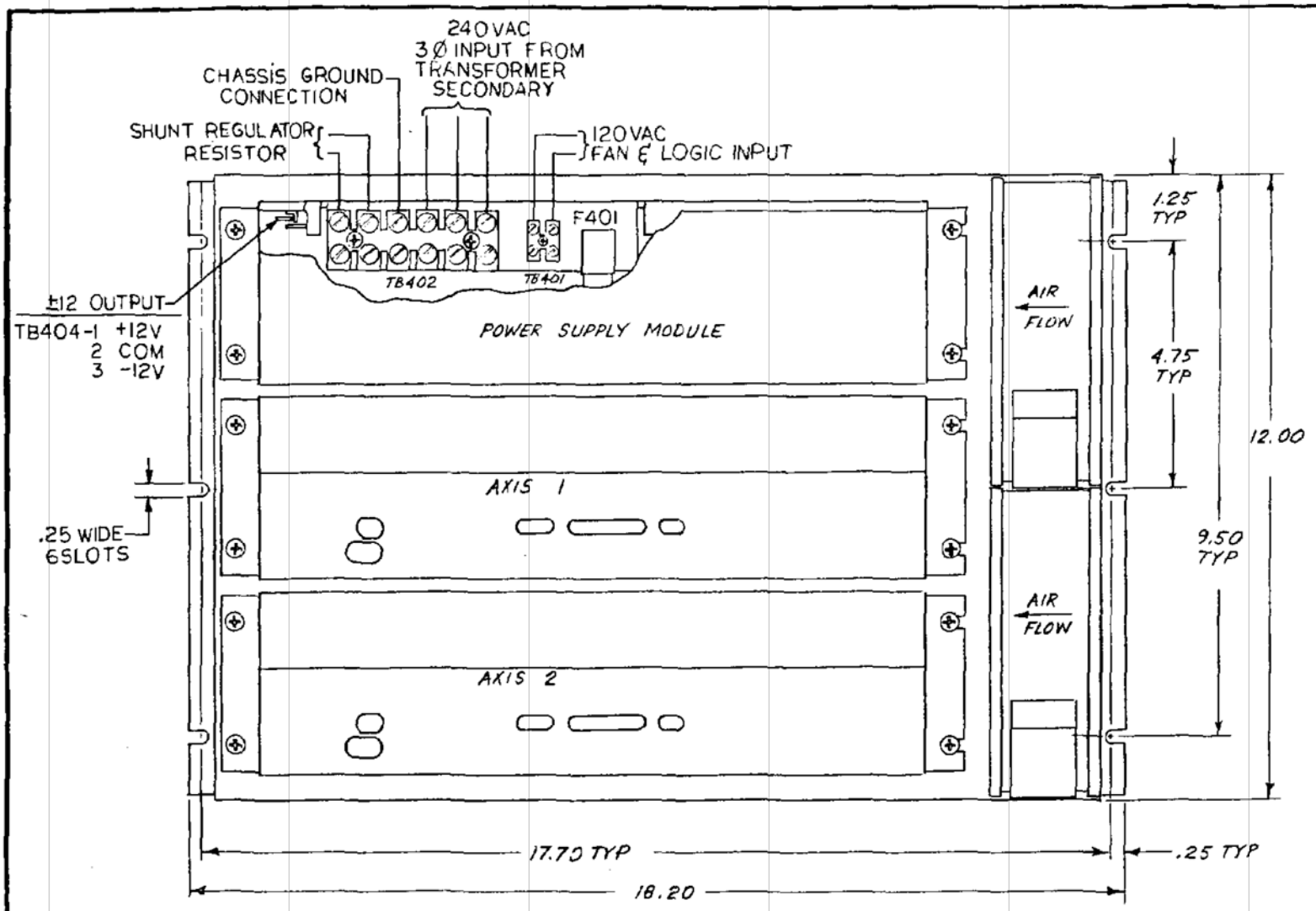
NOTE: AMPLIFIER MAX. HEIGHT IS 11.45"

FUSE DATA		
MODEL NO.	FUSE	F401
	TYPE	MDA
A8212 SERIES		3AMP

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	AMPLIFIER INSTALLATION		
FINISH	MODEL A8212	WESTAMP® INCORPORATED 1542 15TH STREET SANTA MONICA, CAL.	
	DWN OA CHK [illegible] APP'D [illegible] DATE 2-9-89 SCALE 1/4	DWG NO. 33700 SHEET 2	REV

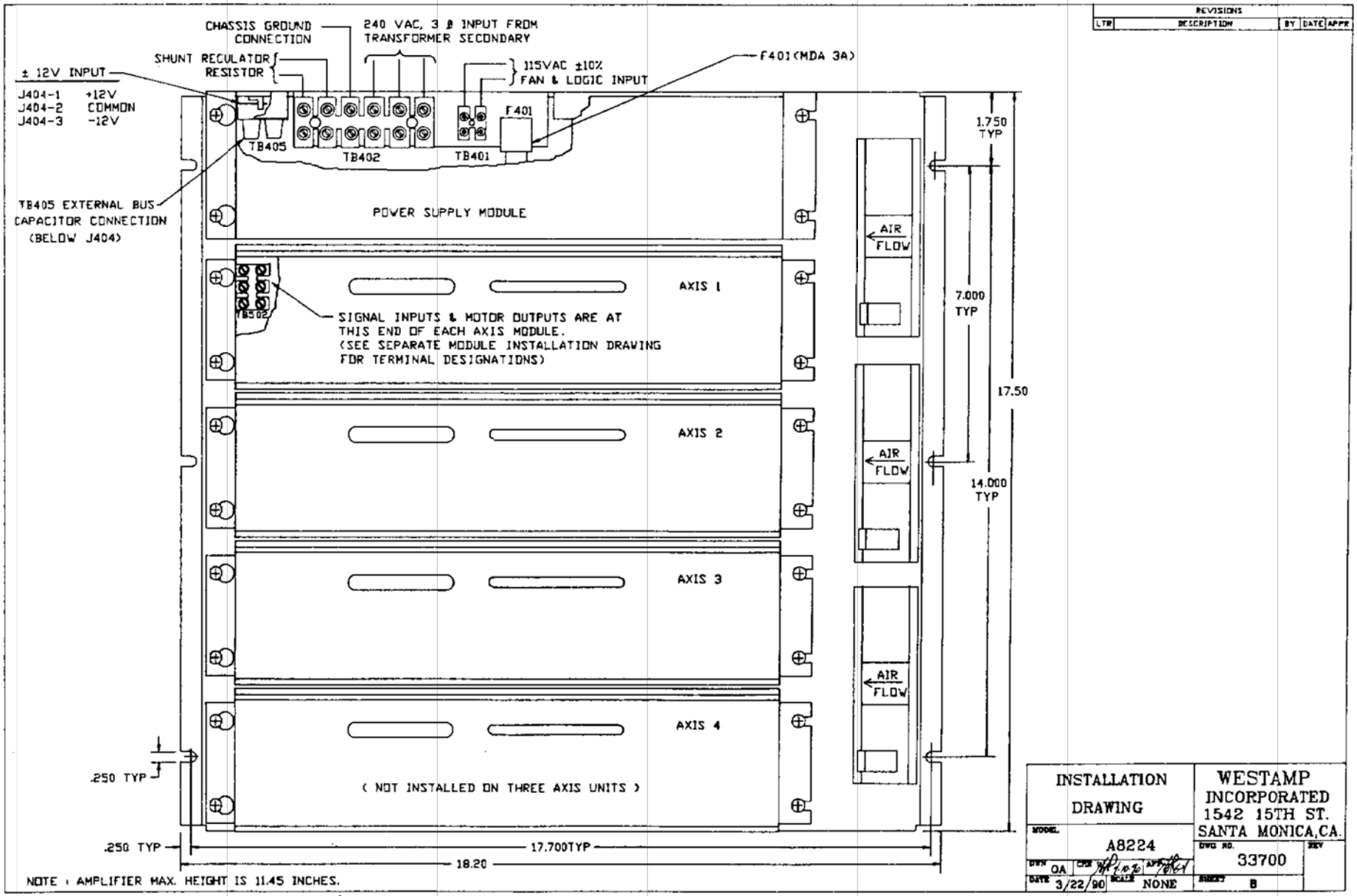
A15

REVISIONS			
LTR	DESCRIPTION	BY	DATE/APPR
A	ADDED CHASSIS GROUND CONNECTION & TB404	DA	4-17-87



NOTE: AMPLIFIER MAX. HEIGHT IS 11.45

PART NO.	DESCRIPTION	MATERIAL	ITEM
UNLESS OTHERWISE SPECIFIED: TOLERANCES: FRACTIONS ± 1/64, .XX ± .03, .XXX ± .010, ANGLES ±2°; BEND RADII ____; BREAK SHARP EDGES .005–.010; FINISH	INSTALLATION DRAWING	WESTAMP INCORPORATED 1942 16TH STREET SANTA MONICA, CAL.	
© 1988	MODELS A8x62/A8222	DWG NO. 32800	REV. A
	DWN [illegible] CHK APP [illegible] DATE 10-21-86 SCALE [illegible]	SHEET 4	


CHASSIS GROUND CONNECTION
240 VAC, 3 ϕ INPUT FROM TRANSFORMER SECONDARY
SHUNT REGULATOR RESISTOR
115VAC ±10% FAN & LOGIC INPUT
F401 (MDA 3A)
± 12V INPUT
J404-1 +12V
J404-2 COMMON
J404-3 -12V
TB405
TB402
TB401
F401
TB405 EXTERNAL BUS CAPACITOR CONNECTION (BELOW J404)
POWER SUPPLY MODULE
AIR FLOW
1.750 TYP
7.000 TYP
17.50
14.000 TYP
AXIS 1
TB502
SIGNAL INPUTS & MOTOR OUTPUTS ARE AT THIS END OF EACH AXIS MODULE. (SEE SEPARATE MODULE INSTALLATION DRAWING FOR TERMINAL DESIGNATIONS)
AXIS 2
AXIS 3
AXIS 4
(NOT INSTALLED ON THREE AXIS UNITS)
.250 TYP
.250 TYP
17.700TYP
18.20
NOTE : AMPLIFIER MAX. HEIGHT IS 11.45 INCHES.
REVISIONS
LTR DESCRIPTION BY DATE APPR
INSTALLATION DRAWING
MODEL A8224
DWN QA
DATE 3/22/90
SCALE NONE
WESTAMP INCORPORATED
1542 15TH ST.
SANTA MONICA,CA.
DWG NO. 33700
REV
SHEET 8

A17