OPERATION
&
SERVICE MANUAL

Model GA4571PR2
Model GA4576PR2
Model GA4581PR2
Model GA4582PR2

Pulse Width Modulated
Servo Amplifier

GLENTEK

"Solutions for Motion Control"

OPERATION AND SERVICE MANUAL

FOR MODEL GA45 - 71PR2 - 76PR2 - 81PR2 - 82PR2

TABLE OF CONTENTS

CHAPTER THREE: PERSONALITY PREAMP CARD

CHAPTER FOUR: THEORY OF OPERATION

CHAPTER FIVE: INSTALLATION PROCEDURE

APPENDIX B: AMPLIFIER DRAWINGS

APPENDIX C: PERSONALITY PREAMP

CHAPTER ONE: INTRODUCTION

NOTE: For clarity, the GA4571PR2, GA4576PR2, GA4581PR2, and GA4582PR2 are referred to simply as the GA45xxPR2 throughout this manual. Where differences exist between the models, they are referred to by their specific model numbers.

1.1 INTRODUCTION TO THE GA45xxPR2 MANUAL:

This manual is intended for use with Glentek's TORQUE~SWITCH™ series of pulse-width-modulated (PWM) servo amplifiers, models GA4571PR2, GA4576PR2, GA4581PR2, and GA4582PR2. 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 can not 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 38 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, MODEL NUMBERING, and SPECIFICATIONS

2.1 DESCRIPTION OF THE GA45xxPR2:

The GA45xxPR2 is a modular, very high power, high bandwidth, PWM, servo amplifier 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 de-manding applications.

2.2 MODEL NUMBERING INFORMATION AND AVAILABLE OPTIONS:

2.2.1 MODEL NUMBERING:

The basic model number for these amplifiers is GA45xxPR2 where xx may be replaced by 71, 76, 81, or 82. These amplifiers differ only in their power output and physical size (see specifications, section 2.4). The P indicates the presence of a plug-in personality card. The R2 indicates two fault relays are used (see protection circuits, section 2.3). Consult Glentek for any special requirements.

In this example, the model is a GA4571PR2. The XXX is the amplifier configuration code:

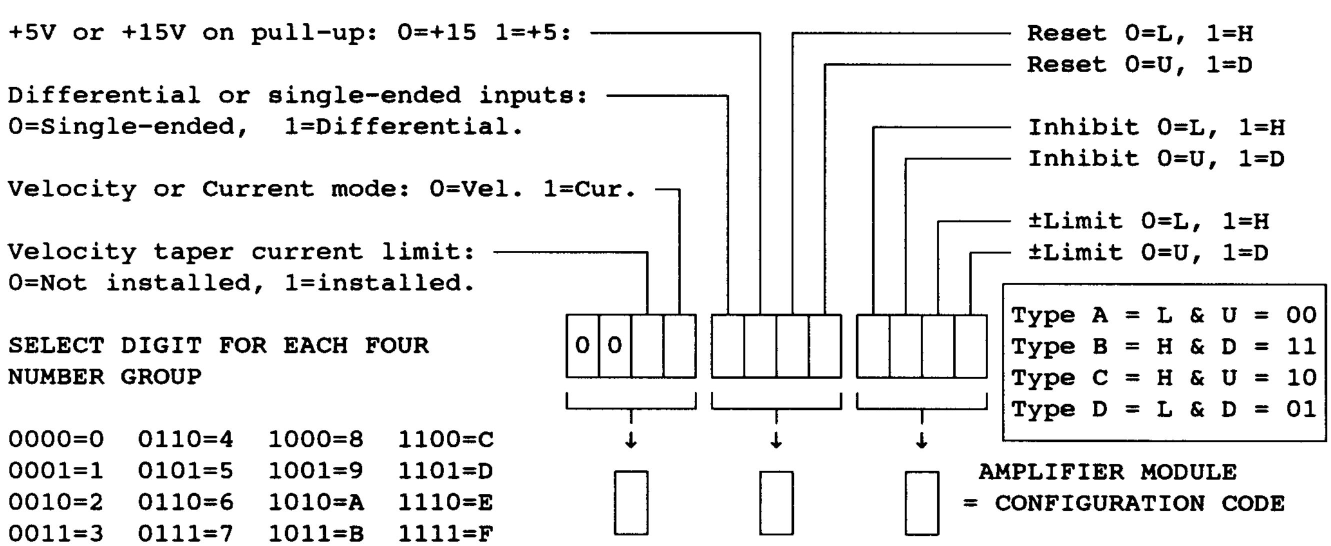
GA4571PR2-XXX

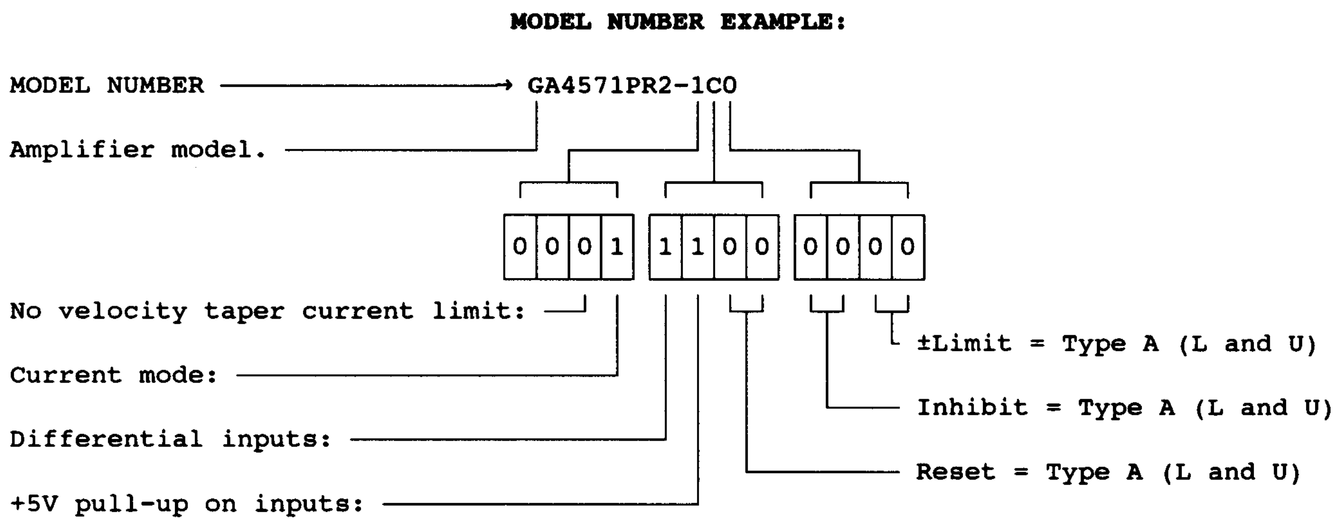
Amplifier model — Amplifier configuration code

The three digits of the configuration code set amplifier options, such as the inhibit configuration. Most of these options are user configurable. However, if you would prefer to have Glentek pre-configure your units, a configuration code may be constructed as shown below.

When constructing the configuration code, choose the desired configuration for each option and enter a "0" or a "1" in the box provided. When all the boxes are filled, convert the 12-digit number to a 3-digit number using the table provided.

AMPLIFIER CONFIGURATION CODE





2.2.2 VELOCITY - MODE OR CURRENT- MODE OPTIONS:

The GA45xxPR2 is most often used to close a critically-damped velocity-loop using a DC tachometer for velocity feedback. However, this high-gain, summing amplifier can be bypassed to provide an input directly to the current-loop amplifier (Refer to Appendix C, drawings 4597-7010 & 4597-7012). If the amplifier is ordered with a Current Mode option, the dedicated Current Mode Personality Preamp Card will be used. (Refer to Appendix C, drawings 4597-5110 & 4597-5112)

2.2.3 LOGIC-INPUT CONFIGURATION:

There are four logic inputs: ± Limits, Inhibit, and Reset. They may be configured for active-high or active-low signals, and pulled-up or pulled-down termination (type A, B, C, and D). In addition, the four inputs may be configured to operate over a 0 to +5VDC or 0 to +15VDC range.

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 type 'A' input configuration and 0 to +15VDC input range.

2.3 PROTECTION CIRCUITS:

The following protection circuits are integral to the GA45xxPR2 plifier 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, drawing 4581-4010.

2.3.1 OVER-TEMP INDICATOR OPERATION (RED LED):

The Over-Temp LED indicator light (D29) will turn ON and latch when the heatsink temperature exceeds 170^{0}F (77^{0}C).

2.3.2 DRIVE INHIBIT INDICATOR (RED LED) AND FAULT RELAY OPERATION:

The Drive Inhibit LED indicator light (D30) will turn ON and the Fault relay (K1) will energize for any of the following fault conditions, the first four of which are latched:

1. Transistor heatsink temperature in excess of 170^{0}F (77^{0}C)
2. Tach-loss fault circuit triggered.

3. High-Speed Electronic Circuit Breaker (HS/ECB) triggered.
4. Low-Speed Electronic Circuit Breaker (LS/ECB) triggered (Does not light Inhibit LED).
5. Low-voltage power-supply under-voltage condition.

The Drive-Inhibit indicator light will also turn ON and OFF with the Total-Inhibit input signal (TB201-10). This is a non-latched and non-fault condition. When the Inhibit indicator is ON, all output current is removed from the motor. After removing the cause of the fault, the fault latch may be reset by depressing the Reset pushbutton located on the control card, or by applying an appropriate signal to the external reset input (TB201-11) (see “Logic” inputs, section 2.2.3).

2.3.3 TACH-LOSS INDICATOR (RED LED) AND RELAY OPERATION:

When the Tach input voltage (TB201-5) falls below the level set by potentiometer R32 at TP20 while the motor current is above the level set by potentiometer R36 at TP21 for more than 32 milliseconds, the Tach-Loss indicator light (D26) will turn ON and the Tach-Loss relay (K2) will energize. This is a latched condition. A loss of Tach voltage will also remove the “Moving” output (active low) from TB202-1. This is a non latched condition.

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

The HS/ECB LED indicator light (D28) 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 always factory set and should not be adjusted.

2.3.5 POWER SUPPLY MONITOR:

This circuit will generate an inhibit if the on-board, low-voltage power supplies can not maintain proper operating voltages. This is a non-latched condition.

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

The LS/ECB LED indicator light (D27) 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. Circuit operation is as follows:

When the motor current exceeds the value set by potentiometer R50 at TP25 (the setting of which varies with the model), U10D switches positive and the voltage on C33 begins integrating up. If the current remains above the set point, typically 1.5 seconds, U9B will trigger the LS/ECB latch.

Note that this fault acts differently than any other fault in that it does not inhibit the output current. Instead, it commands a zero current input to the current-loop summing amplifier (see Theory of Operation, chapter 4). Also it does not light the Inhibit indicator (Since it does not “inhibit” the motor current).

See section 2.3.1 on the clearing of the fault latch.

2.3.7 DC BUS VOLTAGE REGEN’ CLAMP & RESISTOR:

These components are mounted on the base-plate. They function to keep DC Bus voltage surges below a safe level, protecting the amplifier and DC Bus capacitor from over-voltage.

2.3.7 VELOCITY-TAPER CURRENT-LIMIT:

Motor specifications often include SOA (Safe Operating Area) curve which is the maximum motor current as a function of RPM. (See figure 2.3.7.) The optional VTCL (Velocity-Taper Current-Limit) ensures that the maximum available motor current is within SOA limits. Below maximum, the motor 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.

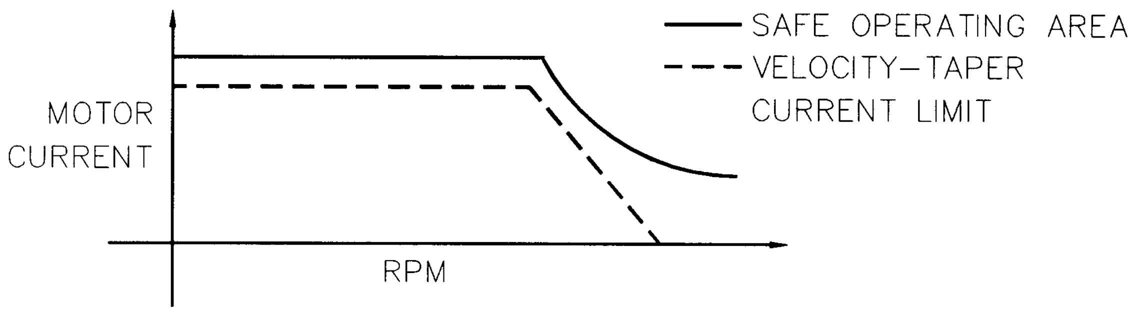


Figure 2.3.7

2.4 SPECIFICATIONS:

2.4.1 OUTPUT POWER:

MODEL	OUTPUT CURRENT PEAK	OUTPUT CURRENT RMS	OUTPUT VOLTAGE TYPICAL	MAXIMUM DC BUS VOLTAGE
GA4571PR2	70A	35A	150VDC	200VDC
GA4576PR2	90A	50A	170VDC	200VDC
GA4581PR2	160A	80A	170VDC	200VDC
GA4582PR2	200A	100A	200VDC	250VDC

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

2.4.2 INPUT POWER:

INPUT POWER FOR FANS: 120 VAC, 50/60 Hz @ 1 AMP

INPUT POWER FOR DC BUS: A fused, three-phase, full-wave rectifier and filter capacitor are provided on the base plate. The AC input to this circuit is supplied by a separately mounted power transformer unique to the application. The power transformer and motor output inductors are not standard parts of the amplifier package. Glentek has power transformers and inductors in stock to meet your system requirements.

2.4.3 SIGNAL INPUTS:

VOLTAGE, MAXIMUM:

Aux. Input: ±13 volts.
Sig. Input: ±70 volts.
Tach. Input: ±90 volts.

Input impedance,
minimum: 10K ohms.

GAIN, MAXIMUM:

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

2.4.4 OTHER INPUTS AND OUTPUTS:

Limits, Inhibit, and Reset inputs: Terminated by 10K ohms to corn or +5/+ 15VDC Guaranteed threshold at 1/3 and 2/3 of the +5/+15V supply (see "Logic" Inputs, section 2.2.3)

Fault & Tach-Loss relays: Form 'C' contacts. 50V, l00mA max.

2.4.5 OTHER SPECIFICATIONS:

Carrier frequency:	4.5Khz (Other frequencies available, consult Glentek.)

2.4.6 MECHANICAL (SEE APPENDIX B4 & B6):

Mounting:	Any Position.
Temperature:	122°F (50^{0}C) ambient max.
Weight & Dimensions:	See appendix B4 & B6.

2.4.7 TYPICAL FACTORY SETTINGS:

ALL MODELS		MODEL	LS/ECB	HS/ECB
Sig. and Aux. Gain:	5V(Sig.)/31.5V(Tach.)	GA4571PR2	35A @ 1.5s	50A @ 10us
Tach. Gain:	50%	GA4576PR2	50A @ 1.5s	150A @ 10us
Loop Gain:	CCW (OFF).	GA4581PR2	100A @ 1.5s	200A @ 10us
Comp:	CW (mm. bandwidth).	GA4582PR2	120A @ 1.5s	250A @ 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, 4597-5010, and 4597-5012, and will be referred to in the following description.

The Personality card contains the main high-gain preamp with all associated system alignment adjust ments. 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 feed back. However, the high-gain, 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. S volt input = 20 amp output current).

R15 **Auxiliary Signal-Gain** potentiometer sets the input voltage to output RPM 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 No.

1. SIGNAL:	Single-ended signal input.
2. +15 VDC:	+15 VDC power.
3. -15 VDC:	-15 VDC power.
4. COMMON:	± 15 VDC 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** under the card on the Amplifier Controller board 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).**

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 TROUBLE SHOOTING 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).

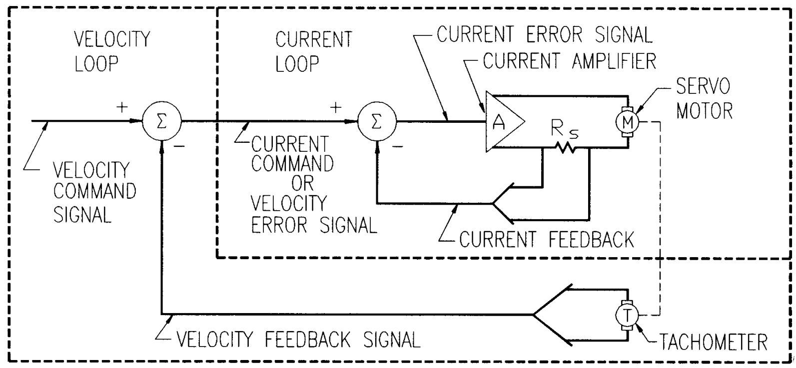


Figure 4.1

The inside control loop is referred to as the “current loop” and the outside loop is referred to as the “velocity 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 “H TYPE” OUTPUT BRIDGE CONFIGURATION:

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

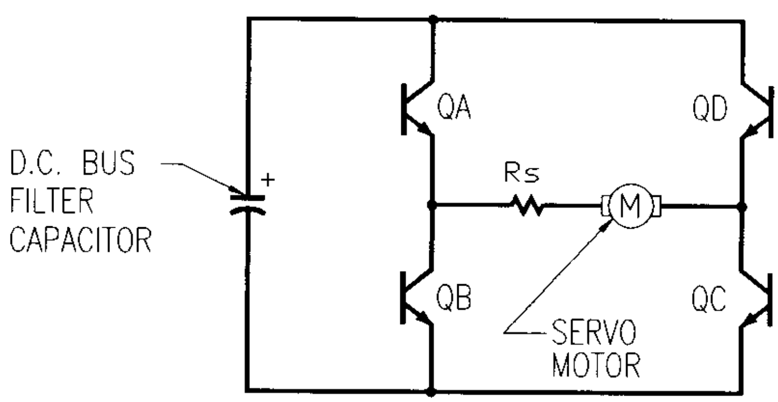


Figure 4.2

The advantage of an “H 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.

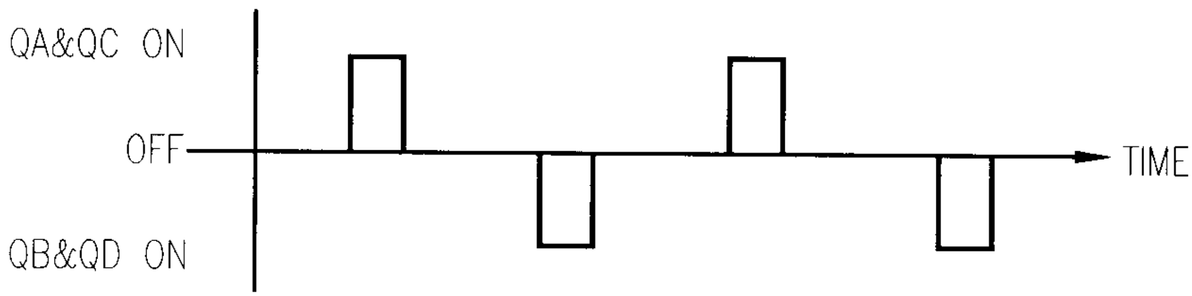


Figure 4.3

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.

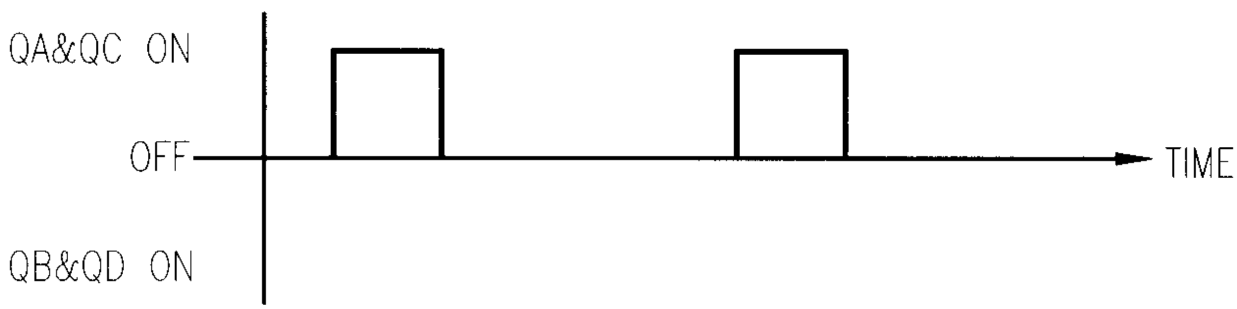


Figure 4.3A

If the input to the current loop had been changed in polarity, the output transistor switching waveform would be as shown in figure4.3B.

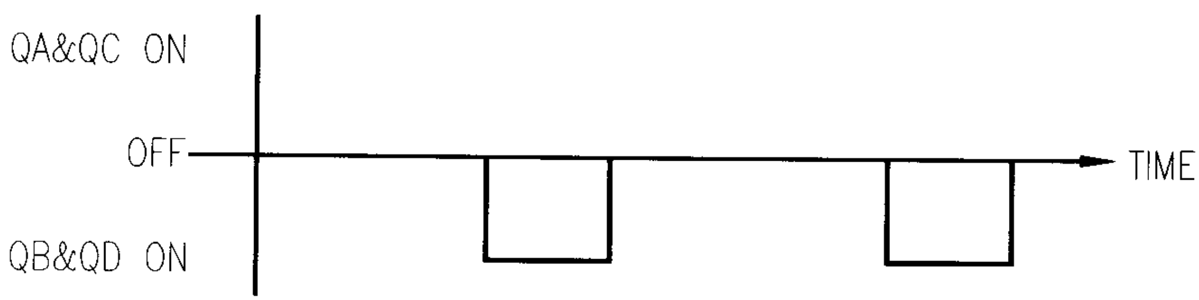


Figure 4.3B

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 modulation. The frequency at which these output transistors are switched ON and OFF is referred to as the "carrier 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 "H 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 "summing 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 "current-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 "current-feedback" signal. The current in the motor in creases 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 com manded 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 "servo 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 "automatic 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 (current-error 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 cadmiurn plated, .060-inch-thick steel.

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 “cold plate” cooling for the amplifier. A standard muffin fan is mounted on the baseplate to cool the amplifier.

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 122^0F (50°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 Appendix B, GA45xxPR2 installation diagrams. 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:

	GA4571PR2	GA4576PR2	GA4581PR2	GA4582PR2
MOTOR ARMATURE:	10AWG	8AWG	6AWG	4AWG
AC POWER INPUT (from secondary of power transformer):	12AWG	10AWG	8AWG	6AWG
120 VAC FOR FANS:	16 AWG			
SIGNAL INPUT:	22 AWG shielded twisted-pair			
TACHOMETER INPUT:	22 AWG shielded twisted-pair. Terminate shield at amplifier end only, to Tachometer Common, TB201 terminal-strip.			

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 AMPLIFIER CONNECTIONS AND FUNCTIONS:

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

Connect the 120VAC to terminals 1 and 2 of terminal barrier-strip TB102 located on the amplifier.

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 bus 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, & 3 of TB103.

DO NOT APPLY ANY POWER YET.

5.3.3 MOTOR:

The motor is connected to terminals 1 (-) and 2 (+) of terminal strip TB101 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 BUS RETURN.

5.3.4 SIGNAL INPUT:

The amplifier has two Signal Inputs, one single-ended (Signal Input TB201-3) and one differential (Auxiliary Signal Input TB201-1 and Auxiliary Return TB201-2). Typically, when operating in the velocity mode, the input signal range is ± 10 VDC. 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.

5.3.5 TACHOMETER INPUT:

The Tachometer is connected to terminals 5 and 6 of terminal strip TB201 of the Control card (see 5.2 for recommended wire type & size).

5.3.6 CURRENT SENSE:

The Current Sense output signal can be monitored at TB201-7 of the Control card. It is an isolated output signal that is proportional to motor current. The scale factor is 1 volt = 15 amps on the GA4571PR2, GA4576PR2, and GA4581PR2, and 1 volt = 25A for the GA4582PR2.

5.3.7 + AND - LIMITS:

The + and - Limits are located respectively at terminals 8 and 9 of terminal strip TB201 of the Control card. 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 “A” limits which means that when terminal TB201-8 or TB201-9 is pulled to common by some external circuit, the amplifier is inhibited in the + or - direction.

5.3.8 TOTAL INHIBIT:

The Total Inhibit is located at terminal 10 of terminal strip TB201 of the Control card. Please refer to 2.2.3 for a description of the different configurations of inhibit that are available. Amplifier modules are nor mally shipped with type “A” inhibit which means that when terminal TB201-10 is pulled to common by some external circuit the amplifier is totally inhibited.

5.3.9 EXTERNAL FAULT-LATCH RESET:

The Reset input at TB201-11 provides a means of externally resetting the fault latch. See Protection Circuits, section 2.3, for a description of the conditions which will set the latch. While reset is in effect, the amplifier commands a zero current output. Please refer to 2.2.3 for a description of the different configurations of Reset that are available. Amplifier modules are normally shipped with type “A” reset which means that when terminal TB201-11 is pulled to common by some external circuit the amplifier is in reset.

Note: The fault must be cleared for reset to work.

5.3.10 FAULT RELAY:

The Fault relay provides one form ‘C’ output on terminal strip TB201, terminals 12, 13, and 14. See Protection Circuits, section 2.3, for a description of the conditions which will energize the relay.

5.3.11 “MOVING” OUTPUT:

Terminal TB202-1 provides an active-low, open-collector output when the tach input voltage is above the level set by R32 at TP20.

5.3.12 TACH-LOSS RELAY:

The Tach-Loss relay provides one form ‘C’ output on terminal strip TB201, terminals 2, 3, and 4. See Tach-Loss, section 2.3.3, for a description of the condition which will energize the relay.

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 correct power voltage is being applied. Your DC bus 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.
6. Make sure Loop-Gain potentiometer (on Preamp card) is turned fully CCW before applying power.
7. **DO NOT** use grounded test equipment on motor leads or power section of amplifier.

6.2 AMPLIFIER ALIGNMENT INTRODUCTION:

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 (TB201-3) or the Auxiliary Signal Input (TB201-1 or TB20l-2).

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 In-

put 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 **“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 TB201-7. The scale factor of this voltage is 1V = 15A or 1V = 25A depending on the model. 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 “hunting”. 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 band width, 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.

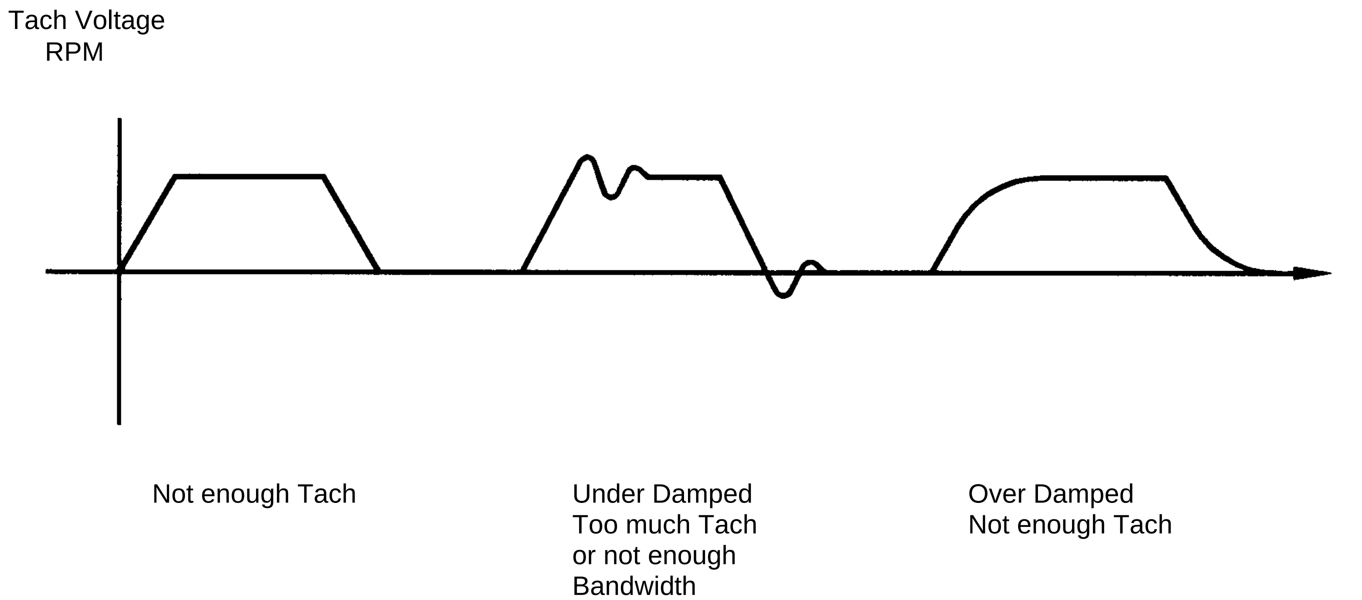


Figure 6.4

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 GA45xxPR2 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.

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 GA45xxPR2 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 trouble shoot the circuit boards to levels lower than those recommended as replaceable.

7.2.1 FAULT TRACING:

This section will aid in the location of defective replaceable components and assemblies. A list of the fault tracing charts in Appendix A, along with the observable fault follows:

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 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.

7.2.3 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 F1-F4.
2. Amplifier Control board.
3. Rectifier BR301-BR303.
4. Transformer T301.
5. Capacitors C301-C302.
6. Fan 201.

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.

7.2.4 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 Drive Inhibit indicator LED is latched ON inhibiting the amplifier.

THE OVERTEMP CONDITION 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

The following is a list of 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 in gested.
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 2.3.1 on resetting the fault latch. Note: The fault latch will not reset unless the fault has been removed.

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.

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

See section 2.3.1 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.

List of possible causes:
1. Shorted motor leads.
2. Intermittent motor short.
3. Motor inductance too low.
4. Motor commutator flash over.

See section 2.3.1 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 GA45xxPR2 to Glentek for repair, please follow the procedure de scribed 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:

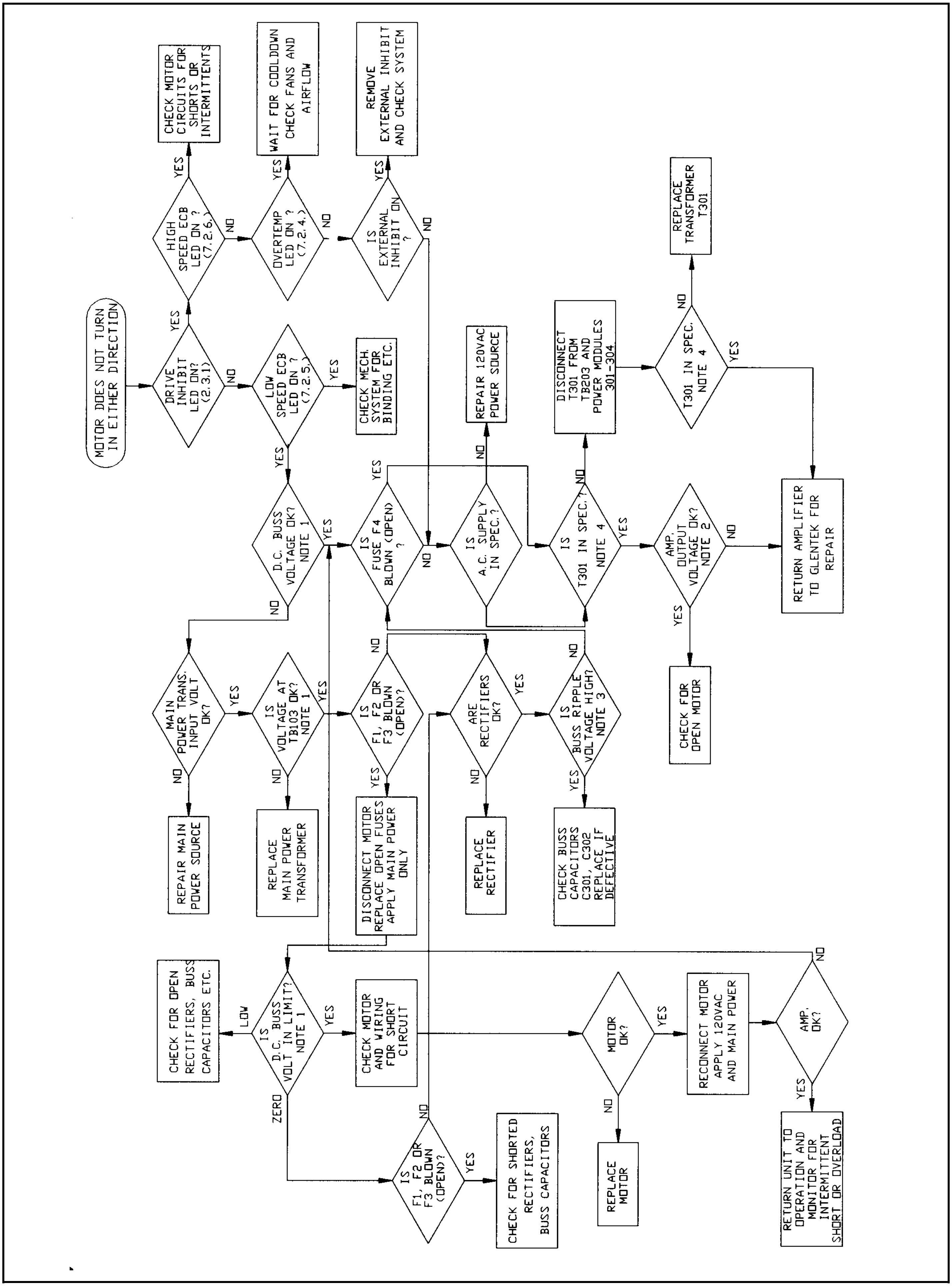
Any product, or part thereof, manufactured by Glentek, Inc., described in this manual, which, under normal operating conditions in the plant of the original purchaser thereof, proves defective in material or workmanship within one year from the date of shipment by us, as determined by an inspection by us, will be repaired or re placed 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, operated within the limits of rated and normal usage, and that no factory sealed adjustments have been tampered with. Glentek's liability is limited to repair or replacement of defective parts.

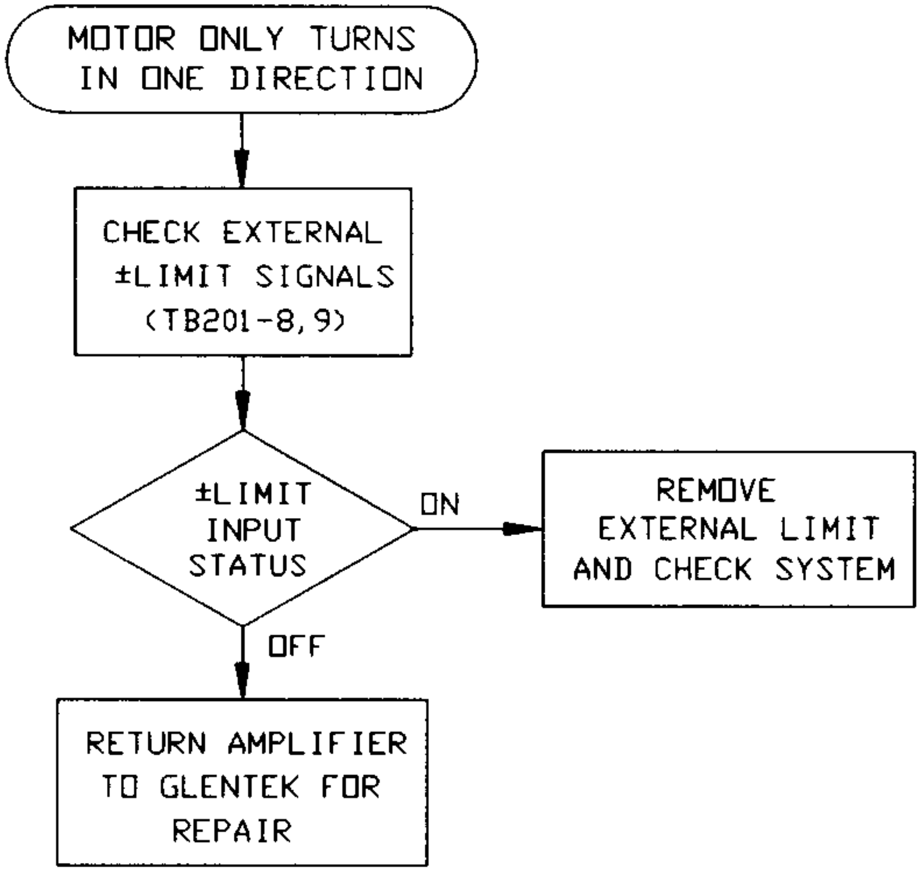
Any product or part manufactured by others and merely installed by us, such as an electric motor, etc., is specifically not warranted by us and it is agreed that such product or part shall only carry the warranty, if any, supplied by the manufacturer of that part. It is also understood that you must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

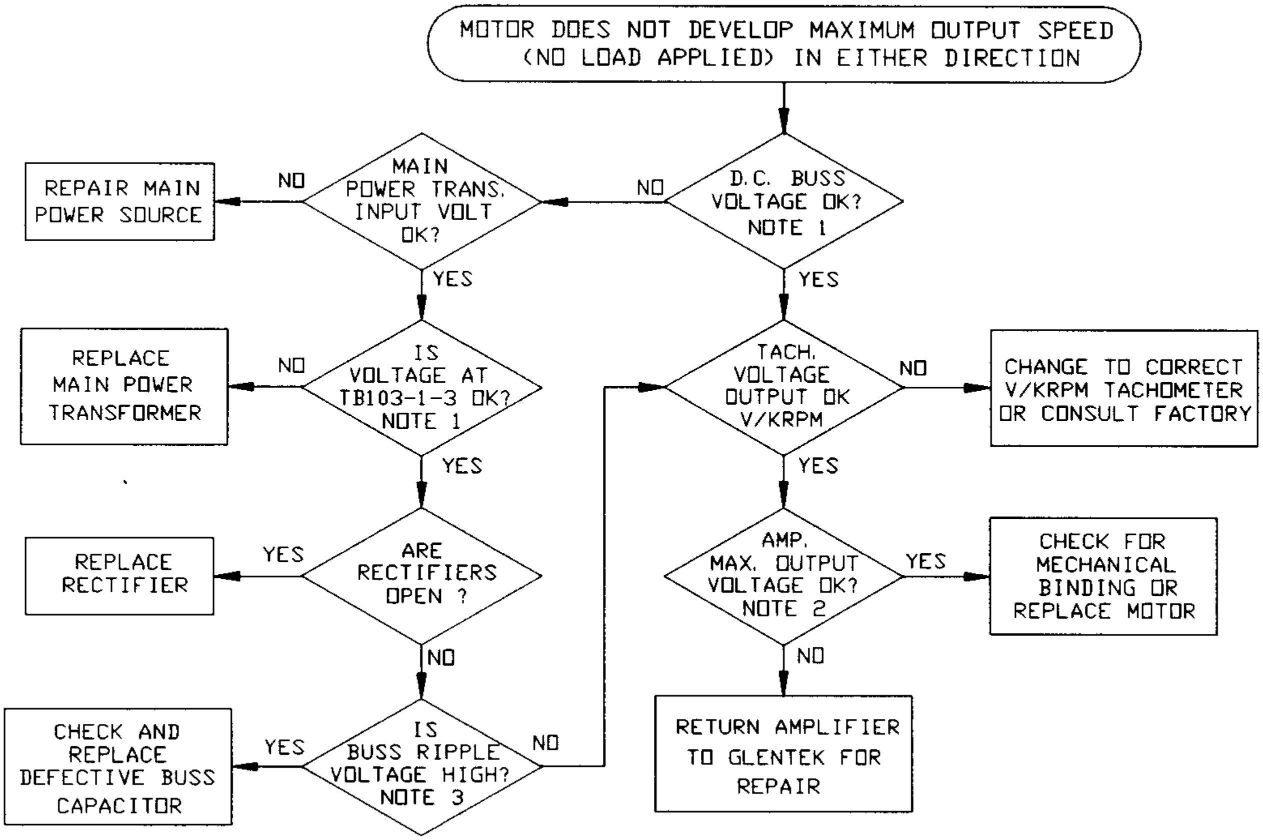
Under no circumstances shall Glentek, Inc. or any of our affiliates have any liability whatsoever for claims or damages arising out of the loss of use of any product or part sold to you. Nor shall we have any liability to your self or anyone for any indirect or consequential damages such as injuries 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.

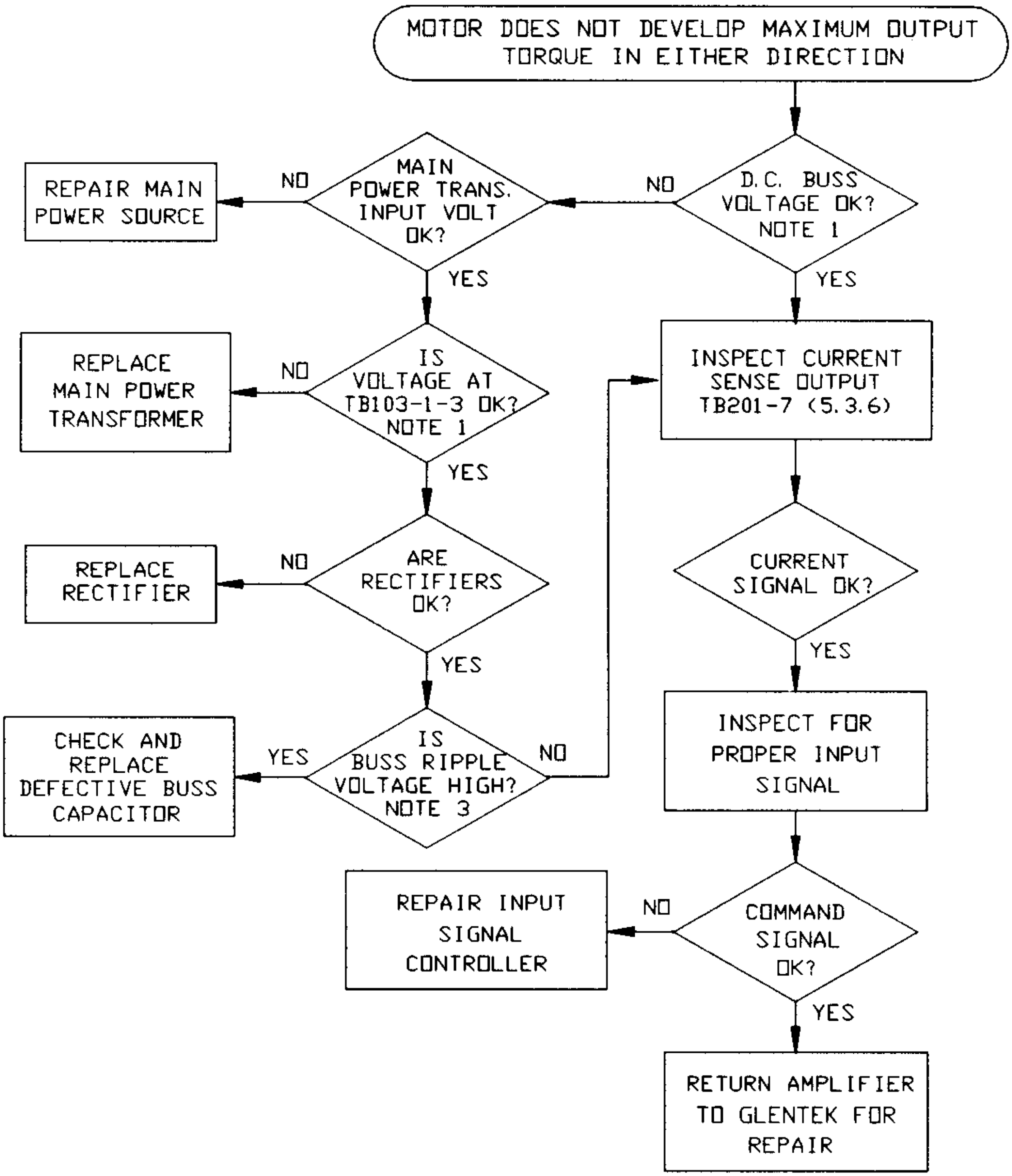
APPENDIX A

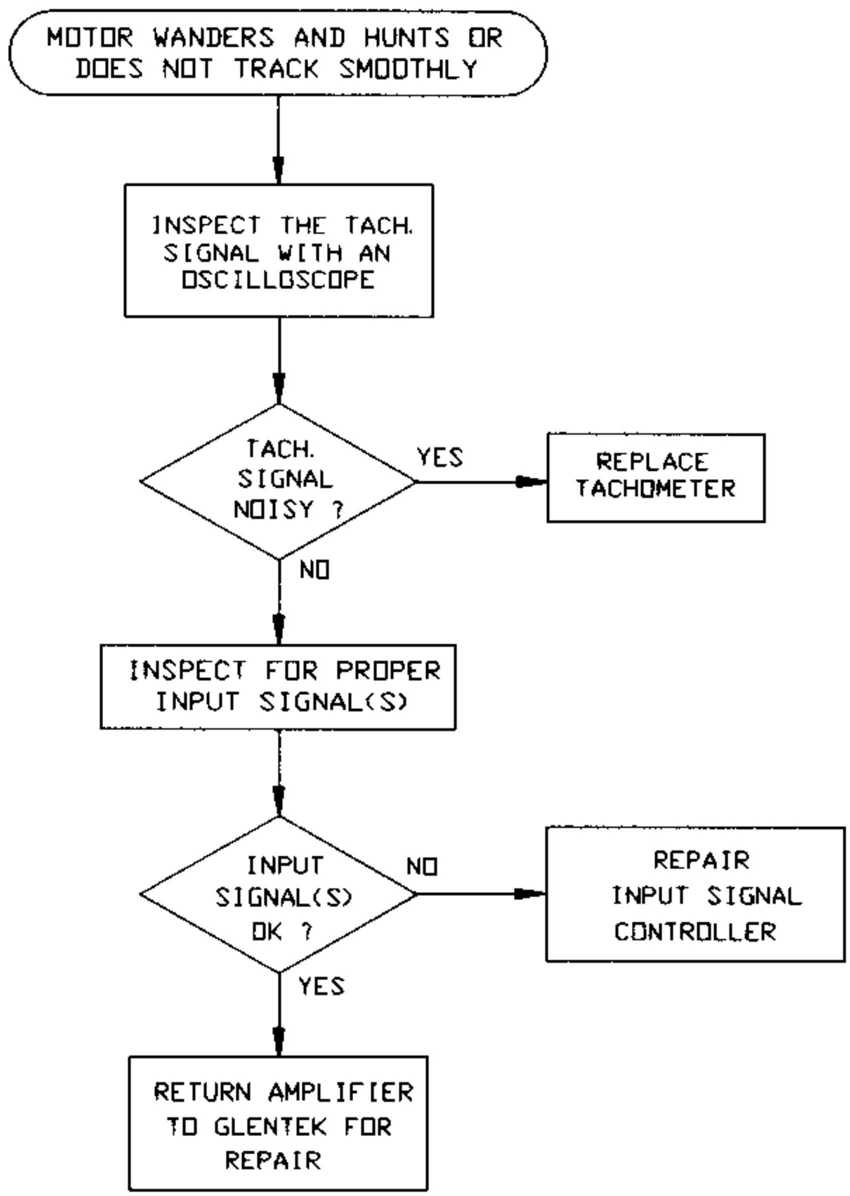
FAULT TRACING CHARTS


MOTOR DOES NOT TURN IN EITHER DIRECTION
DRIVE INHIBIT LED ON? (2.3.1)
HIGH SPEED ECB LED ON ? (7.2.6.)
CHECK MOTOR CIRCUITS FOR SHORTS OR INTERMITTENTS
OVERTEMP LED ON ? (7.2.4.)
WAIT FOR COOLDOWN CHECK FANS AND AIRFLOW
IS EXTERNAL INHIBIT ON ?
REMOVE EXTERNAL INHIBIT AND CHECK SYSTEM
LOW SPEED ECB LED ON ? (7.2.5.)
CHECK MECH. SYSTEM FOR BINDING ETC.
D.C. BUSS VOLTAGE OK? NOTE 1
IS FUSE F4 BLOWN (OPEN) ?
IS A.C. SUPPLY IN SPEC.?
REPAIR 120VAC POWER SOURCE
IS T301 IN SPEC.? NOTE 4
DISCONNECT T301 FROM TB203 AND POWER MODULES 301-304
T301 IN SPEC. NOTE 4
REPLACE TRANSFORMER T301
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 TB103 OK? NOTE 1
REPLACE MAIN POWER TRANSFORMER
IS F1, F2 OR F3 BLOWN (OPEN)?
DISCONNECT MOTOR REPLACE OPEN FUSES APPLY MAIN POWER ONLY
ARE RECTIFIERS OK?
REPLACE RECTIFIER
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
CHECK BUSS CAPACITORS C301, C302 REPLACE IF DEFECTIVE
IS D.C. BUSS VOLT IN LIMIT? NOTE 1
CHECK FOR OPEN RECTIFIERS, BUSS CAPACITORS ETC.
CHECK MOTOR AND WIRING FOR SHORT CIRCUIT
IS F1, F2 OR F3 BLOWN (OPEN)?
CHECK FOR SHORTED RECTIFIERS, BUSS CAPACITORS
MOTOR OK?
REPLACE MOTOR
RECONNECT MOTOR APPLY 120VAC AND MAIN POWER
AMP. OK?
RETURN UNIT TO OPERATION AND MONITOR FOR INTERMITTENT SHORT OR OVERLOAD
YES
NO
LOW
ZERO


MOTOR ONLY TURNS
IN ONE DIRECTION
CHECK EXTERNAL
±LIMIT SIGNALS
(TB201-8, 9)
±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
D.C. BUSS VOLTAGE OK? NOTE 1
NO
YES
MAIN POWER TRANS. INPUT VOLT OK?
NO
YES
REPAIR MAIN POWER SOURCE
IS VOLTAGE AT TB103-1-3 OK? NOTE 1
NO
YES
REPLACE MAIN POWER TRANSFORMER
ARE RECTIFIERS OPEN ?
YES
NO
REPLACE RECTIFIER
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
YES
NO
CHECK AND REPLACE DEFECTIVE BUSS CAPACITOR
TACH. VOLTAGE OUTPUT OK V/KRPM
NO
YES
CHANGE TO CORRECT V/KRPM TACHOMETER OR CONSULT FACTORY
AMP. MAX. OUTPUT VOLTAGE OK? NOTE 2
YES
NO
CHECK FOR MECHANICAL BINDING OR REPLACE MOTOR
RETURN AMPLIFIER TO GLENTEK FOR REPAIR


MOTOR DOES NOT DEVELOP MAXIMUM OUTPUT TORQUE IN EITHER DIRECTION
D.C. BUSS VOLTAGE OK? NOTE 1
NO
YES
MAIN POWER TRANS. INPUT VOLT OK?
NO
YES
REPAIR MAIN POWER SOURCE
IS VOLTAGE AT TB103-1-3 OK? NOTE 1
NO
YES
REPLACE MAIN POWER TRANSFORMER
ARE RECTIFIERS OK?
NO
YES
REPLACE RECTIFIER
IS BUSS RIPPLE VOLTAGE HIGH? NOTE 3
YES
NO
CHECK AND REPLACE DEFECTIVE BUSS CAPACITOR
INSPECT CURRENT SENSE OUTPUT TB201-7 (5.3.6)
CURRENT SIGNAL OK?
YES
INSPECT FOR PROPER INPUT SIGNAL
COMMAND SIGNAL OK?
NO
YES
REPAIR INPUT SIGNAL CONTROLLER
RETURN AMPLIFIER TO GLENTEK FOR REPAIR


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

ENGINEERING NOTES FOR FAULT TRACING CHARTS:

NOTE 1: To measure the DC bus voltage , carefully connect a voltmeter across the bleeder resistor attached to the DC bus filter capacitor. The proper DC bus voltage for your amplifier is calculated by multiplying the AC power input voltage on the main DC bus transformer by 1.4 (e.g. For 70 VAC input, you should read 70 X 1.4 or approx. 100 VDC bus voltage). The DC bus voltage will vary depending on if the motor is under a heavy or light load. The DC bus 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 the motor disconnected from the amplifier.

NOTE 3: A low, but not zero, DC bus voltage could indicate an open or defective DC bus 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.

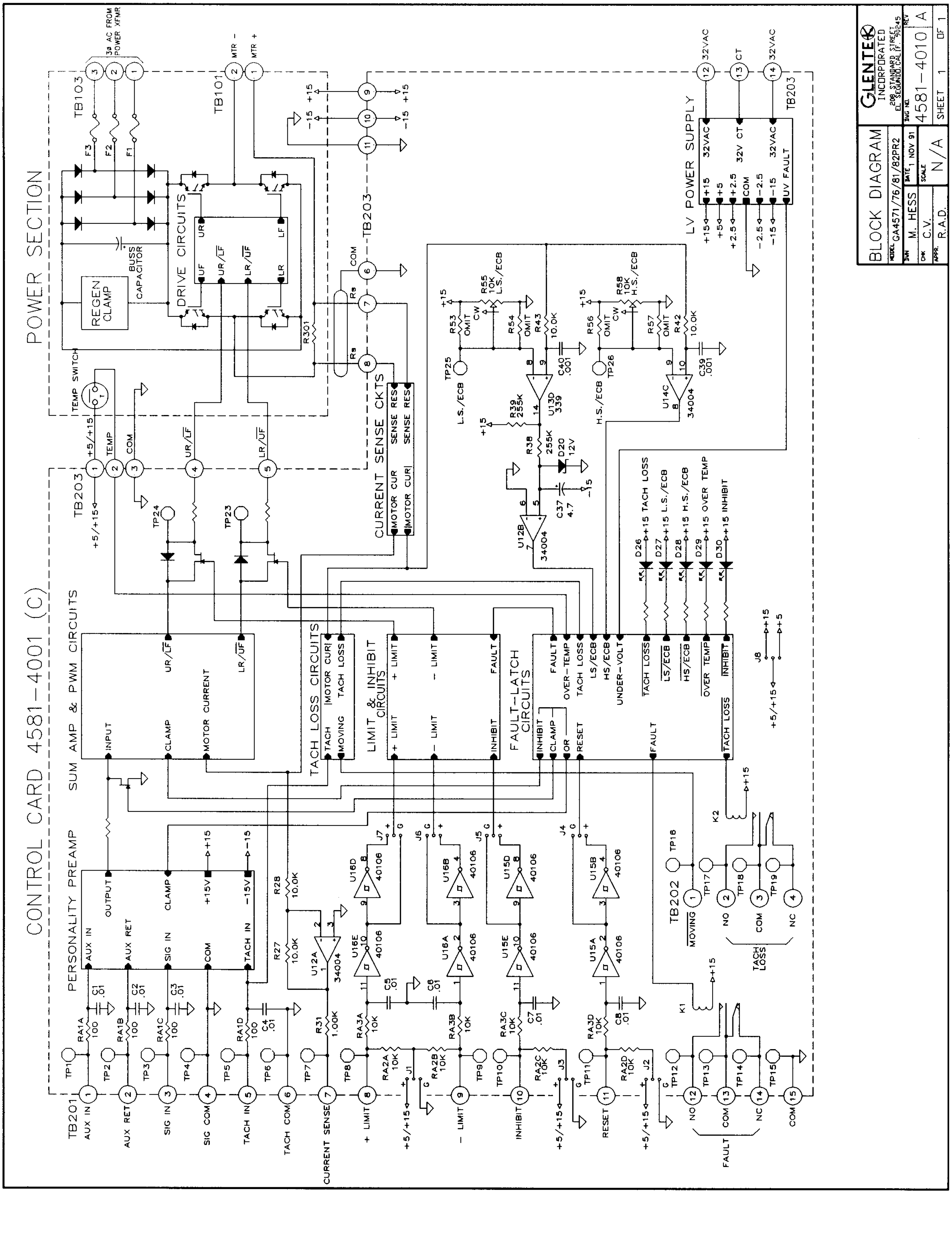
NOTE 4: A blown 120VAC input fuse (F4) indicates a shorted fan, a blown low-voltage transformer (T301) or possibly a shorted load on the transformer secondary. This transformer is located in the amplifier power section. The transformer may be tested with the secondaries disconnected to isolate the fault.

Transformer terminal color-code:

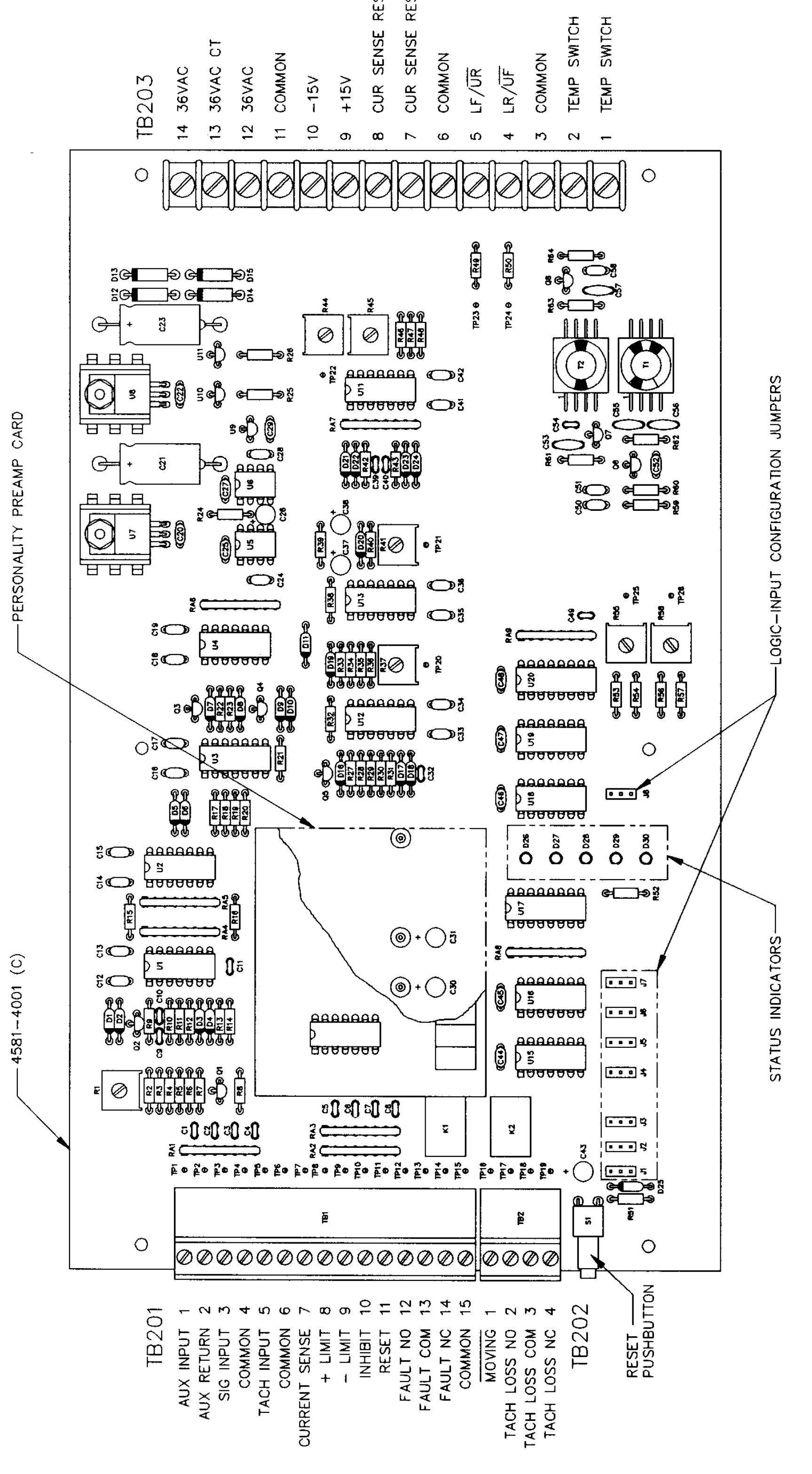
BLK/BLK	120VAC 50/60 Hz primary
VIO/VIO	36VAC secondary for the control board
BLU	36VAC center tap
BRN/BRN	16VAC secondary to power module 301.
RED/RED	16VAC secondary to power module 302.
GRN/GRN	16VAC secondary to power module 303.
ORN/ORN	16VAC secondary to power module 304.

APPENDIX B

AMPLIFIER DRAWINGS



POWER SECTION
CONTROL CARD 4581-4001 (C)
PERSONALITY PREAMP
SUM AMP & PWM CIRCUITS
TACH LOSS CIRCUITS
LIMIT & INHIBIT CIRCUITS
FAULT-LATCH CIRCUITS
CURRENT SENSE CKTS
LV POWER SUPPLY
DRIVE CIRCUITS
REGEN CLAMP
BUSS CAPACITOR
TEMP SWITCH
3φ AC FROM POWER XFMR
TB101
TB103
TB201
TB202
TB203
AUX IN
AUX RET
SIG IN
SIG COM
TACH IN
TACH COM
CURRENT SENSE
+ LIMIT
– LIMIT
INHIBIT
RESET
FAULT
MOVING
TACH LOSS
GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
BLOCK DIAGRAM
GA4571/76/81/82PR2
M. HESS
C.V.
R.A.D.
1 NOV 91
N/A
4581-4010
A
SHEET 1 OF 1



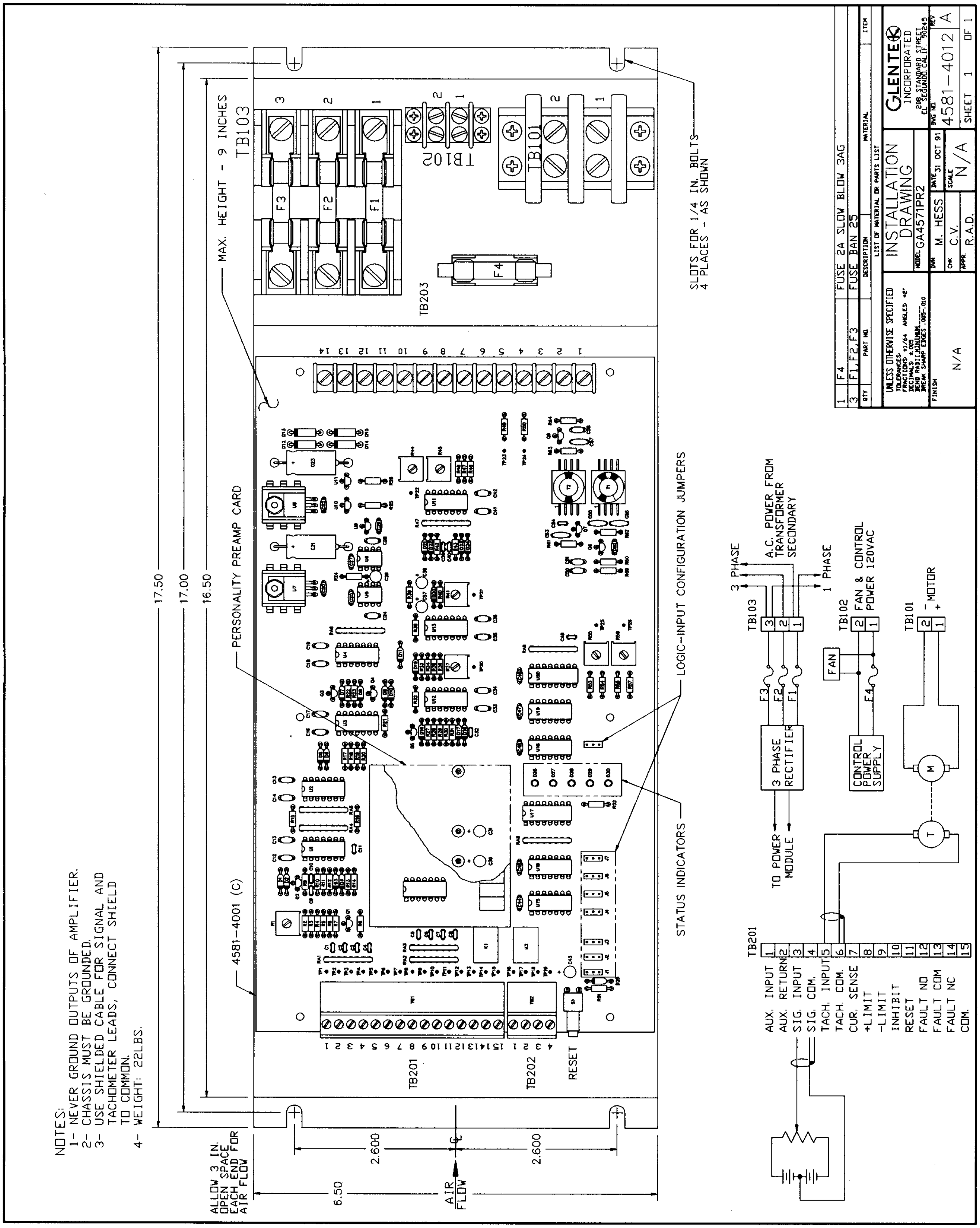
LOGIC-INPUT CONFIGURATION

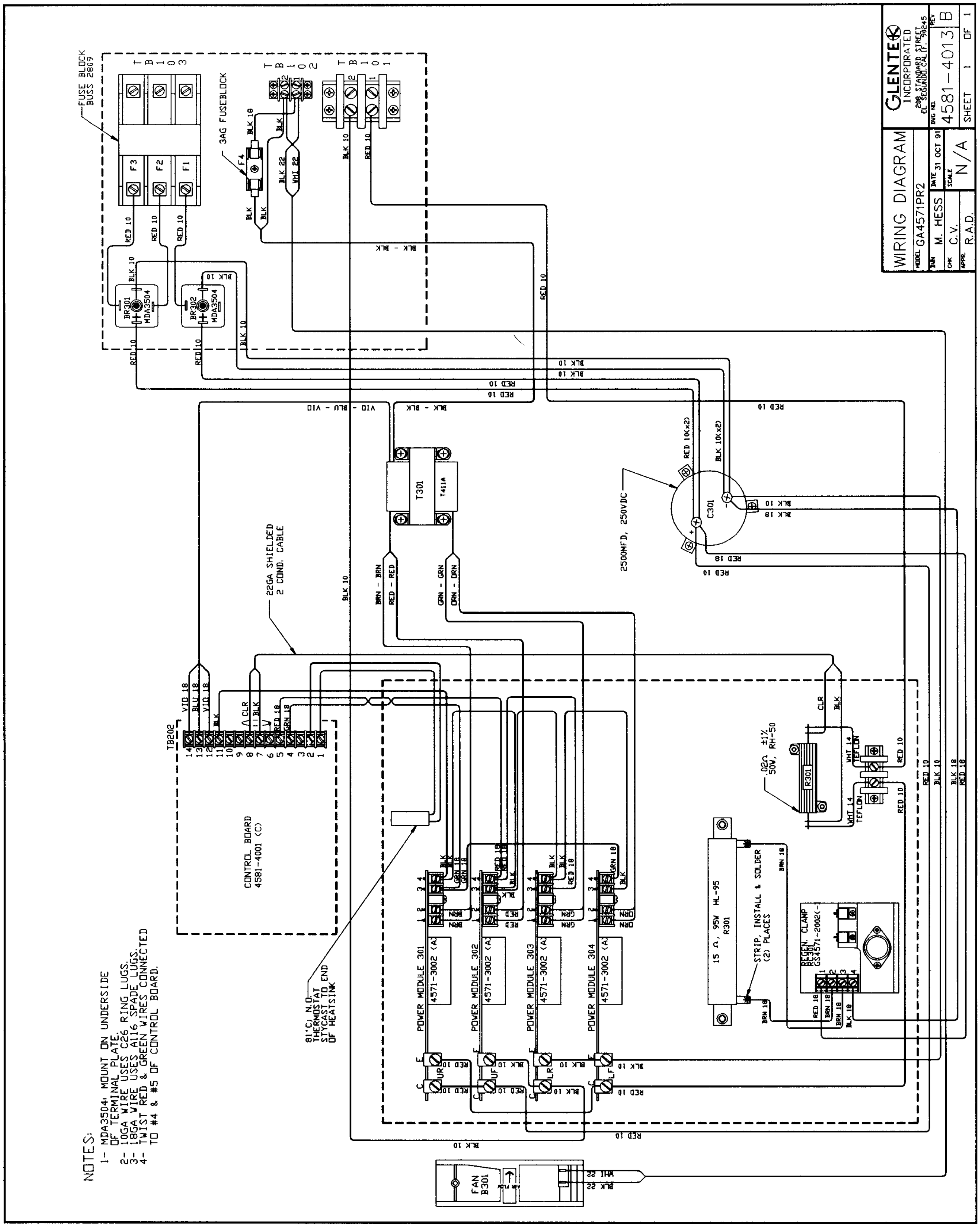
TYPE	+ LIMIT	− LIMIT	INHIBIT	RESET
'A'	J1 "+" & J7 "G"	J1 "+" & J6 "G"	J3 "+" & J5 "G"	J2 "+" & J4 "G"
'B'	J1 "G" & J7 "+"	J1 "G" & J6 "+"	J3 "G" & J5 "+"	J2 "G" & J4 "+"
'C'	J1 "+" & J7 "+"	J1 "+" & J6 "+"	J3 "+" & J5 "+"	J2 "+" & J4 "+"
'D'	J1 "G" & J7 "G"	J1 "G" & J6 "G"	J3 "G" & J5 "G"	J2 "G" & J4 "G"
RANGE	J8 "+5" = 0 – 5V RANGE; J8 "+15" = 0 – 15V RANGE			

1. REFERENCE: SCHEMATIC 4581-4000 (D)
   PCB ASSY 4581-4002 (C)
   EPL 4581-4003 (C)

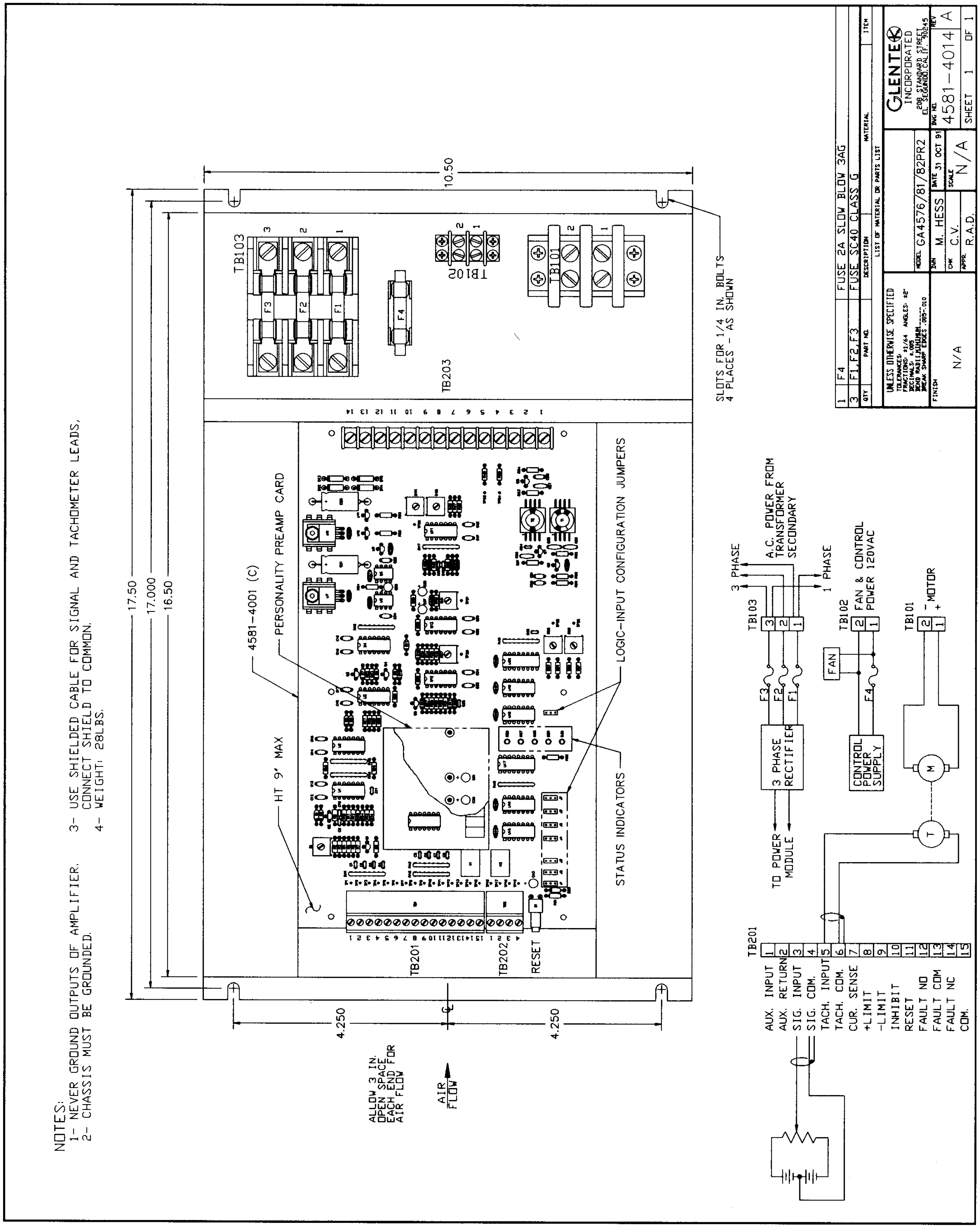
NOTES: UNLESS OTHERWISE SPECIFIED

PCB ASSEMBLY CONTROL CARD	GLENTEK INCORPORATED 208 STANDARD STREET EL SEGUNDO, CALIF. 90245
MODEL GA4571/76/81/B2PR2	
DWN M. HESS	DATE 30 OCT 91
CHK C.V.	SCALE N/A
APPR R.A.D.	
DWG NO. 4581-4011	REV A
SHEET 1 OF 1	

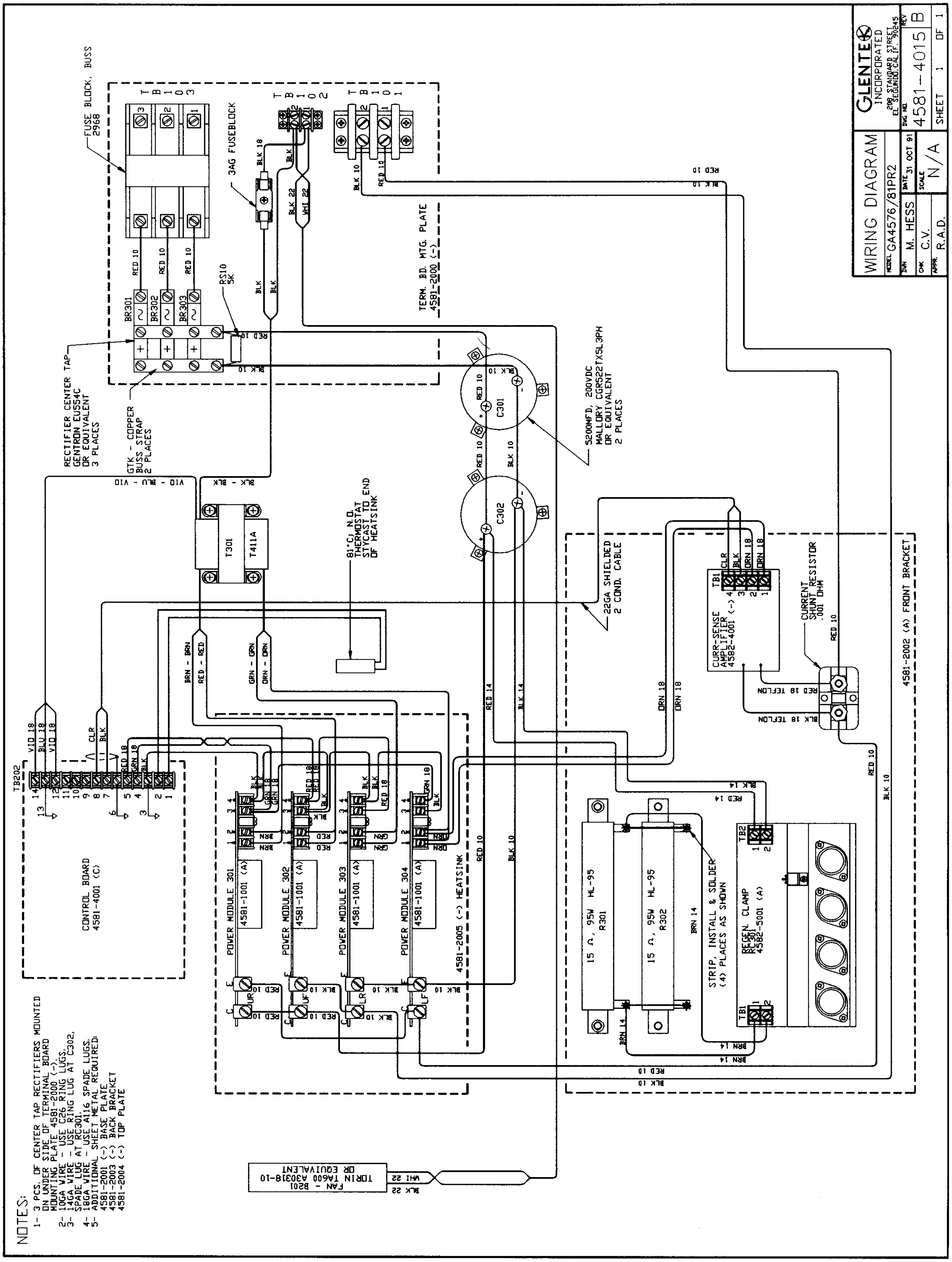

NOTES:
1- NEVER GROUND OUTPUTS OF AMPLIFIER.
2- CHASSIS MUST BE GROUNDED.
3- USE SHIELDED CABLE FOR SIGNAL AND TACHOMETER LEADS, CONNECT SHIELD TO COMMON.
4- WEIGHT: 22LBS.
ALLOW 3 IN. OPEN SPACE EACH END FOR AIR FLOW
AIR FLOW
6.50
2.600
2.600
17.50
17.00
16.50
MAX. HEIGHT - 9 INCHES
SLOTS FOR 1/4 IN. BOLTS 4 PLACES - AS SHOWN
PERSONALITY PREAMP CARD
LOGIC-INPUT CONFIGURATION JUMPERS
STATUS INDICATORS
4581-4001 (C)
TB101
TB102
TB103
TB201
TB202
TB203
RESET
F1
F2
F3
F4
3 PHASE
1 PHASE
A.C. POWER FROM TRANSFORMER SECONDARY
FAN & CONTROL POWER 120VAC
MOTOR
FAN
3 PHASE RECTIFIER
CONTROL POWER SUPPLY
TO POWER MODULE
AUX. INPUT
AUX. RETURN
SIG. INPUT
SIG. COM.
TACH. INPUT
TACH. COM.
CUR. SENSE
+LIMIT
-LIMIT
INHIBIT
RESET
FAULT NO
FAULT COM
FAULT NC
COM.
1 F4 FUSE 2A SLOW BLOW 3AG
3 F1,F2,F3 FUSE BAN 25
QTY PART NO. DESCRIPTION MATERIAL ITEM
LIST OF MATERIAL OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
FINISH N/A
INSTALLATION DRAWING
MODEL GA4571PR2
DWN M. HESS
DATE 31 OCT 91
CHK C.V.
SCALE N/A
APPR R.A.D.
GLENTEK INCORPORATED
DWG NO. 4581-4012
REV A
SHEET 1 OF 1

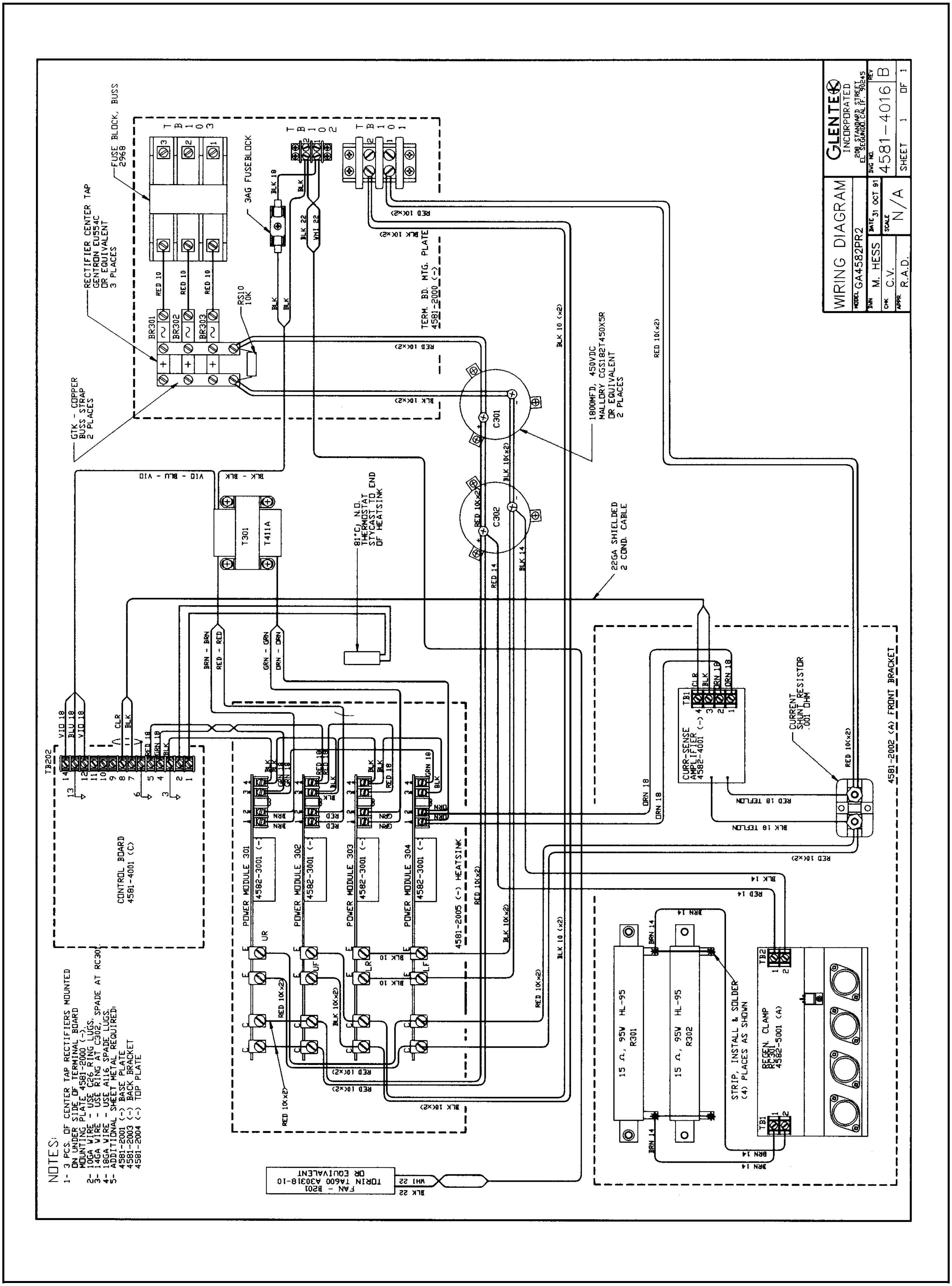


WIRING DIAGRAM
MODEL GA4571PR2
GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
4581-4013
REV B
SHEET 1 OF 1
SCALE N/A
DATE 31 OCT 91
M. HESS
C.V.
R.A.D.
CONTROL BOARD 4581-4001 (C)
POWER MODULE 301 4571-3002 (A)
POWER MODULE 302 4571-3002 (A)
POWER MODULE 303 4571-3002 (A)
POWER MODULE 304 4571-3002 (A)
NOTES:
1- MDA3504: MOUNT ON UNDERSIDE OF TERMINAL PLATE.
2- 10GA WIRE USES C26 RING LUGS.
3- 18GA WIRE USES A116 SPADE LUGS.
4- TWIST RED & GREEN WIRES CONNECTED TO #4 & #5 OF CONTROL BOARD.



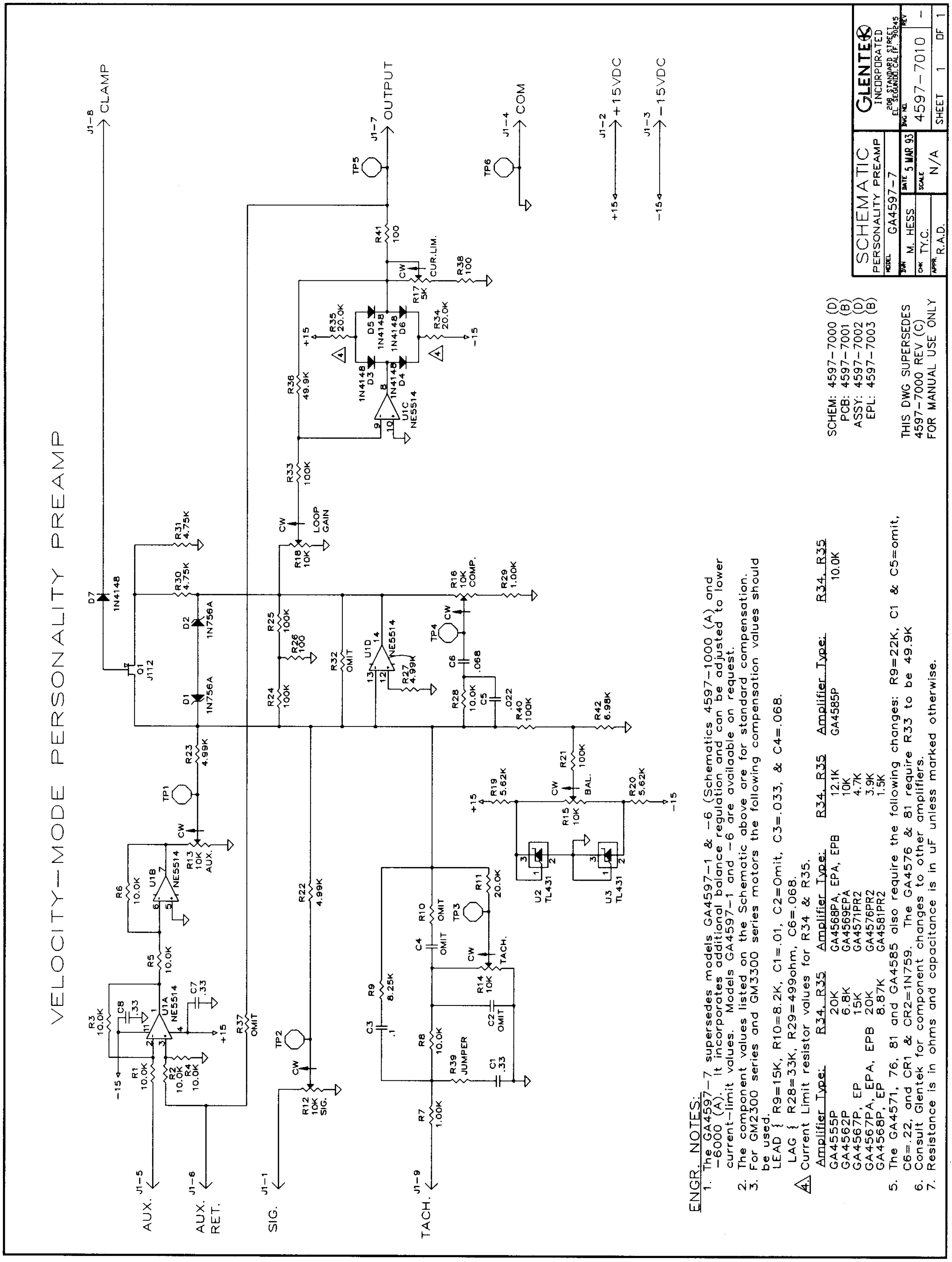
NOTES:
1- NEVER GROUND OUTPUTS OF AMPLIFIER.
2- CHASSIS MUST BE GROUNDED.
3- USE SHIELDED CABLE FOR SIGNAL AND TACHOMETER LEADS, CONNECT SHIELD TO COMMON.
4- WEIGHT: 28LBS.
ALLOW 3 IN. OPEN SPACE EACH END FOR AIR FLOW
AIR FLOW
10.50
17.50
17.000
16.50
4.250
4.250
HT 9" MAX
4581-4001 (C)
PERSONALITY PREAMP CARD
LOGIC-INPUT CONFIGURATION JUMPERS
STATUS INDICATORS
SLOTS FOR 1/4 IN. BOLTS 4 PLACES - AS SHOWN
TB103
TB102
TB101
TB203
TB201
TB202
RESET
F1
F2
F3
F4
3 PHASE
1 PHASE
A.C. POWER FROM TRANSFORMER SECONDARY
FAN & CONTROL POWER 120VAC
MOTOR
FAN
3 PHASE RECTIFIER
CONTROL POWER SUPPLY
TO POWER MODULE
AUX. INPUT
AUX. RETURN
SIG. INPUT
SIG. COM.
TACH. INPUT
TACH. COM.
CUR. SENSE
+LIMIT
-LIMIT
INHIBIT
RESET
FAULT NO
FAULT COM
FAULT NC
COM.
1 | F4 | FUSE 2A SLOW BLOW 3AG
3 | F1,F2,F3 | FUSE SC40 CLASS G
QTY | PART NO. | DESCRIPTION | MATERIAL | ITEM
LIST OF MATERIAL OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
FINISH N/A
MODEL GA4576/81/82PR2
DWN M. HESS
CHK C.V.
APPR. R.A.D.
DATE 31 OCT 91
SCALE N/A
GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
DWG NO. 4581-4014
REV A
SHEET 1 OF 1


GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
WIRING DIAGRAM
GA4576/81PR2
M. HESS
31 OCT 91
C.V.
R.A.D.
N/A
4581-4015
B
SHEET 1 OF 1
NOTES:
1- 3 PCS. OF CENTER TAP RECTIFIERS MOUNTED ON UNDER SIDE OF TERMINAL BOARD MOUNTING PLATE 4581-2000 (-).
2- 10GA WIRE - USE C26 RING LUGS.
3- 14GA WIRE - USE R14 RING LUG AT C302, SPADE LUG AT RC301.
4- 18GA WIRE - USE A116 SPADE LUGS.
5- ADDITIONAL SHEET METAL REQUIRED:
4581-2001 (-) BASE PLATE
4581-2003 (-) BACK BRACKET
4581-2004 (-) TOP PLATE

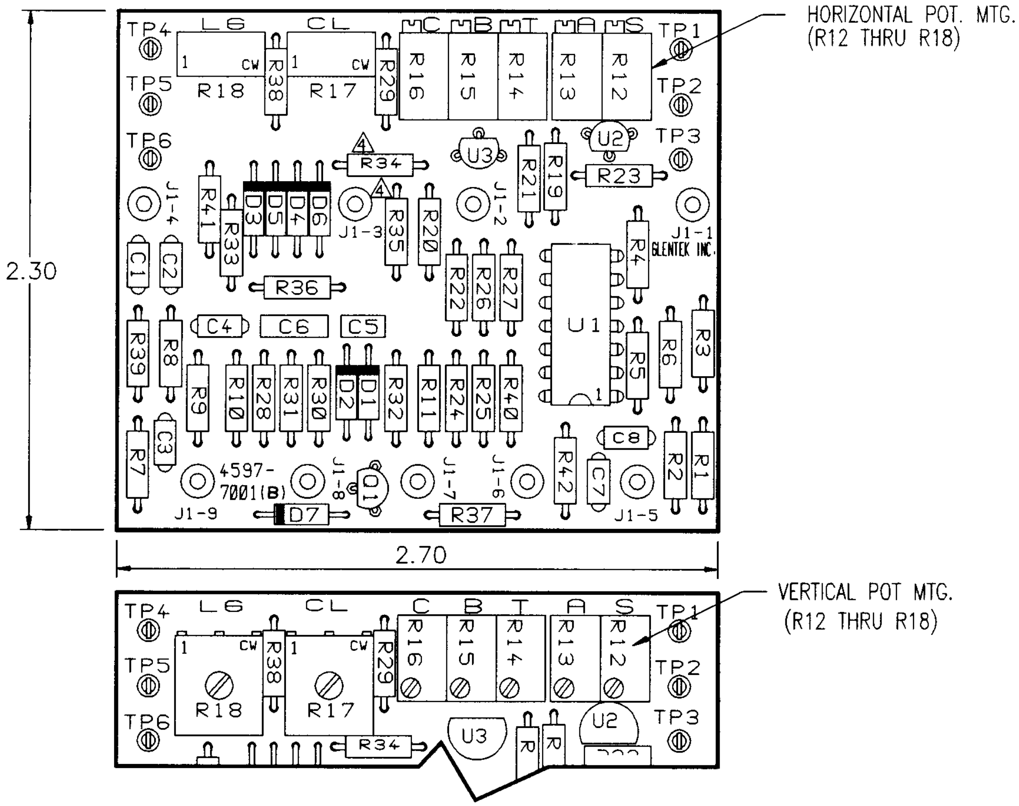

NOTES:
1- 3 PCS. OF CENTER TAP RECTIFIERS MOUNTED ON UNDER SIDE OF TERMINAL BOARD MOUNTING PLATE 4581-2000 (-).
2- 10GA WIRE - USE C26 RING LUGS.
3- 14GA WIRE - USE RING AT C302, SPADE AT RC301.
4- 18GA WIRE - USE A116 SPADE LUGS.
5- ADDITIONAL SHEET METAL REQUIRED:
4581-2001 (-) BASE PLATE
4581-2003 (-) BACK BRACKET
4581-2004 (-) TOP PLATE
WIRING DIAGRAM
GA4582PR2
M. HESS
C.V.
R.A.D.
31 OCT 91
N/A
GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
4581-4016
B
SHEET 1 OF 1
FUSE BLOCK, BUSS 2968
3AG FUSEBLOCK
RECTIFIER CENTER TAP GENTRON EU554C OR EQUIVALENT 3 PLACES
GTK - COPPER BUSS STRAP 2 PLACES
TERM. BD. MTG. PLATE 4581-2000 (-)
1800MFD, 450VDC MALLORY CGS182T450X5R OR EQUIVALENT 2 PLACES
22GA SHIELDED 2 COND. CABLE
81°C, N.O. THERMOSTAT STYCAST TO END OF HEATSINK
CONTROL BOARD 4581-4001 (C)
POWER MODULE 301 4582-3001 (-)
POWER MODULE 302 4582-3001 (-)
POWER MODULE 303 4582-3001 (-)
POWER MODULE 304 4582-3001 (-)
4581-2005 (-) HEATSINK
CURR-SENSE AMPLIFIER 4582-4001 (-)
CURRENT SHUNT RESISTOR .001 OHM
4581-2002 (A) FRONT BRACKET
15 Ω, 95W HL-95 R301
15 Ω, 95W HL-95 R302
STRIP, INSTALL & SOLDER (4) PLACES AS SHOWN
REGEN. CLAMP RC301 4582-5001 (A)
FAN - B201 TORIN TA600 A30318-10 OR EQUIVALENT

APPENDIX C

PERSONALITY PREAMP


VELOCITY—MODE PERSONALITY PREAMP
AUX. J1-5
AUX. RET. J1-6
SIG. J1-1
TACH. J1-9
J1-8 CLAMP
J1-7 OUTPUT
J1-4 COM
J1-2 +15VDC
J1-3 −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

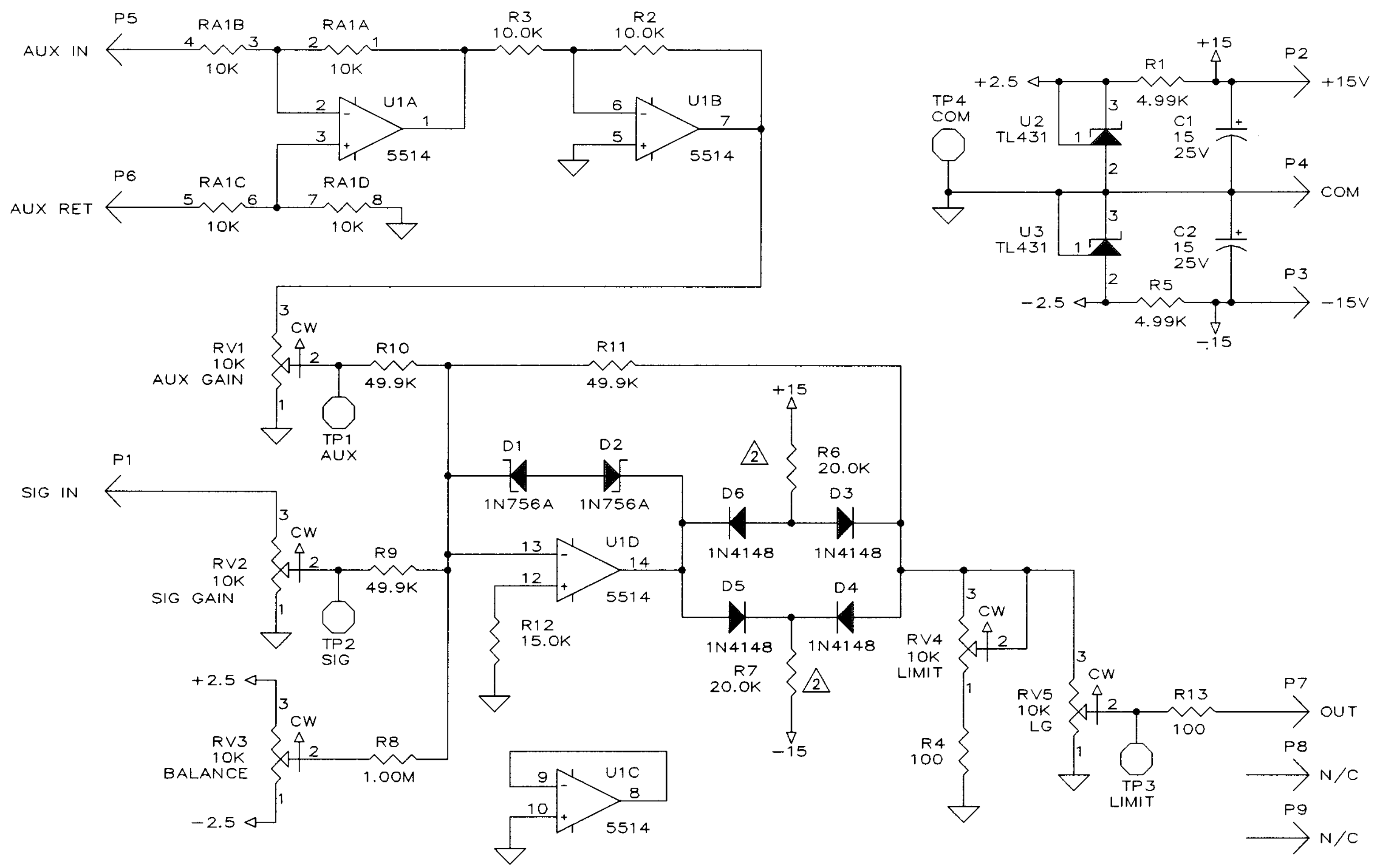
ENGR. NOTES:

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



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.

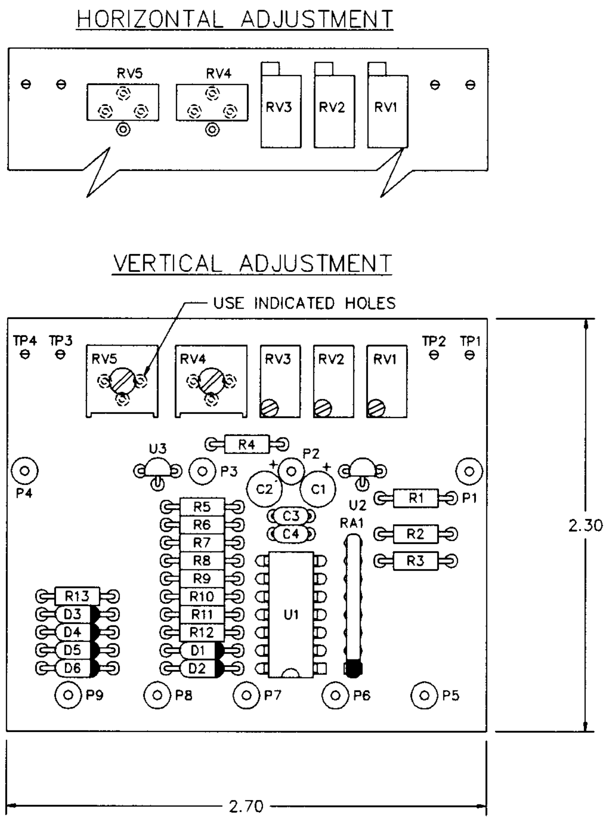
SCHEM: 4597-5100 (A)
PCB: 4597-5101 (A)
ASSY: 4597-5102 (A)
EPL: 4597-5103(A)

THIS DWG SUPERSEDES 4597-5000 REV (-) FOR MANUAL USE ONLY

SCHEMATIC PERSONALITY PREAMP
MODEL GA4597-51
DWN M. HESS — DATE 24 MAR 93
CHK TY.C. — SCALE N/A
APPR. R.A.D.

GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
DWG NO. 4597-5110 REV –
SHEET 1 OF 1

CURRENT—MODE PERSONALITY PREAMP



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

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

LAST USED

C4	R13
D6	TP4
RA1	U3
RV5	P9

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

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

High Bandwidth Brush Type Servo Amplifiers

- Linear Brush type servo amplifiers to 2.25KW
- PWM (Pulse-width-modulated) Brush type servo amplifiers to 70KW

High Bandwidth Brushless Servo Amplifiers

- Linear Brushless servo amplifiers to 2.25KW
- PWM (Pulse-width-modulated) Brushless servo amplifiers to 65KW

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 #: GA45XXPR2A
DATE: 13 April 2001

208 Standard Street, El Segundo, California 90245, USA.
Telephone: (310) 322-3026 Fax: (310) 322-7709
www.glentek.com E-Mail: sales@glentek.com