OPERATION
&
SERVICE MANUAL

Torque Switch
GA4567PA and GA4568PA

Pulse Width Modulated
Servo Amplifier

GLENTEK

"Solutions for Motion Control"

TABLE OF CONTENTS

CHAPTER SIX: START UP AND ADJUSTMENT PROCEDURE

CHAPTER SEVEN: MAINTENANCE, REPAIR AND WARRANTY

APPENDIX A: FAULT TRACING CHARTS

APPENDIX B: AMPLIFIER DRAWINGS

APPENDIX C: PERSONALITY PREAMP

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION to the GA4567PA and GA4568PA MANUAL:

This manual is intended for use with Glentek's TORQUE-SWITCH™ series, models GA4567PA and GA4568PA, pulse-width-modulated (PWM), servo amplifiers. It provides all of the information that is required for installation, alignment, and maintenance of these amplifiers. We suggest that you take the time to read this manual from cover to cover before trying to work with these amplifiers. If you have any questions that you cannot find the answer to in this manual, please feel free to call and discuss your problem or question with a Glentek applications engineer. Having been in the servo system business for over 28 years, we have a vast pool of applications knowledge waiting to help you.

Thank you for using Glentek's products. It is our goal to save you money, time, and provide you with a superior product.

CHAPTER TWO: DESCRIPTION and SPECIFICATIONS

2.1 DESCRIPTION of the GA4567PA and GA4568PA:

The GA4567PA and GA4568PA are modular, medium power, high bandwidth, PWM, servo amplifiers designed for use with DC, permanent-magnet, servo motors. These amplifiers utilize today=s latest technology in power semiconductors for high efficiency, which in turn makes them extremely reliable in today=s and tomorrow=s demanding applications.

2.2 MODEL NUMBERING INFORMATION and AVAILABLE OPTIONS:

2.2.1 BASIC MODEL NUMBER:

The basic model number for these amplifiers is GA4567PA and GA4568PA. Several suffixes may be added to provide various options. These options are described below. Glentek will be happy to discuss any special requirements you may have.

2.2.2 VELOCITY-MODE or CURRENT-MODE OPTIONS:

The GA4567PA and GA4568PA are most often used to close a critically-damped velocity-loop using a DC tachometer for velocity feedback. However, the high-gain, input summing-amplifier can be bypassed to provide an input directly to the current-loop amplifier. The part number designator for this Current-Mode option is CM and follows next in the sequence of the part number (e.g. GA4567PACM). If the CM is absent from the part number, the amplifier will be configured for Velocity Mode. (Refer to Appendix C, drawings 4597-7010 & 4597-7012). If the amplifier is ordered with a CM option, the dedicated CM Personality Preamp Card will be used. (Refer to Appendix C, drawings 4597-5110 & 4597-5112)

2.2.3 LOGIC@ INPUTS:

The Limit and Inhibit inputs may setup in four different configurations (refer to Appendix B, drawings 4567-3106, 4567-3107, 4568-2105, and 4568-2106 for implementation):

Type A: Requires grounding of input to disable amplifier.
Type B: Requires a positive voltage at input to disable amplifier.
Type C: Requires grounding of input to enable amplifier.
Type D: Requires a positive voltage at input to enable amplifier.

The amplifier is normally shipped with the type ›A= input configuration. Designation letter A, B, C, or D is added next to the part number to indicate the type of input circuit desired (e.g. GA4567PACMA, would have type ›A= inputs).

2.2.4 MULTI-AXIS CONFIGURATIONS:

Up to six amplifiers may be mounted on a single baseplate. Following are the part numbers for each configuration:

GA4567PA-1 or GA4568PA-1	Single amplifier module.
GA4567PA-1A-1 or GA4568PA-1A-1	One axis baseplate with one amplifier module.
GA4567PA-2A-1 or GA4568PA-2A-1	Two axis baseplate with one amplifier module.
GA4567PA-2A-2 or GA4568PA-2A-2	Two axis baseplate with two amplifier modules.
GA4567PA-4A-3 or GA4568PA-4A-3	Four axis baseplate with three amplifier modules.
GA4567PA-4A-4 or GA4568PA-4A-4	Four axis baseplate with four amplifier modules.
GA4567PA-6A-5 or GA4568PA-6A-5	Six axis baseplate with five amplifier modules.
GA4567PA-6A-6 or GA4568PA-6A-6	Six axis baseplate with six amplifier modules.

2.2.5 EXAMPLE - MODEL NUMBERING:

The following example of a GA4567PA part number is provided to help you better understand Glentek=s part-numbering system:

Example:		GA4567PACMTA-6A-5
GA4567PA	=	Glentek Amplifier model 4567, Plug-in preamp, version A.
CM	=	Current-Mode option.
T	=	Velocity-Taper Current-Limit option (4568 only).
A	=	Type A logic input option.
6A-5	=	Six axis baseplate with five amplifier modules mounted.

In this example each of the amplifiers would be labeled GA4567PA-1 with a serial number and CMTA designator at the bottom of the label. The six-axis baseplate would be labeled GA4567PA-6A-5 with a serial number and CMTA designator at the bottom of the label.

2.3 PROTECTION CIRCUITS:

The following protection circuits are integral to the GA4567PA and GA4568PA amplifiers to prevent damage to the amplifier or your equipment. Again, Glentek is anxious to work with you in helping to implement any circuit functions your system might require. Note: For sections 2.3.1 to 2.3.7, refer to Appendix B, drawings 4567-3107 and 4568-2105.

2.3.1 FAULT INPUT/OUTPUT:

The open-collector fault output at TB1-12 (4567) or TB2-12 (4568) will go low and latch for any of the following fault conditions:

1. High-Speed Electronic Circuit Breaker (HS/ECB) triggered.
2. Low-Speed Electronic Circuit Breaker (LS/ECB) triggered.
3. Transistor heatsink temperature in excess of 170^{B}F (77^{B}C)
4. DC Buss over-voltage condition.

The Fault output may also be externally pulled low to force a fault condition.

When the Fault output is on, all output current is removed from the motor and the loop gain is reduced. It is analogous to applying the Total Inhibit input.

Refer to section 2.3.6 on resetting the fault latch.

2.3.2 HIGH-SPEED ELECTRONIC CIRCUIT BREAKER (RED LED):

The HS/ECB LED indicator light will turn ON and latch, indicating that the High-Speed Electronic Circuit Breaker (HS/ECB) has fired. This circuit protects the amplifier from dead shorts across the amplifier output terminals. The HS/ECB is factory set and should not be adjusted.

2.3.3 LOW-SPEED ELECTRONIC CIRCUIT BREAKER (RED LED):

The LS/ECB LED indicator light will turn ON and latch, indicating that the Low-Speed Electronic Circuit Breaker (LS/ECB) has fired. This circuit protects the motor, amplifier, and mechanical system from damage due to excessive mechanical bind in the system or possibly driving into a hard mechanical stop.

2.3.4 OVER-TEMP INDICATOR OPERATION (RED LED):

The Over-Ternp LED indicator light will turn ON and latch when the heatsink temperature exceeds 170^{B}F (77^{B}C).

2.3.5 DC-BUSS OVER-VOLTAGE MONITOR (RED LED):

The Over-Volt LED indicator will turn on and latch when the DC Buss voltage exceeds 155VDC. This protects the amplifier and motor from high DC-Buss voltages.

2.3.6 RESETTING the FAULT LATCH:

The fault latch may be reset by pressing the Reset pushbutton on the amplifier board, or by removing power and allowing the power-supply filter capacitors to discharge. Note that the fault latch will not reset unless the fault has been corrected.

2.3.7 LOW-VOLTAGE POWER-SUPPLY MONITOR:

An under-voltage detector circuit monitors the low-voltage power-supply input and will shut down the amplifier the voltage falls below "11VDC. This is a non-latched condition. The amplifier will return to normal operation when the voltages return to normal.

2.3.8 VELOCITY-TAPER CURRENT-LIMIT:

Motor specifications often include a SQA (Safe Operating Area) curve, which is maximum motor current as a function of RPM (See figure 2.3). On the 4568 an optional VTCL (Velocity-Taper Current-Limit) ensures that the maximum available motor current is within SOA limits. Below maximum, the motor current is still controlled by the velocity-error (or current-command) signal. The VTCL may decrease the rate of acceleration and deceleration. Consult a Glentek applications engineer before ordering.

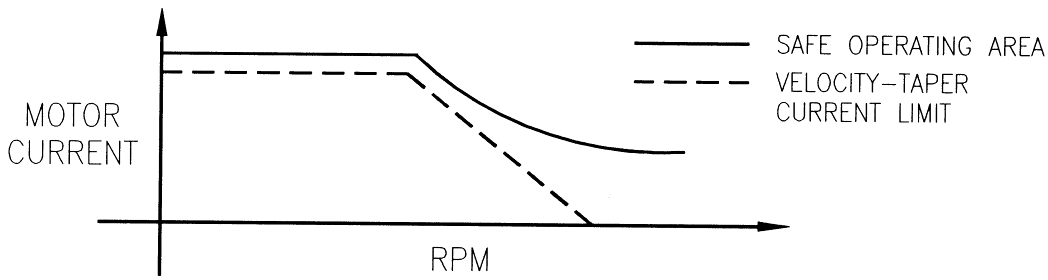


figure 2.3

2.4 SPECIFICATIONS:

2.4.1 OUTPUT POWER: (Each amplifier)

	GA4567PA	GA4568PA
PEAK OUTPUT CURRENT	"25ADC	"40ADC
RMS OUTPUT CURRENT	"15ADC	"20ADC
OUTPUT VOLTAGE (Typical)	"100VDC	"100VDC

Note: Buss voltage should be selected to be 10% to 20% above the maximum voltage required at the motor terminals for maximum system efficiency. Higher buss voltages available, consult Glentek.

2.4.2 INPUT POWER:

DC BUSS (Typical):	70VDC to 100VDC
DC BUSS (Maximum):	150VDC

The DC Buss voltage and control voltages are provided to each amplifier by power supplies on the baseplate. Input power to the base plate is as follows:

FANS and LOW-VOLTAGE POWER SUPPLY:	120VAC, 50/60Hz, 2A.
MAIN POWER (for DC Buss):	12VAC to 105VAC, 50/60Hz, single- or three-phase.

Note: This power is supplied by a separately mounted power-transformer selected for your application. This transformer is not considered a standard part of the amplifier package. Glentek stocks a complete line of power transformers to meet any application.

2.4.3 SIGNAL INPUTS:

VOLTAGE, MAXIMUM:

Aux. Input:	"13 volts.
Sig. Input:	"70 volts.
Tach. Input:	"90 volts.
Input impedance:	10K ohms minimum.

GAIN, MAXIMUM:

Sig., and Aux., Inputs:	15,000 amps/volt.
Tachometer:	7,000 amps/volt.
Drift (ref., to input), maximum:	0.01mV/°C.
Frequency response, minumum:	750 Hz.
Dead band:	none.
Form factor:	1.01.

2.4.4 OTHER INPUTS and OUTPUTS

Limits and Inhibit inputs: Terminated by 8K ohms minumum to com or +15V. Thresholds at 4.2V and 10.3V.

Fault input/output: As input: Terminated by 3.3K ohms to +15VDC. Threshold at 1.5VDC. As output: Can sink 500mA through 100 ohms.

2.4.5 OTHER SPECIFICATIONS

Carrier frequency: 20Khz.

2.4.6 MECHANICAL (SEE APPENDIX B, DRAWINGS 4567-3111 & 4567-3109)

Mounting:	Any Position.
Temperature:	120°F (50°C) ambient max.
Weight & Dimensions:	See Appendix B.

2.4.7 TYPICAL FACTORY SETTINGS

Sig. and Aux. Gain:	5V(Sig.)/7V(Tach.)
Tach. Gain:	50%
Loop Gain:	CCW (OFF).
Comp:	CW (min. bandwidth).

	GA4567PA	GA4568PA
LS/ECB:	15A for 1.5s	20A for 1.5s.
HS/ECB:	35A for 10us	60A for 10us.

CHAPTER THREE: PERSONALITY PREAMP CARD

3.1 INTRODUCTION to the PERSONALITY PREAMP CARD:

The Personality Preamp card is a modular, plug-in card that comes in two versions: velocity mode and current mode. Schematic and board assembly prints for these cards are found in Appendix C, drawing numbers 4597-7010, 4597-7012, 4597-5110, and 4597-5112, and will be referred to in the following description.

The Personality card contains the main high-gain preamp with all associated system alignment adjustments. This card greatly enhances system trouble shooting and repair. If an amplifier should fail, simply remove the Personality card (which has all of the original system constants adjusted in) and re-place it on a spare amplifier. This eliminates system realignment when changing out amplifiers. Also, a motor-tach-load may be aligned at the factory and then just the Personality card sent to the field for system test.

3.1.1 VELOCITY-MODE PERSONALITY PREAMP CARD:

The Velocity-Mode Preamp card contains the main high-gain preamp with all the associated system alignment adjustments to close a velocity loop using a D.C. tachometer for velocity feedback (Refer to Appendix C, drawings 4597-7010 and 4597-7012).

3.1.2 CURRENT-MODE PERSONALITY PREAMP CARD:

The Current-Mode Personality card contains all the system alignment adjustments to control a current-mode amplifier (Refer to Appendix C, drawings 4597-5110 and 4597-5112).

3.2 DESCRIPTION of OPTIONS and ADJUSTMENTS:

The Personality Preamp card is a small printed-circuit card (2.7@ x 2.3@) standing on nine pins (0.6@ long) that mate with appropriate sockets on the amplifier control board.

The Personality card is most often used to close a velocity loop by using a DC tachometer for velocity feedback. However, the high-gain, input summing-amplifier can be bypassed providing an input directly to the current-loop amplifier (Current-Mode option). If the Current-Mode (CM) option is specified, the committed Current-Mode Personality Preamp card will be supplied.

3.2.1 POTENTIOMETER ADJUSTMENTS:

The following is a description of the potentiometer adjustments used for the two modes of operation. Please refer to Chapter Six on Start Up and Adjustment Procedures for a detailed description of how to set these potentiometers.

VELOCITY MODE: (Refer to Appendix C, drawings 4597-7010 and 4597-7012)

R12 **Signal-Gain** potentiometer sets the input voltage to output RPM required by your system for the single-ended input (e.g. 10 volt input = 2000 RPM).

R13 **Auxiliary Signal-Gain** potentiometer sets the input voltage to output RPM required by your system for the differential signal input (e.g. 10 volt input = 2000 RPM).

R14 **Tachometer-Gain** potentiometer sets the amount of tach signal required by your system. Use in conjunction with the Compensation potentiometer, R16, to adjust the system bandwidth.

R15 **Balance** potentiometer is used to null out any DC offset in the amplifier (e.g. 0 volt input = 0 RPM).

R16 **Compensation** potentiometer sets the amount of bandwidth (frequency response) required by your system. Use in conjunction with the Tachometer-Gain potentiometer, R14, to adjust the system bandwidth.

R17 **Current-Limit** potentiometer sets the maximum acceleration and deceleration current.

R18 **Loop-Gain** potentiometer is used to reduce the velocity-loop gain to zero when the system is first turned on to prevent run away operation. Before turning the system on for the first time, this potentiometer is set fully CCW to command zero current to the motor. Once the system is correctly phased this potentiometer is set fully CW for all further system adjustments.

CURRENT MODE: (Refer to Appendix C, drawings 4597-5110 and 4597-5112)

R14 **Signal-Gain** potentiometer sets the input voltage to output current required by your system for the single-ended input (e.g. 5 volt input = 20 amp output current).

R15 **Auxiliary Signal**-Gain potentiometer sets the input voltage to output current required by your system for the differential signal input (e.g. 5 volts input = 20 amps current).

R16 **Current-Limit** potentiometer sets the maximum acceleration and deceleration current.

R17 **Loop-Gain** potentiometer is factory set to prevent amplifier maximum rated current from being exceeded when the current-limit potentiometer is fully CW.

R21 **Balance** potentiometer is used to null out any DC offset in the amplifier (e.g. 0 volts input = 0 current output)

3.2.2 INPUT and OUTPUT SIGNALS:

Pin	NAME	FUNCTION
1.	SIGNAL:	Single-ended signal input.
2.	+ 15VDC:	+ 15VDC power.
3.	- 15VDC:	- 15VDC power.
4.	COMMON:	" 15VDC and signal common.
5.	AUXILIARY:	+ differential signal input.
6.	AUXILIARY RETURN:	- differential signal input.
7.	OUTPUT:	Velocity-error or current-command
8.	CLAMP:	Reduces gain of the summing amplifier.
9.	TACHOMETER:	Tachometer signal input.

3.3 REMOVAL and INSTALLATION:

When removing or installing the Personality Preamp card, **care must be taken not to damage any of the components** on the Amplifier card or on the Personality card.

Removal: Hold the Personality card by its edges and pull straight away from the Amplifier Controller board **(Do not pull on the components)**. For amplifiers with the Personality card mounted vertically, remove amplifier module first before unplugging Personality card.

Installation: Hold the Personality card by its edges and carefully align the nine pins with their mating sockets and push straight toward the amplifier controller board until it is firmly seated **(Do not press on any of the components)**.

3.4 TROUBLESHOOTING with the PERSONALITY CARD:

If your system exhibits a problem, and a working amplifier module is available, fault tracing can be expedited by removing the Personality Preamp card from the malfunctioning amplifier, plugging it into the replacement amplifier, and testing the system. If the system does not work with the new amplifier module, refer to Chapter Seven on Maintenance and Repair for a more detailed fault tracing procedure. However, if the system does work with the new amplifier module, check the malfunctioning unit for loose connections and retest the suspected unit in the system to verify the malfunction.

CHAPTER FOUR: THEORY of OPERATION

4.1 INTRODUCTION to THEORY of OPERATION:

A velocity-mode servo amplifier is essentially comprised of two control loops (fig. 4.1).

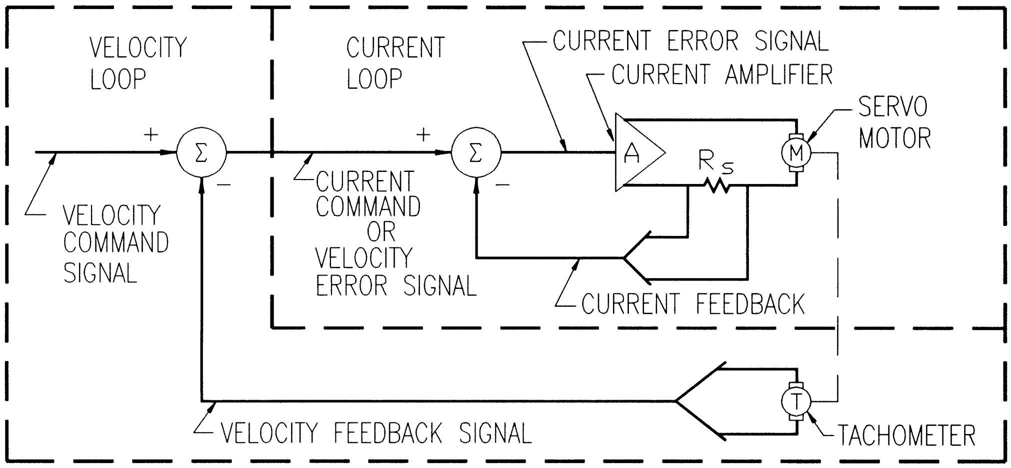


Figure 4.1

The inside control loop is referred to as the Acurrent loop@ and the outside loop is referred to as the Avelocity loop@. Before we begin our analysis of the current loop, let us review some basic concepts which will help you to better understand the amplifier=s operation.

4.2 OPERATION of OUTPUT SWITCHING TRANSISTORS:

The output transistors, for all intents and purposes, operate in only two states. They are analogous to ON/OFF switches. When an output transistor is OFF, there is no current flowing through it (its resistance is infinite). When an output transistor is ON, current flows through it (its resistance is near zero). When the transistor is ON, it is technically referred to as being in saturation.

4.3 AH TYPE@ OUTPUT BRIDGE CONFIGURATION:

The output configuration of the amplifier is an AH TYPE@ bridge (see fig. 4.2 for schematic representation of output bridge with motor connected).

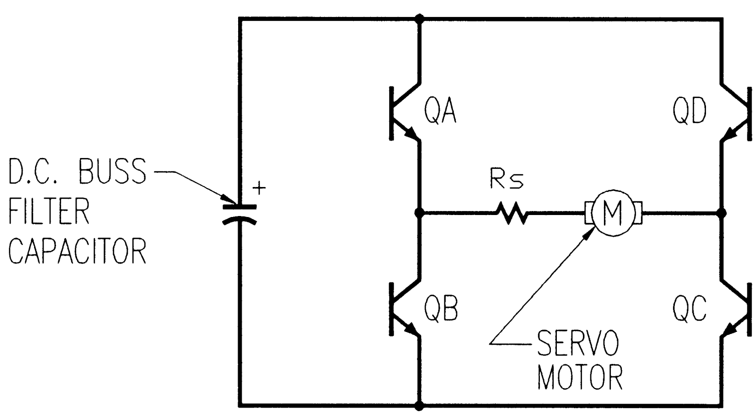


Figure 4.2

The advantage of an AH TYPE@ output bridge configuration is that by controlling the switching of the opposite pairs of transistors, current can be made to flow through the motor in either direction using a single-polarity power supply as shown in figure 4.2.

To provide motor current in one direction, transistors A and C are turned ON, while B and D remain in the OFF state. To provide motor current in the other direction, B and D are turned ON, while A and C remain in the OFF state.

4.4 PULSE-WIDTH-MODULATION (PWM):

Pulse-width modulation@ is the technique used for switching opposite pairs of output transistors ON and OFF to control the motor drive current. When zero current is commanded to the current loop, the opposite pairs of transistors are turned ON and OFF as shown in figure 4.3. Note that since the pulse widths are equal, the net DC current in the motor is equal to zero.

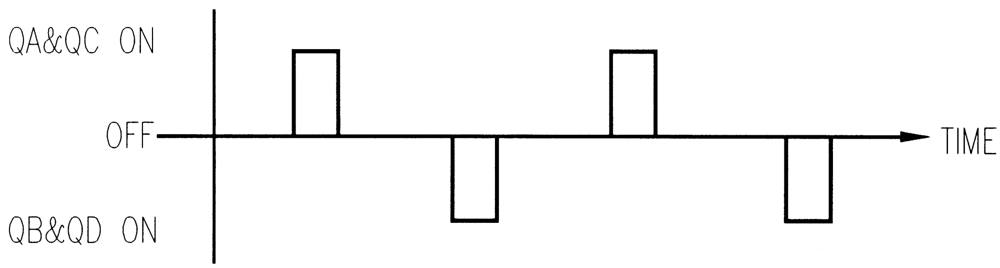


Figure 4.3

When a non-zero current is commanded to the current loop, the transistor switching waveform is as shown in figure 4.3A. Since there is a non-zero current command, the output transistor pulse widths will change and the motor will see a net DC current flowing from A through C.

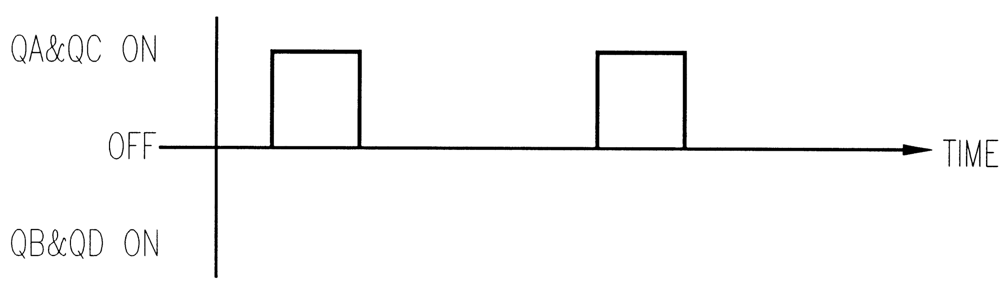


Figure 4.3A

If the input to the current loop had been changed in polarity, the output transistor switching waveform would be as shown in figure 4.3B.

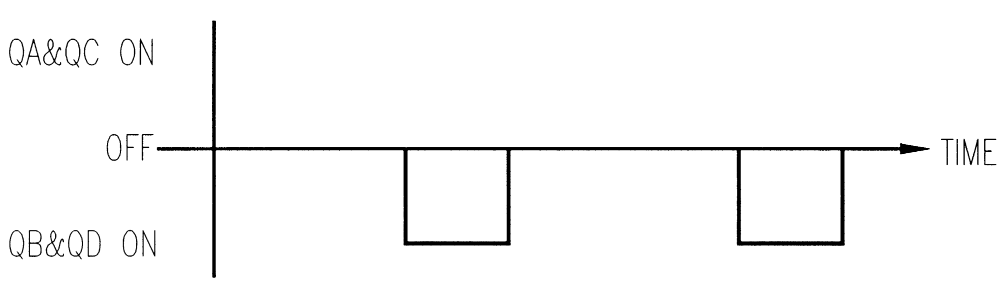


Figure 4.3B

If a larger current of the same polarity was commanded to the output transistors (see fig. 4.3B) the ON-time widths of B and D would automatically increase to provide more current.

From the previous examples it is easy to understand why this output transistor switching technique is referred to as pulse-width modulation.

To change the magnitude and polarity of the current flow in the motor, the pulse widths of the opposite pairs of transistors are modulated. The frequency at which these output transistors are switched ON and OFF is referred to as the Acarrier frequency@.

After realizing how the PWM amplifier output works, it becomes apparent that some inductance must be added to the motor circuit to prevent excessively high AC ripple current and heating in the servomotor. Consult a Glentek applications engineer for recommended inductance.

Now that we have a good understanding of how the current is provided from an AH TYPE@ pulse-width modulated (PWM) bridge, let=s analyze the operation of the current loop.

4.5 CURRENT-LOOP OPERATION:

Please refer to figure 4.1 for a diagram of the current loop. In control electronics the symbol Sigma (with the circle around it) is referred to as a Asumming junction@. The manner in which this summing junction operates is as follows:

The current-command signal (also referred to as the velocity-error signal when received from the output of the velocity loop, as shown in fig. 4.1) is added to the current-feedback signal. The signal resulting from this addition, is referred to as the Acurrent-error@ signal. This current-error signal is fed into the current amplifier, which in turn produces a current in the motor. A voltage which is proportional to the motor current is developed across Rs (shunt resistor). This voltage is referred to as the Acurrent-feedback@ signal. The current in the motor increases until the current-feedback signal is exactly equal in magnitude, but opposite in polarity, to the current-command signal. At this point the current-error signal drops to zero, and the actual current is equal to the commanded current. If anything happens to disturb either the current-command signal, or the current-feedback signal, the same process occurs again until the current-feedback signal is equal in magnitude to the current-command signal, but opposite in polarity.

The type of loop described above is referred to as a Aservo loop@ because the current servos about a commanded value.

We are surrounded in our everyday lives by a multitude of servo loops. For example, many of today=s luxury cars have what is called Aautomatic climate control@. To operate this servo loop, you set the climate control to the temperature that you wish to be maintained in the interior of the car (current-command signal). The selected temperature is then summed with the actual temperature from a thermometer (current-feedback), and the output (currenterror signal) activates either the heater or the air-conditioner until the actual temperature as measured by the thermometer (current-feedback signal) is equal in magnitude, but opposite in polarity, to the set temperature.

4.6 VELOCITY-LOOP OPERATION:

Please refer to figure 4.1 for a diagram of a typical velocity loop. The velocity-loop=s operational description is analogous to the current-loop description, except for the fact that the input signal is called the Velocity Command and the feedback signal from the DC tachometer is called the Velocity Feedback.

CHAPTER FIVE: INSTALLATION PROCEDURE

5.1 MOUNTING:

The installation diagrams in Appendix B show the bolt hole mounting pattern to support the amplifier. The mounting holes will accept 1/4 inch dia. bolts. The base material is cadmium plated, .094-inch-thick aluminum.

THE MOUNTING BOLTS SHOULD PROVIDE AN ELECTRICAL GROUND FOR THE CHASSIS TO MINIMIZE SHOCK HAZARD.

The surface that the amplifier package will be mounted on must be able to support its weight, but does not need to provide Acold plate@ cooling for the amplifier. One, two, or three standard muffin fans are mounted on the baseplate to cool the amplifiers.

It is IMPORTANT to allow a minimum of three inches between both the fan side and the module side (opposite fans) of the amplifier baseplate and the cabinet wall.

The distance between the other two sides and top of the amplifier and the cabinet walls are not critical. However, some space should be provided for wire routing and terminal strip access.

The amplifier package should be mounted in a clean, dry enclosure with a maximum ambient temperature of 122^{N}F (50^{N}C). To ensure maximum reliability, keep the amplifier cabinet cool and free from dust, oil and other contaminates.

NEVER INSTALL THE AMPLIFIER PACKAGE IN ANY LOCATION WHERE FLAMMABLE OR EXPLOSIVE VAPORS ARE PRESENT

5.2 WIRING SIZE and PROPER TECHNIQUE:

Please refer to the installation diagrams in Appendix B. These installation diagrams show the necessary external connections to ensure proper amplifier operation.

Glentek recommends that your wiring be in accordance with all national and local codes that are applicable to your system. Wire size must be sufficient to accommodate the maximum continuous current that will be run through it.

Recommended wire sizes for the amplifier are as follows:

MOTOR ARMATURE:	14AWG (4567) or 12AWG (4568), shielded twisted pair or run in metallic conduit (for RFI suppression).
MAIN AC POWER INPUT:	12AWG, twisted pair.
120VAC and "15VDC:	16AWG, twisted pair.
SIGNAL INPUT:	22AWG, shielded twisted-pair. Terminate shield, at amplifier end only, to Tachometer Common, TB1-6
TACHOMETER INPUT:	22AWG shielded twisted-pair. Terminate shield, at amplifier end only, to Tachometer Common, TB1-6
LOGIC INPUT/OUTPUT:	22AWG Twist with return lead.

When wiring to-and-from the drive cabinet, it is considered good technique to route the power lines (16 AWG and larger) along different paths than the signal and tachometer lines. This minimizes the amount of stray noise pick-up that is injected into the amplifier.

5.3 BASEPLATE CONNECTIONS:

5.3.1 120 VAC 50/60 Hz FOR FANS and LOW-VOLTAGE POWER SUPPLY:

Connect the 120VAC to terminals 5 and 6 of terminal barrier-strip TB201 located on the baseplate.

DO NOT APPLY ANY POWER YET.

5.3.2 INPUT from SECONDARY of POWER TRANSFORMER:

The AC voltage that is used to form the DC buss of the amplifier package, is supplied from a separately mounted transformer that has been selected by Glentek for your application. Connect the secondary of the power transformer to input terminals 1 & 2 of TB201 for a single-phase input, and terminals 1, 2, & 3 for a three-phase input.

DO NOT APPLY ANY POWER YET.

5.4 AMPLIFIER CONNECTIONS and FUNCTIONS:

5.4.1 DC BUSS:

The DC Buss, from the filter capacitor, is connected to terminals 1 (+) and 2 (-) of terminal strip TB2 (4567), or TB1 (4568) on each amplifier. This connection is already made for you on our multi-axis packages. The power transformer is not a standard part of the amplifier package and must be selected for your application. Many sizes and styles are in stock at Glentek.

5.4.2 MOTOR:

The motor is connected to terminals 1 (-) and 2 (+) of terminal strip TB2 (4567) or TB1 (4568) of the amplifier module. In most cases, if the motor inductance is less than 1 millihenry, an inductor should be connected in series with the motor leads. The inductor is considered to be a separate part from the amplifier package. Glentek can advise on the inductor specifications, and most styles and sizes are in stock at Glentek.

IT IS IMPERATIVE THAT YOU DO NOT USE GROUNDED TEST EQUIPMENT ON THE MOTOR ARMATURE NOR CONNECT EITHER END OF THE MOTOR ARMATURE TO SIGNAL GROUND OR DC BUSS RETURN.

5.4.3 SIGNAL INPUT:

Each amplifier has two Signal Inputs, one single-ended (Signal Input), TB1-3 & TB1-4 (4567), or TB2-3 & TB1-4 (4568), and one differential (Auxiliary Signal Input and Auxiliary Return), TB1-1 & TB1-2 (4567), or TB2-1 & TB2-2 (4568) respectfully. Typically, when operating in the velocity mode, the input signal range is "10VDC. The input voltage is summed with a precision DC tachometer to provide accurate velocity control at the servo motor shaft (see fig. 4.1). The Signal Gain potentiometer R12, and Auxiliary Gain potentiometer, R13, adjust the motor velocity desired for a given input-voltage velocity-command.

5.4.4 TACHOMETER INPUT:

The Tachometer is connected to TB1-5 & TB1-6 (4567) or TB2-5 & TB2-6 (4568).

5.4.5 CURRENT SENSE:

The Current Sense output signal can be monitored at TB1-7 (4567), or TB2-7 (4568). It is an isolated output signal that is proportional to motor current. The scale factor is 1V=10A.

5.4.6 + and - LIMITS:

The + and - Limits are located at TB1-8 & TB1-9 (4567), or TB2-8 & TB2-9 (4568), respectively. Please refer to 2.2.3 for a description of the different configurations of limits that are available. Amplifier modules are normally shipped with type AA@ limits which means that when a limit input is pulled to common by some external circuit, the amplifier is inhibited in the + or - direction.

5.4.7 TOTAL INHIBIT:

The Total Inhibit is located at TB1-10 (4567) or TB2-10 (4568). Please refer to 2.2.3 for a description of the different configurations of inhibit that are available. Amplifier modules are normally shipped with type AA@ inhibit which means that when the inhibit input is pulled to common by some external circuit, the amplifier is totally inhibited.

5.4.8 FAULT INPUT/OUTPUT:

The fault input/output is on TB1-12 (4567), or TB2-12 (4568). Please refer to chapters 2.3 and 7 for a description of the protection circuits that will generate a fault. When there is a fault, this open-collector output will go to ground. Externally pulling this pin to ground will inhibit the amplifier.

5.4.9 LOW-VOLTAGE POWER SUPPLY:

The common from the low-voltage power supply is connected to TB1 -13 (4567) or TB2-13 (4568), the + 15VDC is connected to TB1-14 (4567) or TB2-14 (4568), and the -15VDC is connected to TB1-15 (4567) or TB2-15 (4568). On our multi-axis baseplates these connections are made for you.

CHAPTER SIX: START UP and ADJUSTMENT PROCEDURE

6.1 SAFETY PRECAUTIONS:

Before starting the adjustment and alignment procedure please be sure to observe the following precautions:

1. Be certain that there are no visibly loose or damaged components.
2. Check that all connections are tight.
3. Check all power and signal wiring. Remove power input fuses, apply power and measure that the correct power voltage is being applied. Your DC buss voltage will be 1.4 times the AC voltage applied (Refer to Appendix A, note 1).
4. Be sure that the motor mechanism is clear of all obstructions. If motor is connected to an axis lead screw or other device with limited motion, place at mid-position.
5. Make sure Loop-Gain potentiometer (on Preamp card) is turned fully CCW before applying power.
6. **DO NOT** use grounded test equipment on motor leads or power section of amplifier.

6.2 AMPLIFIER ALIGNMENT INTRODUCTION:

The following procedure must be done to each amplifier in a multi-axis system. Work on only one amplifier at a time.

When adjusting an amplifier for optimum velocity-loop operation it is desirable to achieve a critically damped, stable-step velocity response with maximum Tach Gain. The following discussion will describe how to best achieve this result:

Your amplifier has been run at the factory with a known motor, tachometer and inertial load. In testing at the factory, we try to simulate the same conditions you will have in your system. For this reason it is a good idea to start with the initial settings as shipped from the factory.

Note: All of the following adjustments are to be made on the Personality Preamp card (Refer to Appendix C, drawings 4597-7010 & 4597-7012).

6.3 VELOCITY-LOOP PHASING:

For proper servo operation it is necessary for the amplifier to receive negative feedback from the tachometer. If the tachometer leads are reversed (positive feedback), the amplifier will run away. To check the phasing of the motor and tachometer proceed as follows:

1. Make sure Loop-Gain potentiometer, R18, is full CCW (as shipped from factory).
2. Make sure that nothing is connected to the Signal Input TB1-3 (4567)or TB2-3 (4568) or the Auxiliary Signal Input TB1-1 & TB1-2 (4567), or TB2-1 & TB2-2 (4568).
3. Apply the main power and the 120 volt power.
4. Slowly turn the Loop-Gain potentiometer, R18, CW. If the motor starts to run away, turn the Loop-Gain potentiometer full CCW and reverse the tachometer leads (do not move the shield lead). Again, slowly turn the Loop-Gain potentiometer CW. The motor should be stopped or rotating slowly.
5. Leave the Loop-Gain potentiometer, R18, full CW for all remaining adjustments and operations.

6.4 TACH-GAIN ADJUSTMENT:

1. At this point the motor will be stopped or rotating slowly. Adjust the Balance potentiometer, R15, until the motor rotation is stopped.
2. While observing the tachometer output voltage with an oscilloscope, apply a step voltage at the Signal Input terminal of the amplifier. A step voltage can be simulated by applying and removing a flashlight battery to the Signal Input. For this purpose, the battery is usually mounted inside of a small box with a switch. Common names used to describe this DC signal voltage source are Battery Box or DC Simulator. Elaborate signal sources made for this purpose often include bipolar output, potentiometer output adjust and polarity reversing

switches, etc. You often hear the phrase A**DC Box the velocity loop servo**@ used by people working on servo systems. (This Signal Box may be purchased from Glentek Inc., Part Number BB700)

3. At this point the motor should be running smoothly. While applying and removing the DC input signal, adjust the Current-Limit potentiometer, R17, for desired maximum acceleration and deceleration. Motor current should be observed by using an oscilloscope at TB1-7 (4567), or TB2-7 (4568). The scale factor of this voltage is 1V=10A. Leave the Current-Limit potentiometer at this setting for all remaining adjustments.

4. Adjust the Signal-Gain potentiometer, R12. or the Aux Signal-Gain potentiometer, R13, (depending on the input you are using) so that when you apply the DC signal the motor rotates at approximately 400 RPM.

5. Observe the tachometer voltage with an oscilloscope while applying and removing the DC input signal. You will observe one of three possible waveforms: critically damped, under damped, or over damped (see figure 6.4).

6. The optimum waveform for most systems is the critically-damped waveform. If the waveform that you are observing is critically damped, proceed to step 9.

7. If your waveform is under damped, make the following adjustments:

   Turn the Compensation potentiometer, R16, CCW until the waveform becomes critically damped. Note here that the limiting factor will be motor oscillation or Ahunting@. You must always leave the Compensation potentiometer far enough CW so that the velocity loop remains stable.

   If the waveform is still under damped after adjusting the Compensation potentiometer for maximum bandwidth, turn the Tachometer-Gain potentiometer, R14, 2 turns CCW and then adjust Compensation potentiometer, R16, CCW until waveform becomes critically damped. Repeat procedure if necessary. Again, the servo velocity-loop must at all times remain stable. Consult the factory if necessary.

8. If the waveform is over damped, make the following adjustments:

   Turn the Tachometer-Gain potentiometer, R14, CW until a slight overshoot appears on the waveform; then turn the Compensation potentiometer, R16, CCW until a critically damped waveform is observed.

9. Now that the waveform is critically damped, leave the Compensation, R16, and Tachometer Gain, R14, at these settings for all remaining adjustments and operations.

10. Next, set the Signal potentiometer, R12 or R13, to the gain required by your system (e.g. 10 volts = 2000 RPM).

11. Adjust Balance potentiometer, R15, one more time to null out any offset (with 0 volt input).

12. For all remaining adjustments when placing the amplifier in your system only the Signal potentiometer, R12 or R13, and Balance potentiometer, R15, should be adjusted.

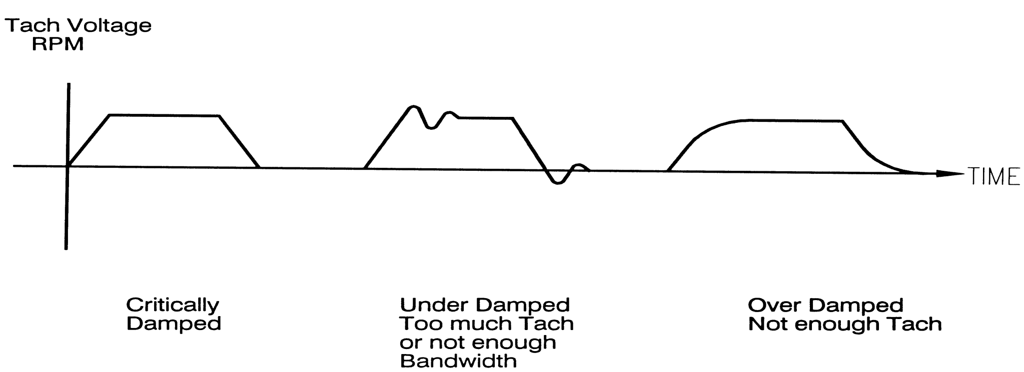


Figure 6.4

6.5 CONNECTING AMPLIFIER to a DIGITAL POSITION LOOP:

1. Before connecting the amplifier to a digital position loop, be sure the adjustments of section 6.4 have been made. Start out with Loop-Gain potentiometer, R18, fully CCW and activate the digital position loop. Slowly

turn Loop-Gain potentiometer CW. If servo runs away, immediately adjust Loop Gain fully CCW and turn power OFF.

It is possible, at this time, that the digital loop is reverse phased. An example of this would be if a positive voltage from the velocity DAC (digital to analog converter) required the motor to turn CW. However, it turned CCW instead causing the encoder feedback signal to count up instead of down. This would cause a run away condition.

If you are out of phase as described, be sure power is OFF and reverse the motor leads at the amplifier. This will cause the motor to rotate in the opposite direction than it did before, properly phasing the digital loop.

2. With the Digital Loop operating, turn the Loop-Gain potentiometer, R18, fully CW and command a small move. Slowly increase or decrease the Signal-Gain potentiometer, R12 or R13, until the servo is operating as required. It should be noted here that too much Signal Gain can cause instability (oscillation). **Do not** stay in this oscillating condition long, as it may result in system mechanical or electrical damage. Be sure when all signal adjustments are made that the Balance is re-checked and adjusted for zero rotation for zero signal input.

   It should also be noted here that the GA4567PA and GA4568PA is designed to operate with many different systems and if, after reading this manual, you have further questions, do not hesitate to call a Glentek applications engineer.

ENGINEERING NOTE:

After all systems are aligned and functioning, it is good practice to remove power from the amplifier and, using a digital ohm-meter, measure the impedance value of the following potentiometer wiper settings with respect to signal ground. These values may be useful for the next machine you align or for maintenance of this system at a later date. Make these measurements on each amplifier on a multi-axis baseplate. For your convenience, a table has been provided below:

	AMP1	AMP2	AMP3	AMP4	AMP5	AMP6
1. Tach-Gain potentiometer wiper to common (ohms):	_____	_____	_____	_____	_____	______
2. Signal-gain potentiometer wiper to common (ohms):	_____	_____	_____	_____	_____	______
3. Compensation potentiometer wiper to common (ohms):	_____	_____	_____	_____	_____	______
4. Current limit potentiometer wiper to common (ohms):	_____	_____	_____	_____	_____	______
5. Signal input to Tach input voltage ratio: ___ volts Signal. ___ volts Tach.	_____	_____	_____	_____	_____	______

Date data taken: ___ ___ ___

Note any changes to compensation components, etc:

CHAPTER SEVEN: MAINTENANCE, REPAIR and WARRANTY

7.1 MAINTENANCE:

The GA4567PA and GA4568PA amplifiers do not require any scheduled maintenance. The only wear-out items are the cooling fans which are specified to have in excess of 15,000 hours MTBF by their manufacturer.

7.2 REPAIR:

If your system exhibits a problem, this manual should assist you to identify the fault and to replace the defective component or sub-assembly. It is Glentek=s recommendation that only major assemblies be replaced in the field and the assemblies be returned to Glentek for failure analysis and repair. However, appendices B and C contain complete system schematics that, in case of extreme emergency, should permit a skilled electronic technician to troubleshoot the circuit boards to levels lower than those recommended as replaceable.

7.2.1 FAULT TRACING CHARTS:

The fault tracing charts in Appendix A start with an observable fault listed at the top of each chart. Follow the line connections between blocks by your answers to the questions noted in the diamond shape blocks until the defective part is isolated. The charts are to be used only as a guide to identify the parts or assemblies that Glentek recommends as the lowest level of repair.

The fault tracing procedures assume that only a single failure mode exists.

Fault Chart 1	Motor does not turn in either direction.
Fault Chart 2	Motor only turns in one direction.
Fault Chart 3	Motor does not develop maximum output speed (no load applied) in either direction.
Fault Chart 4	Motor does not develop maximum output torque in either direction.
Fault Chart 5	Motor wanders and hunts or does not track smoothly.

7.2.2 PART REPLACEMENT:

The removal and replacement of the defective assembly can be accomplished with standard shop procedures. The assemblies that may be easily removed are as follows:

1. Fuses F201-F203 the base plate and F1 on each amplifier.
2. Rectifiers BR201 and BR202.
3. Capacitor C201.
4. Fans 201 - 203.
5. Amplifier modules A1 - A6.
6. Low-voltage power supply PS201.

After reviewing the fault tracing charts you may conclude that the complete amplifier should be returned to Glentek for failure analysis, repair and retesting to specifications. This is particularly true with failure modes in the amplifier power section.

**FAULT SHUT-DOWNS CAN ONLY BE CAUSED BY ABNORMAL CONDITIONS.
THE CAUSE SHOULD BE INVESTIGATED BEFORE REPEATED RECYCLING OF
THE MOTOR DRIVE TO PREVENT POSSIBLE DAMAGE TO THE AMPLIFIER**

7.2.3 OVER-TEMPERATURE SHUTDOWN:

When the heatsink temperature has reached a level that, if exceeded, would damage the output transistors, the Temp indicator LED is latched ON and the amplifier will be inhibited.

Possible causes:

1. Loss of cooling air - Fans are defective or airflow is blocked.
2. Excessive rise in cooling air temperature due to cabinet ports being blocked or excessive hot air being ingested.
3. Extended operational duty cycle due to mechanical overload of motor or defective motor.
4. Defective power output section due to component failure (Return to Glentek for repair).
5. Noisy Tachometer Signal - A noisy tachometer causes a considerable amount of random switching of the power output transistors, thus increasing the amount of heat developed in the output section. The higher the bandwidth, the more the heating due to a noisy tachometer. A noisy tachometer can be

identified by a large amount of rumbling and twitching of the motor at low or zero shaft speeds.

See section 2.3.6 on resetting the fault latch. Note: The fault latch will not reset unless the fault has been removed.

7.2.4 OVER-VOLTAGE SHUTDOWN:

When the DC Buss voltage has exceeded 155VDC, the Over-Voltage indicator will latch on and the amplifier will be inhibited. This circuit protects the motor and amplifier from high DC Buss voltages.

Possible causes:

1. AC main voltage too high.
2. Wrong power transformer installed.
3. A spinning DC motor is basically a DC generator which produces a back EMF in proportion to the RPM. This BEMF voltage adds to the DC Buss voltage (regen voltage) when the amplifier is commanded to decelerate a motor=s inertial load. If the regen voltage is high enough to cause an Over-Voltage condition, consult with Glentek about adding a Regen Clamp to your system.

7.2.5 LOW-SPEED ELECTRONIC CIRCUIT BREAKER (LS/ECB) SHUTDOWN:

The LS/ECB is tripped when a preset current threshold is exceeded for a preset length of time. See Typical Settings, section 2.4.7.

Possible causes:

1. Binding or stalling of motor shaft.
2. Overload of amplifier output to motor.
3. Large reflected load inertia.

See section 2.3.6 on resetting the fault latch. Note: The fault latch will not reset unless the fault has been removed.

7.2.6 HIGH-SPEED ELECTRONIC CIRCUIT BREAKER (HS/ECB) SHUTDOWN:

The HS/ECB is tripped when a preset current threshold is exceeded for a preset length of time. See Typical Settings, section 2.4.7.

Possible causes:

1. Shorted motor leads.
2. Intermittent motor short.
3. Motor inductance too low.
4. Motor commutator flash over.

See section 2.3.6 on resetting the fault latch.

Note: The fault latch will not reset unless the fault has been removed.

7.3 FACTORY REPAIR:

Should it become necessary to return a GA4567PA or GA4568PA to Glentek for repair, please follow the procedure described below:

1. Reassemble the unit, if necessary, making certain that all the hardware is in place.
2. Tag the unit with the following information:
   - A. Serial number and assembly unit.
   - B. Company name and representative returning the unit.
   - C. A brief notation explaining the malfunction.
   - D. Date the unit is being returned.
3. Repackage the unit with the same care and fashion in which it was received. Label the container with the appropriate stickers (e.g. FRAGILE: HANDLE WITH CARE).
4. Contact a Glentek representative, confirm the unit is being returned to the factory and obtain an RMA (Return Material Authorization) number.
5. Return the unit by the best means possible. The method of freight chosen will directly affect the timeliness of its return.

7.4 WARRANTY:

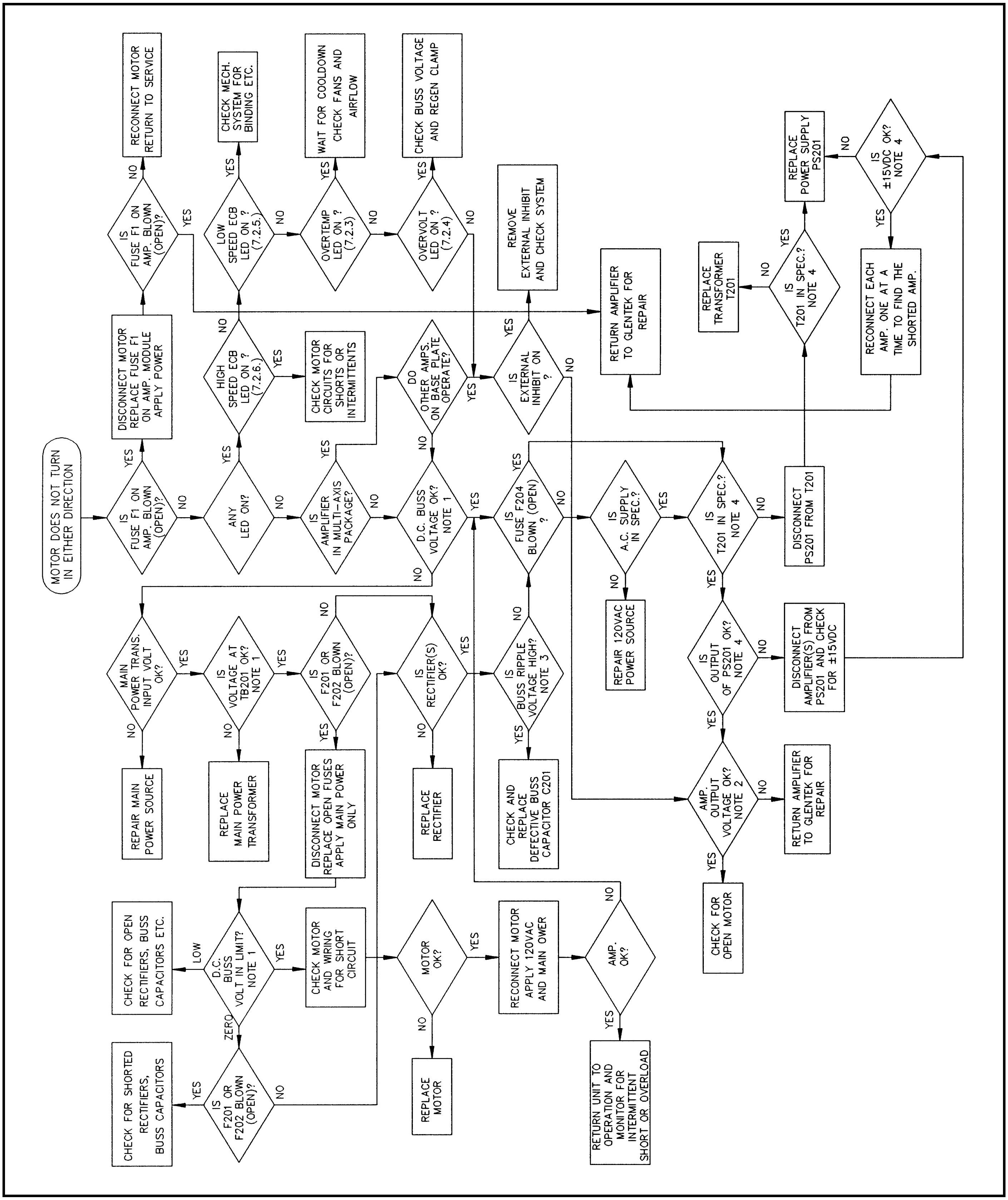
Any product or part thereof manufactured by Glentek, Inc. described in the manual which, under normal operation conditions in the plant of the original purchaser thereof, proves defective in material or workmanship within one year from the date of shipment by us, as determined by an inspection by us, will be repaired or replaced free of charge FOB our factory, El Segundo, California provided that you promptly send to us notice of the defect and establish that the product has been properly installed, maintained and operated within the limits of rated and normal usage. Glentek=s liability is limited to repair or replacement of defective parts.

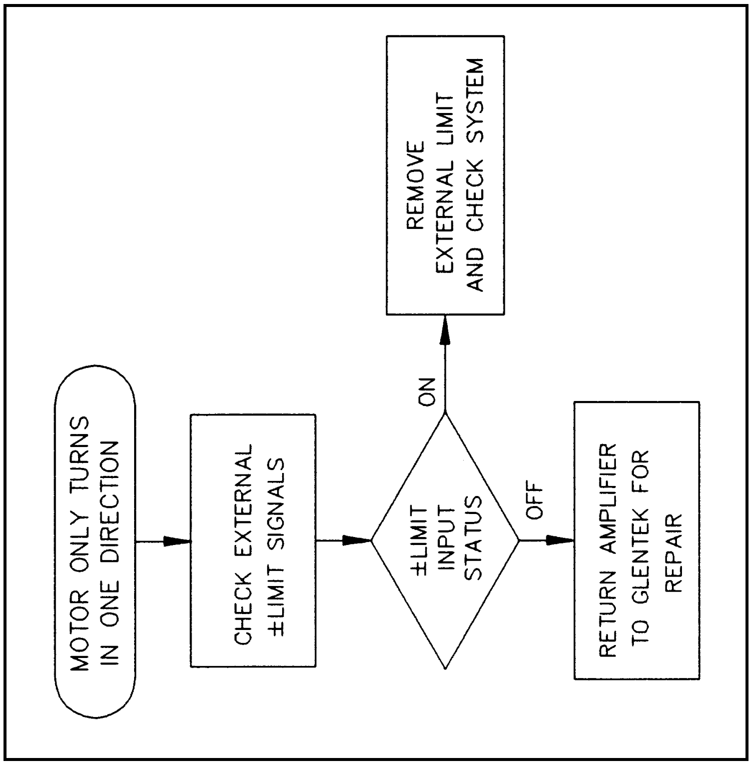
Any product or part manufactured by others and merely installed by us, such as electric motors etc., is specifically not warranted by us and it is agreed that such product or part shall only carry the warranty, if any, supplied by the manufacturer. It is also understood that you must look directly to such manufacturer for any defect, failure, claim or damage caused by such product or part, including power transistors.

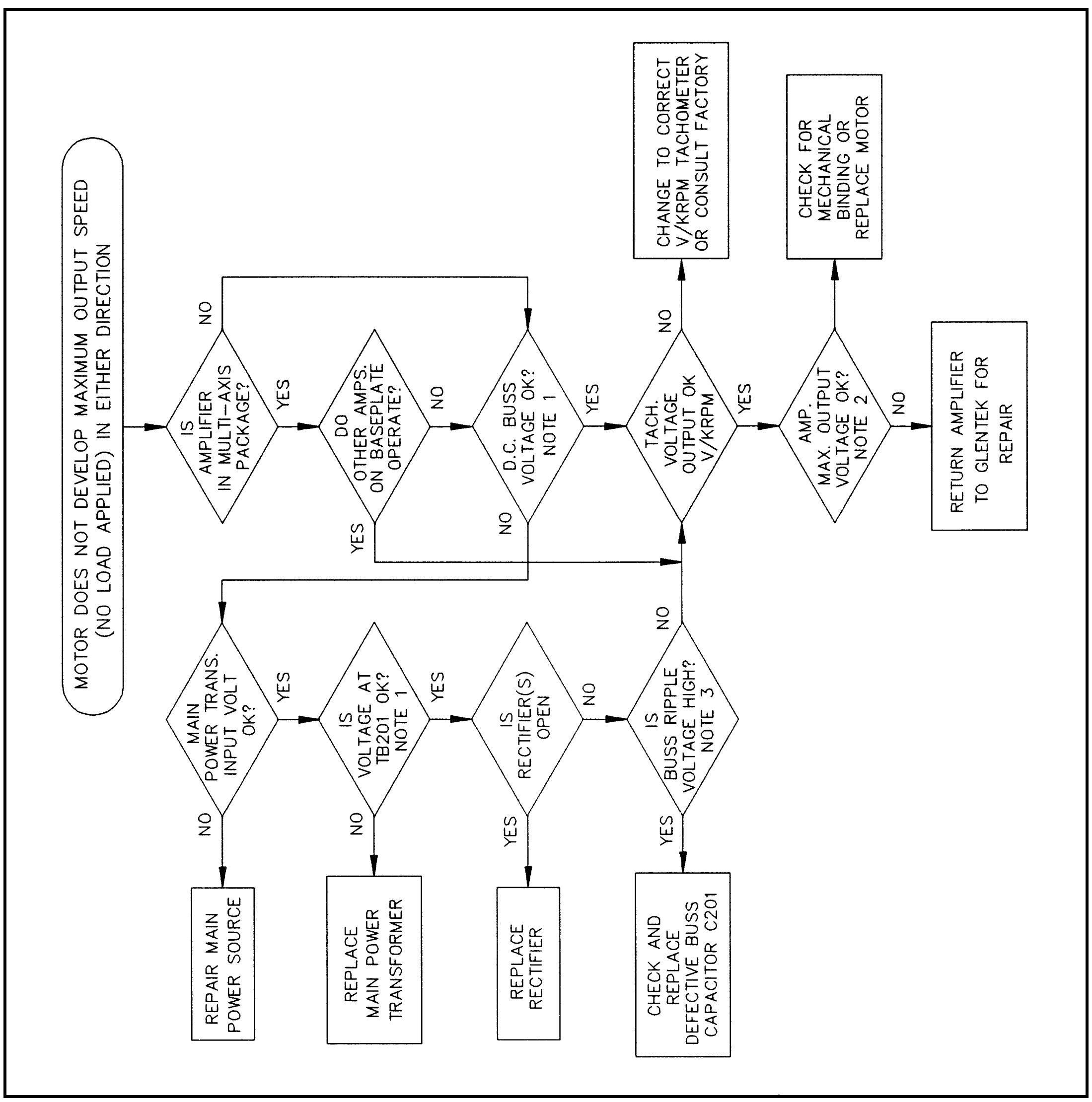
Under no circumstances shall Glentek, Inc. or any of our affiliates have any liability whatsoever for claims or damages arising out of the loss of use of any product or part sold to you. Nor shall we have any liability to yourself or anyone for any indirect or consequential damages such as injuries to person and property caused directly or indirectly by the product or part sold to you, and you agree in accepting our product or part to save us harmless from any and all such claims or damages that may be initiated against us by third parties.

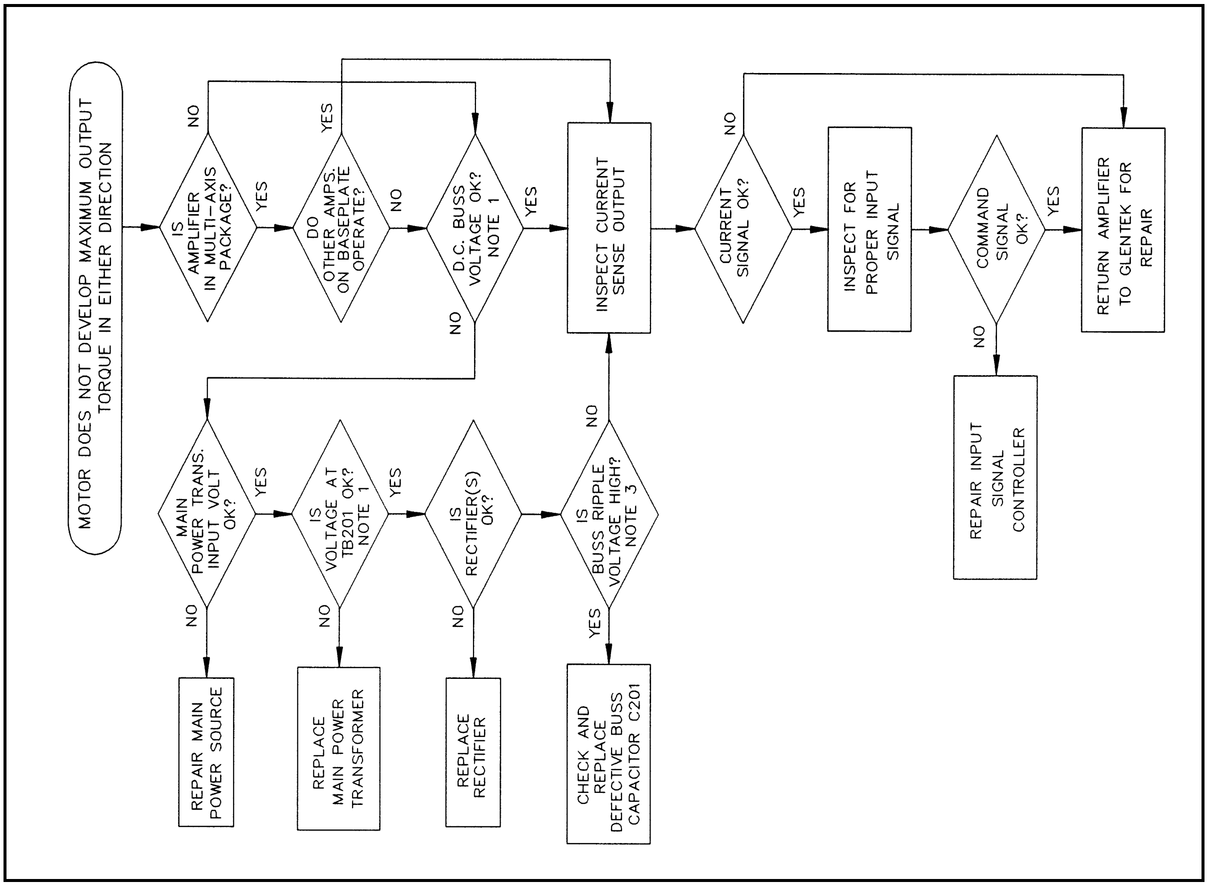
APPENDIX A

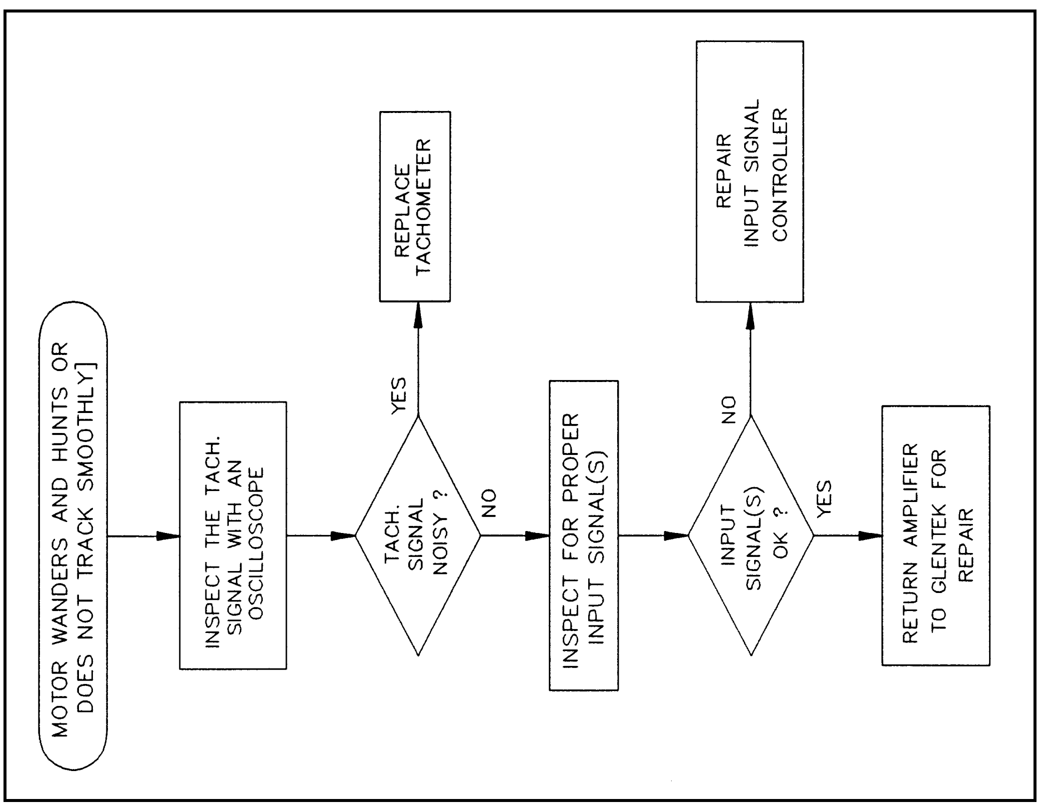
FAULT TRACING CHARTS


MOTOR DOES NOT TURN IN EITHER DIRECTION
IS FUSE F1 ON AMP. BLOWN (OPEN)?
DISCONNECT MOTOR REPLACE FUSE F1 ON AMP. MODULE APPLY POWER
IS FUSE F1 ON AMP. BLOWN (OPEN)?
RECONNECT MOTOR RETURN TO SERVICE
ANY LED ON?
HIGH SPEED ECB LED ON ? (7.2.6.)
CHECK MOTOR CIRCUITS FOR SHORTS OR INTERMITTENTS
LOW SPEED ECB LED ON ? (7.2.5.)
CHECK MECH. SYSTEM FOR BINDING ETC.
OVERTEMP LED ON ? (7.2.3)
WAIT FOR COOLDOWN CHECK FANS AND AIRFLOW
OVERVOLT LED ON ? (7.2.4)
CHECK BUSS VOLTAGE AND REGEN CLAMP
IS AMPLIFIER IN MULTI-AXIS PACKAGE?
DO OTHER AMPS. ON BASE PLATE OPERATE?
D.C. BUSS VOLTAGE OK? NOTE 1
IS EXTERNAL INHIBIT ON ?
REMOVE EXTERNAL INHIBIT AND CHECK SYSTEM
RETURN AMPLIFIER TO GLENTEK FOR REPAIR
IS FUSE F204 BLOWN (OPEN) ?
IS A.C. SUPPLY IN SPEC.?
REPAIR 120VAC POWER SOURCE
IS T201 IN SPEC.? NOTE 4
DISCONNECT PS201 FROM T201
IS T201 IN SPEC.? NOTE 4
REPLACE TRANSFORMER T201
REPLACE POWER SUPPLY PS201
IS ±15VDC OK? NOTE 4
RECONNECT EACH AMP. ONE AT A TIME TO FIND THE SHORTED AMP.
IS OUTPUT OF PS201 OK? NOTE 4
DISCONNECT AMPLIFIER(S) FROM PS201 AND CHECK FOR ±15VDC
AMP. OUTPUT VOLTAGE OK? NOTE 2
RETURN AMPLIFIER TO GLENTEK FOR REPAIR
CHECK FOR OPEN MOTOR
MAIN POWER TRANS. INPUT VOLT OK?
REPAIR MAIN POWER SOURCE
IS VOLTAGE AT TB201 OK? NOTE 1
REPLACE MAIN POWER TRANSFORMER
IS F201 OR F202 BLOWN (OPEN)?
DISCONNECT MOTOR REPLACE OPEN FUSES APPLY MAIN POWER ONLY
IS RECTIFIER(S) OK?
REPLACE RECTIFIER
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
CHECK AND REPLACE DEFECTIVE BUSS CAPACITOR C201
D.C. BUSS VOLT IN LIMIT? NOTE 1
LOW
ZERO
CHECK FOR OPEN RECTIFIERS, BUSS CAPACITORS ETC.
CHECK MOTOR AND WIRING FOR SHORT CIRCUIT
IS F201 OR F202 BLOWN (OPEN)?
CHECK FOR SHORTED RECTIFIERS, BUSS CAPACITORS
MOTOR OK?
REPLACE MOTOR
RECONNECT MOTOR APPLY 120VAC AND MAIN OWER
AMP. OK?
RETURN UNIT TO OPERATION AND MONITOR FOR INTERMITTENT SHORT OR OVERLOAD


MOTOR ONLY TURNS IN ONE DIRECTION
CHECK EXTERNAL ±LIMIT SIGNALS
±LIMIT INPUT STATUS
ON
REMOVE EXTERNAL LIMIT AND CHECK SYSTEM
OFF
RETURN AMPLIFIER TO GLENTEK FOR REPAIR


MOTOR DOES NOT DEVELOP MAXIMUM OUTPUT SPEED (NO LOAD APPLIED) IN EITHER DIRECTION
IS AMPLIFIER IN MULTI-AXIS PACKAGE?
YES
NO
DO OTHER AMPS. ON BASEPLATE OPERATE?
NO
YES
D.C. BUSS VOLTAGE OK? NOTE 1
YES
NO
TACH. VOLTAGE OUTPUT OK V/KRPM
NO
CHANGE TO CORRECT V/KRPM TACHOMETER OR CONSULT FACTORY
YES
AMP. MAX. OUTPUT VOLTAGE OK? NOTE 2
CHECK FOR MECHANICAL BINDING OR REPLACE MOTOR
NO
RETURN AMPLIFIER TO GLENTEK FOR REPAIR
MAIN POWER TRANS. INPUT VOLT OK?
NO
REPAIR MAIN POWER SOURCE
YES
IS VOLTAGE AT TB201 OK? NOTE 1
NO
REPLACE MAIN POWER TRANSFORMER
YES
IS RECTIFIER(S) OPEN
YES
REPLACE RECTIFIER
NO
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
YES
CHECK AND REPLACE DEFECTIVE BUSS CAPACITOR C201
NO


MOTOR DOES NOT DEVELOP MAXIMUM OUTPUT TORQUE IN EITHER DIRECTION
IS AMPLIFIER IN MULTI-AXIS PACKAGE?
YES
NO
DO OTHER AMPS. ON BASEPLATE OPERATE?
YES
NO
D.C. BUSS VOLTAGE OK? NOTE 1
YES
NO
INSPECT CURRENT SENSE OUTPUT
CURRENT SIGNAL OK?
YES
NO
INSPECT FOR PROPER INPUT SIGNAL
COMMAND SIGNAL OK?
YES
NO
RETURN AMPLIFIER TO GLENTEK FOR REPAIR
REPAIR INPUT SIGNAL CONTROLLER
MAIN POWER TRANS. INPUT VOLT OK?
YES
NO
IS VOLTAGE AT TB201 OK? NOTE 1
YES
NO
IS RECTIFIER(S) OK?
NO
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
NO
YES
REPAIR MAIN POWER SOURCE
REPLACE MAIN POWER TRANSFORMER
REPLACE RECTIFIER
CHECK AND REPLACE DEFECTIVE BUSS CAPACITOR C201


MOTOR WANDERS AND HUNTS OR DOES NOT TRACK SMOOTHLY]
INSPECT THE TACH. SIGNAL WITH AN OSCILLOSCOPE
TACH. SIGNAL NOISY ?
YES
NO
REPLACE TACHOMETER
INSPECT FOR PROPER INPUT SIGNAL(S)
INPUT SIGNAL(S) OK ?
NO
YES
REPAIR INPUT SIGNAL CONTROLLER
RETURN AMPLIFIER TO GLENTEK FOR REPAIR

ENGINEERING NOTES FOR FAULT TRACING CHARTS:

NOTE 1:

To measure the DC buss voltage, carefully connect a voltmeter across the bleeder resistor attached to the DC buss filter capacitor. The proper DC buss voltage for your amplifier is calculated by multiplying the AC power input voltage on the main DC buss transformer by 1.4 (e.g. For 70 VAC input you should read 70 x 1.4 or approx. 100 VDC buss voltage). The DC buss voltage will vary depending on if the motor is under a heavy or light load. The DC buss voltage will sag under heavy loads. This is normal for unregulated DC power supplies.

NOTE 2:

The output voltage to the motor can be checked by alternately applying a positive and then negative voltage to the signal input and observing the voltage swing at the amplifier motor output terminals. Keep in mind that the Loop Gain and Signal potentiometers must be set at least somewhat CW. This test can be made with motor disconnected from amplifier.

NOTE 3:

A low, but not zero, DC buss voltage could indicate an open or defective DC buss filter capacitor. To check capacitor, remove from circuit and check with an ohmmeter. A visual check of the capacitor port seal could show a blown pressure seal caused by a failed, overheated capacitor.

NOTE 4:

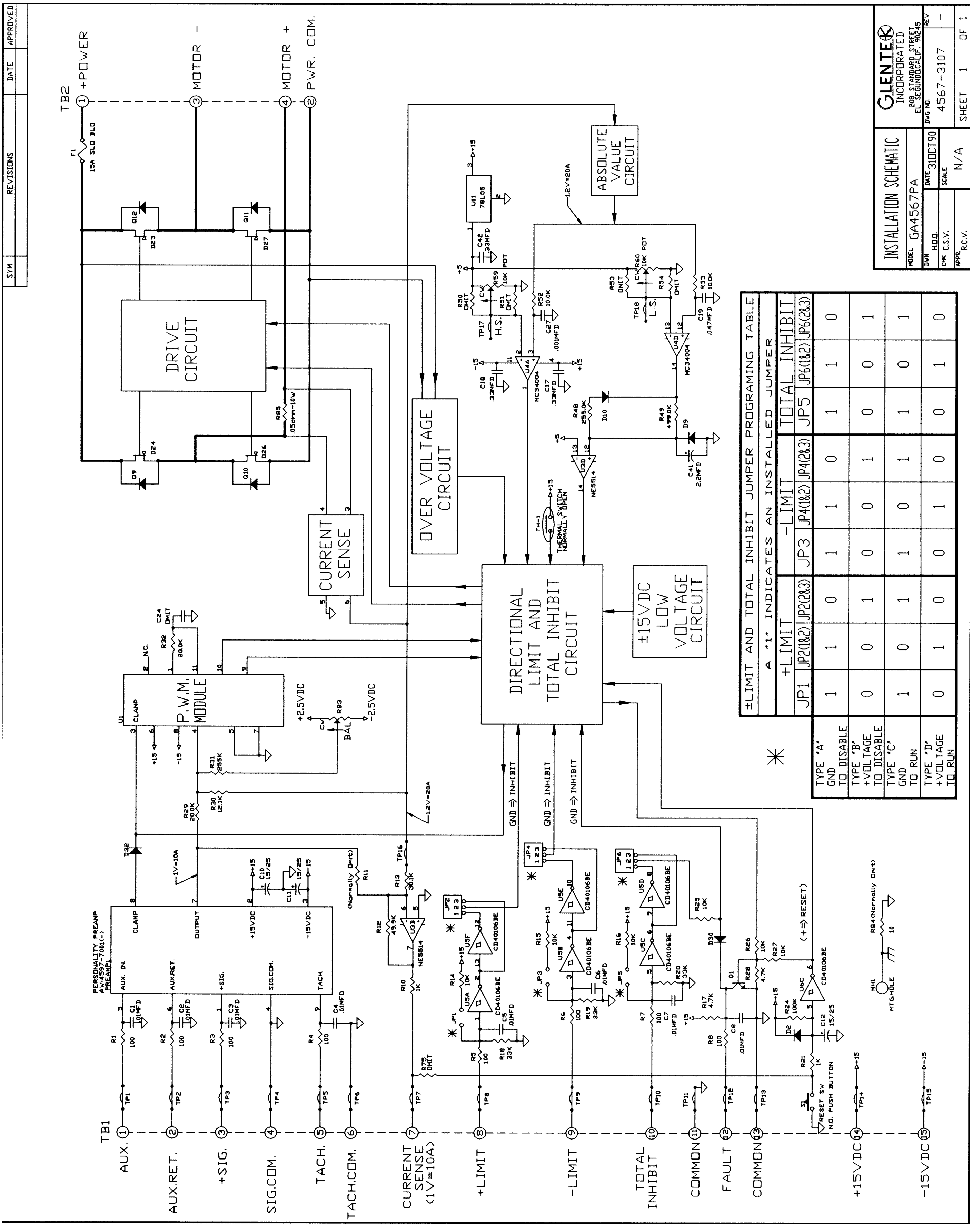
If the 120VAC fuse, F204, is blown it may indicate a defective low-voltage power supply, a shorted fan, or possible a defective low-voltage transformer. This transformer is located on the baseplate near the low-voltage power supply. The transformer wires are color coded as follows:

Red & Brn: Primary,	120VAC.
Orn, Yel, and Grn: Secondary,	32VAC center-tapped.

APPENDIX B

AMPLIFIER DRAWINGS

MODEL: GA4567PA

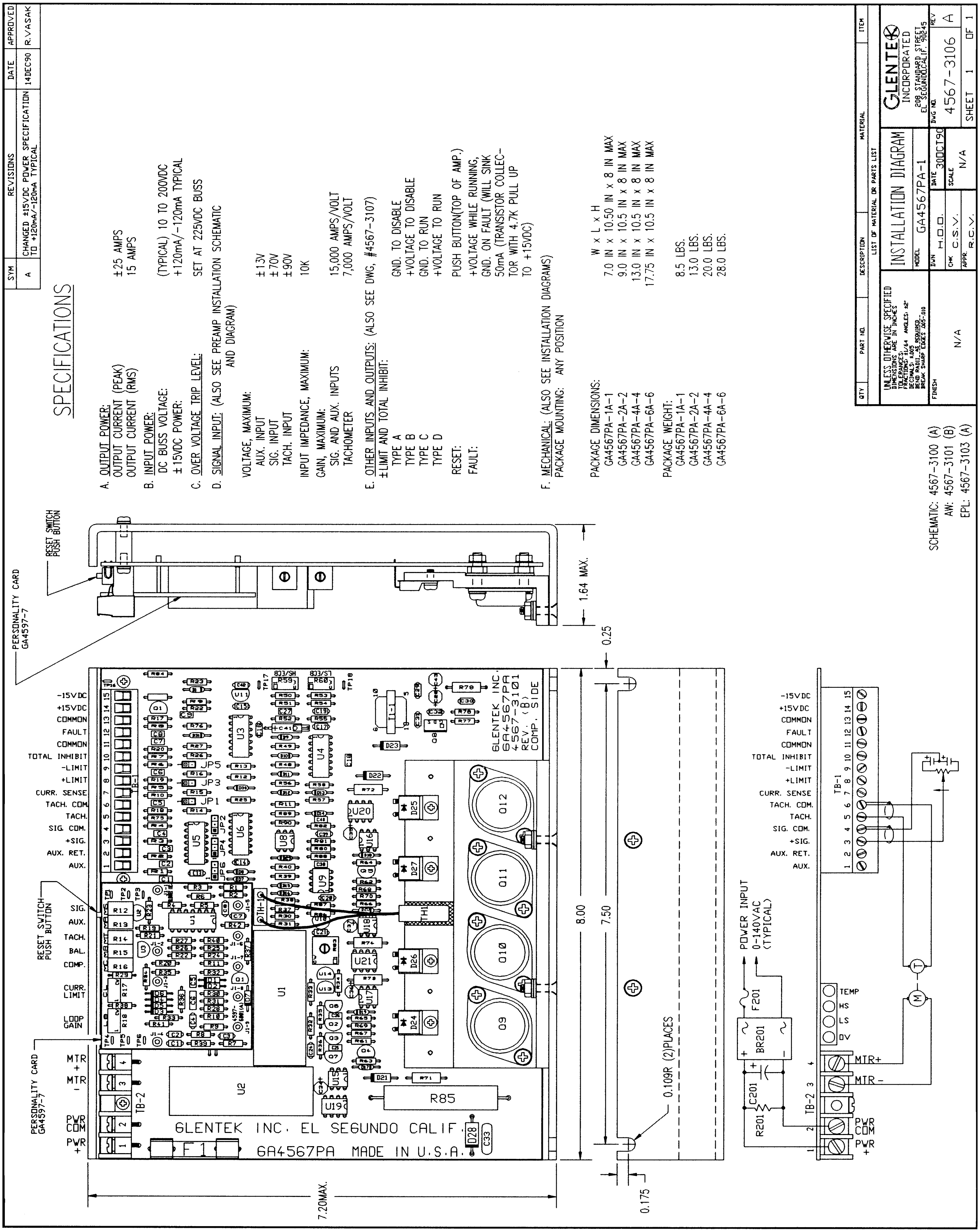


±LIMIT AND TOTAL INHIBIT JUMPER PROGRAMING TABLE

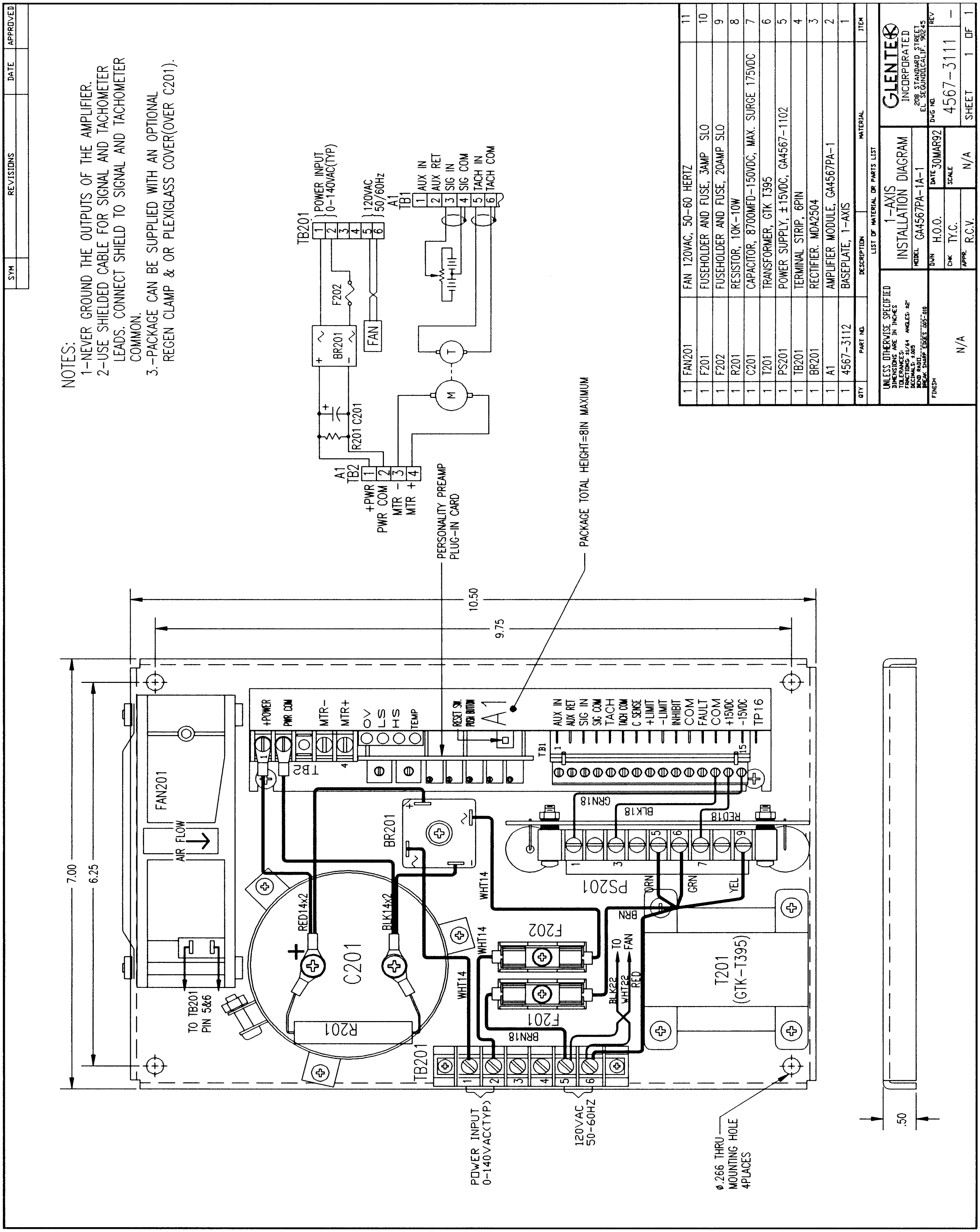
A "1" INDICATES AN INSTALLED JUMPER

	+LIMIT			-LIMIT			TOTAL INHIBIT		
	JP1	JP2(1&2)	JP2(2&3)	JP3	JP4(1&2)	JP4(2&3)	JP5	JP6(1&2)	JP6(2&3)
TYPE "A" GND TO DISABLE	1	1	0	1	1	0	1	1	0
TYPE "B" +VOLTAGE TO DISABLE	0	0	1	0	0	1	0	0	1
TYPE "C" GND TO RUN	1	0	1	1	0	1	1	0	1
TYPE "D" +VOLTAGE TO RUN	0	1	0	0	1	0	0	1	0

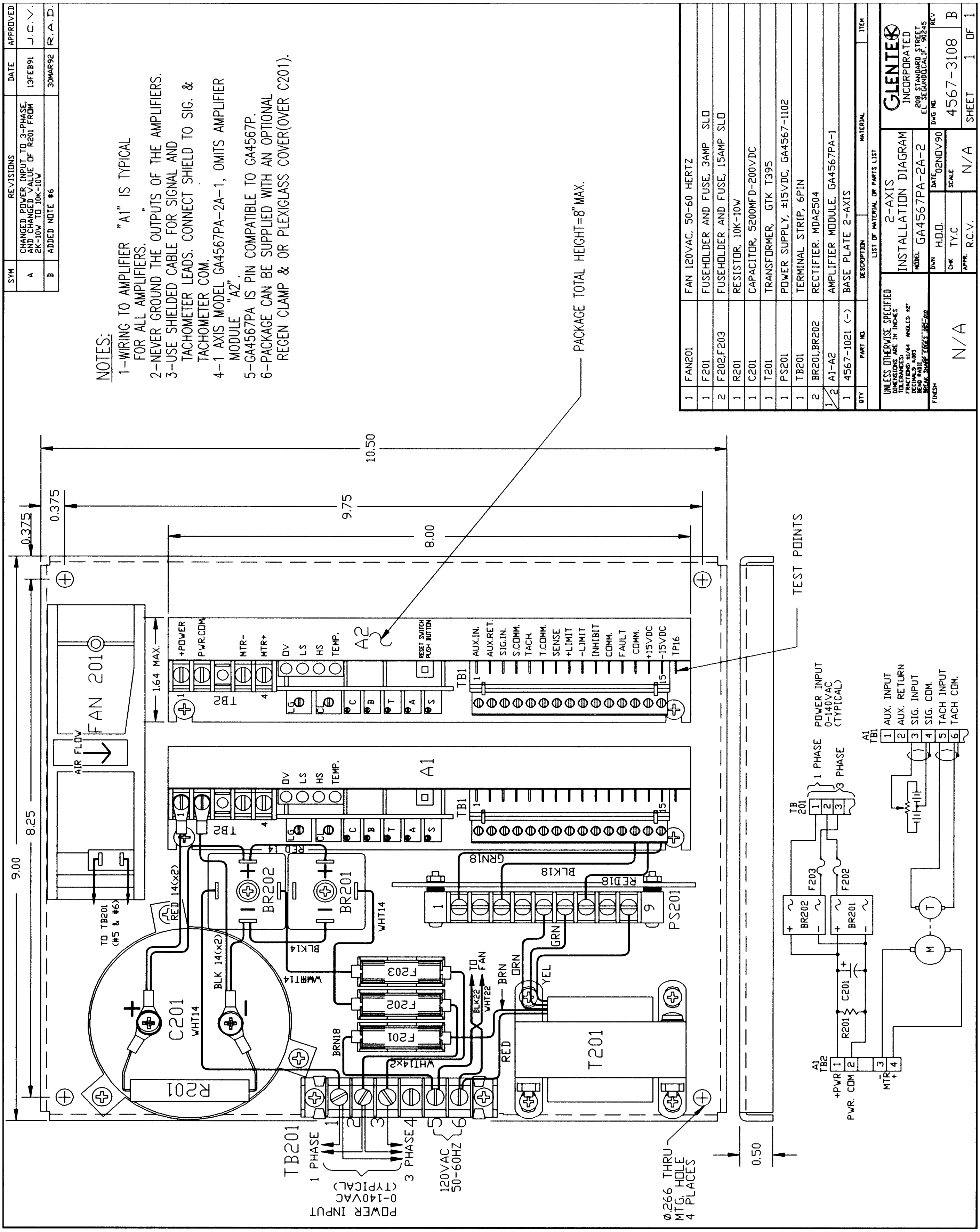
MODEL: GA4567PA



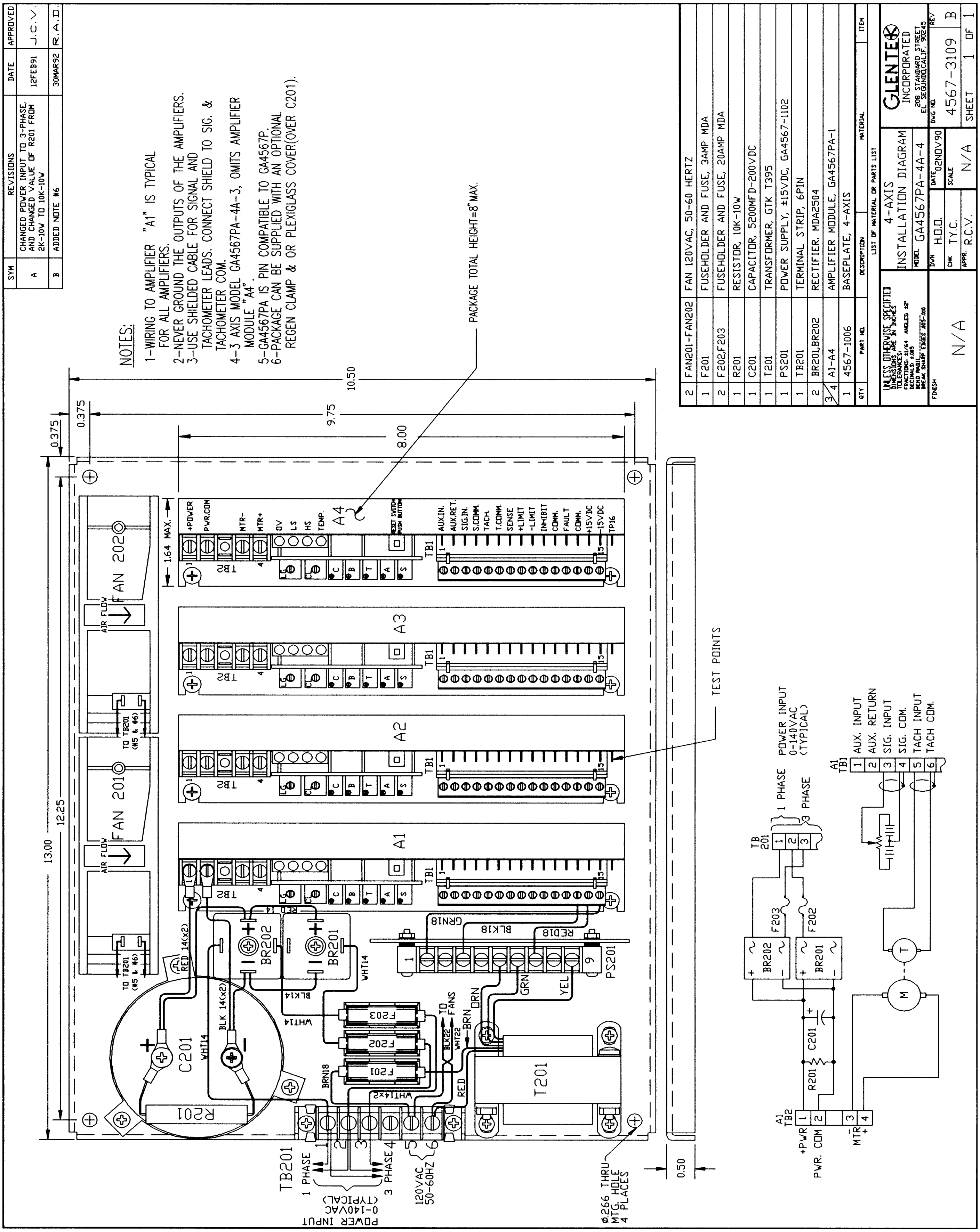
MODEL: GA4567PA-1A-1



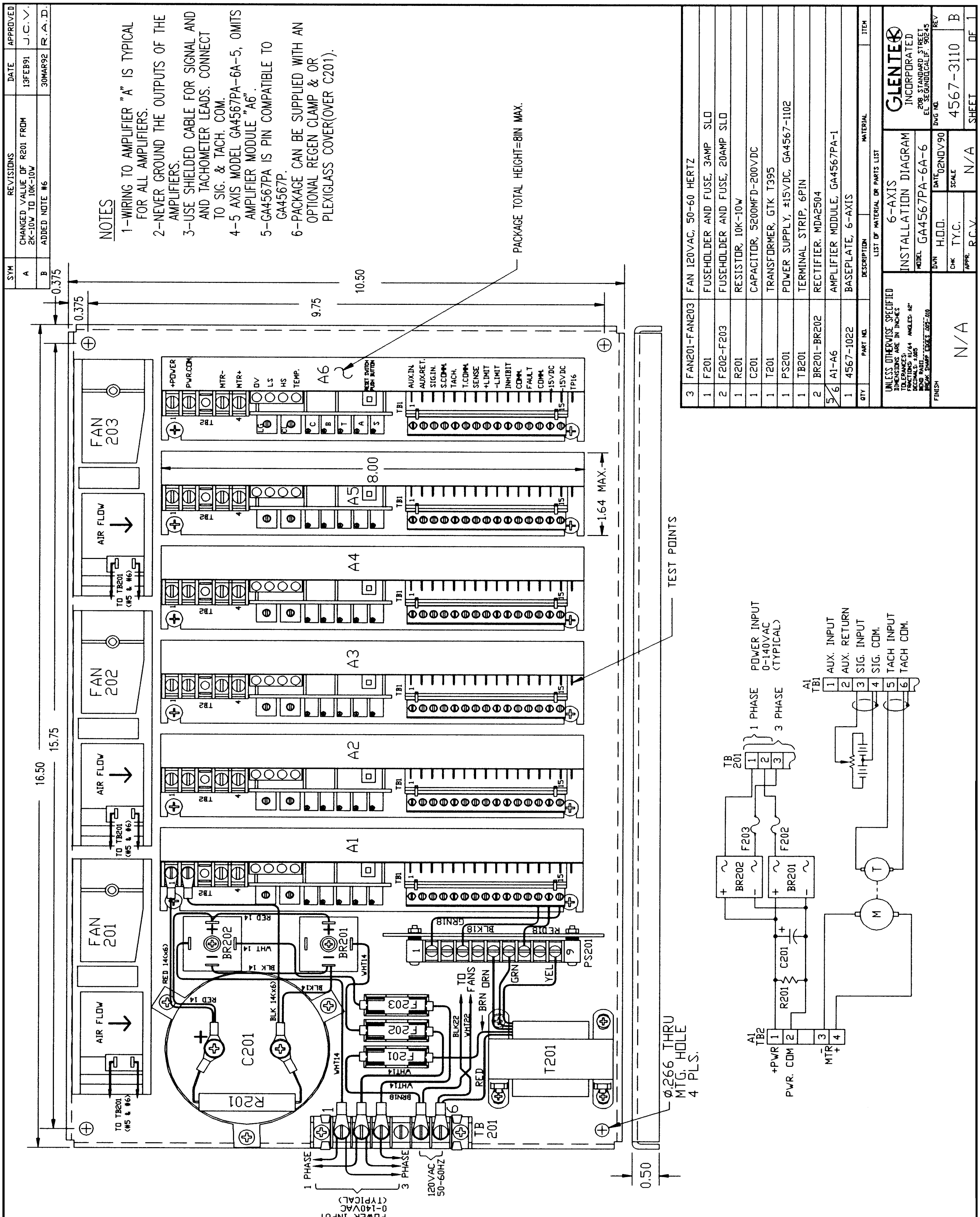
MODEL: GA4567PA-2A-2



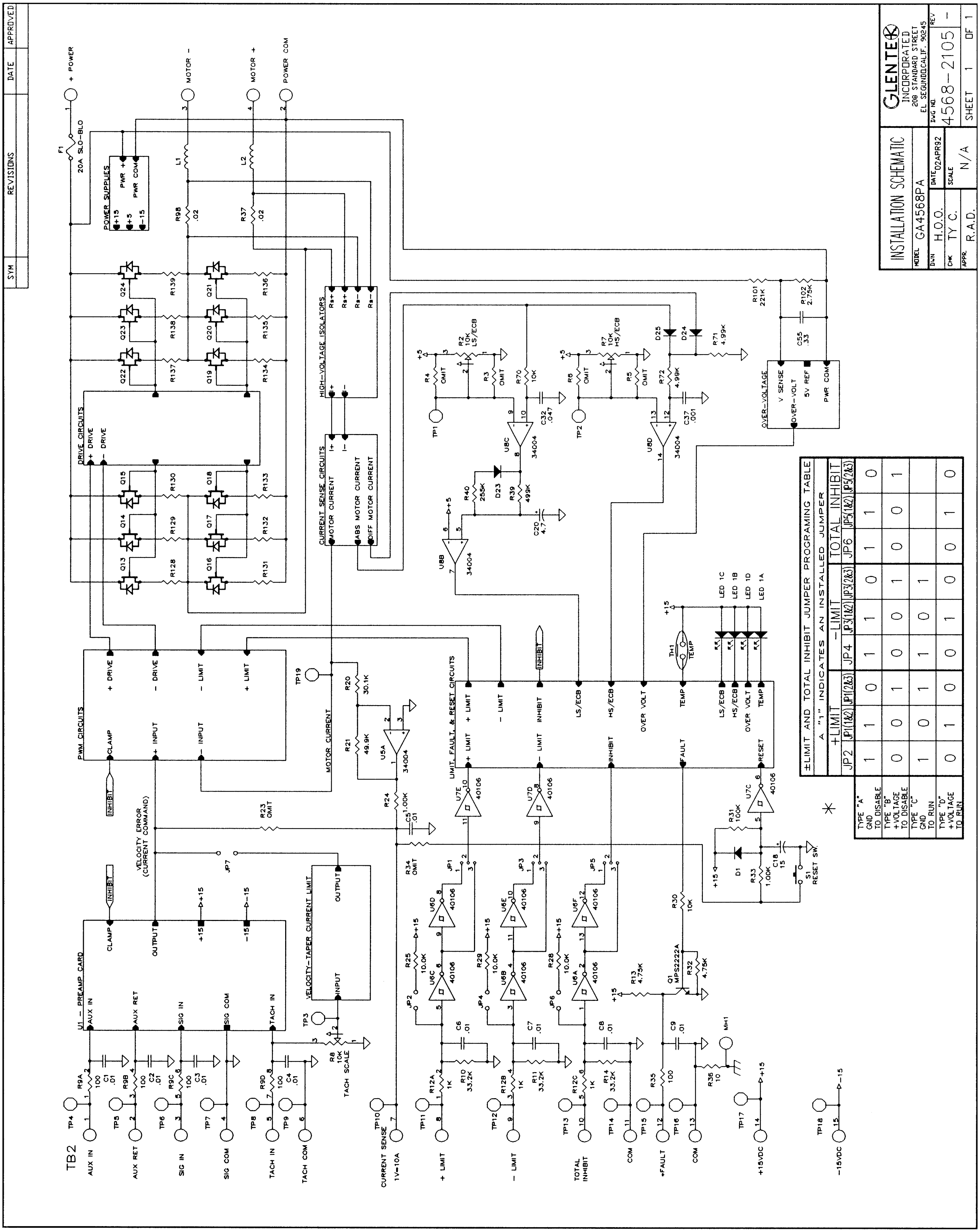
MODEL: GA4567PA-4A-4



MODEL: GA4567PA-6A-6



MODEL: GA4568PA

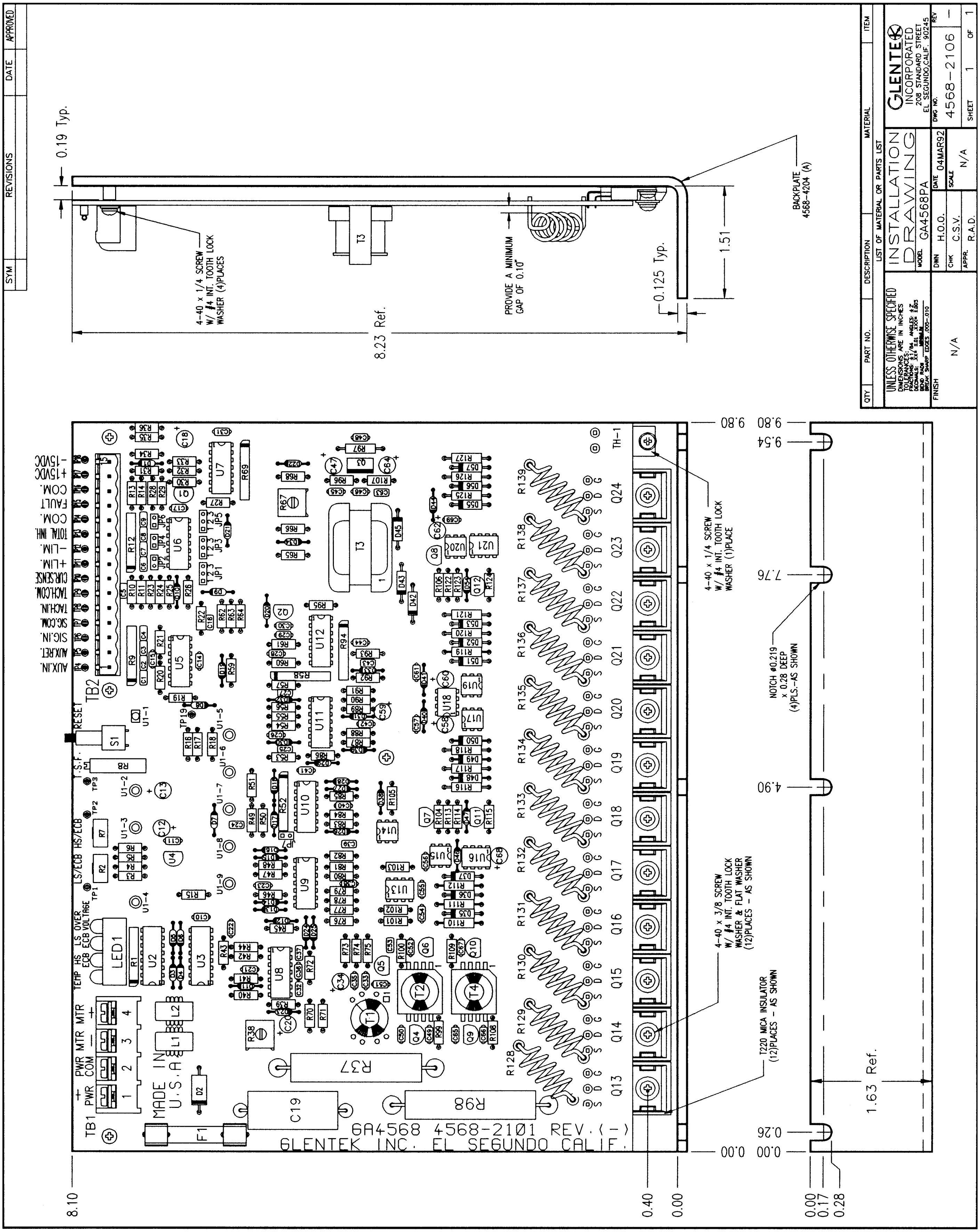


±LIMIT AND TOTAL INHIBIT JUMPER PROGRAMING TABLE

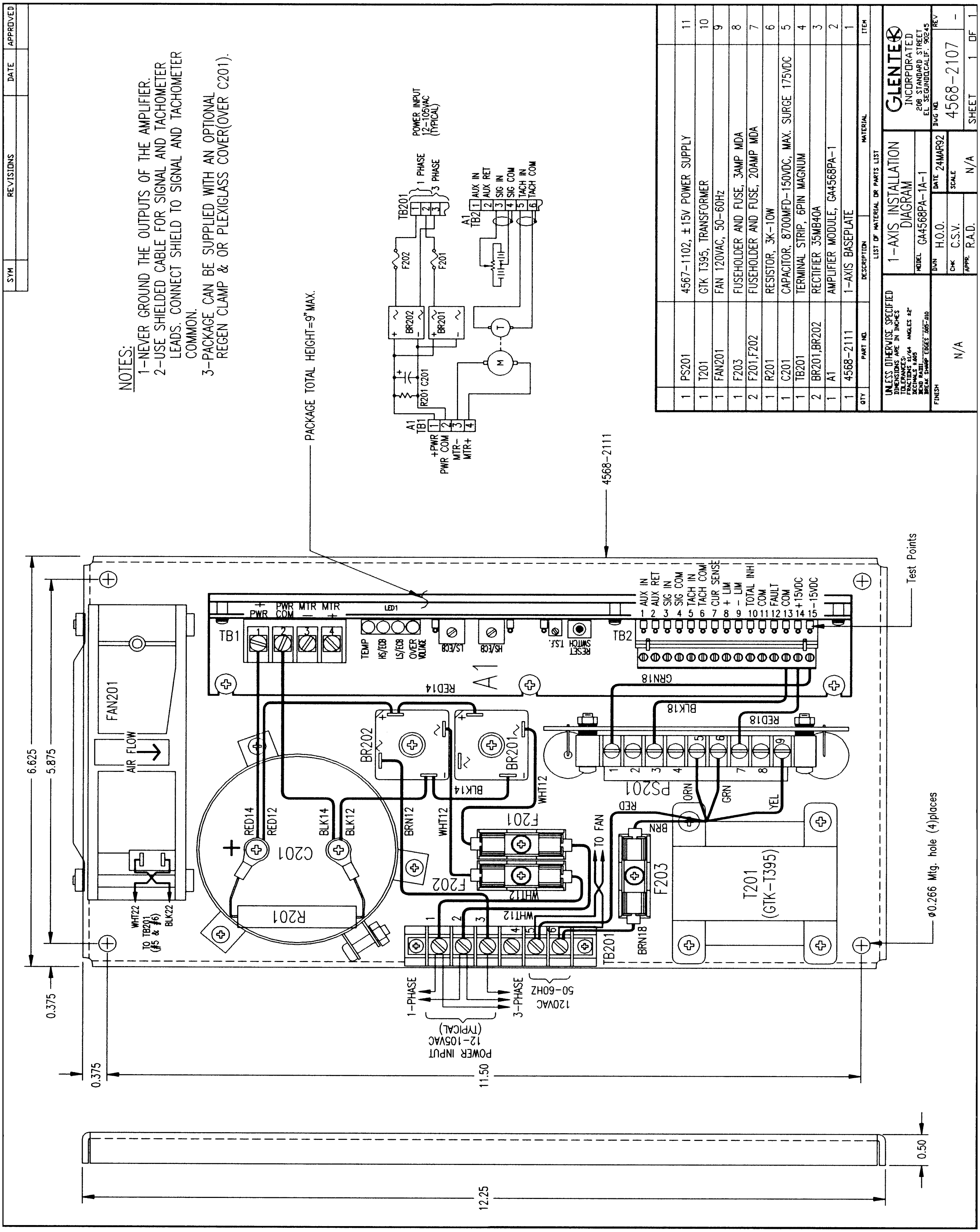
A "1" INDICATES AN INSTALLED JUMPER

	+LIMIT			−LIMIT			TOTAL INHIBIT		
	JP2	JP1(1&2)	JP1(2&3)	JP4	JP3(1&2)	JP3(2&3)	JP6	JP5(1&2)	JP5(2&3)
TYPE "A" GND TO DISABLE	1	1	0	1	1	0	1	1	0
TYPE "B" +VOLTAGE TO DISABLE	0	0	1	0	0	1	0	0	1
TYPE "C" GND TO RUN	1	0	1	1	0	1			
TYPE "D" +VOLTAGE TO RUN	0	1	0	0	1	0	0	1	0

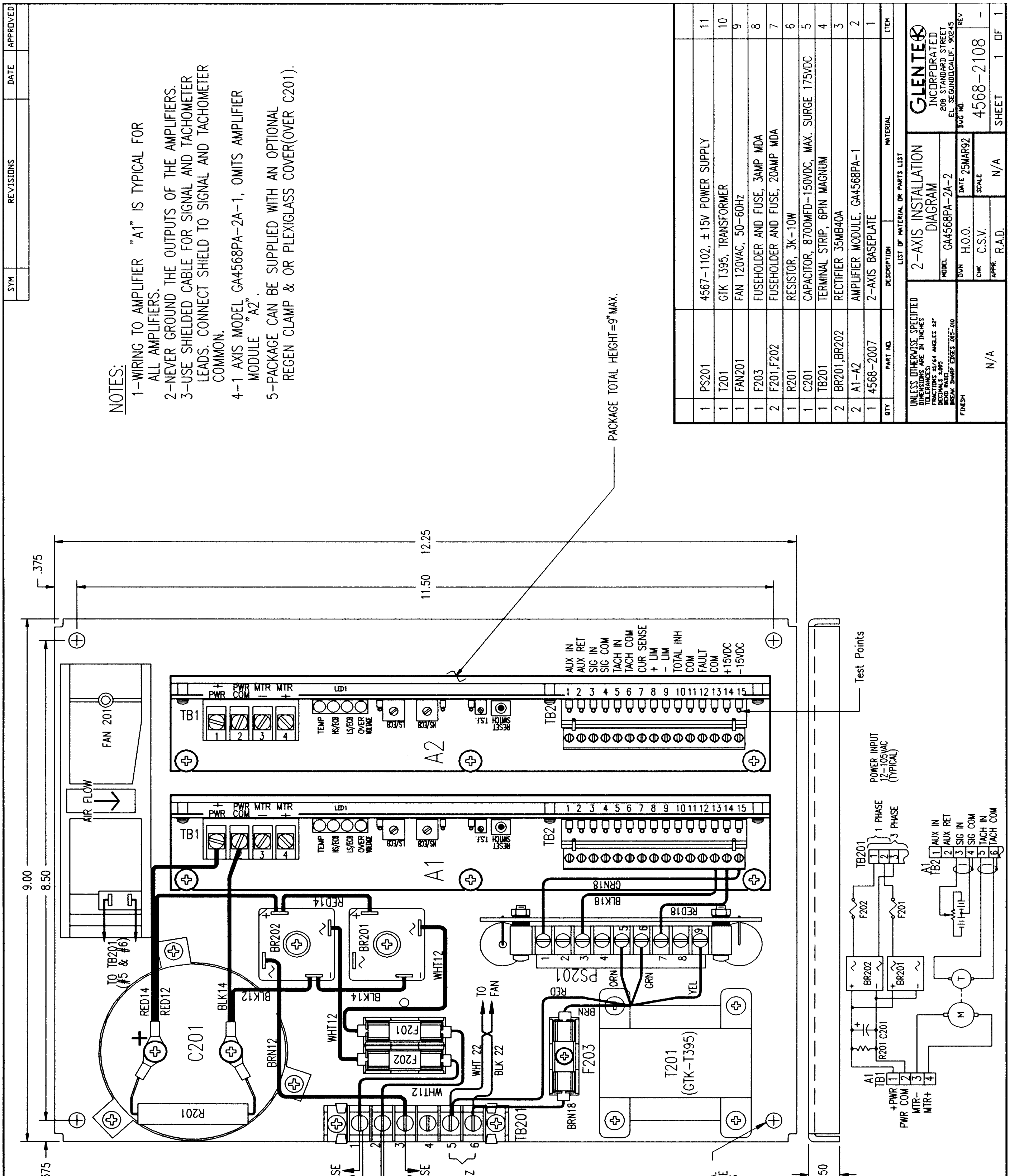
MODEL: GA4568PA



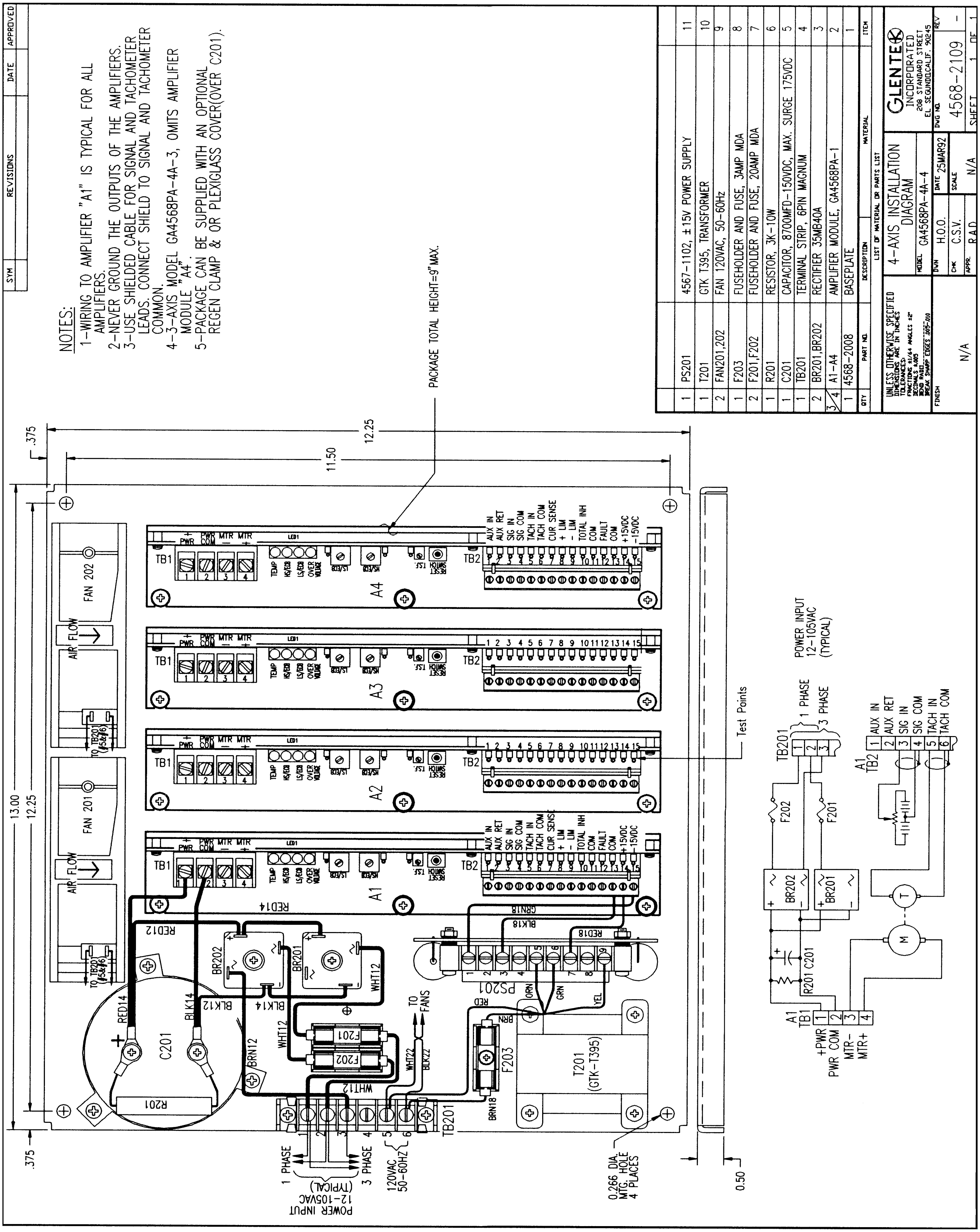
MODEL: GA4568PA-1A-1



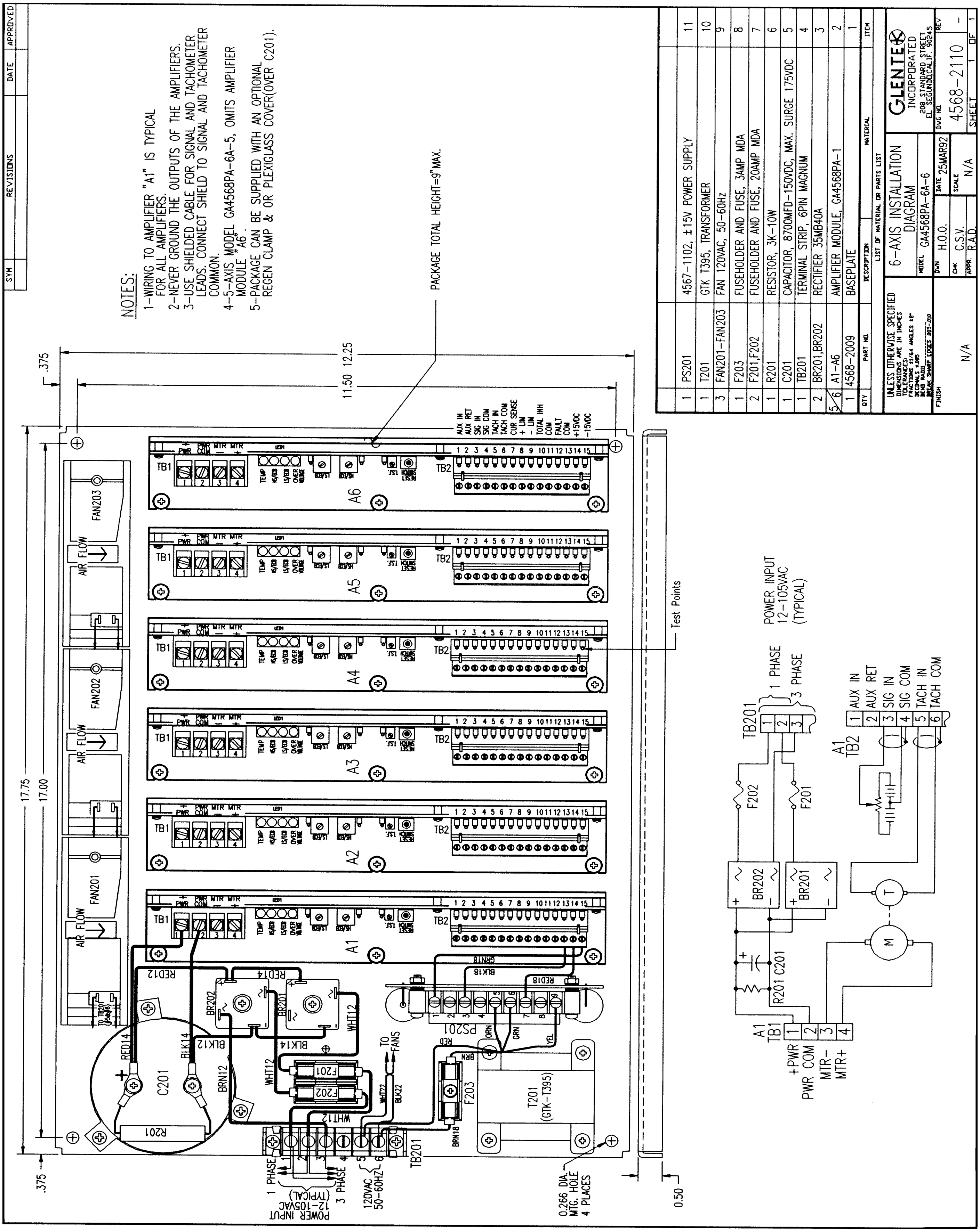
MODEL: GA4568PA-2A-2



MODEL: GA4568PA-4A-4



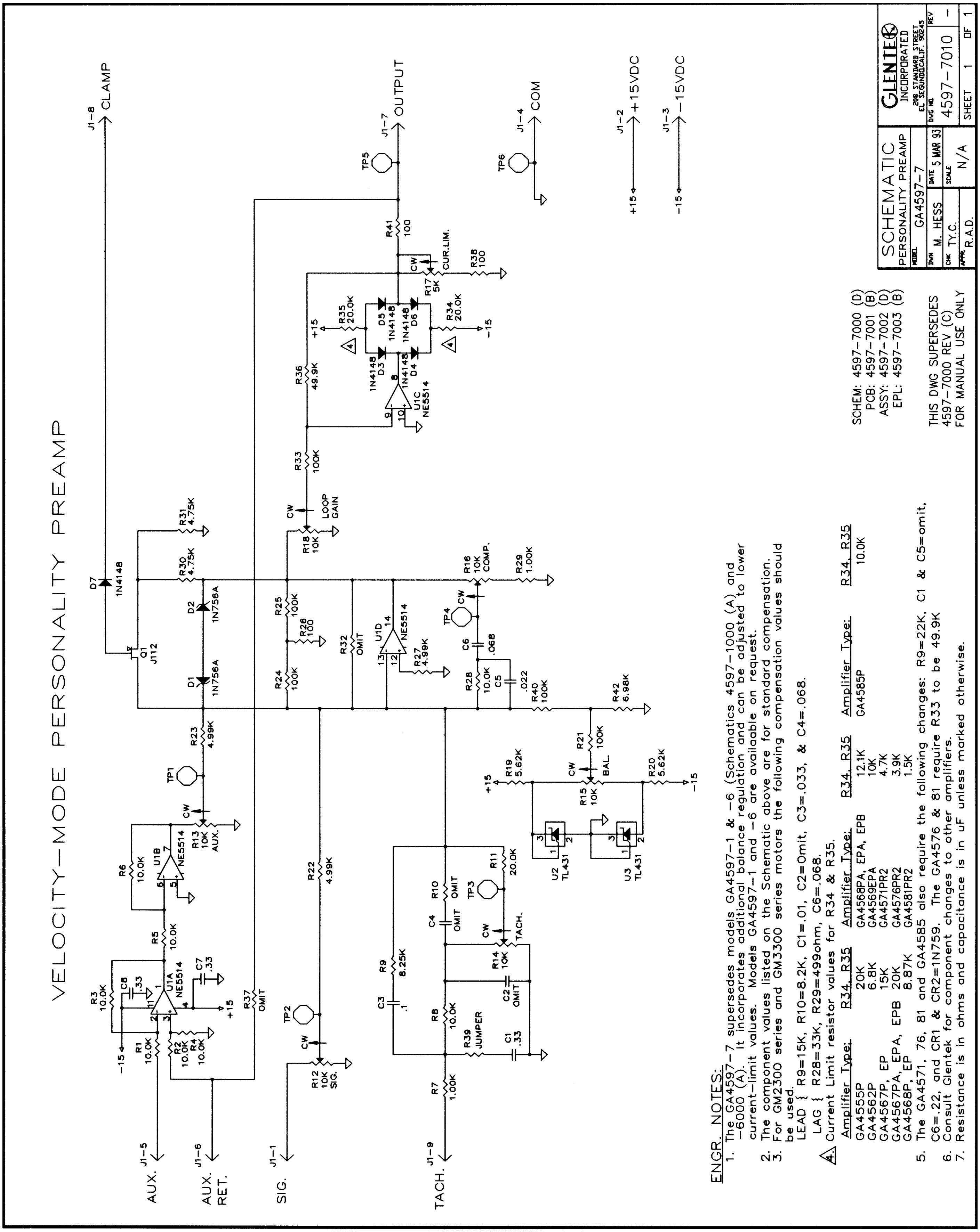
MODEL: GA4568PA-6A-6



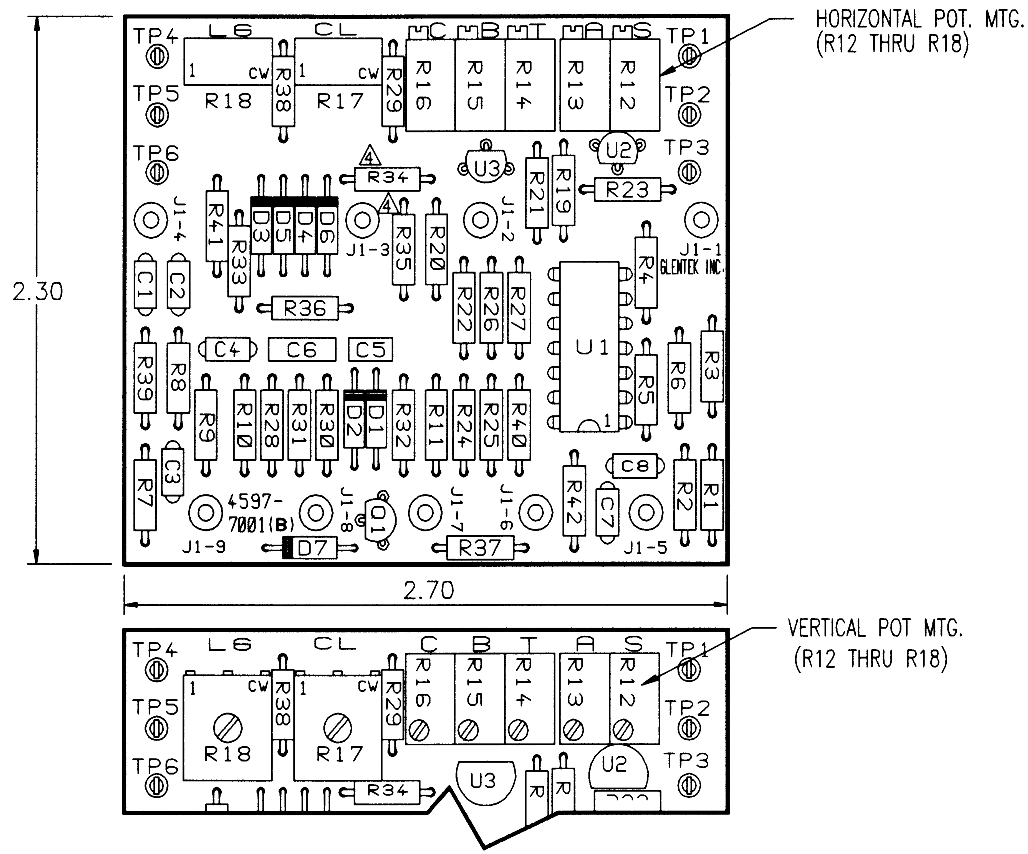
QTY	PART NO.	DESCRIPTION	MATERIAL	ITEM
1	PS201	4567-1102, ±15V POWER SUPPLY		11
1	T201	GTK T395, TRANSFORMER		10
3	FAN201-FAN203	FAN 120VAC, 50-60Hz		9
1	F203	FUSEHOLDER AND FUSE, 3AMP MDA		8
2	F201,F202	FUSEHOLDER AND FUSE, 20AMP MDA		7
1	R201	RESISTOR, 3K-10W		6
1	C201	CAPACITOR, 8700MFD-150VDC, MAX. SURGE 175VDC		5
1	TB201	TERMINAL STRIP, 6PIN MAGNUM		4
2	BR201,BR202	RECTIFIER 35MB40A		3
6	A1-A6	AMPLIFIER MODULE, GA4568PA-1		2
1	4568-2009	BASEPLATE		1

APPENDIX C

PERSONALITY PREAMP


VELOCITY–MODE PERSONALITY PREAMP
AUX.
AUX. RET.
SIG.
TACH.
CLAMP
OUTPUT
COM
+15VDC
−15VDC
ENGR. NOTES:
1. The GA4597−7 supersedes models GA4597−1 & −6 (Schematics 4597−1000 (A) and −6000 (A). It incorporates additional balance regulation and can be adjusted to lower current−limit values. Models GA4597−1 and −6 are available on request.
2. The component values listed on the Schematic above are for standard compensation.
3. For GM2300 series and GM3300 series motors the following compensation values should be used.
LEAD { R9=15K, R10=8.2K, C1=.01, C2=Omit, C3=.033, & C4=.068.
LAG { R28=33K, R29=499ohm, C6=.068.
4. Current Limit resistor values for R34 & R35.
Amplifier Type: R34, R35 | Amplifier Type: R34, R35 | Amplifier Type: R34, R35
GA4555P 20K | GA4568PA, EPA, EPB 12.1K | GA4585P 10.0K
GA4562P 6.8K | GA4569EPA 10K
GA4567P, EP 15K | GA4571PR2 4.7K
GA4567PA, EPA, EPB 20K | GA4576PR2 3.9K
GA4568P, EP 8.87K | GA4581PR2 1.5K
5. The GA4571, 76, 81 and GA4585 also require the following changes: R9=22K, C1 & C5=omit, C6=.22, and CR1 & CR2=1N759. The GA4576 & 81 require R33 to be 49.9K
6. Consult Glentek for component changes to other amplifiers.
7. Resistance is in ohms and capacitance is in uF unless marked otherwise.
SCHEM: 4597−7000 (D)
PCB: 4597−7001 (B)
ASSY: 4597−7002 (D)
EPL: 4597−7003 (B)
THIS DWG SUPERSEDES 4597−7000 REV (C) FOR MANUAL USE ONLY
SCHEMATIC PERSONALITY PREAMP
MODEL GA4597−7
DWN M. HESS
DATE 5 MAR 93
CHK TY.C.
SCALE N/A
APPR. R.A.D.
GLENTEK INCORPORATED 208 STANDARD STREET EL SEGUNDO, CALIF. 90245
DWG NO. 4597−7010
REV −
SHEET 1 OF 1

VELOCITY−MODE PERSONALITY PREAMP



SCHEM: 4597−7000 (D)
PCB: 4597−7001 (B)
ASSY: 4597−7002 (D)
EPL: 4597−7003 (B)

LAST USED

C8	R42
D7	TP6
Q1	U3
RV7	P9

THIS DWG SUPERSEDES
4597−7002 REV (C)
FOR MANUAL USE ONLY

QTY	PART NO.	DESCRIPTION	MATERIAL	ITEM
2	U2, U3	TL431 CLP (T092 PKG.)		30
1	U1	NE5514 QUAD OP−AMP		29
1	TP6	TESTPOINT SPCJ−123−03		28
6	TP1−TP5	TESTPOINT SPCJ−123−01		27
3	R10,R32,R37	OMIT		26
1	R42	6.98K 1% 1/4W		25
1	R39	JUMPER		24
1	R36	49.9K 1% 1/4W		23
2	R30,R31	4.75K 1% 1/4W		22
3	R26,R38,R41	100 1% 1/4W		21
3	R22,R23,R27	4.99K 1% 1/4W		20
5	R21,R24,R25 R33,R40	100K 1% 1/4W		19
2	R19,R20	5.62K 1% 1/4W		18
1	R18	10K POT 63WR10K OR 63PR10K		17
1	R17	5K POT 63XR5K OR 63PR5K		16
5	R12−R16	10K POT 68XR10K OR 68WR10K		15
1	R11	20.0K 1% 1/4W		14
2	R34,R35	SEE NOTE 4		13
1	R9	8.25K 1% 1/4W		12
2	R7,R29	1.00K 1% 1/4W		11
8	R1−R6,R8,R28	10.0K 1% 1/4W		10
1	Q1	J112		9
9	J1−1 TO J1−9	CONCORD PIN #10−892−2−03		8
5	D3−D7	1N4148		7
2	D1,D2	1N756A 8.2V ZENER		6
1	C6	.068uF DIPPED CERAMIC		5
1	C5	.022uF DIPPED CERAMIC		4
1	C3	.1uF DIPPED CERAMIC		3
2	C2,C4	OMIT		2
3	C1,C7,C8	.33uF DIPPED CERAMIC		1

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
FRACTIONS: ±1/64 ANGLES: ±2°
DECIMALS: ±.005
BEND RADII MINIMUM
BREAK SHARP EDGES .005−.010

FINISH

BOARD ASSEMBLY
PERSONALITY PREAMP
MODEL GA4597−7

DWN M. HESS | DATE 24 MAR 93
CHK TY C. | SCALE FULL
APPR. M.E.V.

GLENTEK
INCORPORATED
208 STANDARD STREET
EL SEGUNDO,CALIF. 90245

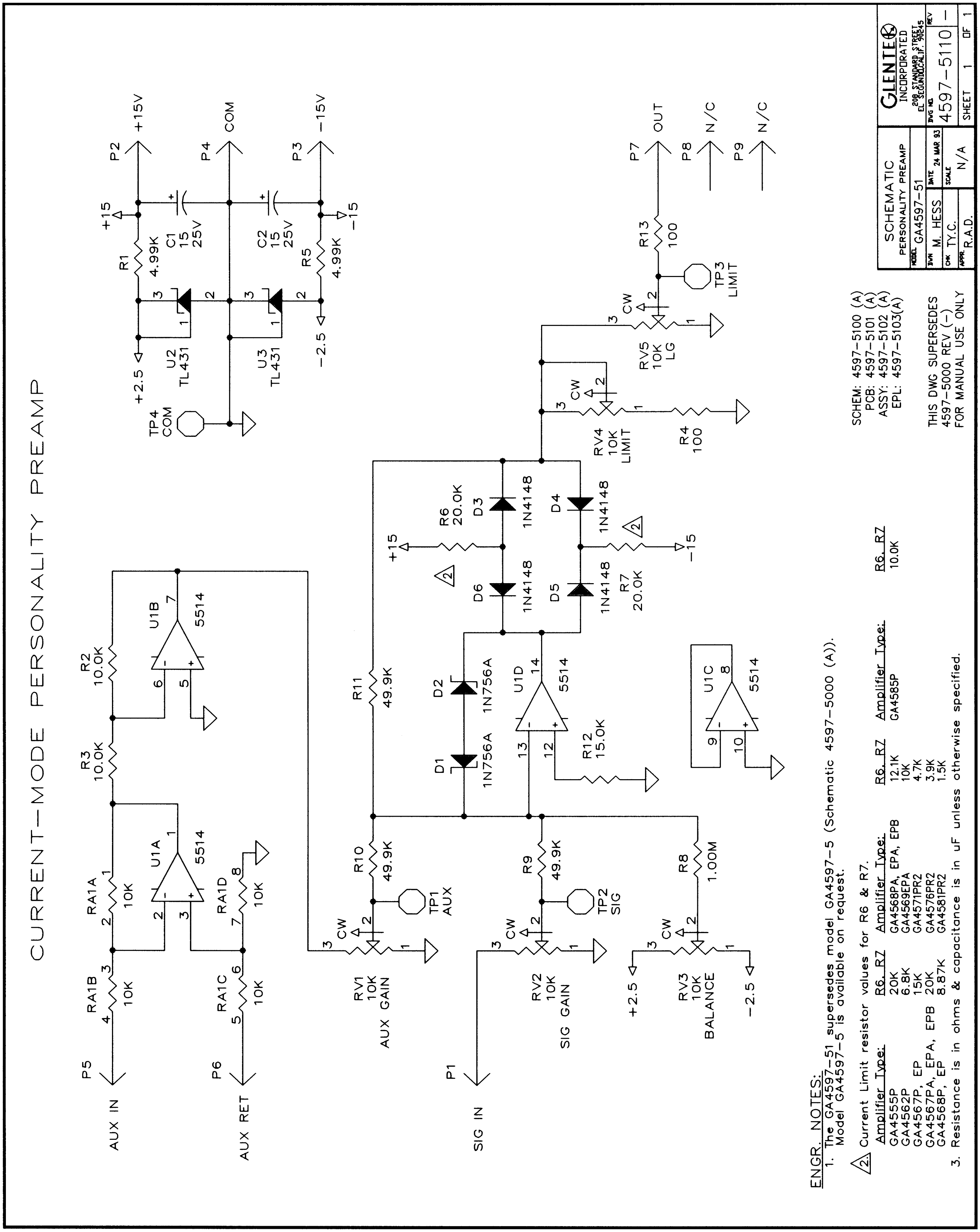
DWG NO. 4597−7012 REV −
SHEET 1 OF 1

ENGR. NOTES:

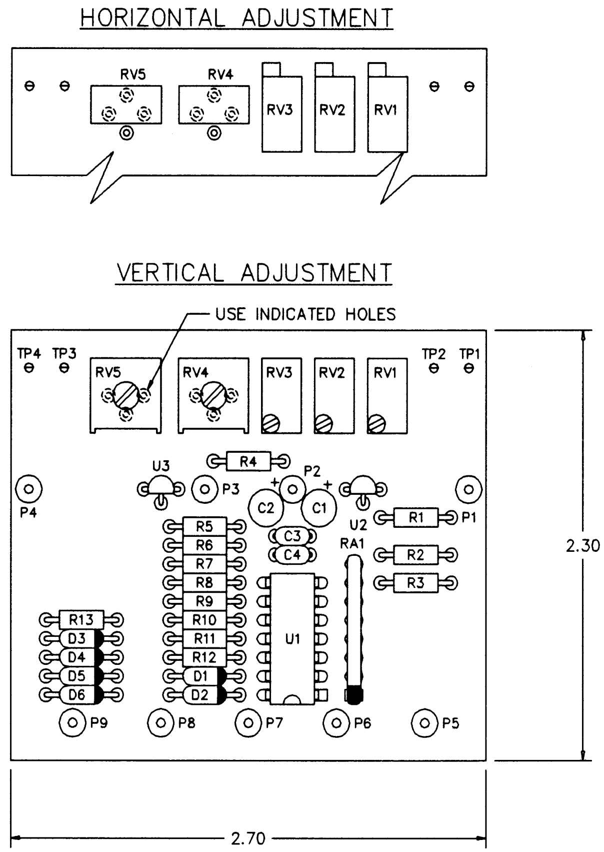
1. The GA4597−7 supersedes models GA4597−1 & −6 (Schematics 4597−1000 (A) and −6000 (A). It incorporates additional balance regulation and can be adjusted to lower current−limit values. Models GA4597−1 and −6 are available on request.
2. The component values listed on the Schematic above are for standard compensation.
3. For GM2300 series and GM3300 series motors the following compensation values should be used.
   LEAD { R9=15K, R10=8.2K, C1=.01, C2=Omit, C3=.033, & C4=.068.
   LAG { R28=33K, R29=499ohm, C6=.068.
4. Current Limit resistor values for R34 & R35.

Amplifier Type:	R34, R35	Amplifier Type:	R34, R35	Amplifier Type:	R34, R35
GA4555P	20K	GA4568PA, EPA, EPB	12.1K	GA4585P	10.0K
GA4562P	6.8K	GA4569EPA	10K		
GA4567P, EP	15K	GA4571PR2	4.7K		
GA4567PA, EPA, EPB	20K	GA4576PR2	3.9K		
GA4568P, EP	8.87K	GA4581PR2	1.5K		

5. The GA4571, 76, 81 and GA4585 also require the following changes: R9=22K, C1 & C5=omit, C6=.22, and CR1 & CR2=1N759. The GA4576 & 81 require R33 to be 49.9K
6. Consult Glentek for component changes to other amplifiers.
7. Resistance is in ohms & capacitance is in uF unless otherwise specified.


CURRENT-MODE PERSONALITY PREAMP
GLENTEK INCORPORATED 208 STANDARD STREET EL SEGUNDO, CALIF. 90245
SCHEMATIC PERSONALITY PREAMP
MODEL GA4597-51
DWN M. HESS
CHK TY.C.
APPR R.A.D.
DATE 24 MAR 93
SCALE N/A
DWG NO 4597-5110
REV –
SHEET 1 OF 1
SCHEM: 4597-5100 (A)
PCB: 4597-5101 (A)
ASSY: 4597-5102 (A)
EPL: 4597-5103(A)
THIS DWG SUPERSEDES 4597-5000 REV (–) FOR MANUAL USE ONLY
ENGR. NOTES:
1. The GA4597-51 supersedes model GA4597-5 (Schematic 4597-5000 (A)). Model GA4597-5 is available on request.
2. Current Limit resistor values for R6 & R7.
Amplifier Type: R6, R7
GA4555P 20K
GA4562P 6.8K
GA4567P, EP 15K
GA4567PA, EPA, EPB 20K
GA4568P, EP 8.87K
GA4568PA, EPA, EPB 12.1K
GA4569EPA 10K
GA4571PR2 4.7K
GA4576PR2 3.9K
GA4581PR2 1.5K
GA4585P 10.0K
3. Resistance is in ohms & capacitance is in uF unless otherwise specified.
AUX IN
AUX RET
SIG IN
P1
P2 +15V
P3 –15V
P4 COM
P5
P6
P7 OUT
P8 N/C
P9 N/C
TP1 AUX
TP2 SIG
TP3 LIMIT
TP4 COM
RV1 10K AUX GAIN
RV2 10K SIG GAIN
RV3 10K BALANCE
RV4 10K LIMIT
RV5 10K LG
U1A 5514
U1B 5514
U1C 5514
U1D 5514
U2 TL431
U3 TL431
D1 1N756A
D2 1N756A
D3 1N4148
D4 1N4148
D5 1N4148
D6 1N4148
C1 15 25V
C2 15 25V

CURRENT—MODE PERSONALITY PREAMP



SCHEM: 4597-5100 (A)
PCB: 4597-5101 (A)
ASSY: 4597-5102 (A)
EPL: 4597-5103(A)

LAST USED

C4	R13
D6	TP4
RA1	U3
RV5	P9

THIS DWG SUPERSEDES
4597-5002 REV (A)
FOR MANUAL USE ONLY

QTY	PART NO.	DESCRIPTION	MATERIAL	ITEM
2	U2,U3	TL431		19
1	U1	NE5514		18
1	TP4	TEST POINT, SPCJ-123-03		17
3	TP1-TP3	TEST POINT, SPCJ-123-01		16
1	R12	15.0K 1% 1/4W		15
3	R9-R11	49.9K 1% 1/4W		14
1	R8	1.00M 1% 1/4W		13
2	R6,R7	SEE NOTE 2		12
2	R4,R13	100 1% 1/4W		11
2	R2,R3	10.0K 1% 1/4W		10
2	R1,R5	4.99K 1% 1/4W		9
2	RV4,RV5	10K POT 63XR10K OR 63PR10K		8
3	RV1-RV3	10K POT 68XR10K OR 68WR10K		7
1	RA1	10K 8-PIN 4-RES ARRAY		6
9	P1-P9	PIN, CONCORD 10-892-2-03		5
4	D3-D6	1N4148		4
2	D2,D1	1N756A		3
2	C3,C4	.33uF DIPPED CERAMIC		2
2	C1,C2	15uF 25V DIPPED TANTALUM		1

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
TOLERANCES:
FRACTIONS: ±1/64 ANGLES: ±2°
DECIMALS: ±.005
BEND RADII_MINIMUM_____
BREAK SHARP EDGES .005-.010

FINISH

BOARD ASSEMBLY
PERSONALITY PREAMP
MODEL GA4597-51

DWN M. HESS DATE 24 MAR 93
CHK TY C. SCALE FULL
APPR. M.E.V.

GLENTEK
INCORPORATED
208 STANDARD STREET
EL SEGUNDO,CALIF. 90245

DWG NO. 4597-5112 REV –
SHEET 1 OF 1

ENGR. NOTES:

1. The GA4597-51 supersedes model GA4597-5 (Schematic 4597-5000 (A)). Model GA4597-5 is available on request.

2. Current Limit resistor values for R6 & R7.

Amplifier Type:	R6, R7	Amplifier Type:	R6, R7	Amplifier Type:	R6, R7
GA4555P	20K	GA4568PA, EPA, EPB	12.1K	GA4585P	10.0K
GA4562P	6.8K	GA4569EPA	10K		
GA4567P, EP	15K	GA4571PR2	4.7K		
GA4567PA, EPA, EPB	20K	GA4576PR2	3.9K		
GA4568P, EP	8.87K	GA4581PR2	1.5K		

3. Resistance is in ohms & capacitance is in uF unless otherwise specified.

NOTES

Omega Series Digital PWM Brushless Servo Amplifiers

- PWM (Pulse-Width-Modulated) Brushless servo amplifiers to 20KW

Analog Brush Type Servo Amplifiers

- Linear Brush type servo amplifiers to 2.6KW
- PWM (Pulse-Width-Modulated) Brush type servo amplifiers to 28KW

Analog Brushless Servo Amplifiers

- Linear Brushless servo amplifiers to 3.5KW
- PWM (Pulse-Width-Modulated) Brushless servo amplifiers to 51KW

Permanent Magnet DC Brush Type Servo Motors

- Continuous Torques to 335 in. lb.
- Peak Torques to 2100 in. lb.

Permanent Magnet DC Brushless Servo Motors

- Continuous Torques to 1100 in. lb.
- Peak Torques to 2200 in. lb.

GLENTEK
"Solutions for Motion Control"

MANUAL#: 4567-3140-000
REVISION: (C)
DATE: 15 May 2002

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