INSTALLATION
&
OPERATION MANUAL

Model SMB7230
Model SMB7275
Model SMB72100

H-Bridge Brush Type Servo Amplifiers
(HI-AK Series Replacements)

GLENTEK
"Solutions for Motion Control"

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INTRODUCTION

Glentek's brush type and brushless DC servo motors and amplifiers offer the ultimate in low maintenance and high performance motion control. Glentek offers a full line of matched motors and amplifiers to meet virtually every motion control application.

This manual provides all the technical information necessary to install, configure, operate, and maintain our TORQUE-SWITCH™ series, brush type servo amplifiers, model SMB7230, SMB7275 and SMB72100. There is also an informative theory-of-operation chapter.

We suggest that you take the time to read this manual from cover-to-cover before attempting to work with these amplifiers for the first time. If at any time you have questions, or have any special requirements, please feel free to call and discuss them with a Glentek applications engineer. We are happy to provide both off-the-shelf and custom products. With over four decades in the servo-motor/amplifier business, we have a vast pool of applications knowledge waiting to assist you.

Thank you for selecting Glentek for your motion control needs. It is our goal to save you time, money, and to provide you with a superior product.

CHAPTER ONE: DESCRIPTION, FEATURES AND SPECIFICATIONS

1.1 Description:

This brush type servo amplifier system has been designed to offer you, our customer, a large degree of flexibility and customization with a standard, in stock product. The amplifier is of a modular, 'open' construction for ease of installation and service.

The amplifier system is available as a stand alone one axis amplifier, SMB7130-1A-1, SMB71075-1A-1 and SMB71100-1A-1, which contains a DC power supply, cooling fan, soft start circuitry, fusing and a shunt regulator. Please see section 1.2.1 for more detailed information.

Each amplifier accepts a bipolar DC control input. The polarity of this signal determines the direction of rotation. This signal may be used to control either the velocity (RPM) or the current (torque) of the motor (see Servo Loops, section 2.3). The amplifier provides Pulse-Width Modulated (PWM) power to the motor in proportion to the input signal.

Each amplifier has several 'logic' inputs to stop the motor in one or both directions. These inputs are very useful for connecting to mechanical limit switches or digital equipment.

Each amplifier has several protection circuits to protect the amplifier, motor, and operator from almost any kind of fault. LED's show what fault has occurred, and a separate output can be used to signal other equipment.

1.2 Features:

- Ergonomic design: Easy access to connections, adjustments, and test points.
- Complete isolation: Low voltage input electrically isolated from high voltage.
- Dual signal inputs: One single-ended and one differential. Both inputs may be used simultaneously. Both have up to 15,000A/V gain (velocity mode), and inputs will accept the typical ±10VDC analog signal.
- Dual mode operation: The amplifier may be field configured for velocity (RPM) control or torque (current) control.
- Current limit: Maximum peak motor current is adjustable.
- +/- Limits/Inhibit: Three separate logic inputs can stop the motor in either or both directions. Inputs may be configured for active-high or active-low, pull-up or pull-down termination, and a 0 to +5VDC or 0 to+15VDC range. See Logic Input Configuration, section 5.2.
- Fault input/output: Open-collector output goes low in the event of a fault. Forcing the fault terminal low will inhibit the amplifier. The fault terminalsoutputs in a multi-axis system may be connected together (wire-ORed) to shut down all amplifiers should any amplifier have a fault.
- Silent operation: Carrier frequency is 18KHz.
- Short circuit protection: Complete short circuit and ground fault protection.
- LED diagnostics: A Red LED flashes to display various fault conditions and a green LED illuminates to indicate normal operating conditions.
- Tachometer Tachometer feedback is required to operate in velocity mode.
- Frequency response 750 Hz minimum.(Velocity Loop):
2 KHz minimum.(Current Loop):
- External fault reset: A separate input is provided to reset the amplifier after a fault.
- High-Speed Electronic Circuit Breaker (HS/ECB): Instantly shuts down the amplifier in the event of a short across outputs or a ground fault condition.
- Low-Speed Electronic Circuit Breaker (LS/ECB): Shuts down the amplifier if the amplifier is operated above the maximum continuous current rating for 3 seconds.
- Over/under voltage and over temperature: These circuits constantly monitor amplifier power-supply voltages, and amplifier-heatsink temperature. They will shut down the amplifier in the event of any out-of-specification amplifier condition.
- Surface mount technology: Constructed with surface mount components.

- Line or transformer AC power operation, 60-120VAC: Single or three phase AC input with in-rush current protection at turn-on. Power isolation transformer is not required but is recommended..
- Regen clamp circuit (shunt regulator) with LED indicator and internal load resistor bank bleeds off excess DC Buss voltage when decelerating a large load inertia (95 watts for the SMB7230 and 800 watts for the SMB7275 and SMB72100). The regen clamp circuit is set to turn on at 245-255VDC.
- All faults can be monitored through isolated logic signals.
- Bridge rectifier(s) and filter capacitor(s).
- Cooling fans. Separate 120VAC input required to power fans.

1.3 Specifications:

1.3.1 Input and Output Power:

The amplifiers require external AC power. Three phase is necessary to achieve maximum ratings.

Amplifier Model	Input Voltage (VAC)	Fan Voltage (VAC)	Output Current (Amps)	
			R.M.S.	Peak
SMB7230-1A-1	60-120	120	30	60
SMB7275-1A-1	60-120	120	75	120
SMB72100-1A-1	60-120	120	100	120

1.3.2 Signal Inputs:

Signal Input	Voltage VDC (maximum)	Impedance (minimum) ohms	Velocity Gain Amp./Volt	Current Gain Amp./Volt
Differential	±10	10,000	15,000	0-5
Single-ended	±20	4,000	15,000	0-5
Tachometer input	±90	10,000	7,000	N/A

1.3.3 Digital Inputs:

- ±Limit, Inhibit and Reset: +24V max. Terminated by 10K ohms.
- Fault (as input): +40V max. Pulled up by 10K ohms.
- Typical for all digital inputs: Digital inputs have hysteresis with thresholds at 1/3 and 2/3 of +5V or +15V depending on range selected.

1.3.4 System:

- Drift offset over temperature reference to input: 0.01mV/ ^{O}C max.
- Frequency response (Velocity loop): 750Hz min.
- Frequency response (Current loop): 2KHz min.
- Dead band: None.
- Form factor: 1.01.

1.3.5 Outputs:

- Fault (as output): Active low. Open-collector output can sink 75mA max. through 10 ohms.
- Motor current: Bipolar output. 1V=10A for SMB7230; 1V=40A for SMB7275 & SMB72100. 10mA max.

1.3.6 Mechanical:

Model	L x W x H (inches)	Weight (lbs)
SMB7230-1A-1	12.4 x 5.32 x 10.19	11.00
SMB7275-1A-1	17.63 x 5.92 x 12.47	28.00
SMB72100-1A-1	17.63 x 5.92 x 12.47	28.00

CHAPTER TWO: THEORY OF OPERATION

2.1 Introduction:

This chapter contains the basic control theory of how brush type and brushless servo motors and amplifiers operate. It also compares and contrasts the advantages and disadvantages of brushless and brush type motors and amplifiers to help you select which is best suited for your application. The following is a summary of the topics:

- The theory behind an amplifier driving DC servo motors.
- A comparison between brush type and brushless motors.
- Operation of output switching transistors.
- “H Type” output bridge configuration.
- Pulse-Width-Modulation (PWM).
- Current-Loop and Velocity-Loop operation.
- Protection circuits.

2.2 Driving DC Servo-Motors:

The torque of any DC motor is proportional to motor current: the stronger the magnetic field, the stronger the pull. Motor current may be controlled in two ways: linear and PWM (Pulse-Width Modulation). Linear control is achieved by simply inserting a resistance in series with the motor. This resistance is usually a partially turned on transistor. The transistor is said to be in its "linear" region. Linear amplifiers are simple, accurate, and effective. However, they are very inefficient and they generate a lot of heat. Linear amplifiers are used when low electrical noise, high bandwidths (2KHz or higher) and or low inductance (less than 1mH) motors are used. In pulse-width modulation the control devices (output transistors) are rapidly turned full on and full off. The ratio of the on time (the pulse width) and off time determines the average motor current. Refer to figure 2.1. For example: if the output is on 25% of the time and off 75% of the time, the average motor current is approximately 25% of maximum.

A coil of wire, such as the windings of a motor, forms an inductor. Inductors resist changes in current. This resistance to change, known as reactance, acts to dampen or average the high-current spikes that would otherwise occur when the output devices are on. In fact, if motor inductance is low, external inductors may have to be added in series with each motor lead to ensure proper operation.

A brush type motor may be run from a steady DC voltage since the brushes and commutator switch the current from winding to winding. However, a brushless motor requires that the voltage be switched from winding to winding externally; the voltage that drives a brushless motor is a constantly changing AC waveform. Section 2.5 discusses these waveforms.

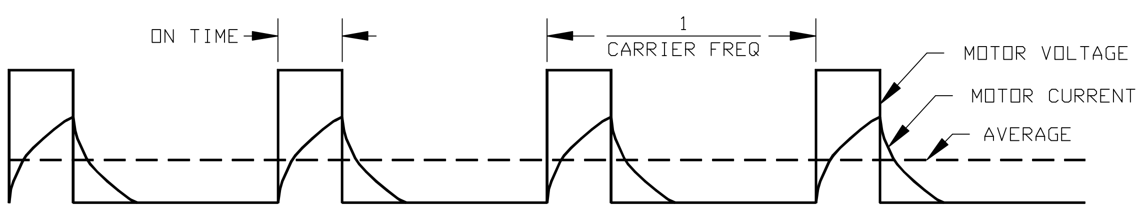


Figure 2.1 Pulse Width Modulation Waveform

2.3 Servo Loops:

A basic velocity mode servo loop for a brush type motor is shown in figure 2.2a. An external controller commands a given velocity (RPM). The velocity loop summing amplifier compares this command with the actual motor velocity, supplied by a DC tachometer on the motor shaft, and produces an error voltage proportional to the difference between the actual and commanded velocity.

The velocity error is used to command motor current in the inner servo-loop. The current loop summing amplifier compares the command current (velocity error) with the actual current in the motor and produces an error voltage proportional to the difference between the actual and commanded current.

Finally, the current error signal is used to produce an output (linear or PWM) to drive the motor.

The velocity loop may be bypassed, and an external current command fed directly to the current loop. In this case, the external command signal controls the torque of the motor, rather than the velocity. This is known as current-mode operation.

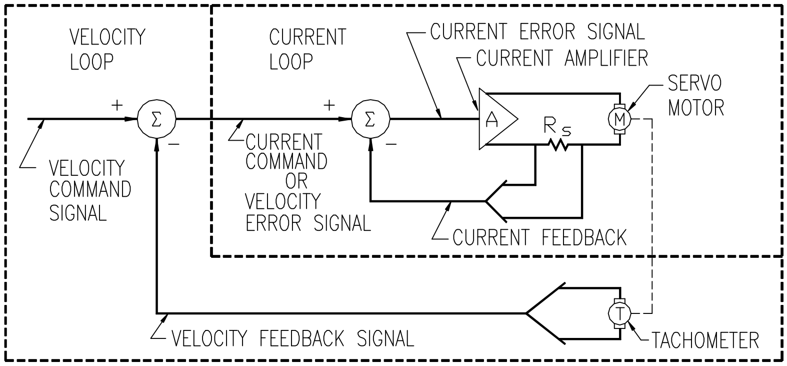


Figure 2.2a
Velocity mode sevo loop for a brush type motor

The servo-loops of a brushless amplifier (figure 2.2b) operate in much the same way, except there are now three current loops, one for each phase of the motor.

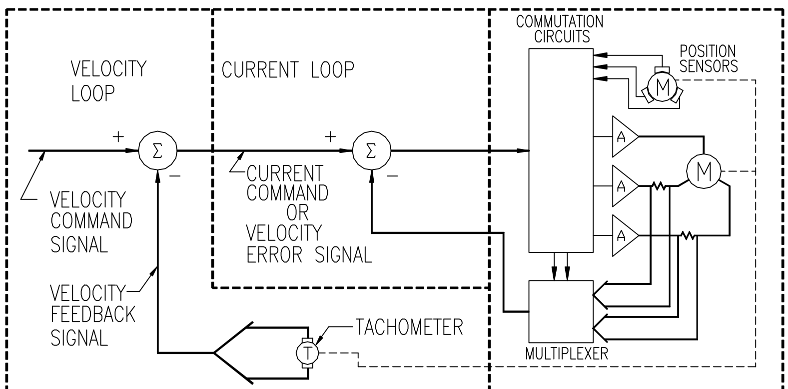


Figure 2.2b
Velocity mode sevo loop for a brushless motor

2.4 Brushed Motors vs. Brushless Motors:

There are two basic types of motor design that are used for high-performance motion control systems: brush type PM (permanent magnet), and brushless type PM. As you can see in figure 2.3, a brush type motor has windings on the rotor (shaft) and magnets in the stator (frame). In a brushless type motor, the magnets are on the rotor and the windings are in the stator.

To produce optimal torque in a motor, it is necessary to direct the flow of current to the appropriate windings with respect to the magnetic fields of the permanent magnets. In a brush-type motor, this is accomplished by using a commutator and brushes. The brushes, which are mounted in the stator, are connected to the motor wires, and the commutator contacts, which are mounted on the rotor, are connected to the windings. As the rotor turns, the brushes switch the current flow to the windings which are optimally oriented with respect to the magnetic field, which in turn produces maximum torque.

In a brushless motor there is no commutator to direct the current flow through the windings. Instead, an encoder, hall sensors or a resolver on the motor shaft senses the rotor position (and thus the magnet orientation). The position data is fed to the amplifier which in turn commutates the motor electronically by directing the current through the appropriate windings to produce maximum torque. The effect is analogous to a string of sequencing Christmas lights: the lights seem to chase each other around the string. In this case, the magnets on the rotor "chase" the magnetic fields of the windings as the fields "move" around the stator.

The relative advantages and/or disadvantages of a brush type motor/amplifier combination vs. a brushless motor/ amplifier combination can be significant. On the next page is a summary of advantages and disadvantages of brush type motor/amplifiers and brushless type motor/amplifiers to help you decide which type to select for your applications.

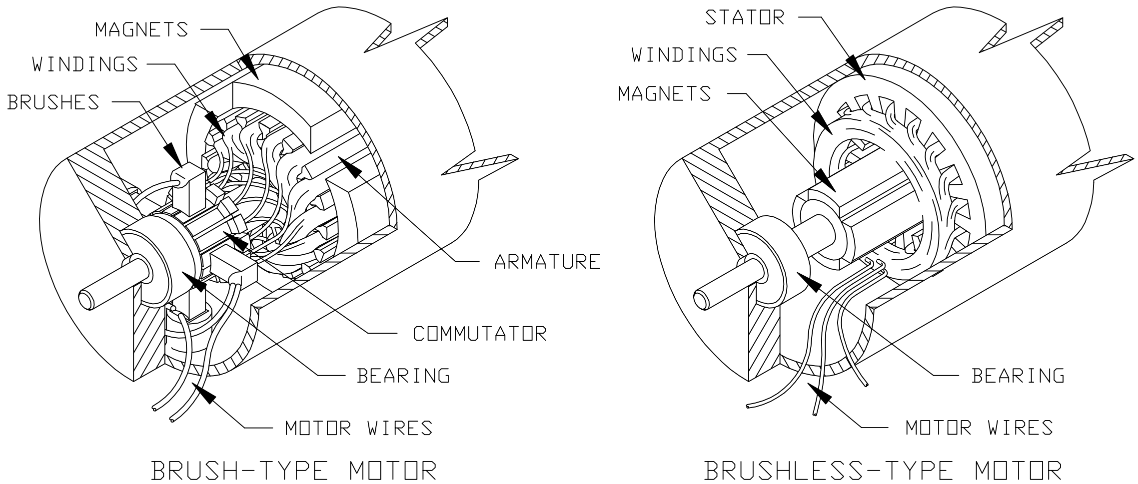


Figure 2.3 Brush type and Brushless type Motors

Brushless Motors/Amplifiers	Brushed Motors/Amplifiers
Advantages	**Disadvantages**
No scheduled maintenance and no brush dust is generated.	Motor brushes must be checked periodically for wear and excess brush dust.
Higher RPM limits.	Approximately 3000RPM maximum.
Lower inertia/torque ratio.	Higher inertia to torque ratio.
Dissipates heat more efficiently due to windings being located in stator.	Not as efficient at dissipating heat. Heat is trapped at rotor and shortens bearing life.
Safer for explosive atmospheres. Quieter and less electrical noise generated.	Brushes spark and generate electrical and audible noise.
Disadvantages	**Advantages**
Amplifiers are complicated and expensive.	Amplifiers are simpler and less expensive.
Higher torque ripple.	Lower torque ripple.
No Industry standard packaging.	Industry standard packaging.

2.5 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.

2.6 "H" Type Output Bridge Configuration:

The output configuration of the amplifier is an "H TYPE" bridge (see figure 2.4 for schematic representation of an output bridge with a motor connected).

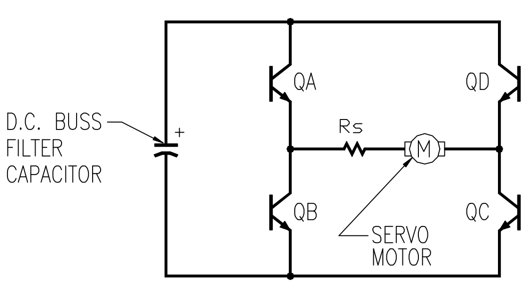


Figure 2.4
Schematic representation of an output bridge with a motor connected.

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.

To provide motor current in one direction, transistor 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.

2.7 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 transistor are turned ON and OFF as shown in figure 2.5. Note that since the pulse widths are equal, the net DC current in the motor is equal to zero.

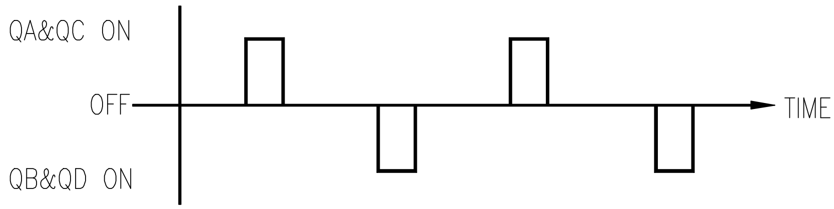


Figure 2.5
Transistor switching waveform at zero current

When a non-zero current is commanded to the current loop, the transistor switching waveform is as shown in figure 2.6A. 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.

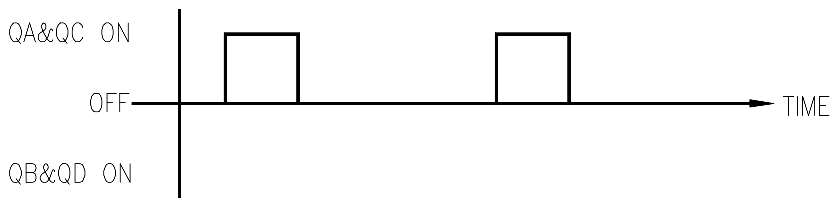


Figure 2.6A
Transistor switching waveform when current flows from A through C

If the input to the current loop had been changed in polarity, the output transistor switching waveform would be as shown in figure 2.6B.

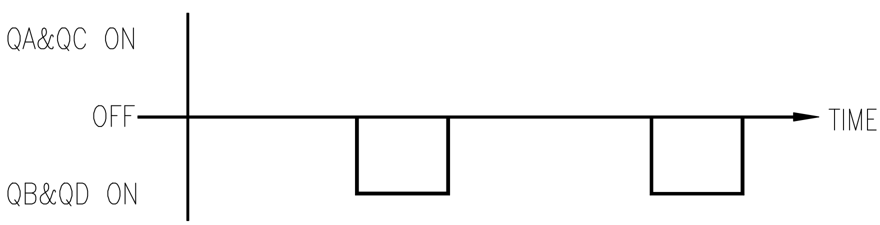


Figure 2.6B
Transistor switching waveform when current flows from B through D

If a larger current of the same polarity was commanded to the output transistor (see figure 2.6B) 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 'carrier frequency'.

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.

2.8 Current Loop Operation:

Please refer to figure 2.2A 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 figure 2.2A) 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 increases until the current-command signal is equaled. 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 “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.

2.9 Velocity Loop Operation:

Please refer to figure 2.2A 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.

2.10 Protection Circuits:

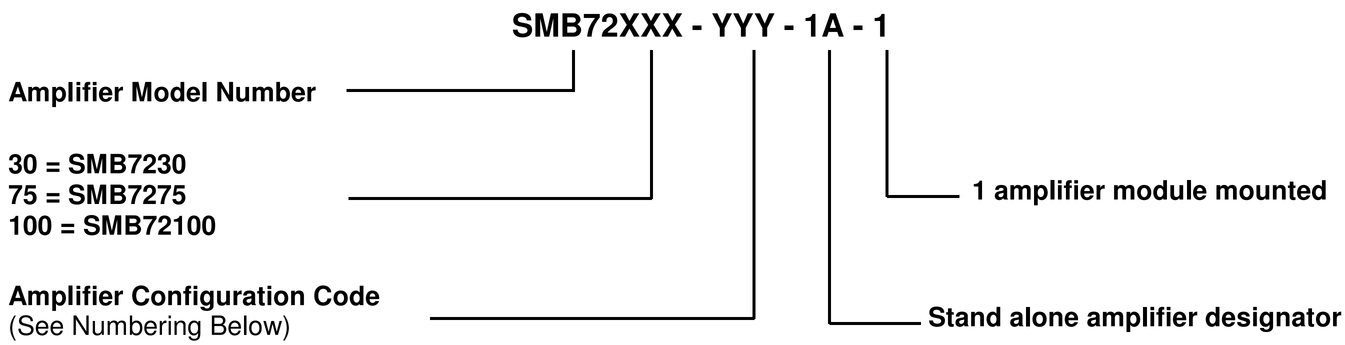
The High and Low Speed Electronic Circuit Breakers (HS/ECB and LS/ECB) protect the amplifier and motor from being damaged by high motor current (specified max. peak and rms current values). The Over Temperature and Over Voltage detection circuits will shut off the amplifier when the temperature of the amplifier or the buss (B+) voltage exceeds a specified limit. Also, there are circuits which limit the motor from running in either or both directions.

CHAPTER THREE: MODEL NUMBERING

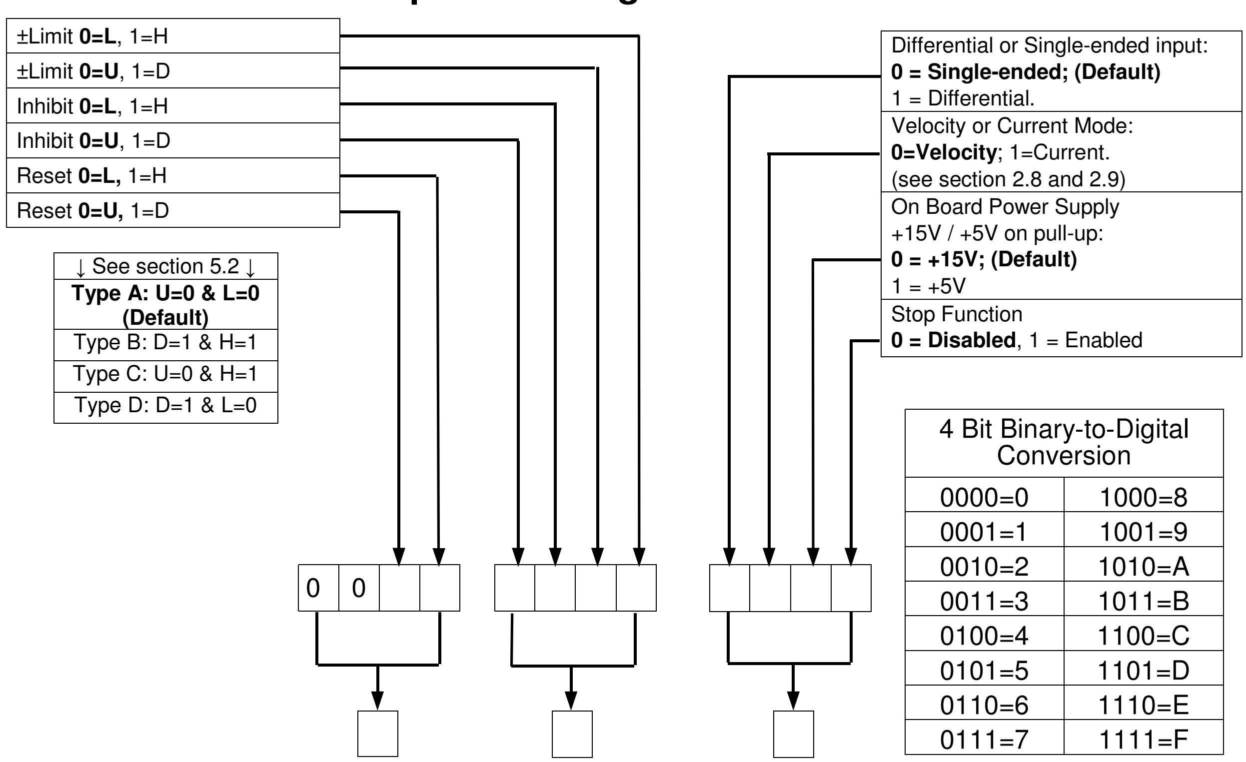
3.1 Introduction:

This chapter contains the model numbering system for the SMB700 series stand alone single axis amplifiers. The model numbering system is designed so that you, our customer, will be able to create the correct model number of the product that you need quickly and as accurate as possible.

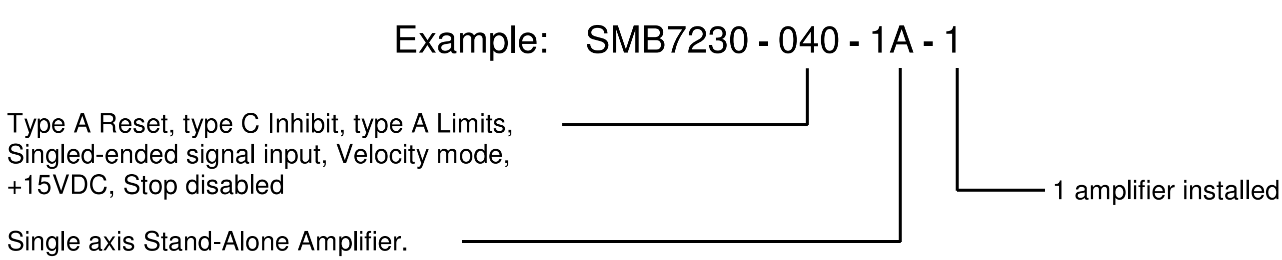
3.2 Model Numbering:



Amplifier Configuration Code



4 Bit Binary-to-Digital Conversion	
0000=0	1000=8
0001=1	1001=9
0010=2	1010=A
0011=3	1011=B
0100=4	1100=C
0101=5	1101=D
0110=6	1110=E
0111=7	1111=F



CHAPTER FOUR: INSTALLATION

4.1 Introduction:

This chapter provides the necessary information to make all the wiring connections for the amplifiers to operate properly.

4.2 Mounting:

Appendix A contains all the wiring diagrams, assembly drawings, and mechanical information necessary to install the amplifiers. The amplifier package should be mounted in a clean, dry enclosure, free of dust, oil, or other contaminants.

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

IMPORTANT: Muffin fan(s) are mounted along one side of the amplifier to provide cooling. At least 3 inches must be allowed between the fan side and the side opposite the fans and any other surface. The clearance to any other side of the amplifier package is not critical, although sufficient space should be allowed for easy wiring and servicing.

4.3 Wiring:

DO NOT APPLY POWER UNTIL INSTRUCTED TO DO SO.

4.3.1 RFI/EMI and Wiring Technique:

IMPORTANT: All PWM equipment inherently generates radio-frequency interference (RFI), and wiring acts as antennae to transmit this interference. In addition, motors inherently generate electromagnetic interference (EMI). Unless the wiring is very short, some sort of shielding on the motor wires is necessary to meet FCC RFI/EMI guidelines and to protect other equipment from the effects of RFI/EMI. We recommend that shielded wire be used, or the wires should be run in metallic conduit. The shield or conduit should be connected to the amplifier baseplate, which in turn must be earth grounded. In addition, a conductor of the same gauge as the motor wires must be connected from the motor case to the amplifier baseplate to provide protection from shock hazard. The earth grounding is necessary to meet National Electrical Code (NEC) requirements as well as suppressing RFI/EMI.

Additional RFI suppression may be obtained by placing inductors in each motor lead near the amplifier. Consult a Glentek applications engineer for inductor recommendations. Glentek stocks a complete line of inductors for virtually every application.

IMPORTANT: The signal wiring to the tachometer, encoder (if used) and the signal inputs to the amplifier are susceptible to noise pickup. Excessive noise pickup will cause erratic amplifier operation. We urge that each signal input line each be run in separate, twisted-pair, shielded cable. In each case the shield should be terminated at the amplifier end only to a common terminal. We also recommend that the signal lines be kept as far as possible from any power or motor wires.

4.3.2 Wire Size and Type:

IMPORTANT: To ensure safe operation, Glentek strongly recommends that all wiring conform to all local and national codes.

Recommended Wire Size and Type:

- Motor Wires: 12AWG, shielded - SMB7230
6AWG, shielded - SMB7275
4AWG, shielded - SMB72100
- Motor Case Ground: Same gauge as motor wires
- Main Input Power: 14AWG, twisted - SMB7230 (3 phase)
8AWG, twisted - SMB7275 (3 phase)
6AWG, twisted - SMB72100 (3 phase)
- Fan Power: 18AWG, twisted.
- Signal and Tach Input: 22AWG, twisted-pair, shielded.
- Logic Inputs/Outputs: 22AWG, shielded with its return lead.

4.3.3 Connector Size and Type:

4.3.3.1 SMB7230 Amplifier- Power/Motor Mating Connector:

- Phoenix, 8 Pin, P/N 1975642
  (Glentek P/N EJ531F08)

4.3.3.2 SMB7230 Amplifier- Fan Power Mating Connector:

- Phoenix, 2 pin, P/N 1792757
  (Glentek P/N EJ741V02)

4.3.3.3 SMB7230, SMB7275 and SMB72100- Signal Mating Connector:

Phoenix, 15 pin, P/N 1803701

(Glentek P/N EJ521P15)

4.3.4 Amplifier Module Connections:

4.3.4.1 Power Connections for the SMB7230:

Signal Name	Terminal	Notes
MTR A	TB1-1	Motor Output
N/C	TB1-2	No connection
MTR B	TB1-3	Motor Output
N/C	TB1-4	No connection
N/C	TB1-5	No connection
AC 3	TB1-6	AC power input - 3Ø
AC 2	TB1-7	AC power input - 1Ø
AC 1	TB1-8	AC power input - 1Ø
FAN PWR	TB2-1	AC fan 120VAC
FAN PWR	TB2-2	AC fan 120VAC

4.3.4.2 Power Connections for the SMB7275 and SMB72100:

Signal Name	Terminal	Notes
MTR B	TB1-1	Motor Output
N/C	TB1-2	No connection
MTR A	TB1-3	Motor Output
FAN PWR	TB1-4	120VAC
FAN PWR	TB1-5	120VAC
AC 3	TB1-6	AC power input - 3Ø
AC 2	TB1-7	AC power input - 1Ø
AC 1	TB1-8	AC power input - 1Ø

4.3.4.3 Signal Connections (All Models):

Signal Name	Terminal	Notes
SIGNAL 1 (-)	J1-1	Differential signal inverting input.
SIGNAL 1 (+)	J1-2	Differential signal non-inverting input.
SIGNAL 2 (+)	J1-3	Single-ended signal input.
COMMON	J1-4	Common for all signals and shields.
TACH IN	J1-5	Tachometer input. Not used in current-mode.
COMMON	J1-6	Common for all signals and shields.
MOT CUR	J1-7	Scale factor: 1V=10A for the SMB7230; 1V=40A for the SMB7275, SMB72100.
LIMIT +	J1-8	Inhibits the motor in the + direction.
LIMIT -	J1-9	Inhibits the motor in the - direction.
INHBIT	J1-10	Inhibits the motor in both directions.
FAULT	J1-11	Goes low if there is a fault in the amplifier. May be externally forced low to stop motor rotation in both directions.
COMMON	J1-12	Common for all signals and shields.
RESET IN	J1-13	Resets the fault latch. May also be used as an inhibit.
MTR TEMP	J1-14	Motor over temperature switch input (NC switch)
MSTR/SLAVE	J1-15	Master/Slave I/O or 5V out

CHAPTER FIVE: CONFIGURATION

5.1 Introduction:

This chapter describes the field configurable features of the SMB7200 series. This flexibility allows the user to adapt the amplifiers to many different requirements. If desired, Glentek will be happy to pre-configure your amplifiers.

NOTE: Each amplifier is configured and shipped according to the model number (instructions to construct a model number is in chapter three) when the order is placed. It is important for the user to realize that any changes to the jumpers (micro-shunts) by the user will result in discrepancies between the model number and the actual configuration of the amplifier.

5.2 Logic Input Configuration:

There are five logic inputs: Limit +, Limit -, Inhibit, Reset In and Motor Temp. The first four may be configured for active-high or active-low signals, and pulled-up or pulled-down termination (type A, B, C, and D). The motor-temp may be configured for active-high (NC switch)or disabled, and is always pulled-up to 5VDC. The other four logic inputs (as a group) may be pulled up to 5VDC or 15VDC.

Type "A": Requires grounding of input to disable the amplifier (pull-up, active-low).
Type "B": Requires a positive voltage at input to disable the amplifier (pull-down, active-high).
Type "C": Requires grounding of input to enable the amplifier (pull-up, active-high).
Type "D": Requires a positive voltage at input to enable the amplifier (pull-down, active-low).

5.3 Amplifier Configuration:

The following table shows where to install the jumpers (micro-shunts) to achieve the desired (Type A, B, C, and D) configuration. The default configuration (**Type A**) is shown in bold.

	Type A	Type B	Type C	Type D
LIMIT±	**JP12: 2-3** **JP: 3-4**	JP12: 2-1 JP8: 3-4 Omit	JP12: 2-3 JP8: 3-4 Omit	JP12: 2-1 JP8: 3-4 Install
INHIBIT	**JP13: 2-3** **JP8: 5-6 Install**	JP13: 2-1 JP8: 5-6 Omit	JP13: 2-3 JP8: 5-6 Omit	JP13: 2-1 JP8: 5-6: Install
RESET IN	**JP10: 2-3** **JP8: 7-8 Install**	JP10: 2-1 JP8: 7-8 Omit	JP10: 2-3 JP8: 7-8 Omit	JP10: 2-1 JP8: 7-8 Install

5.3.1 +15V/+5V Logic Level Configuration (Default: JP14: 1-2):

+15V: JP14: 1-2
+5V: JP14: 2-3

5.3.2 Velocity and Current Mode Configuration (Default: JP6 Omit, JP7 Install):

Velocity Mode: JP6: omit, JP7: install.
Current Mode: JP6: install, JP7 omit.

5.3.3 Tach Lead (Default: JP5: Omit):

The tach lead jumper is added to add capacitance to the tach lead circuit. This may be needed if you have a large one hook overshoot when monitoring tach out. This jumper should remain omitted unless instructed to add by a Glentek engineer.

5.3.4 Motor Temp Input (Default: JP11: Install):

JP11 grounds J1-14 (Motor Temp) and enables the amplifier.. When connecting a normally closed temperature switch remove JP11.

5.3.5 Motor Reverse Configuration (Default: JP1: 1-2, JP2: 1-2):

The motor reverse jumper (JP1) can reverse the motor direction for both current and velocity modes by moving it from the 1-2 position to the 2-3 position. Note: JP2 must be installed in the 1-2 position.

5.3.6 Stop Configuration (Default: JP8: 9-10 Installed):

If the stop function is enabled (JP8: 9-10 omitted), when the inhibit function at J1-9 is activated the amplifier will actively decelerate the motor for 150 mSec, then all output current will cease. When the stop function is disabled, the inhibit function immediately turns off output current to the motor and the motor may coast for a bit.

5.3.7 J1-15 Configuration (Default: JP9: 1-2):

Terminal 15 of the 15 pin I/O connector is configurable to serve as the master/slave I/O or as a 5V source (JP9: 2-3). See 5.3.8 below.

5.3.8 Master/Slave Configuration

The SMB7200 series of amplifiers are designed so they can easily be configured for master/slave applications. The master amplifier is configured by installing JP3, JP2: 1-2 and JP9: 1-2. The slave amp is configured by omitting JP3, installing JP2: 2-3, JP4 (slave balance) and JP9: 1-2.

By wiring J1-15 of the master to J1-15 of the slave the velocity error signal of the master commands the current loop of both master and slave amps allowing them to jointly share the load of a single axis.

CHAPTER SIX: START UP AND CALIBRATION

6.1 Introduction:

This chapter contains the procedure required for initial start up and amplifier calibration. The SMB7230, SMB7275 and SMB72100 amplifiers can be field configured to run in velocity mode (6.3) or current mode (6.4).

Required Equipment: Oscilloscope, voltmeter & battery box. The battery box serves as a step input voltage command, applying and removing a flashlight battery can also be used for this function. Glentek sells a battery box, BB-700, which is ideal for this function.

6.2 Initial Start Up:

When applying power to start up your amplifier system for the first time, we recommend you follow this procedure. If you have already gone through this procedure you can skip to the appropriate calibration procedure.

1. Check for any loose or damaged components.
2. Check that all connections are tight.
3. Be sure that the motor mechanism is clear of obstructions. If the mechanism has limited motion,e.g: a lead-screw, set the mechanism to mid-position.
4. Disconnect the signal and auxiliary inputs.
5. Be sure the Loop-Gain pot(s) are fully CCW.
6. Apply main power. Check for the correct AC voltage at input terminal. The DC Bus (amplifier supply-voltage) will be 1.4 times this value.
7. Work on only one amplifier at a time.

6.3 Calibration of the Velocity Mode Amplifier:

The amplifier, in this configuration, receives an analog, bi-polar input command which is proportional to the required motor velocity. The amplifier receives velocity feedback from a tachometer or encoder (option) which is usually mounted to the rear of the motor. The following pots will be set during calibration: (Note: RV8 is a single turn pot and the others are 20-turn pots.)

Note: RV9 is factory set and should not be adjusted.

Pots	Name of Pot	Notes
RV1	Differential Gain, **SIGNAL 1**	Sets the input voltage to velocity (current) ratio for differential signal input.
RV2	Signal Gain, **SIGNAL 2**	Sets the input voltage to velocity (current) ratio for single-ended signal input.
RV3	Tach. Gain, **TACH**	Sets the DC tachometer gain.
RV4	Balance, **BAL**	Used to null any offsets in system.
RV5	Compensation, **COMP**	Used in conjunction with tach. gain to set the system bandwidth.
RV7	Current Limit, **I LIMIT**	Sets the maximum peak motor current. Shipped set CW (max. current).
RV8	**LOOP GAIN**	Used to shut off uncalibrated amplifiers. When the loop gain is full CCW, no current is delivered to the motor.

PROCEDURE:

1. Apply the main power and fan power.
2. Slowly turn the Loop Gain pot (RV8) CW. The motor should be stopped or turning slowly. If the motor starts running away, remove the power, reverse the tach leads, and retest.
3. Set the Balance pot (RV4) for zero motor rotation.
4. Connect an oscilloscope to J1-7 (MOT CUR) and a battery box to J1-3 (J1-4 is common for both). The voltage on J1-7 is a function of motor current (See section 4.3.4.2). While applying a step input voltage, adjust the Current Limit pot (RV7) for the desired peak current.

The purpose of the following procedure is to set the system bandwidth to obtain a critically-damped response or a one hook overshoot response with the maximum possible Tach. Gain. There are many possible settings of Tach. Gain and Compensation which will yield the desired waveform. The optimum setting will occur when Tach Gain is as CW as possible and Compensation is as CCW as possible. However, the servo loop may become unstable (the motor oscillates or hunts) with a very low (near CCW) setting of Compensation. In this case, stability is the limiting factor. At no time should the servo-loop be allowed to be unstable.

Amplifiers are normally shipped with the Tach. Gain pot (RV3) set at 100%. This is a good place to start (Note: For high voltage tachometers (31.5V/KRPM) start at 50%) . If you are unsure of where the Tach. Gain is set, turn the Tach Gain (RV3) fully CW (up to 20 turns).

5. Connect an oscilloscope to J1-5 (TACH IN) and J1-4, common. Set the battery box for a DC signal output to obtain approximately 400RPM. The RPM may be set by measuring the tach voltage at J1-5, e.g., 2.8VDC for a 7V/KRPM tach is 400RPM.
6. Pulse the input and compare the waveform with figure 6.1.

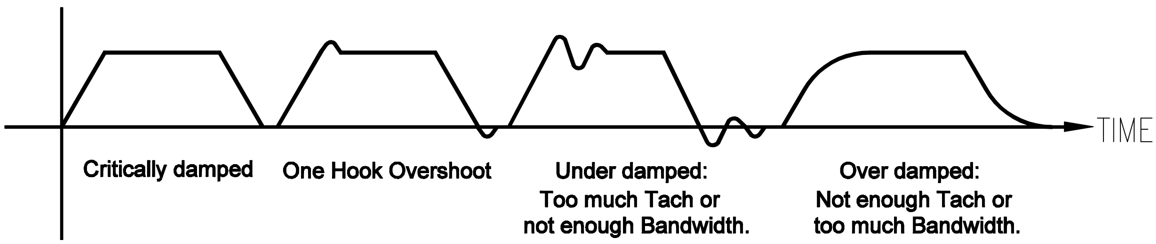


Figure 6.1 Critically damped, One Hook Overshoot, Under and Over damped waveforms

7. Adjust the Compensation pot (RV5) CCW until the waveform is critically damped or one hook overshoot. Then proceed to step 9.
8. If the desired waveform cannot be obtained by adjusting the Compensation pot, back off (CCW) the Tach Gain pot (RV3) a few turns and repeat step 7.
9. Do not adjust the Tach Gain or Compensation pots for the rest of the calibration procedure.
10. With the battery box still connected at J1-3 and J1-4 for single-ended input (or if your system uses the Differential input, move battery box to J1-1 and J1-2), set the battery box for a known DC voltage. Adjust the Signal Gain pot (RV2) or (RV1 for differential input) to obtain the desired motor velocity.
11. If the motor is rotating in the wrong direction for a given input polarity, remove power and reverse both the motor leads and the tach leads.
12. Remove the battery box, and repeat step 3.
13. Calibration complete. Reconnect signal wires.

6.4 Calibration of the Current Mode Amplifier:

The amplifier in this configuration, receives an analog, bi-polar input command which is proportional to the required motor current (motor torque). The following potentiometers (pots) will be set during calibration: (Note: RV8 is a single turn pot and the others are 20-turn pots.)

Pots	Name of Pot	Notes
RV1	Differential Gain, **SIGNAL 1**	Sets the input voltage to current ratio for differential signal input.
RV2	Signal Gain, **SIGNAL 2**	Sets the input voltage to current ratio for single-ended signal input.
RV4	Balance, **BAL**	Used to null any offsets in system.
RV7	Current Limit, **I LIMIT**	Sets the maximum peak motor current. Shipped set at full CW (Max. current).
RV8	**LOOP GAIN**	Used to shut off uncalibrated amplifiers. When the loop gain is full CCW, no current is delivered to the motor.

Note: RV9 is factory set and should not be adjusted.

PROCEDURE:

1. Apply the main power and fan power.
2. Slowly turn the Loop Gain pot (RV8) CW. The motor should be stopped or turning slowly. Set the Balance pot (RV4) for zero motor rotation.
3. Connect an oscilloscope to J1-7 (MOT CUR) and a battery box to J1-3 (J1-4 is common for both). The voltage on J1-7 is a function of motor current (See section 4.3.4.2). While applying a step input voltage, adjust the Current Limit pot (RV7) for the desired peak current. If the desired peak current cannot be achieved with the Current Limit pot full CW, increase either the input signal or the Signal Gain pot (RV2) for single-ended input or Differential Gain pot (RV1) for differential input.
4. With the battery box still connected at J1-3 and J1-4 for single-ended input (or if your system uses the Differential input, move battery box to J1-1 and J1-2), set the battery box for a known DC voltage. Apply ± input signal pulses and adjust the Signal Gain pot (RV2) or (RV1 for differential input) to obtain the desired current gain of the amplifier.
5. If the motor is rotating in the wrong direction for a given input polarity, remove the power and reverse the motor leads.
6. Remove the battery box, and repeat step 2.
7. Calibration complete. Reconnect signal wires.

6.5 Calibration Setup Record:

It is good practice to keep a record of all pot settings. Doing so will facilitate calibration on future units and repair on this unit. Although not a substitute for the calibration procedure, it will at least get you "in the ballpark." Remove the power and allow all capacitors to discharge before taking measurements. Note: The balance pot should not be measured in this fashion, set per step 3 in the calibration procedure.

Pot/Dip-Switches	AMP1	AMP2	AMP3	AMP4
Differential Gain pot wiper to common (ohms):				
Signal Gain pot wiper to common (ohms):				
Tach Gain pot wiper to common (ohms):				
Compensation pot wiper to common (ohms):				
Current Limit pot wiper to common (ohms):				

Note: Tach voltage is measured at J1-5. Common for all measurements is at J1-12.

Date data taken: _____ / _____ / _____

Serial number S/N: ___________________________________

Model number: SMB72____________________________

Note any changes to components or any special features in the space below:

CHAPTER SEVEN: MAINTENANCE, REPAIR, AND WARRANTY

7.1 Maintenance:

Glentek amplifiers do not require any scheduled maintenance, although it is a good idea to occasionally check for dust build up or other contamination.

7.2 Amplifier Faults:

If an amplifier should cease to operate and the fault LED is lit or flashing, review the sections which follow on the fault in question for information and possible causes.

A FAULT CAN ONLY BE CAUSED BY ABNORMAL CONDITIONS. LOCATE AND CORRECT THE CAUSE OF THE FAULT BEFORE REPEATED RECYCLING OF POWER TO THE AMPLIFIER TO PREVENT POSSIBLE DAMAGE.

7.2.1 Table of Fault LED Conditions:

Input or Fault Condition	RED LED FLASHES	GREEN LED	FAULT OUTPUT
RUN	OFF	**ON**	**HIGH**
AMPLIFIER INHIBIT	OFF	OFF	**HIGH**
EXT. FAULT/RESET	**ON**	OFF	**LOW**
AMPLIFIER OVER TEMP (LATCHED)	**ONCE**	OFF	**LOW**
OVER VOLT (LATCHED)	**TWICE**	OFF	**LOW**
LS/ECB (LATCHED)	**THREE TIMES**	OFF	**LOW**
HS/ECB (LATCHED)	**FOUR TIMES**	OFF	**LOW**
MOTOR OVERTEMP (LATCHED)	**FIVE TIMES**	OFF	**LOW**

7.2.2 High Speed Electronic Circuit Breaker (HS/ECB) Fault:

When the peak output of the amplifier exceeds 85A for the SMB7230 and 210A for the SMB7275 and SMA71100 for 10 microseconds, the Run LED will turn off, the FAULT LED will flash four times a Fault Output is generated, and the amplifier is inhibited. **NOTE: This fault can be reset only by cycling the input power.**

The following is a list of possible causes:

- Shorted motor leads.
- Motor inductance too low.
- Short from a motor lead to ground.

7.2.3 Low Speed Electronic Circuit Breaker (LS/ECB) Fault:

When the RMS output of the amplifier is exceeded for 3 seconds, the Run LED will turn off, the FAULT LED will flash three times and a Fault Output is generated, and the amplifier is inhibited. NOTE: This is a latched condition.

The following is a list of possible causes:

- Binding or stalling of motor shaft due to excessive mechanical overload.
- Overload of amplifier output to motor.
- Large reflected load inertia.

7.2.4 Amplifier Over Temp Fault:

When the amplifier heatsink temperature has reached a level that, if exceeded, would damage the output transistors, the Run LED will turn off, the FAULT LED will flash one time and a Fault Output is generated, and the amplifier is inhibited. NOTE: This is a latched condition.

The following is a list of possible causes:

- Loss of cooling or fans are defective or airflow is blocked.
- Excessive rise in cooling air temperature due to cabinet ports being blocked or excessive
- Hot air being ingested.
- Extended operational duty cycle due to mechanical overload of motor or defective motor.
- Regen resistor has overheated due to excessive deceleration/ high load inertia.

7.2.5 Over Voltage Fault:

When the DC Buss voltage reaches 270VDC, the Run LED will turn off, the FAULT LED will flash two times and a Fault Output is generated, and the amplifier is inhibited. NOTE: This is a latched condition.

The following is a list of possible causes:

- Main AC line voltage is too high.
- Faulty regen circuit.

7.2.6 Resetting A Fault:

A fault may be reset by pushing the Reset button, activating the Reset input J1-13 or by removing power and allowing the filter capacitor(s) to discharge.

Note: A HS/ECB fault can be reset only by cycling the input power.

7.3 Amplifier Failure:

If an amplifier should fail, that is, if it should cease to operate with no apparent fault, the drawings in appendix A will enable a skilled technician to troubleshoot an amplifier to even lower levels. The modular construction of the amplifier allows for fast and easy repair.

7.4 Factory Repair:

Should it become necessary to return an amplifier 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 model number.
   B. Company name, phone number, 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 that the unit is being returned to the factory and obtain an RMA (Return Material Authorization) number. The RMA number must accompany the unit upon return to Glentek.
5. Return the unit by the best means possible. The method of freight chosen will directly affect the

timeliness of its return.
Glentek also offers a 24-48hr. repair service in the unlikely event that your system is down and you do not have a replacement amplifier module.

7.5 Warranty:

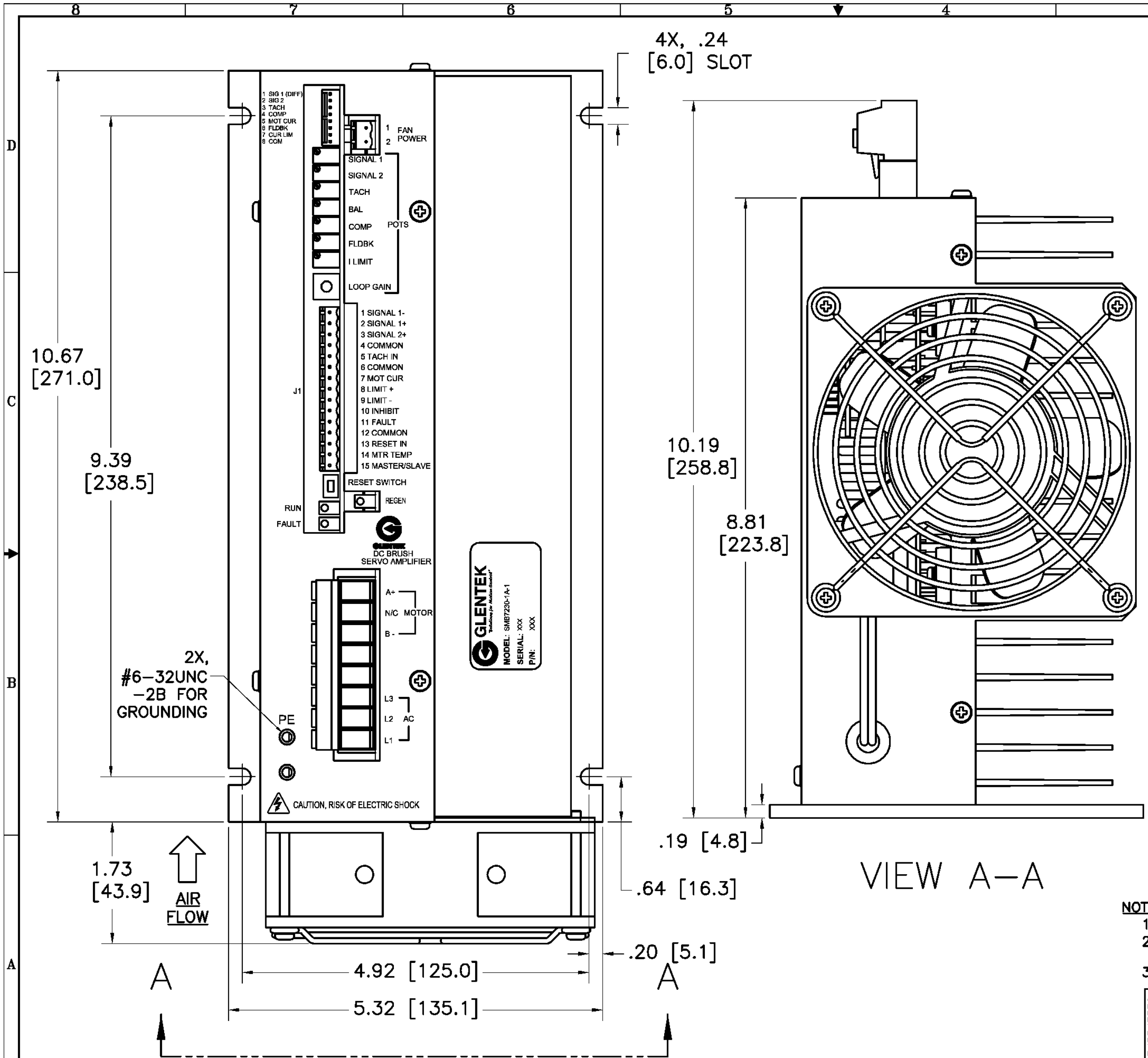
Any product, or part thereof, manufactured by Glentek, Inc., described in this manual, which, under normal operating conditions in the plant of the original purchaser thereof, proves defective in material or workmanship within one year from the date of shipment by us, as determined by an inspection by us, will be repaired or replaced free of charge, FOB our factory, El Segundo, California, U.S.A. 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, 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 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

AMPLIFIER DRAWINGS



REV	DESCRIPTION	ECO	DATE	CHG BY	APPD BY
A	INITIAL RELEASE	8058	29SEP09	M.T.	C.V.

Specifications and Features	
AC Input Voltage	60 - 120 VAC, 50/60 Hz, 3 Phase
Inrush Current at Power Up	260 A max. @ 120 VAC
Modes of Operation	Current or Velocity Mode (Field Configurable)
Peak Current Output	60 A @ 25 °C Ambient
Continuous Current Output	30 A @ 25 °C Ambient
PWM Switching Frequency	9 KHz base / 18 KHz effective
Command Inputs (Adjustable Signal Gains)	Signal 1 ±10 V Differential Signal 2 ±10 V Single Ended
Tachometer Input	+/- 90 Vdc Maximum
Fault Protection	Short circuit protection from motor terminal to terminal, motor terminal to DC bus, motor terminal to chassis. Amplifier RMS over current, DC bus over voltage. Amplifier over temperature and motor over temperature.
Amplifier Isolation	Logic Isolated From High Voltage
I/O Configuration (Limits, Inhibit, Reset)	Field Configurable; Pull Up to 5/15 Vdc or Pull Down, Active High or Active Low
Analog Output Current Monitor	10A/V
Motor Over Temperature Input	Pulled Up, Active High (NC Temp Switch)
Fan Power	120 VAC On Dedicated Input Terminals
Dedicated Fault Output	Open Collector, pulled up to 5Vdc or 15 Vdc
Low Speed Electronic Circuit Breaker (LS/ECB)	Fault when output current exceed 30 A for greater than 3 seconds.
Internal Regen	15 Ohms, 95 W. Regen turns on at 230-250 VDC
Bus Over Voltage	Trips normally at 270-280 VDC
Operating Temperature	0 °C to +60 °C
Storage Temperature	-40 °C to +80 °C
Humidity	5% to 95% non-condensing
Mounting Hardware	#10-32 or M5 Screws, Qty. = 4
Dimension (L x H x W - inches)	12.50 x 10.09 x 5.32

Mating Connectors, Power Input, and Motor Output Conductors	
Controller I/O, 15 Pin Phoenix	Glentek P/N: EJ521P15; Phoenix P/N: 18 03 70 1
Fan Power, 2 Pin Phoenix	Glentek P/N: EJ741V02 ; Phoenix P/N: 17 92 75 7
Power Connector, 8 Pin Phoenix	Glentek P/N: EJ531F08; Phoenix P/N: 1975642
Power Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 12 AWG or 3.31 mm²
Motor Output Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 12 AWG or 3.31 mm²
Fan Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 18 AWG or 0.82 mm²

NOTES:
1. DIMENSIONS ARE IN INCHES [MILLIMETERS].
2. MAINTAIN A MIN. OF 2" – 3" OF SPACE AT BOTH ENDS AND TOP OF THE AMPLIFIER TO ENSURE PROPER VENTILATION FOR THE UNIT.
3. PREFERED MOUNTING SO AIR FLOW IS UP.

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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. BREAK ALL SHARP EDGES .005 TO .015. TOLERANCES: DECIMALS .XX ± .01, .XXX ± .005; ANGULAR ± 0.5°

MODEL: SMB7230-1A-1 — DRAWN BY: M.T. — DATE: 29SEP09 — CHECKED BY: C.V. — APPROVED BY: L.P. — MATERIAL: – — FINISH: – — REF. / CONFIGURATION CODE NUMBER: 3

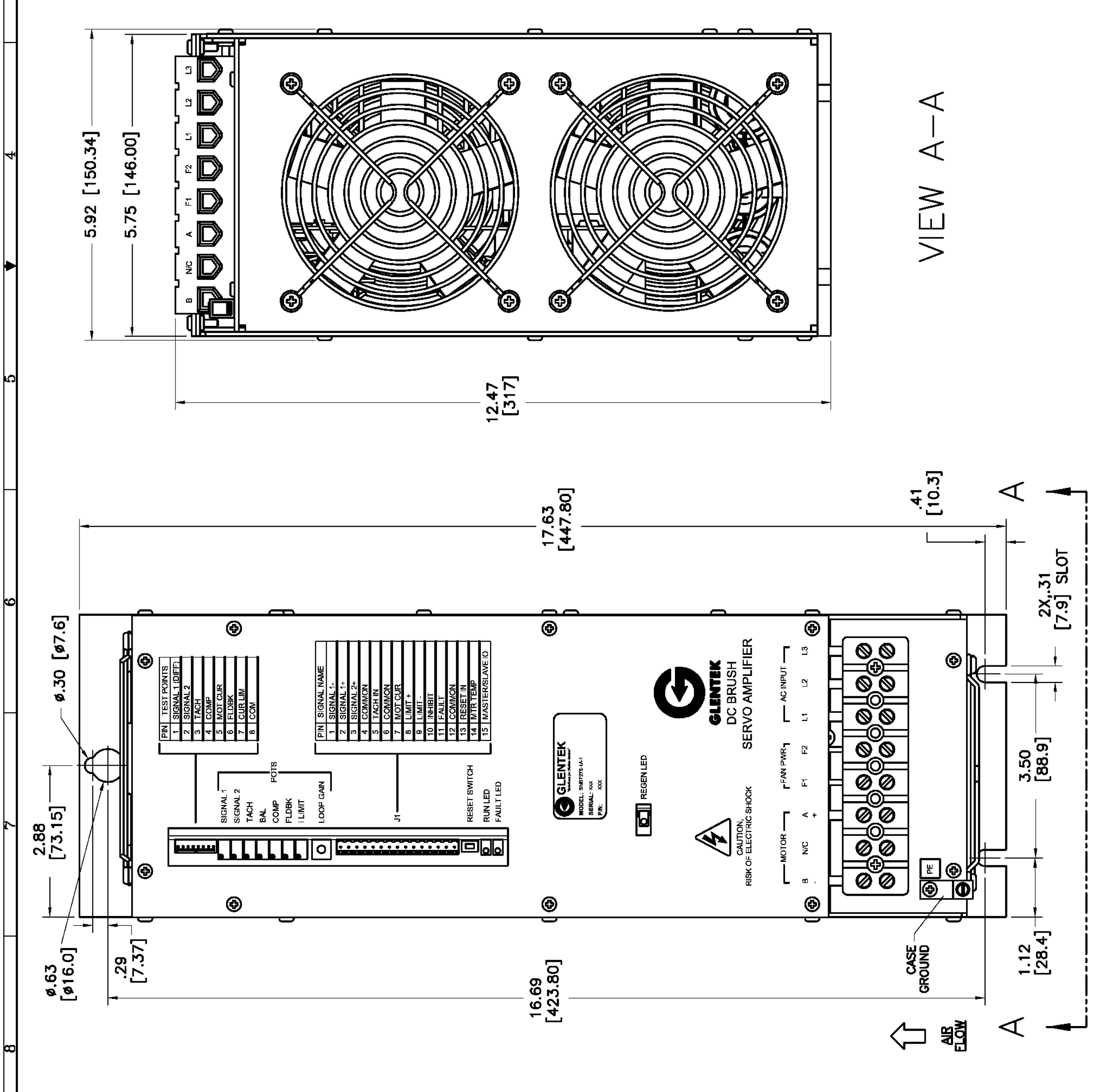
GLENTEK "Solutions for Motion Control" — 208 Standard Street, El Segundo, CA 90234 USA, 310.322.3026 FAX 310.322.7709, www.glentek.com

TITLE: INSTALLATION,SMB7230–1A–1
SIZE: D — DRAWING NUMBER: 7230–1042–000 — REV: A
SCALE: 1.375:1 — FILE: 7230–1042–000–A.DWG — SHEET 1 OF 1

REV	DESCRIPTION	ECO	DATE	CHG BY	APPD BY
A	INITIAL RELEASE	3056	18SEP09	M.T.	C.V.
B	PEAK CURRENT WAS 180A	3056	30DEC11	CV	LP

Specifications and Features	
AC Input Voltage	60 - 120 VAC, 50/60 Hz, 3 Phase, isolation transfomer typical.
Inrush Current at Power Up	260 A max. @ 120 VAC
Modes of Operation	Current or Velocity Mode (Field Configurable)
Peak Current Output	120 A @ 25 °C Ambient
Continuous Current Output	75 A @ 25 °C Ambient
PWM Switching Frequency	9 KHz base / 18 KHz effective
Current Loop Bandwidth	Adjustable to 3 KHz
Command Inputs (Adjustable Signal Gains)	Signal 1 ±10 V Differential Signal 2 ±10 V Single Ended
Tachometer Input	+/- 90 Vdc Maximum
Fault Protection	Short circuit protection from motor terminal to terminal, motor terminal to DC bus, motor terminal to chassis. Amplifier RMS over current, DC bus over voltage. Amplifier over temperature and motor over temperature.
Amplifier Isolation	Logic Isolated From High Voltage
I/O Configuration (Limits, Inhibit, Reset)	Field Configurable; Pull Up to 5/15 Vdc or Pull Down, Active High or Active Low
Analog Output Current Monitor	40A/V
Motor Over Temperature Input	Pulled Up, Active High (NC Temp Switch)
Fan Power	120 VAC On Dedicated Input Terminals
Dedicated Fault Output	Open Collector, pulled up to 5Vdc or 15 Vdc
Low Speed Electronic Circuit Breaker (LS/ECB)	Fault when output current exceed 75 A for greater than 3 seconds.
Internal Regen	12 Ohms, 800 W. Regen turns on at 230-250 VDC
Bus Over Voltage	Trips normally at 270-280 VDC
Operating Temperature	0 °C to +60 °C
Storage Temperature	-40 °C to +80 °C
Humidity	5% to 95% non-condensing
Mounting Hardware	1/4-20 or M8 Screw, Qty = 3
Dimension (L x H x W - inches)	17.63 x 12.60 x 5.92

Mating Connectors, Power Input, and Motor Output Conductors	
Controller I/O, 15 Pin Phoenix	Glentek P/N: EJ521P15; Phoenix P/N: 18 03 70 1
Power Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 8 AWG or 8.37 mm²
Motor Output Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 6 AWG or 13.3 mm²
Fan Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 18 AWG or 0.82mm²



NOTES:
1. DIMENSIONS ARE IN INCHES [MILLIMETERS].
2. MAINTAIN A MIN. OF 2" - 3" OF SPACE AT BOTH ENDS AND TOP OF THE AMPLIFIER TO ENSURE PROPER VENTILATION FOR THE UNIT.
3. PREFERED MOUNTING SO AIR FLOW IS UP.

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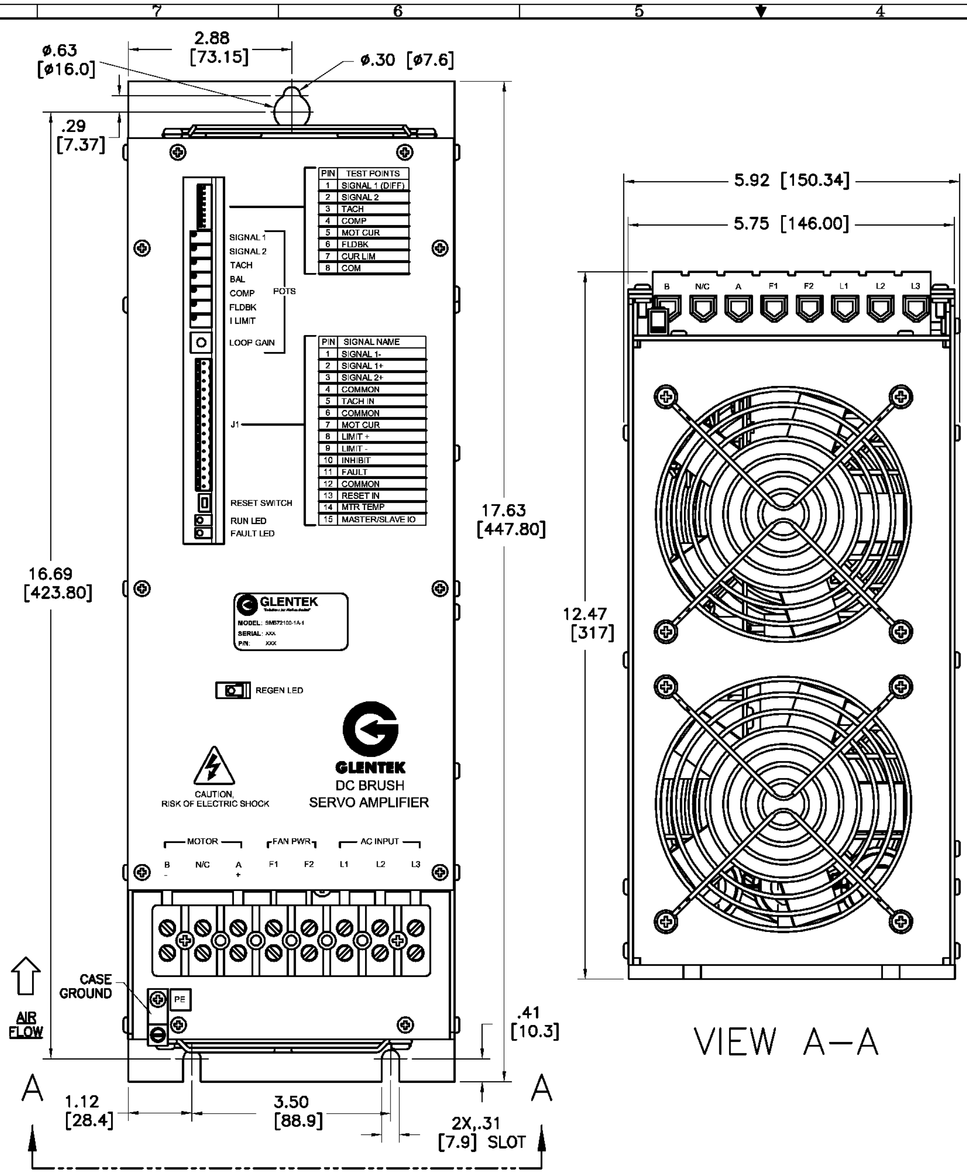
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. BREAK ALL SHARP EDGES. SURFACE ROUGHNESS .005 TO .015. TOLERANCES: DECIMALS .XX ± .01, .XXX ± .005; ANGULAR ± 0.5°. MATERIAL: -. FINISH: -.

MODEL: SMB7275-1A-1 | DRAWN BY: M.T. | DATE: 18SEP09 | CHECKED BY: C.V. | APPROVED BY: L.P.

GLENTEK "Solutions for Motion Control" 208 Standard Street, El Segundo, CA 90234 USA, 310.322.3026 FAX 310.322.7709, www.glentek.com

TITLE: INSTALLATION,SMB7275-1A-1 (HI-AC REPLACEMENT)

SIZE: D | DRAWING NUMBER: 7275-1042-000 | REV: B | SCALE: 1:1 | FILE: 7275-1042-000-B.DWG | SHEET 1 OF 1



REVISIONS					
REV	DESCRIPTION	ECO	DATE	CHG BY	APPD BY
A	INITIAL RELEASE	3056	18SEP09	M.T.	C.V.
B	PEAK CURRENT WAS 150A	3056	30DEC11	CV	LP

Specifications and Features	
AC Input Voltage	60 - 120 VAC, 50/60 Hz, 3 Phase, isolation transformer typical.
Inrush Current at Power Up	260 A max. @ 120 VAC
Modes of Operation	Current or Velocity Mode (Field Configurable)
Peak Current Output	120 A @ 25 °C Ambient
Continuous Current Output	100 A @ 25 °C Ambient
PWM Switching Frequency	9 KHz base / 18 KHz effective
Current Loop Bandwidth	Adjustable to 3 KHz
Command Inputs (Adjustable Signal Gains)	Signal 1 ±10 V Differential Signal 2 ±10 V Single Ended
Tachometer Input	+/- 90 Vdc Maximum
Fault Protection	Short circuit protection from motor terminal to terminal, motor terminal to DC bus, motor terminal to chassis. Amplifier RMS over current, DC bus over voltage. Amplifier over temperature and motor over temperature.
Amplifier Isolation	Logic Isolated From High Voltage
I/O Configuration (Limits, Inhibit, Reset)	Field Configurable; Pull Up to 5/15 Vdc or Pull Down, Active High or Active Low
Analog Output Current Monitor	40A/V
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Fan Power	120 VAC On Dedicated Input Terminals
Dedicated Fault Output	Open Collector, pulled up to 5Vdc or 15 Vdc
Low Speed Electronic Circuit Breaker (LS/ECB)	Fault when output current exceed 100 A for greater than 3 seconds.
Internal Regen	12 Ohms, 800 W. Regen turns on at 230-250 VDC
Bus Over Voltage	Trips normally at 270-280 VDC
Operating Temperature	0 °C to +60 °C
Storage Temperature	-40 °C to +80 °C
Humidity	5% to 95% non-condensing
Mounting Hardware	1/4-20 or M8 Screw, Qty = 3
Dimension (L x H x W - inches)	17.63 x 12.60 x 5.92

Mating Connectors, Power Input, and Motor Output Conductors	
Controller I/O, 15 Pin Phoenix	Glentek P/N: EJ521P15; Phoenix P/N: 18 03 70 1
Power Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 6 AWG or 13.3 mm²
Motor Output Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 4 AWG or 21.2 mm²
Fan Input Conductors	Insulation Type: PVC 105 °C or better is recommended Cross Sectional Area: 18 AWG or 0.82 mm²

PIN	TEST POINTS
1	SIGNAL 1 (DIFF)
2	SIGNAL 2
3	TACH
4	COMP
5	MOT CUR
6	FLDBK
7	CUR LIM
8	COM

PIN	SIGNAL NAME
1	SIGNAL 1-
2	SIGNAL 1+
3	SIGNAL 2+
4	COMMON
5	TACH IN
6	COMMON
7	MOT CUR
8	LIMIT +
9	LIMIT -
10	INHIBIT
11	FAULT
12	COMMON
13	RESET IN
14	MTR TEMP
15	MASTER/SLAVE IO

NOTES:

1. DIMENSIONS ARE IN INCHES [MILLIMETERS].
2. MAINTAIN A MIN. OF 2" - 3" OF SPACE AT BOTH ENDS AND TOP OF THE AMPLIFIER TO ENSURE PROPER VENTILATION FOR THE UNIT.
3. PREFERED MOUNTING SO AIR FLOW IS UP.

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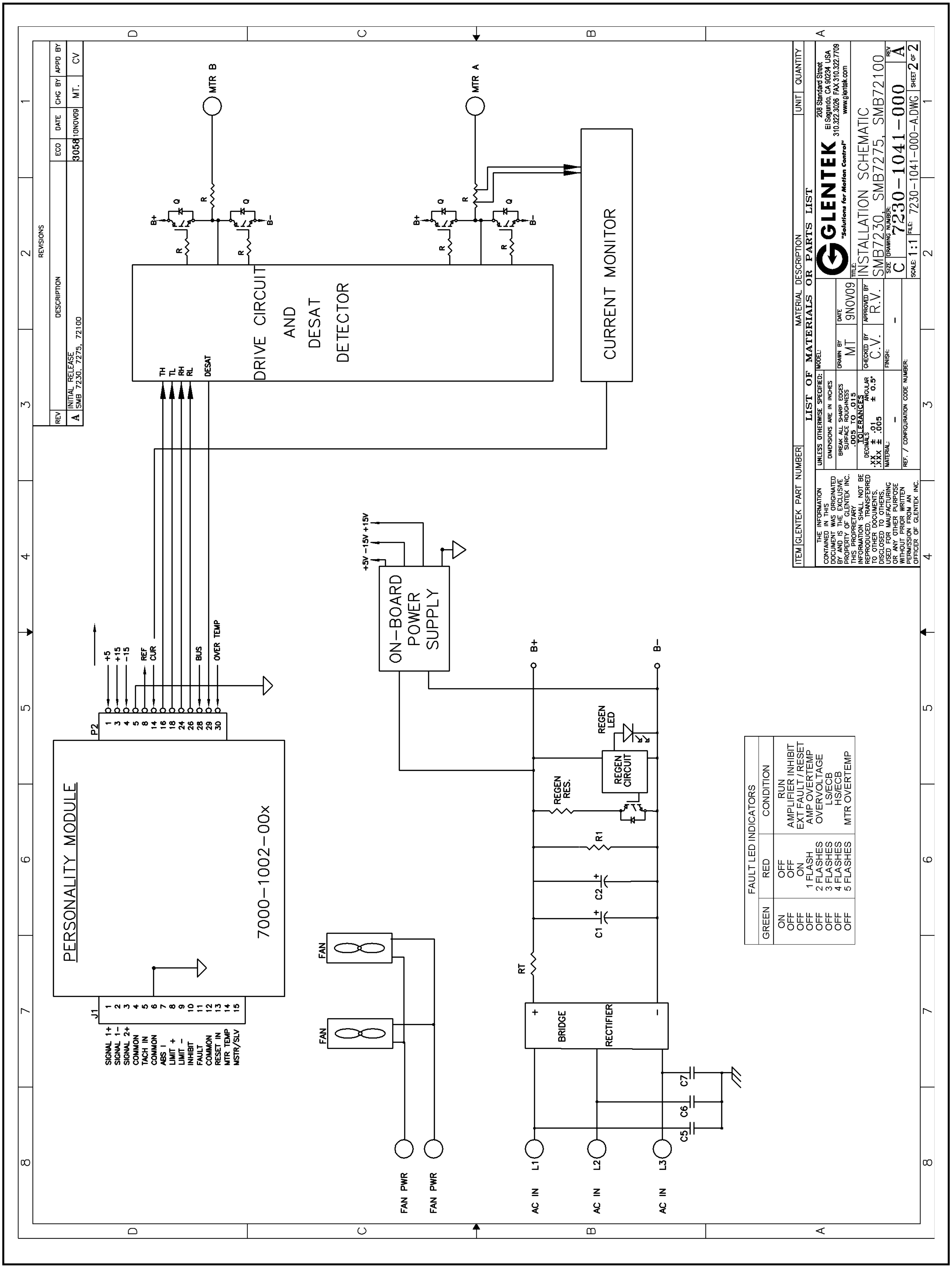
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. BREAK ALL SHARP EDGES. SURFACE ROUGHNESS .008 TO .016. TOLERANCES: DECIMALS .XX ± .01, .XXX ± .005; ANGULAR ± 0.5°. MATERIAL: -. FINISH: -.

MODEL: SMB72100-1A-1 — DRAWN BY: M.T. — DATE: 18SEP09 — CHECKED BY: C.V. — APPROVED BY: L.P.

GLENTEK "Solutions for Motion Control" — 208 Standard Street, El Segundo, CA 90234 USA, 310.322.3026 FAX 310.322.7709, www.glentek.com

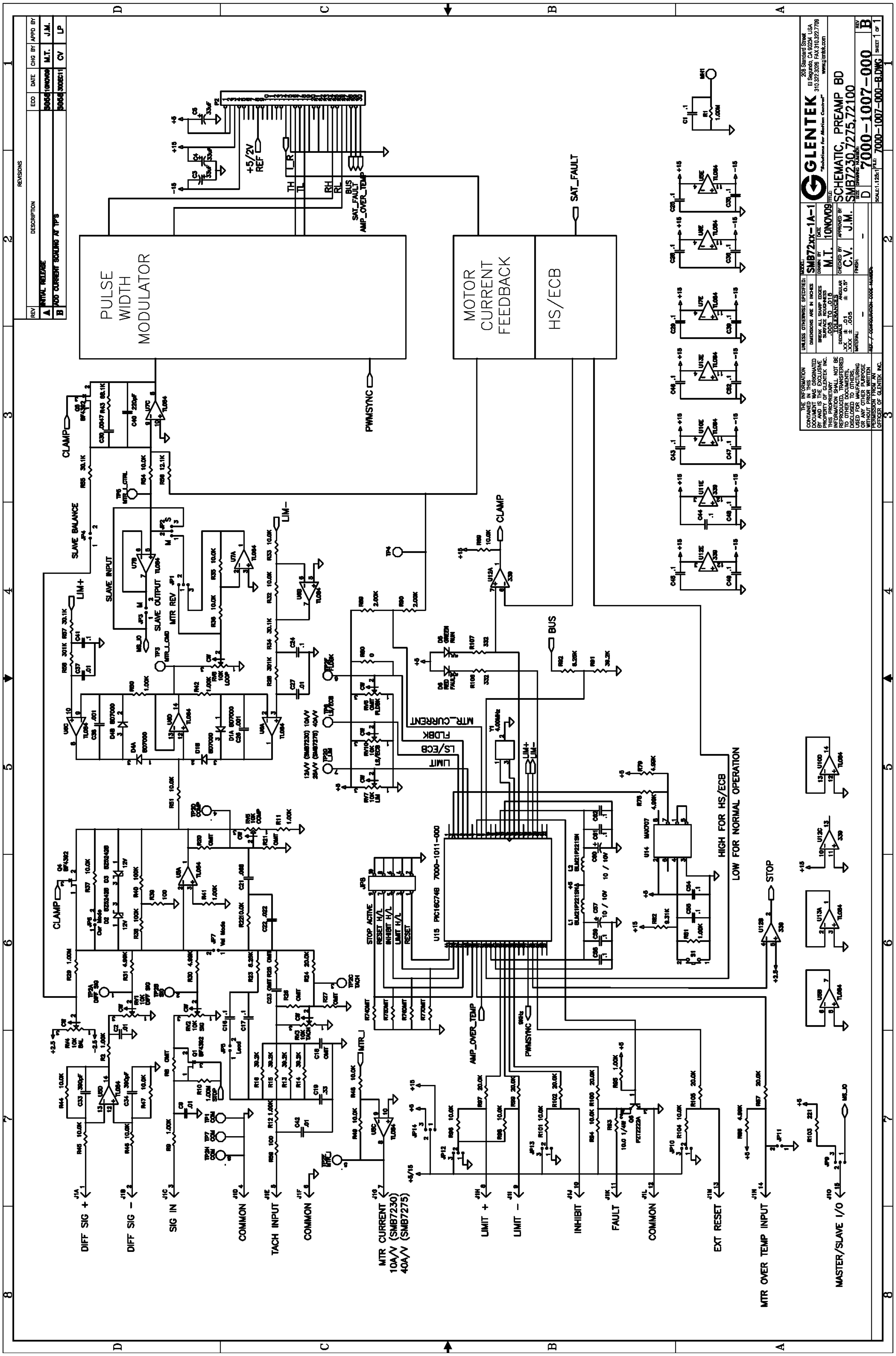
TITLE: INSTALLATION,SMB72100-1A-1 (HI-AC REPLACEMENT)

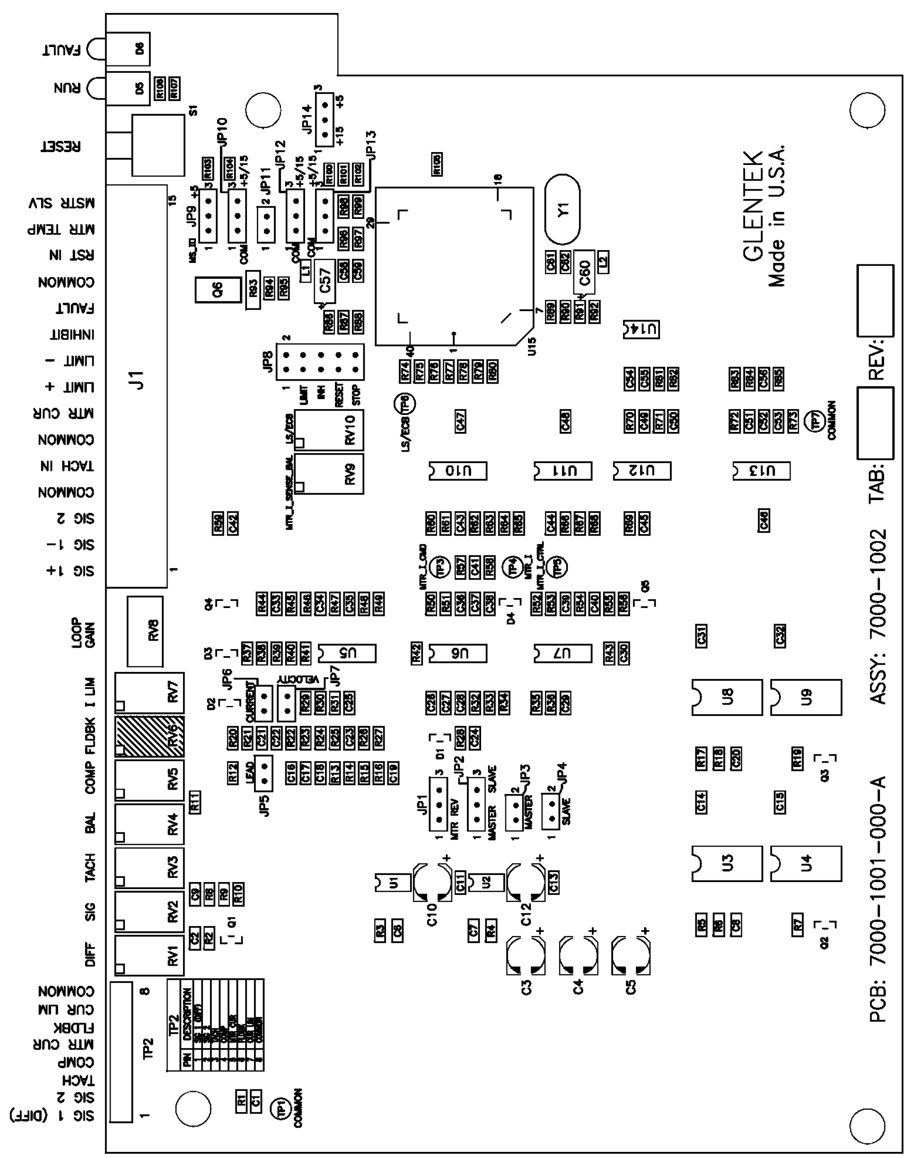
SIZE: D — DRAWING NUMBER: 72100-1042-000 — REV: B — SCALE: 1:1 — FILE: 72100-1042-000-B.DWG — SHEET 1 OF 1


REVISIONS
REV
DESCRIPTION
ECO
DATE
CHG BY
APPD BY
A
INITIAL RELEASE
SMB 7230, 7275, 72100
3058
10NOV09
MT.
CV
MTR B
MTR A
CURRENT MONITOR
DRIVE CIRCUIT
AND
DESAT
DETECTOR
TH
TL
RH
RL
DESAT
ON-BOARD
POWER
SUPPLY
+5V -15V +15V
PERSONALITY MODULE
7000-1002-00x
P2
J1
SIGNAL 1+
SIGNAL 1-
SIGNAL 2+
COMMON
TACH IN
COMMON
ABS I
LIMIT +
LIMIT -
INHIBIT
FAULT
COMMON
RESET IN
MTR TEMP
MSTR/SLV
+5
+15
-15
REF
CUR
BUS
OVER TEMP
B+
B-
REGEN LED
REGEN CIRCUIT
REGEN RES.
R1
C1
C2
RT
BRIDGE
RECTIFIER
C5
C6
C7
FAN
FAN PWR
AC IN
L1
L2
L3
FAULT LED INDICATORS
GREEN
RED
CONDITION
ON
OFF
RUN
OFF
OFF
AMPLIFIER INHIBIT
OFF
ON
EXT FAULT / RESET
OFF
1 FLASH
AMP OVERTEMP
OFF
2 FLASHES
OVERVOLTAGE
OFF
3 FLASHES
LS/ECB
OFF
4 FLASHES
HS/ECB
OFF
5 FLASHES
MTR OVERTEMP
LIST OF MATERIALS OR PARTS LIST
GLENTEK
"Solutions for Motion Control"
208 Standard Street
El Segundo, CA 90234 USA
310.322.3026 FAX 310.322.7709
www.glentek.com
INSTALLATION SCHEMATIC
SMB7230, SMB7275, SMB72100
DRAWN BY MT
DATE 9NOV09
CHECKED BY C.V.
APPROVED BY R.V.
SIZE C
DRAWING NUMBER 7230-1041-000
REV A
SCALE: 1:1
FILE: 7230-1041-000-A.DWG
SHEET 2 OF 2

APPENDIX B

PERSONALITY MODULE


PULSE WIDTH MODULATOR
MOTOR CURRENT FEEDBACK
HS/ECB
PWMSYNC
SAT_FAULT
CLAMP
HIGH FOR HS/ECB
LOW FOR NORMAL OPERATION
DIFF SIG +
DIFF SIG −
SIG IN
COMMON
TACH INPUT
COMMON
MTR CURRENT
10A/V (SMB7230)
40A/V (SMB7275)
LIMIT +
LIMIT −
INHIBIT
FAULT
COMMON
EXT RESET
MTR OVER TEMP INPUT
MASTER/SLAVE I/O
GLENTEK
SCHEMATIC, PREAMP BD
SMB7230,7275,72100
7000-1007-000



REVISIONS

REV	DESCRIPTION	ECO	DATE	CHG BY	APPD BY
A	INITIAL RELEASE	3058	05NOV09	M.T.	C.V.
B	JP14, 1-2 was 5V, JP14, 2-3 was 15V (Microshunt Table)	3058	30DEC11	CV	LP

Microshunt (Jumper) Table

JP	Position	Name	Default Configuration
1:	1 - 2	Motor Forward	Install
	2 - 3	Motor Reverse	
2:	1 - 2	Master	Install
	2 - 3	Slave	
3:	1 - 2	Master Output	Install
4:	1 - 2	Slave Balance	Omit
5:	1 - 2	Tach Lead	Omit
6:	1 - 2	Current Mode	Omit
7:	1 - 2	Velocity Mode	Install
8:	1 - 2	N/C	Omit
	3 - 4	+/- Limits Active Hi/Lo	Install (Lo)
	5 - 6	Inhibit Active Hi/Lo	Install (Lo)
	7 - 8	Reset Active Hi/Lo	Install (Lo)
	9 - 10	Stop	Install (Disabled)
9:	1 - 2	Master/Slave I/O @ J1-15	
	2 - 3	5V @ J1-15	Install
10:	1 - 2	Ext Reset Pull Down	
	2 - 3	Ext Reset Pull Up	Install
11:	1 - 2	Mtr Over temp Pull Down	Install
12:	1 - 2	+/- Lim Pull Down	
	2 - 3	+/- Lim Pull Up	Install
13:	1 - 2	Inhibit Pull Down	
	2 - 3	Inhibit Pull Up	Install
14:	1 - 2	Pull up = 15V	Install
	2 - 3	Pull up = 5V	

NOTES: UNLESS OTHERWISE SPECIFIED.

1. HATCHED COMPONENTS ARE OMITTED.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
BREAK ALL SHARP EDGES SURFACE ROUGHNESS .005 TO .015
TOLERANCES: DECIMALS .XX ± .01, .XXX ± .005; ANGULAR ± 0.5°
MATERIAL: -
REF. / CONFIGURATION CODE NUMBER: -

MODEL: SMB72XX-1A-1
DRAWN BY: M.T. DATE: 05NOV09
CHECKED BY: C.V. APPROVED BY: J.M.
FINISH: -

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El Segundo, CA 90234 USA
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www.glentek.com

TITLE: ASSEMBLY,PREAMP BD SMB72xx-1A-1
SIZE: B DRAWING NUMBER: 7000-1008-000 REV: B
SCALE: 1.5:1 FILE: 7000-1008-000-B.DWG SHEET 1 OF 1

APPENDIX C

EUROPEAN UNION EMC DIRECTIVES

ELECTROMAGNETIC COMPATIBILITY GUIDELINES FOR MACHINE DESIGN

This document provides background information about Electromagnetic Interference (EMI) and machine design guidelines for Electromagnetic Compatibility (EMC)

Introduction

Perhaps no other subject related to the installation of industrial electronic equipment is so misunderstood as electrical noise. The subject is complex and the theory easily fills a book. This section provides guidelines that can minimize noise problems.

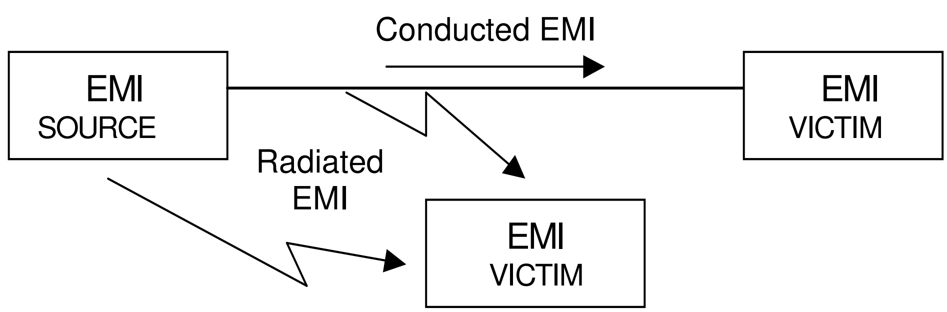
The majority of installations do not exhibit noise problems. However, these filtering and shielding guidelines are provided as counter measures. The grounding guidelines provided below are simply good grounding practices. They should be followed in all installations.

Electrical noise has two characteristics: the generation or emission of electromagnetic interference (EMI), and response or immunity to EMI. The degree to which a device does not emit EMI, and is immune to EMI is called the device's Electromagnetic Compatibility (EMC).

Equipment, which is to be brought into the European Union legally, requires a specific level of EMC. Since this applies when the equipment is brought into use, it is of considerable importance that a drive system, as a component of a machine, be correctly installed.

"EMI Source-Victim Model" shows the commonly used EMI model. The model consists of an EMI source, a coupling mechanism and an EMI victim. A device such as servo drives and computers, which contain switching power supplies and microprocessors, are EMI sources. The mechanisms for the coupling of energy between the source and victim are conduction and radiation. Victim equipment can be any electromagnetic device that is adversely affected by the EMI coupled to it.

Figure 1 - EMI Source-Victim Model



Immunity to EMI is primarily determined by equipment design, but how you wire and ground the device is also critical to achieving EMI immunity. Therefore, it is important to select equipment that has been designed and tested for industrial environments. The EMI standards for industrial equipment include the EN61000-4-X series (IEC 1000-4-X and IEC8O1-X), EN55011 (CISPR11), ANSI C62 and C63 and MIL-STD-461. Also, in industrial environments, you should use encoders with differential driver outputs rather than single ended outputs, and digital inputs/outputs with electrical isolation, such as those provided with optocouplers.

The EMI model provides only three options for eliminating the EMC problem:

Reduce the EMI at the source.

Increase the victim's immunity to EMI (harden the victim).

Reduce or eliminate the coupling mechanism.

In the case of servo drives, reducing the EMI source requires slowing power semiconductor switching speeds. However, this adversely affects drive performance with respect to heat dissipation and speed/torque regulation.

Hardening the victim equipment may not be possible, or practical. The final and often the most realistic solution is to reduce the coupling mechanism between the source and victim. Filtering, shielding and grounding can achieve this.

Filtering

As mentioned above, high frequency energy can be coupled between circuits via radiation or conduction. The AC power wiring is one of the most important paths for both types of coupling mechanisms. The AC line can conduct noise into the drive from other devices, or it can conduct noise directly from the drive into other devices. It can also act as an antenna and transmit or receive radiated noise between the drive and other devices.

One method to improve the EMC characteristics of a drive is to use isolation AC power transformer to feed the amplifier its input power. This minimizes inrush currents on power-up and provides electrical isolation. In addition, it provides common mode filtering, although the effect is limited in frequency by the interwinding capacitance. Use of a Faraday shield between the windings can increase the common mode rejection bandwidth, (shield terminated to ground) or provide differential mode shielding (shield terminated to the winding). In some cases an AC line filter will not be required unless other sensitive circuits are powered off the same AC branch circuit.

> **NOTE**: “Common mode” noise is present on all conductors that are referenced to ground. “Differential mode” noise is present on one conductor referenced to another conductor.

The use of properly matched AC line filters to reduce the conducted EMI emitting from the drive is essential in most cases. This allows nearby equipment to operate undisturbed. The basic operating principle is to minimize the high frequency power transfer through the filter. An effective filter achieves this by using capacitors and inductors to mismatch the source impedance (AC line) and the load impedance (drive) at high frequencies.

For drives brought into use in Europe, use of the correct filter is essential to meet emission requirements. Detailed information on filters is included in the manual and transformers should be used where specified in the manual.

AC Line Filter Selection

Selection of the proper filter is only the first step in reducing conducted emissions. Correct filter installation is crucial to achieving both EMIL attenuation and to ensure safety. All of the following guidelines should be met for effective filter use.

The filter should be mounted to a grounded conductive surface.

The filter must be mounted close to the drive-input terminals, particularly with higher frequency emissions *(5-30* MHz). If the distance exceeds 600mm (2 feet), a strap should be used to connect the drive and filter, rather than a wire.

The wires connecting the AC source to the filter should be shielded from, or at least separated from the wires (or strap) that connects the drive to the filter. If the connections are not segregated from each other, then the EMI on the drive side of the filter can couple over to the source side of the filter, thereby reducing, or eliminating the filter effectiveness. The coupling mechanism can be radiation, or stray capacitance between the wires. The best method of achieving this is to mount the filter where the AC power enters the enclosure. “AC Line Filter Installation” shows a good installation and a poor installation.

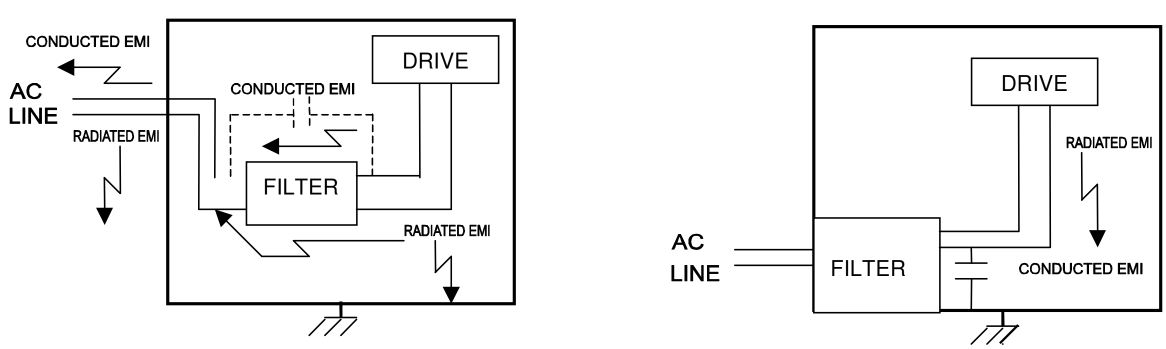
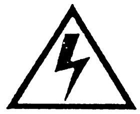


Figure 2- AC Line Filter Installation

When multiple power cables enter an enclosure, an unfiltered line can contaminate a filtered line external to the enclosure. Therefore, all lines must be filtered to be effective. The situation is similar to a leaky boat. All the holes must be plugged to prevent sinking



WARNING

Large leakage currents exist in AC line filters. They must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels prior to handling the equipment. Failure to observe this precaution could result in severe bodily injury.

If the filter is mounted excessively far from the drive, it may be necessary to mount it to a grounded conductive surface, such as the enclosure, to establish a high frequency (HF) connection to that surface. To achieve the HF ground, direct contact between the mounting surface and the filter must be achieved. This may require removal of paint or other insulating material from the cabinet or panel.

The only reasonable filtering at the drive output terminals is the use of inductance. Capacitors would slow the output switching and deteriorate the drive performance. A common mode choke can be used to reduce the HF voltage at the drive output. This will reduce emission coupling through the drive back to the AC line. However, the motor cable still carries a large HF voltage and current. Therefore, it is very important to segregate the motor cable from the AC power cable. More information on cable shielding and segregation is contained in the section on shielding.

Grounding

High frequency (HF) grounding is different from safety grounding. A long wire is sufficient for a safety ground, but is completely ineffective as a HF ground due to the wire inductance. As a rule of thumb, a wire has an inductance of 8 nH/in regardless of diameter. At low frequencies it acts as constant impedance, at intermediate frequencies as an inductor, and at high frequencies as an antenna. The use of ground straps is a better alternative to wires. However the length to width ratio must be *5:1,* or better yet 3:1, to remain a good high frequency connection.

The ground system's primary purpose is to function as a return current path. It is commonly thought of as an equipotential circuit reference point, but different locations in a ground system may be at different potentials. This is due to the return current flowing through the ground systems finite impedance. In a sense, ground systems are the sewer systems of electronics and as such are sometimes neglected.

The primary objective of a high frequency ground system is to provide a well-defined path for HF currents and to minimize the loop area of the HF current paths. It is also important to separate HF grounds from sensitive circuit grounds. "Single Point Ground Types" shows single point grounds for both series (daisy chain) and parallel (separate) connections. A single point, parallel connected ground system is recommended.

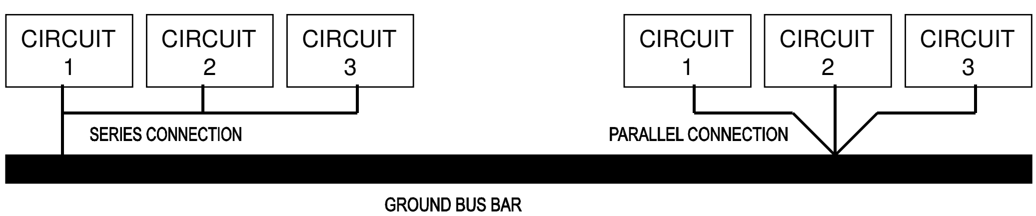


Figure 3-Single Point Ground Types

A ground bus bar or plane should be used as the "single point" where circuits are grounded. This will minimize common (ground) impedance noise coupling. The ground bus bar (GBB) should be connected to the AC ground, and if necessary, to the enclosure. All circuits or subsystems should be connected to the GBB by separate connections. These connections should be as short as possible and straps should be used when possible. The motor ground conductor must return to the ground terminal on the drive, not the GBB.

Shielding and Segregation

The EMI radiating from the drive enclosure drops off very quickly over distance. Mounting the drive in an enclosure, such as an industrial cabinet, further reduces the radiated emissions. The cabinet should have a high frequency ground and the size of the openings should be minimized. In addition, the drive is considered an "open" device that does not provide the proper IP rating for the environment in which it is installed. For this reason the enclosure must provide the necessary degree of protection. An IP rating or Nema rating (which is similar to IP) specifies the degree of protection that an enclosure provides.

The primary propagation route for EMI emissions from a drive is through cabling. The cables conduct the EMI to other devices, and can also radiate the EMI. For this reason, cable segregation and shielding are important factors in reducing emissions. Cable shielding can also increase the level of immunity for a drive. For example:

- Shield termination at both ends is extremely important. The common misconception that shields should be terminated at only one end originates from audio applications with frequencies ≤ 20 kHz. RF applications must be terminated with the shield at both ends, and possibly at intermediate points for exceptionally long cables.
- When shielded cables are not terminated at the cable connection and pass through the wall of a cabinet, the shield must be bonded to the cabinet wall to prevent noise acquired inside the cabinet from radiating outside the cabinet, and vice versa.
- When shielded cables are terminated to connectors, the shield must be able to provide complete 360^0 coverage and terminate through the connector backshell. The shield must *not* be grounded inside the connector through a drain wire. Grounding the shield inside the connector couples the noise on the shield to the signal conductors sharing the connector and virtually guarantees failure to meet European EMC requirements.
- The shield must be continuous. Each intermediate connector must continue the shield connection through the backshell.
- All cables, both power and signal should use twisted wire pairing.

The shield termination described above provides a coaxial type of configuration, which provides magnetic shielding, and the shield provides a return path for HF currents that are capacitively coupled from the motor windings to the frame. If power frequency circulating currents are an issue, a 250 VAC capacitor should be used at one of the connections to block 50/60 Hz current while passing HF currents. Use of a properly shielded motor cable is essential to meet European EMC requirements.

The following suggestions are recommended for all installations.

1. Motor cables must have a continuous shield and be terminated at both ends. The shield must connect to the ground bus bar or drive chassis at the drive end, and the motor frame at the motor end. Use of a properly shielded motor cable is essential to meet European EMC requirements.
2. Signal cables (encoder, serial, and analog) should be routed away from the motor cable and power wiring. Separate steel conduit can be used to provide shielding between the signal and power wiring. Do not route signal and power wiring through common junctions or raceways.
3. Signal cables from other circuits should not pass within 300 mm (1 ft.) of the drive.
4. The length or parallel runs between other circuit cables and the motor or power cable should be minimized. A rule of thumb is 300 mm (1 ft.) of separation for each 10 m (30 ft.) of parallel run. The 300 mm (1 ft.) separation can be reduced if the parallel run is less than 1 m (3 ft.).
5. Cable intersections should always occur at right angles to minimize magnetic coupling.
6. The encoder mounted on the brushless servomotor should be connected to the amplifier with a cable using multiple twisted wire pairs and an overall cable shield. Encoder cables are offered in various lengths that have correct terminations.

Persistent EMI problems may require additional countermeasures. The following suggestions for system modification may be attempted.

1. A ferrite toroid or “doughnut” around a signal cable may attenuate common mode noise, particularly RS-232 communication problems. However, a ferrite toroid will not help differential mode noise. Differential mode noise requires twisted wire pairs.
2. Suppress each switched inductive device near the servo amplifier. Switch inductive devices include solenoids, relay coils, starter coils and AC motors (such as motor driven mechanical timers).
3. DC coils should be suppressed with a “free-wheeling” diode connected across the coil.
4. AC coils should be suppressed with RC filters (a 200 Ohm 1/2 Watt resistor in series with a *0.5* uF, 600 Volt capacitor is common).

Following these guidelines can minimize noise problems. However, equipment EMC performance must meet regulatory requirements in various parts of the world, specifically the European Union. Ultimately, it is the responsibility of the machine builder to ensure that the machine meets the appropriate requirements as installed.

RECOMMENDATIONS FOR GLENTEK AMPLIFIERS

All amplifiers installed in a NEMA 12 enclosures or equivalent with wiring in metal conduit or enclosed metal wire trough (see Shielding and segregation).

Use Glentek shielded feedback and motor cables.

An AC line filter properly installed in a NEMA 12 enclosure or equivalent (see Filtering).

AC line filters for single-phase applications

1A-15A input current, 120-250VAC use: Corcom 15ET1 or equivalent.

15A-25A input current, 120-250VAC use: Corcom 25FC10 or equivalent.

25A-36A input current, 120-250VAC use: Corcom 36FC10 or equivalent.

AC line filters for 3-phase applications

1A-25A input current, 120-250VAC use: Corcom 25FCD10 or equivalent.

25A-36A input current, 120-250VAC use: Corcom 36FCD10 or equivalent.

36A-50A input current, 120-250VAC use: Corcom 50FCD10 or equivalent.

50A-80A input current, 120-250VAC use: Corcom 80FCD10 or equivalent.

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.

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CE