OPERATION
&
SERVICE MANUAL

Torque-Switch Series®

Model SMA8715

Brushless Amplifier System

GLENTEK

"Solutions for Motion Control"

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Introduction

Glentek's brushless DC 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, brushless servo-motor amplifiers, model SMA8715 and the high power version: SMA8715HP.

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 not addressed in this manual, 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 three 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 and money, and to provide you with a superior product.

Chapter One: Description, Features and Specifications

1.1 Description:

This brushless amplifier system has been designed to offer you, our customer, a large degree of flexibility and customization with a standard, in stock product. Each amplifier module consists of a standard power output board with a personality module mounted on it. Following is a brief description of this personality module and its mode(s) of operation:

1.1.1 Standard Encoder to Sine Mode (SMA8715/SMA8715HP) - In this mode of operation, the brushless motor is commutated by hall sensors and an encoder, or an encoder which contains three commutation signals (comm. tracks). This personality module can be configured for the following two different types of operation:

VELOCITY MODE - In this mode of operation, the personality module generates a tachometer signal which is used to close a velocity loop in the amplifier.

CURRENT MODE - In this mode of operation, which is also commonly referred to as torque mode, a current in the motor is produced which is directly proportional to the input signal.

1.1.2 **Twang Mode (SMA8715/SMA8715HP) -** In this mode of operation, the brushless motor is commutated by an encoder only.

These brushless amplifiers come with all industry standard inputs such as "limit, fault output, etc. They are available in the following types of configurations:

As amplifier modules where you supply the DC Buss voltage, cooling fan(s), fusing and shunt regulator. Please see section 1.2.1 for more detailed information.

As a stand alone one axis amplifier, SMA8715-1A-1, which contains a DC power supply, cooling fan, fusing and shunt regulator. Please see section 1.2.2 for more detailed information.

For multi-axis applications, the multi-axis baseplate power supply can supply DC power, cooling fans, zero crossing solid state relays, fusing and a shunt regulator for up to 6 axis or 60 amperes continuous. Please see section 1.2.3 for more detailed information.

1.2 Features:

1.2.1 Single Amplifier Module (SMA8715-1):

Ergonomic design:	Easy access to connections, adjustments, and test points.

Wide operating	70-350 VDC. buss voltage:
Complete isolation:	Complete isolation from input to output.
Dual signal inputs:	Two single-ended or one differential. Both single-ended inputs may be used simultaneously. All inputs have up to 15,000 A/V gain, and all inputs will accept +/-13VDC.
Dual mode operation:	The standard amplifier may be configured for velocity (RPM) control or current (torque) control.
Current limit:	Maximum motor current is adjustable.
Silent operation:	Carrier frequency is 20KHz.
Short circuit protection:	Complete short circuit and ground fault protection.
LED diagnostics:	Red LED(S) illuminate to display various fault conditions and a green LED illuminates to indicate normal operating conditions.
Frequency response: (Velocity Loop)	750 Hz minimum.
Frequency response: (Current Loop)	2 KHz minimum.
Digital limit/enable Inputs:	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 +5V or 0 to +15V range.
Tachometer output:	DC output proportional to motor RPM.
Fault input/output:	Open-collector output goes low in the event of a fault. This input is configured so that externally forcing this output low will inhibit the amplifier. This allows all fault outputs in a multi-axis system to be connected together (wire-ORed) to

	shut down all amplifiers should any amplifier have a fault.
Manual and external fault reset:	Push button and 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 the motor leads or a ground fault condition. (i.e. amplifier exceeds 80A for 10 microseconds)
Low-Speed Electronic Circuit Breaker (LS/ECB):	Shuts down the amplifier if the amplifier is operated above the maximum continuous current rating (i.e.15A for standard 120VAC, 10A for standard 240VAC; 20A for High Power 120VAC and 15A for High Power 240VAC) for a pre-determined period (i.e. 3 seconds).
Over/under voltage and over temperature:	These circuits constantly monitor the amplifier power-supply voltages, and the motor and amplifier-heatsink temperatures. They will shut down the amplifier in the event of any out-of-specification condition. (The overvoltage protection circuit is set to turn on at +250VDC for 120VAC line input and +450VDC for 240VAC line input.)
Multi-axis chassis:	Up to six amplifier modules may be mounted on a single baseplate. Multi-axis baseplates include a DC power supply, cooling fan(s) and wiring for each respective amplifier module.

1.2.2 Stand Alone One Axis Amplifier (SMA8715-1A-1):

The stand alone amplifier has all the features that the Single Amplifier Module (section 1.2.1) have, plus the following additional features:

Line operated AC power operation: Fused AC input for single or three phase input with in-rush current protection at turn-on. No power isolation transformer is required.

Fused regen clamp circuit (shunt regulator) with LED indicator and 50W internal load resistor bank bleeds off excess DC Buss voltage when decelerating a large load inertia. The regen clamp circuit is set to turn on at +215VDC for 120VAC operation and +400VDC for 240VAC operation.

All faults can be monitored through isolated logic signals.

1.2.3 Multi-Axis Power Supply (GP8600-203X):

Power supply for 2 to 6 axis amplifier baseplate.

Line operated AC power operation: Fused AC input for single or three phase inputs with a solid state zero-crossing switch which limits in-rush current at turn-on. No power isolation transformer is required.

Fused regen circuit (shunt regulator) with LED indicator and 300W internal load resistor bank bleeds off excess DC Buss voltage when decelerating a large load inertia. Additional regen resistor can be connected externally.

Bridge rectifier(s) and filter capacitor.

Power turn on in-rush limiter (solid state zero crossing switch).

Cooling fans.

1.3 Specifications:

This section contains the specifications for the brushless encoder to sine mode Servo Amplifiers. These specifications also include power supplies for the amplifiers.

NOTE: All data in this section is based on the following ambient conditions: 120 ^{o}F (50 ^{o}C) maximum. Forced air cooling.

1.3.1 Single Amplifier Module (SMA8715-1):

The amplifier module(s) require an external DC power supply which must include a bridge rectifier, buss capacitor, solid-state relay and shunt regulator. Forced air cooling is required to meet the maximum power ratings specified below.

Input Power/ Buss Voltage(B+)	Output Power (current)			
	Standard		High Power	
	R.M.S.	Peak	R.M.S.	Peak
120VAC/170VDC	15A	25A	20A	40A
240VAC/340VDC	10A	25A	15A	35A

1.3.1.1 Input and Output Power:

Amplifier Model	Signal Input	Maximum Voltage (VDC)	Minimum Impedance W	Velocity Gain Amp./Volt	Current Gain Amp./Volt
8715	Differential	13	10,000	15,000(min.)	0-5
8715	Single-ended	±13	10,000	15,000(min.)	0-5

1.3.1.2 Signal Inputs:

1.3.1.3 Digital Inputs:

± Limit, Inhibit & Reset:	40/-0.5V max. Terminated by 10,000W.
Fault (as input):	40/-0.5V max. Terminated by 10,000W.
Typical for all digital inputs:	Digital inputs have hysteresis with thresholds at 1/3 and 2/3 of +5V or +15V depending on range select jumper.

1.3.1.4 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.

1.3.1.5 Outputs:

Fault (as output): Active low.	Open-collector output can sink 500mA max.
Abs. motor current:	10A/V.
Tachometer :	1000W source impedance, a high input

impedance meter must be used (1MW /volt).

1.3.2 Stand Alone One Axis Amplifier (SMA8715-1A-1):

The stand alone one axis amplifier contains a single amplifier module, a DC power supply, a cooling fan, fusing and shunt regulator in a sheet metal enclosure. It has the same specifications as the single amplifer module, refer to 1.3.1, except the DC power supply and cooling fan are included. The shunt regulator within the DC power supply has a 50W internal load resistor bank which bleeds off excess DC Buss voltage when decelerating a large load inertia. (Consult with factory).

NOTE: Customer must specify the input AC voltage(105-120VAC/205-250VAC) and the number of input phases (Single or Three Phase) when ordering (see chapter 3: model numbering), so that the proper fan and power supply can be installed.

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Model	L x W x H (inches)	Weight (lbs)
SMA8715-1(Single Amplifier Module)	7.125 x 1.38 x 4.53	1.28
SMA8715-1A-1 (Stand Alone Amplifier)	9.025 x 4.00 x 5.66	5.25
SMA8715-2A-2 (2 Axis Amplifier System)	9.00 x 10.50 x 7.70	9.36
SMA8715-4A-4 (4 Axis Amplifier System)	13.00 x 10.50 x 7.70	15.12
SMA8715-6A-6 (6 Axis Amplifier System)	16.50 x 10.50 x 7.70	19.90

1.3.3 Mult Axis Power Supply:

The multi-axis power supply contains all items listed under 1.2.3. Note: If you do not need the shunt regulator and or solid state zero crossing switch, please specify at time of order as these items can be deleted which will in-turn decrease the cost of the unit accordingly.

1.3.3.1 Input and Output Power:

Input Power (Buss, B+, Control Power, Fans):	120/240VAC.
Buss Voltage, B+:	170/340VDC.
Output Power:	30/60A continuous.

1.3.4 Mechanical:

Chapter Two: Theory of Operation

2.1 Current Mode vs Velocity Mode:

The fundamental difference between current mode and velocity mode is that in current mode, an external command signal controls the torque of the motor, rather than the velocity. In velocity mode, an external command signal controls the velocity (RPM) of the motor, rather than the torque. In a current mode amplifier, the command signal is proportional to the motor current, thus it is also proportional to the torque of the motor. In a velocity mode amplifier, the current loop amplifier stage is preceded by a high gain error amplifier which compares the command signal and the tachometer feedback signal.

Current mode amplifiers are usually used in Position Control Systems where no tachometer feedback is required. While velocity mode amplifiers are usually used in Classic Cascaded Contol Systems where there are position, velocity and current loops in the system. Velocity loops tend to have a higher bandwidth and operate better near zero speed.

2.2 Protection Circuit:

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 SMA8715 single module, multi axis, and stand alone amplifiers. The model numbering system is designed so that you will be able to create the correct model number of the amplifier needed.

When placing an order for the SMA8715 amplifier system please contact Glentek sales dept. and have the following information available:

1. Type of motor you will be using and motor specs.

2. Pole pitch of the motor; if linear motor, electrical cycle (The distance from one North magnet to the other North magnet, or South to South). If rotary motor, number of poles.

3. The encoder resolution of your system.
   - Rotary - Pulses per revolution.
   - Linear - Linear distance between encoder pulses. It is important that encoder resolution be for a single channel, not for two channels operating in que.

4. Machine power voltage available at sight i.e. 3-phase, 208.

5. The phase-to-phase inductance of the motor.

6. The maximum speed for motor.

7. BEMF voltage of motor.

8. Max. continuous and max. peak current required at motor.

9. Amplifier mode of operation, current mode or velocity mode.

10. If known, types of inhibit, limits, and reset. If not specified, amplifier will be shipped with type “A” inhibit, limits and reset.

11. Input option will be set single-ended. It may be set differential, although Glentek recommends a single-ended input whenever possible.

From the above information the Glentek representative will issue a Custom Configuration Code for your specific application.

Note: Whenever possible, it is very desirable to have the motor sent to Glentek for initial system checkout at the factory, this tends to eliminate many field problems.

3.2 Single Module:

SMA8715XX - YYY - 1

Amplifier Model Number — SMA8715XX

Power Rating — XX
Omit = Standard (15A cont., 25A peak)
HP = High Power (20A cont., 40A peak)

Custom Configuration Code — YYY
(This is assigned at the factory and
is a permanent model number)

Single Module Designator — 1

3.3 Multi Axis Amplifier:

SMA8715XX - YYY - _A - _ - ZZ

Amplifier Model Number — SMA8715XX

Power Rating — XX
Omit = Standard (15A cont., 25A peak)
HP = High Power (20A cont., 40A peak)

Custom Configuration Code for the amplifier modules — YYY

Maximum number of amplifier modules the baseplate will hold. — _A
2 = 2 axis baseplate
4 = 4 axis baseplate
6 = 6 axis baseplate

The total number of amplifier modules mounted on the baseplate — _

Power Supply Configuration Code — ZZ
00=110-130VAC
01=208-240VAC
02=SPECIAL

3.4 Stand Alone Amplifier:

SMA8715XX - YYY - 1A - 1 - ZZ

Amplifier Model Number — SMA8715

Power Rating — XX
Omit = Standard (15A cont., 25A peak)
HP = High Power (20A cont., 40A peak)

Custom Configuration Code for the amplifier module — YYY

Stand alone amplifier designator — 1A

1 amplifier module mounted — 1

Power Supply Configuration Code — ZZ
00=110-130VAC, SINGLE PHASE
01=208-240VAC, SINGLE PHASE
02=110-130VAC, THREE PHASE
03=208-240VAC, THREE PHASE
04=SPECIAL

Chapter Four: Installation

4.1 Introduction:

This chapter provides information for connecting amplifiers to your system. If you need additional help, contact a Glentek applications engineer.

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 edge of the baseplate 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:

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 hall-sensors and encoder, 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 be run in a twisted-pair, shielded cable. The hall-sensor signal lines and the encoder signal lines should be run in a three 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:	14AWG, shielded - Standard. 12AWG, shielded - High Power.
Motor Case Ground:	Same as motor wires, or use metallic conduit.
Main Power:	Same as motor wires.
Signal Input:	22AWG, twisted-pair, shielded.
Logic Inputs/Outputs:	22AWG, shielded with its return lead.
External Tachometer:	22AWG, twisted-pair, shielded.
Hall Sensors :	22AWG, three twisted-pairs, over-all shielded.
Encoder :	22AWG, three twisted-pairs, over-all shielded.

4.3.3 Connector Size and Type:

4.3.3.1 The Power Connector of the Single Amplifier Modules - J2 of the Main Amplifier:

All amplifiers are shipped with the right angle AUGAT terminal block mounted as it power connector. The vertical angle AUGAT terminal block and the PHOENIX connector are two options one can choose to use for the power connector. The specifications of these connectors are listed as follow:

- AUGAT® RDI 6 Series Tri-Barrier Terminal Blocks(PART# 6PCR-05) - **Default**:
  - Screw Size/Spacing: 6 (#6-32 on .375" centers).
  - Terminal Style: PC (Printed Circuit Pin).
  - Terminal Orientation: R (**Right Angle**).
  - Number of Screw Terminals: 05 (5 screw positions).
  - Terminal lugs: Thomas & Betts (PART# A116 for 18AWG wire, PART# B19 for 14AWG wire and PART# C133 for 12/10AWG wire).

- AUGAT® RDI 6 Series Tri-Barrier Terminal Blocks(PART# 6PCV-05):
  - Screw Size/Spacing: 6 (#6-32 on .375" centers).
  - Terminal Style: PC (Printed Circuit Pin).
  - Terminal Orientation: V (**Vertical Angle**).

- Number of Screw Terminals: 05 (5 screw positions).
- Terminal lugs: Thomas & Betts (PART# A116 for 18AWG wire, PART# B19 for 14AWG wire and PART# C133 for 12/10AWG wire).

- PHOENIX CONTACT, COMBICON Headers and Plugs with 7.62mm pitch (Header P/N: GMSTBA 2,5/5-G-7,62, Plug P/N: GMSTB 2,5/5-ST-7,62):
  - Header with side panels, plug-in direction parallel to PCB.
  - 5 positions.
  - Color: green.

4.3.3.2 The Signal Connector:

The signal connectors are supported by the molex® KK .100" (2,54mm) Centerline Connector System.

- J1 of the Main Amplifier:
  - Mating Connector: molex® 2695 Series .100 (2.54mm) Center Crimp Terminal Housing(P/N: 22-01-3175): red nylon housing.
  - 15 positions.
  - with polarizing rib.

- J4 and J5 of the Encoder to Sine Pre-amp:
  - Mating connector for J4: molex® 2695 Series (P/N: 22-01-30107).
  - Mating connector for J5: molex® 2695 Series (P/N: 22-01-3067).
  - Crimp Terminals for the above mating connector: molex® Crimp Terminals (P/N: 08-55-0102):
  - 15 microinch select gold plated.
  - brass.

4.3.3.3 The Power and Motor Connector of the Stand Alone Amplifier:

- Motor - J2 of the Stand Alone Amplifier:
  Mating Connector: PHOENIX CONTACT, COMBICON Plugs in 7.62mm Pitch (P/N: GMVSTBR 2.5/3-ST-7.62):
  - with vertical plug-in direction to the conductor axis.
  - 3 positions.
  - Color: green.

- Power Input - J6 of the Stand Alone Amplifier:
  Mating Connector: PHOENIX CONTACT, COMBICON Plugs in 7.62mm Pitch (P/N: GMVSTBW 2.5/4-ST-7.62):
  - with vertical plug-in direction to the conductor axis.
  - 4 positions.
  - Color: green.

Signal Name	Terminal	Notes
B -	J2-1	DC Buss -
B +	J2-2	DC Buss+
MOTOR T	J2-3	Phase T of the motor.
MOTOR S	J2-4	Phase S of the motor.
MOTOR R	J2-5	Phase R of the motor.

Signal Name	SMA8715 Terminal	Notes
SIGNAL 1+	J1-1	Differential signal input.
SIGNAL 1-	J1-2	Differential signal return.
SIGNAL 2+	J1-3	Single-ended signal 2 in.
COMMON	J1-4	Signal common.
MODE 1	J1-5	Factory use only
COMMON	J1-6	Common.
ABS. I	J1-7	Absolute value of the motor current (10A/V)
LIMIT +	J1-8	Inhibits the motor in + direction.
LIMIT -	J1-9	Inhibits the motor in - direction.
INHIBIT	J1-10	Inhibits the motor in both directions.
FAULT	J1-11	Goes low for a fault, or inhibits the amplifier when forced low.
COMMON	J1-12	Digital common.
RESET IN	J1-13	Resets fault latch.
MTR TEMP	J1-14	Motor over temperature switch input.
MODE 2	J1-15	Factory use only

4.4 Single Amplifier Module Connections(SMA8715-1):

4.4.1 Buss and Motor Connections - J2:

4.4.2 Signal Connections for the Encoder to Sine Mode Amplifier - J1:

Signal Name	Terminal	Notes
Encoder Input (J4):		
N/C	J4-A	No Connection
A	J4-B	Phase A signal input.
$\overline{A}$	J4-C	Negative phase A signal input.
B	J4-D	Phase B signal input.
$\overline{B}$	J4-E	Negative phase B signal input.
Z	J4-F	Phase Z signal input.
$\overline{Z}$	J4-G	Negative phase Z signal input
COM	J4-H	Common for Encoder.
COM	J4-I	Common for Encoder.
COM	J4-J	Common for Encoder.
Hall Sensor Input (J5):		
+V	J5-A	+VDC for Hall Effect Sensors
HALL 1	J5-B	Hall Sensor 1. Check motor data for phasing
HALL 2	J5-C	Hall Sensor 2. Check motor data for phasing
HALL 3	J5-D	Hall Sensor 3. Check motor data for phasing
COM	J5-E	Common for Hall Sensors
COM	J5-F	Common for Hall Sensors

Signal Name	Terminal	Notes
MOTOR T	J2-1	Motor phase T
MOTOR S	J2-2	Motor phase S
MOTOR R	J2-3	Motor phase R

4.4.3 Signal connections for the Encoder to Sine Mode Pre-amp:

Signal Name	Terminal	Notes
GND	J6-1	Chassis ground.
AC	J6-2	AC power input. (Omit for single-phase input)
AC	J6-3	AC power input.
AC	J6-4	AC power input.

Signal Name	Terminal	Notes
AC - FAN	TB201 on baseplate.	AC fan power input.
AC - FAN	TB201 on baseplate.	AC fan power input.
AC - MAIN	FB301 on Power Supply Sub-assembly	AC main power input.
AC - MAIN	FB301 on Power Supply Sub-assembly	AC main power input.
AC - MAIN	FB301 on Power Supply Sub-assembly	AC main power input.

4.5 Stand Alone Amplifier Connections (SMA8715-1A-1):

The Stand Alone Amplifier has the same signal connections as the Single Amplifier Module. The Power and Motor connections are as follows:

4.5.1 Motor Connections - J2:

4.5.2 Power Connections - J6:

4.6 Multi Axis Power Supply Connections:

Connector TB201 is shown in the following drawings: 8000-1833 for 2-axis baseplate, 8000-1835 for 4-axis baseplate and 8000-1837 for 6-axis baseplate. Fuse Block FB301 is shown in drawings 8600-2030 and 8600-2031. All of the above drawings are in Appendix A.

	Type A	Type B	Type C	Type D
LIMIT±	**S2-8 - OFF** **S2-5 - ON**	S2-8 - ON S2-5 - OFF	S2-8 - OFF S2-5 - OFF	S2-8 - ON S2-5 - ON
INHIBIT	**S2-7 - OFF** **S2-4 - ON**	S2-7 - ON S2-4 - OFF	S2-7 - OFF S2-4 - OFF	S2-7 - ON S2-4 - ON
RESET IN	**S2-6 - OFF** **S2-3 - ON**	S2-6 - ON S2-3 - OFF	S2-6 - OFF S2-3 - OFF	S2-6 - ON S2-3 - ON
MTR TEMP	**S2-2 - ON**	not available	S2-2 - OFF	not available
FAULT	standard	not available	not available	not available

Chapter Five: Configuration

5.1 Introduction:

Each amplifier has several configuration options. This chapter describes these options and how to implement them. If desired, Glentek will be happy to pre-configure your amplifiers.

NOTE :

Dip Switch (S1)	Name	Velocity Mode	Current Mode
S1-8	CURRENT MODE	OFF	ON
S1-7	VELOCITY MODE	ON	OFF
S1-6	TACH LEAD	OFF	OFF
S1-5	TACH REVERSE	ON	ON
S1-4	MTR REVERSE	OFF	OFF
S1-3	COARSE BALANCE	OFF	OFF
S1-2	HALL 60/120	OFF	OFF
S1-1	ENCODER REVERSE	OFF	OFF

Each amplifier module and multi-axis 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 adjustment on the dip-switches 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, 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 or active-low signals, and is always pulled-up (type A, and C). All five logic inputs have a selectable 0 to +5VDC or 0 to +15VDC range.

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 Encoder to Sine Mode Amplifier Configuration:

The following table shows the dip switches that need to be configured for the Type A, B, C, and D configurations. The standard configuration is shown in bold.

Dip Switch (S3)	Name	(DEFAULT) SETTINGS
S3-1	CPLD SETTING	(See 5.3.13)
S3-2	CPLD SETTING	(See 5.3.13)
S3-3	CPLD SETTING	(See 5.3.13)
S3-4	CPLD SETTING	(See 5.3.13)
S3-5	CPLD SETTING	(See 5.3.13)
S3-6	TACH PULSE WIDTH SETTING	FACTORY SET
S3-7	TACH PULSE WIDTH SETTING	FACTORY SET
S3-8	TACH PULSE WIDTH SETTING	FACTORY SET

Dip Switch (S3)	Name	(DEFAULT) SETTINGS
S3-1	N/A	OFF
S3-2	TRAP ONLY (FORCED HALL)	OFF
S3-3	N/A	OFF
S3-4	N/A	OFF
S3-5	RANGE	OFF
S3-6	N/A	OFF
S3-7	N/A	OFF
S3-8	N/A	OFF

5.3.1 +15V/+5V Logic Level Configuration (Default: S2-1=OFF):

+15V: S1-1 = OFF.
+5V: S1-1 = ON.

5.3.2 Standard Configuration for Encoder to Sine Velocity Mode and Current Mode:

POLES	ENCODER	S3-1	S3-2	S3-3	S3-4	S3-5
2	500	ON	ON	ON	OFF	ON
2	512	ON	ON	OFF	OFF	ON
2	625	OFF	ON	OFF	ON	ON
2	1000	OFF	ON	ON	OFF	ON
2	1024	OFF	ON	OFF	OFF	ON
2	1250	ON	OFF	OFF	ON	ON
2	2000	ON	OFF	ON	OFF	ON
2	2048	ON	OFF	OFF	OFF	ON
2	2500	OFF	OFF	OFF	ON	ON
2	4000	OFF	OFF	ON	OFF	ON
2	4096	OFF	OFF	OFF	OFF	ON
4	1000	ON	ON	ON	OFF	ON
4	1024	ON	ON	OFF	OFF	ON
4	1250	OFF	ON	OFF	ON	ON
4	2000	OFF	ON	ON	OFF	ON
4	2048	OFF	ON	OFF	OFF	ON
4	2500	ON	OFF	OFF	ON	ON
4	4000	ON	OFF	ON	OFF	ON
4	4096	ON	OFF	OFF	OFF	ON
4	5000	OFF	OFF	OFF	ON	ON
4	8000	OFF	OFF	ON	OFF	ON
4	8192	OFF	OFF	OFF	OFF	ON
6	500	ON	ON	ON	OFF	OFF
6	512	ON	ON	OFF	OFF	OFF
6	625	OFF	ON	OFF	ON	OFF
6	1000	OFF	ON	ON	OFF	OFF
6	1024	OFF	ON	OFF	OFF	OFF
12	1250	OFF	ON	OFF	ON	OFF
12	2000	OFF	ON	ON	OFF	OFF
12	2048	OFF	ON	OFF	OFF	OFF
12	2500	ON	OFF	OFF	ON	OFF

POLES	ENCODER	S3-1	S3-2	S3-3	S3-4	S3-5
12	4000	ON	OFF	ON	OFF	OFF
12	4096	ON	OFF	OFF	OFF	OFF
12	5000	OFF	OFF	OFF	ON	OFF
12	8000	OFF	OFF	ON	OFF	OFF
12	8192	OFF	OFF	OFF	OFF	OFF
TRAP		X	X	ON	ON	ON
INDEX		X	X	ON	ON	OFF
6	1250	ON	OFF	OFF	ON	OFF
6	2000	ON	OFF	ON	OFF	OFF
6	2048	ON	OFF	OFF	OFF	OFF
6	2500	OFF	OFF	OFF	ON	OFF
6	4000	OFF	OFF	ON	OFF	OFF
6	4096	OFF	OFF	OFF	OFF	OFF
8	1250	ON	ON	OFF	ON	ON
8	2000	ON	ON	ON	OFF	ON
8	2048	ON	ON	OFF	OFF	ON
8	2500	OFF	ON	OFF	ON	ON
8	4000	OFF	ON	ON	OFF	ON
8	4096	OFF	ON	OFF	OFF	ON
8	5000	ON	OFF	OFF	ON	ON
8	8000	ON	OFF	ON	OFF	ON
8	8192	ON	OFF	OFF	OFF	ON
8	10000	OFF	OFF	OFF	ON	ON
8	16000	OFF	OFF	ON	OFF	ON
8	16384	OFF	OFF	OFF	OFF	ON
12	625	ON	ON	OFF	ON	OFF
12	1000	ON	ON	ON	OFF	OFF
12	1024	ON	ON	OFF	OFF	OFF

5.3.3 Tach Lead (Default: S1-6=OFF):

The tach lead switch is turned ON 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 switch should remain off unless instructed to turn on by a Glentek engineer.

5.3.4 Tach - Reverse Configuration (Default: S1-5=ON):

The tachometer reverse switch is turned ON to reverse the spinning direction of the motor or prevent the motor from running away in case of incorrect polarity of the feedback signal.

5.3.5 Motor- Reverse Configuration (Default: S1-4=OFF):

The motor reverse switch is turned ON to reverse the spinning direction of the motor for both current and velocity mode. It can also solve the problem when a motor running away by reversing the polarity of the motor leads without physically reversing the motor leads.

5.3.6 Coarse Balance (Default: S1-3=OFF):

Occasionally it is necessary to turn the coarse balance switch ON to extend the range of the balance pot due to various offsets in the external signal.

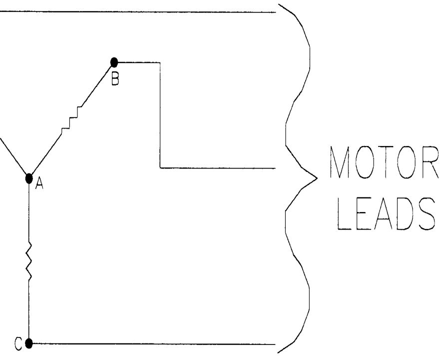


Figure 6.0
Three same value resistors

5.3.7 Hall 60/120 (Default: S1-2=OFF):

There are four standard sensor configurations: 60^o, 120 ^{o}, 240^o, and 300^o. The 60^o/300^o, and 120^o/240^o sensor spacing are identical except for the direction of motor rotation which results.

To configure the amplifiers for 60^o/300^o sensor configuration: S1-2 (ON).
To configure the amplifiers for 120^o/240^o sensor configuration: S1-2 (OFF).

5.3.8 Encoder- Reverse Configuration (Default: S1-5=OFF):

The encoder reverse switch is used as part of the phasing procedure. It is turned ON to switch the A and B encoder channels without physically switching the encoder leads.

5.3.9 Rotary Motor (S3) Settings:

5.3.10 Linear Motor (S3) Settings:

5.3.11 Trap Only - Forced Hall (Default: S3-2=OFF) :

The SMA8715 can be configured to run in Trap Mode. To do this, switch S3-2 ON for linear motor and S3-3, S3-4, S3-5 ON for rotary motor.

5.3.12 Range (Default: S3-5=OFF):

The CPLD on theSMA8715 contains either two different encoder resolutions or two different pole pitches. Use S3-5 to switch between each of them.

5.3.13 Encoder Configuration (For Rotary Motors Only) - S3:

Pots	Name of Port	Note
RV1	SIG 1 (Differential Input Signal Gain)	Sets the input voltage to RPM ratio, e.g. 10V=2000RPM (velocity mode) or input voltage to torque ratio, e.g. 10V=25A (current mode) required by your system for the differential input.
RV2	SIG 2 (Single-ended Input Signal Gain)	Same as Signal 1 input, except this is for single-ended input.
RV3	TACH (Tach Gain)	Used in conjunction with the compensation pot to set the system bandwidth. Not used in current mode. Shipped set at 100%. (full CW)
RV4	BAL (Balance)	Used to null any offsets in system.
RV5	COMP (Compensation)	Used in conjunction with the TACH pot to set the system bandwidth. Not used in current mode. Shipped set at full CW (minimum bandwidth).
RV6	I LIMIT (Current Limit)	Sets the maximum motor current. Shipped set at full CW (maximum current limit).
RV7	LOOP (Loop Gain)	Used to shut off uncalibrated amplifiers. When the loop gain is CCW, no current is delivered to the motor. Shipped set at full CCW.

5.3.13 Encoder Configuration (For Rotary Motors Only) - S3: (Continued)

Chapter Six: Start up and Calibration

6.1 Introduction:

This chapter contains the procedure required for initial start up and amplifier calibration.

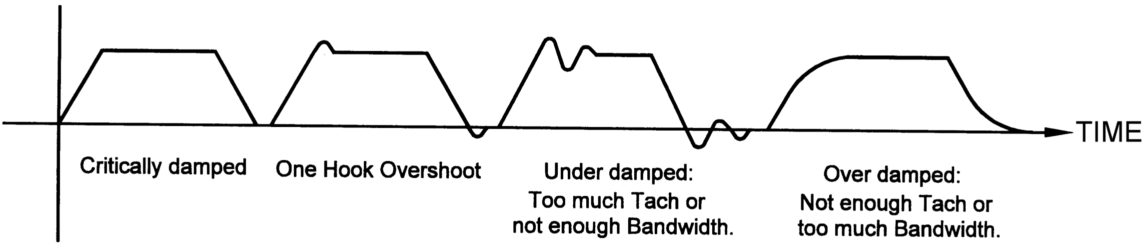


Figure 6.1
Critically damped, One Hook Overshoot, Under and Over damped waveforms

The SMA8715 can be configured to run in velocity mode and current mode operations.

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.
6. 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.
7. Remove input fuses on the baseplate and apply main power. Check for the correct AC voltage at fuse block. The DC Bus (amplifier supply-voltage) will be 1.4 times this value. If voltage is correct, remove power and reinstall fuses.
7. Work on only one amplifier at a time.

6.3 Phasing Procedures

1. Record dip-switch settings. (S3)
2. Using motor data, connect the Encoder and Hall Sensors to the amp. If using an encoder w/commutation tracks, connect the encoder to the proper pinouts on J4 and the commutation tracks to the Hall Sensor connection at J5 (Hall 1 = Comm. track 1 etc.) See section 4.4.3 for more details. Also, connect +5 VDC to the encoder. Typically this can be found on the controller.
3. If using a separate encoder and hall sensors, connect the encoder to J4 and the hall sensors to J5. The power for the Hall Sensors is also located on J5. However, also connect +5 VDC for the encoder from an external source (Typically the controller).
4. The encoder signals will also have to be “daisy chained” to the controller.

Pot/Dip Switches	**AMP1**	**AMP2**	**AMP3**	**AMP4**	**AMP5**	**AMP6**
TACH J3-C to J3-G or H (Ω)						
SIG. 1 J3-A to J3-G or H(Ω)						
SIG. 2 J3-B to J3-G or H(Ω)						
COMP J3-D to J3-G or H (Ω)						
CURRENT LIMIT J3-E to J3-G or H (Ω)						
Signal input to Tach ratio: _V Signal / _V Tach						
LIMIT(PULL UP/DN) S2-8						
INHIBIT(PULL UP/DN) S2-7						
RESET(PULL UP/DN) S2-6						
LIMIT(ACTIVE HI/LOW) S2-5						
INHIBIT(ACTIVE HI/LOW) S2-4						
RESET(ACTIVE HI/LOW) S2-3						
MTR TEMP(ACTIVE HI/LOW) S2-2						
+15/+5 S2-1						

amplifier and the controller. Ensure that the shield from the encoder cable is also connected at these points.

5. Connect the three motor leads to a resistor network as per figure 6.0. All three resistors should be the same value.
6. Place one scope probe on point B; connect ground of scope probe to point A. Remove cover from the amplifier. Connect 2nd scope probe to J1, pin 4 (phase R command) use J1-14 for scope ground. **J1 is located on the main power board, on the left-hand side of the amp when viewing it from the front side (cover side). It is the only connector that has 14 pins. Pin 1 is at the top (Near fault LEDS).**
7. Turn loop gain pot (RV7) on amplifier full Clockwise. Turn on B+ power and apply an analog input signal to either sig. 1 or sig. 2 on J1 of the amplifier. To do this, use a battery box, 1.5 VDC, 9 VDC battery, or analog offset signal from the controller.
8. Turn or slide motor. Compare the two sinewaves. Waveforms should be in phase or 180° out of phase. If sinewave is 180° out of phase, reversing motor

Input or Fault Condition	RUN LED	HS/ECB LED	LS/ECB LED	OVER VOLT LED	OVERTEMP LED	HALL ERROR LED	FAULT OUTPUT
Normal Operation	**ON**	OFF	OFF	OFF	OFF	OFF	NO
Limit + (ON)	**ON**	OFF	OFF	OFF	OFF	OFF	NO
Limit - (ON)	**ON**	OFF	OFF	OFF	OFF	OFF	NO
Inhibit (ON)	**OFF**	OFF	OFF	OFF	OFF	OFF	NO
Reset In (ON)	**OFF**	OFF	OFF	OFF	OFF	OFF	NO
Ext. Fault (ON)	**OFF**	OFF	OFF	OFF	OFF	OFF	**YES**
Undervoltage (+15V)	OFF	OFF	OFF	OFF	OFF	OFF	**YES**
HS/ECB (Latched)	OFF	**ON**	OFF	OFF	OFF	OFF	**YES**
LS/ECB (Latched)	OFF	OFF	**ON**	OFF	OFF	OFF	**YES**
Over-voltage B+ (Latched)	OFF	OFF	OFF	**ON**	OFF	OFF	**YES**
Overtemp (Latched)	OFF	OFF	OFF	OFF	**ON**	OFF	**YES**
Hall Error (Latched)	OFF	OFF	OFF	OFF	OFF	**ON**	**YES**

direction will align it.

9. If the waveforms are not in phase, move the scope probe from point B to point C. Repeat step 7. If is still not in phase, move scope probe to point D and repeat step 7. Repeat this process for J1-6 (S phase) and J1-8 (T phase),

always rotating or sliding motor in the same direction. Make a note of which color motor lead aligns with which motor phase.(Example: Red = phase R etc.)

10. Remove input signal and remove power from amplifier.
11. Set the amp to “Trap Mode”; S3-2 ON for linear motor; S3-3, S3-4, S3-5 ON for rotary motor. (Refer to 5.3.13 for rotary, 5.3.10 for linear). Set scope probe back to J1-4 (phase R)
11 Apply power and re-connect the input signal.
12 Observe phasing as done earlier, now however, one waveform will be trapezoidal.
13. If waveforms are not in phase, remove signal input, turn power off and change the hall sensor wires on J5 until they are in phase. (note: there are six possible combinations)
14. Remove input signal and remove power from unit.
15. Return dipswitches to original position(s), as recorded on step #1.
16. Connect motor leads to amplifier, R, S, T according to your notes.
17. Proceed to step 6.4

Note: All other axis or units that have the same wiring and components will be connected in the same manner. There is no need to repeat this procedure for every system or axis. Just use your notes from the above procedure to make connections.

6.4 Encoder to Sine Mode Amplifier Calibration:

The following pots will be set during calibration:

Note: RV7 is a single turn pot; RV1-RV6 and RV8-RV14 are 12-turn pots.

Note: RV8-RV14 are factory set and should not be adjusted. Adjusting these pots voids warranty.

6.4.1 Encoder to Sine Mode Amplifier Calibration Procedure - Velocity Mode:

The amplifier, in this configuration, receives an analog, bi-polar input command which is proportional to the required motor velocity.

1. Turn the Current Limit (R67) to mid position and the Loop Gain (RV7) full CCW.
2. Apply main power and fan power.
3. Slowly turn the Loop Gain (RV7) CW. The motor should be stopped or turning slowly. If the motor starts running away, turn Loop Gain pot(RV7) CCW, switch TACH REVERSE (S1-5) from OFF to ON (or vice versa) and retest. Leave the Loop Gain (RV7) full CW for all remaining adjustments.
4. Set the Balance (RV4) for zero motor rotation.
5. Connect the oscilloscope to ABS I (J1-7) and the battery box to Signal 2 Input. The voltage at J1-7 is a function of motor current: 1V=10A for SMA8715. While applying a step input voltage, adjust the Current Limit (RV6) for the desired peak current. If the desired peak current cannot be achieved with the pot full CW, increase the input voltage or increase the Signal Gain (RV2).

   The purpose of the following procedure is to set the system bandwidth to obtain a critically-damped response with the maximum possible tach gain. There are many possible settings of Tach Gain and Compensation which will yield a critically damped waveform. The optimum setting will occur when the Tach Gain is as CW as possible and the 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 (RV3) set at 100%. This is a good place to start. If you are unsure of where the Tach Gain is set, turn the Tach Gain fully CW (up to 12 turns).
6. Move the oscilloscope to the TACH OUT (J3-3), set the battery box for a steady DC voltage and adjust the input voltage or Signal 2 gain for about 400RPM.
7. Pulse the input and compare the waveform with figure 6.1.
8. Adjust the Compensation pot CCW until the waveform is critically damped or one hook overshoot. Then proceed to step 10.
9. If the desired waveform cannot be obtained by adjusting the Compensation pot, back off (CCW) the Tach Gain pot a few turns and repeat step 8.
10. Do not adjust the Tach Gain or Compensation pots for the rest of the calibration procedure.
11. 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 battery box for a known DC voltage. Adjust Signal 2 Gain (RV2) or (RV1 for differential input) to obtain the desired motor velocity.

12. If the motor is rotating in the wrong direction for a given input polarity, turn the Loop Gain pot full CCW. Switch MTR REVERSE (S1-4) from OFF to ON (or vice-versa). Turn the Loop Gain pot back to full CW.
13. Remove the battery box, and repeat only step 4.
14. Calibration complete. Reconnect signal wires.

6.4.2 Encoder to Sine Mode Amplifier Calibration Procedure - Current Mode:

The amplifier in this configuration, receives an analog, bi-polar input command which is proportional to the required motor current (motor torque).

1. Turn the current limit (RV6) to mid position and the Loop Gain (RV7) full CCW.
2. Apply main power and fan power. Slowly turn the Loop Gain (RV7) full CW. Motor should be stopped or turning slowly.
3. Set Balance (RV4) for 0V at ABS I (J1-7).
4. Connect the oscilloscope to ABS I (J1-7), and the battery box to the Signal 2 Signal-ended Input (J1-3 and J1-4). The voltage on J1-7 is a function of motor current: 1V=10A. While pulsing a step input voltage, adjust the Current Limit for the desired peak current. If the desired peak current cannot be achieved with the pot full CW, increase the input voltage or increase the Signal 2 Gain (RV2).
5. With 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 battery box for a known DC voltage. Apply)input signal pulses and adjust the Signal 2 Gain pot (RV2) or (RV1 for differential input) to obtain the desired current gain of the amplifier.
6. If the motor is rotating in the wrong direction for a given input polarity, turn the Loop Gain pot full CCW. Switch MTR REVERSE (S1-4) from OFF to ON (or vice-versa). Turn the Loop Gain pot back to full CW.
7. Remove battery box, and repeat step 3.
8. Calibration complete. Reconnect single wires.

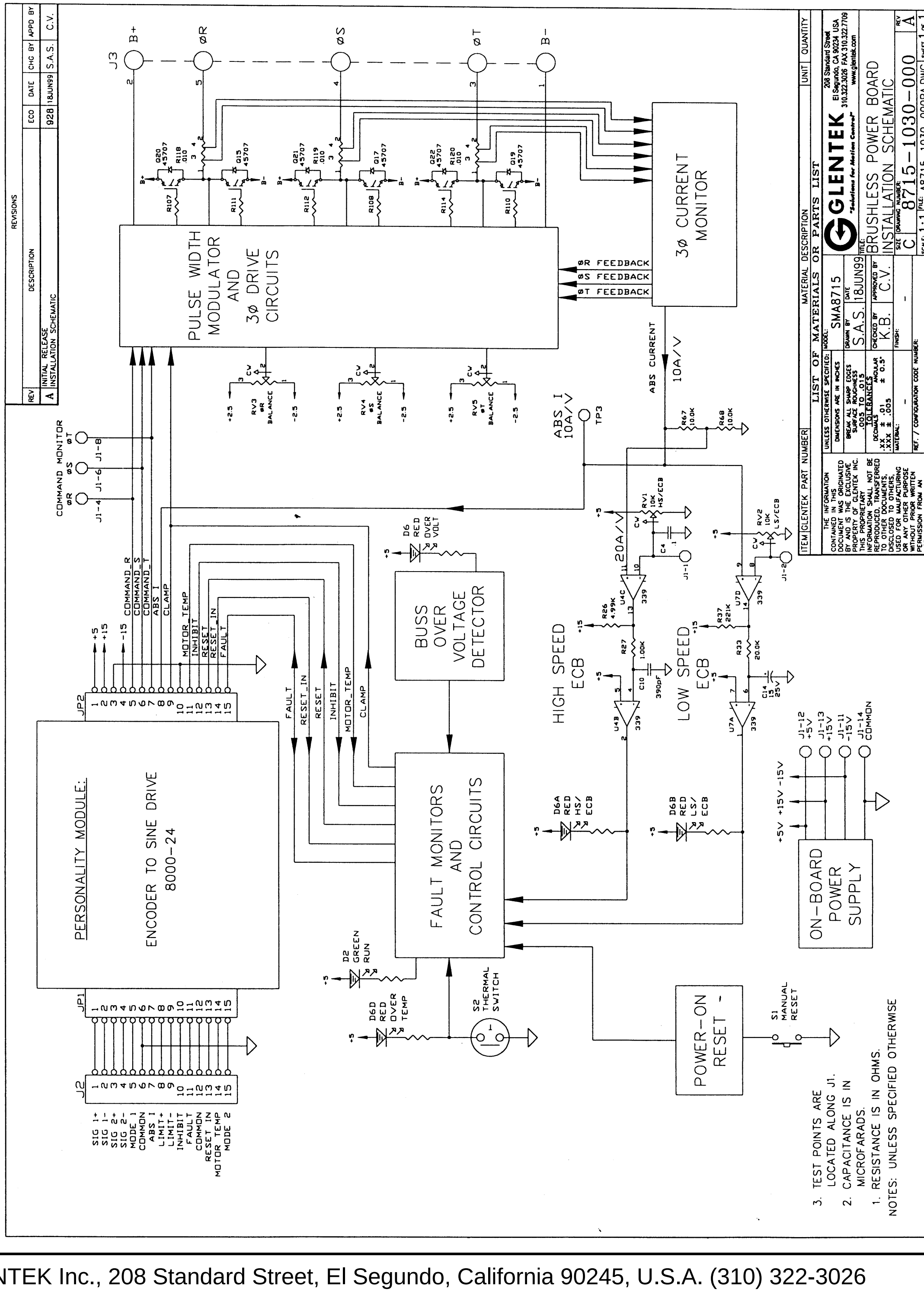
6.5 Calibration Setup Record:

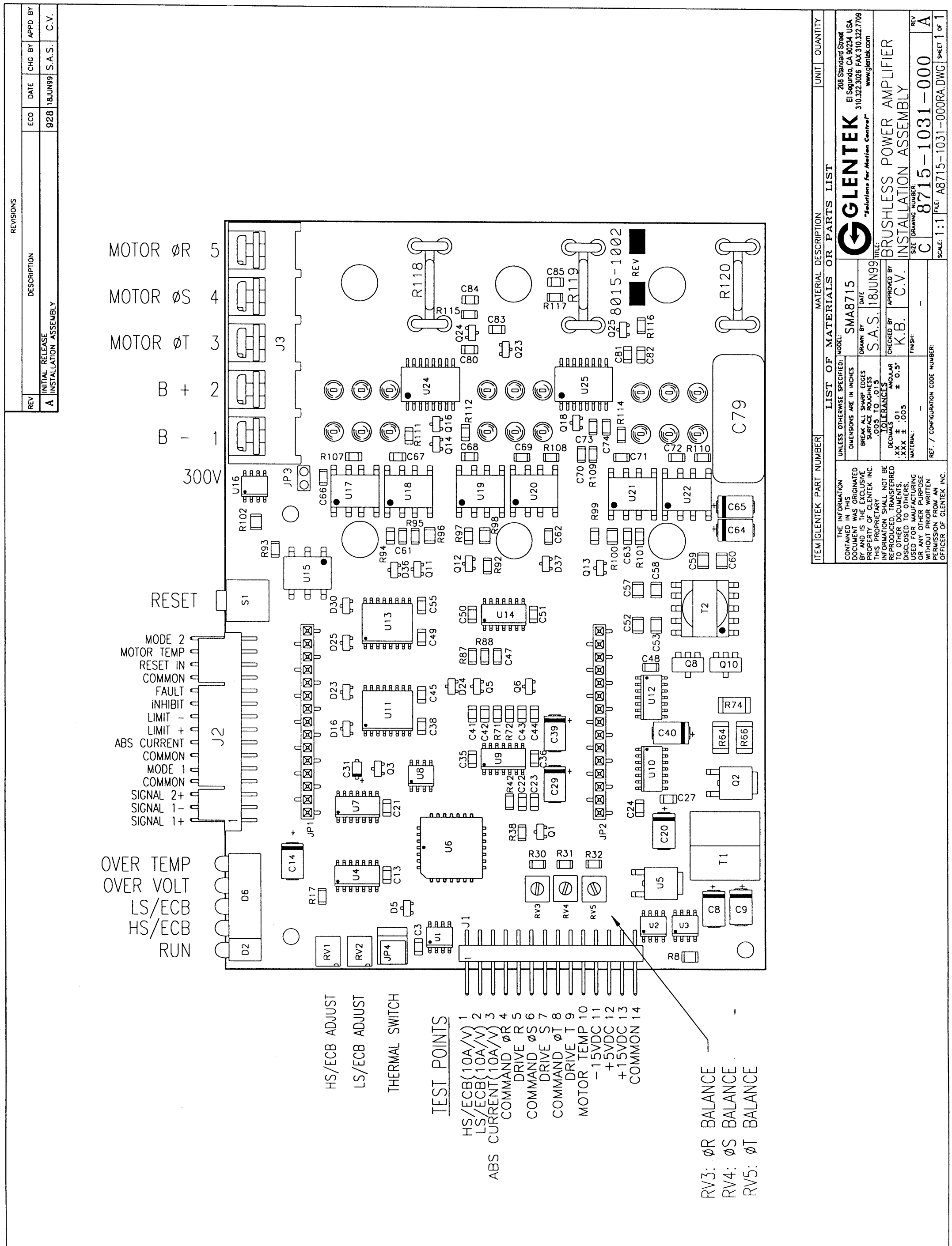
It is good practice to keep a record of all pot settings. Doing so will facilitate calibration on future units and repair on this unit. Although not a substitute for the calibration procedure, it will at least get you "in the ballpark." Remove the power and allow all capacitors to discharge before taking measurements. Note: The balance pot should not be measured in this fashion, set per step 4 in the calibration procedure.

Date data taken: / / Serial number S/N:_______________
Model number SMA____

Appendix A

Amplifier Drawings


REVISIONS
REV
DESCRIPTION
ECO
DATE
CHG BY
APPD BY
A
INITIAL RELEASE
INSTALLATION SCHEMATIC
928
18JUN99
S.A.S.
C.V.
J3
B+
ØR
ØS
ØT
B-
3Ø CURRENT MONITOR
PULSE WIDTH MODULATOR AND 3Ø DRIVE CIRCUITS
ØR FEEDBACK
ØS FEEDBACK
ØT FEEDBACK
ABS CURRENT
10A/V
ABS I 10A/V
TP3
COMMAND MONITOR
ØR
ØS
ØT
J1-4
J1-6
J1-8
COMMAND_R
COMMAND_S
COMMAND_T
ABS I
CLAMP
MOTOR_TEMP
INHIBIT
RESET
RESET_IN
FAULT
BUSS OVER VOLTAGE DETECTOR
D6 RED OVER VOLT
HIGH SPEED ECB
LOW SPEED ECB
20A/V
RV1 10K HS/ECB
RV2 10K LS/ECB
FAULT MONITORS AND CONTROL CIRCUITS
D6A RED HS/ECB
D6B RED LS/ECB
PERSONALITY MODULE:
ENCODER TO SINE DRIVE
8000-24
JP1
JP2
J2
SIG 1+
SIG 1-
SIG 2+
SIG 2-
MODE 1
COMMON
ABS I
LIMIT+
LIMIT-
INHIBIT
FAULT
COMMON
RESET IN
MOTOR TEMP
MODE 2
D2 GREEN RUN
D6D RED OVER TEMP
S2 THERMAL SWITCH
POWER-ON RESET -
S1 MANUAL RESET
ON-BOARD POWER SUPPLY
+5V +15V -15V
J1-12 +5V
J1-13 +15V
J1-11 -15V
J1-14 COMMON
NOTES: UNLESS SPECIFIED OTHERWISE
1. RESISTANCE IS IN OHMS.
2. CAPACITANCE IS IN MICROFARADS.
3. TEST POINTS ARE LOCATED ALONG J1.
LIST OF MATERIALS OR PARTS LIST
GLENTEK
208 Standard Street
El Segundo, CA 90234 USA
310.322.3026 FAX 310.322.7709
www.glentek.com
BRUSHLESS POWER BOARD
INSTALLATION SCHEMATIC
SMA8715
S.A.S.
18JUN99
K.B.
C.V.
C
8715-1030-000
A
SCALE: 1:1
A8715-1030-000RA.DWG
SHEET 1 OF 1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REV | DESCRIPTION | ECO | DATE | CHG BY | APPD BY
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MOTOR ØR 5
MOTOR ØS 4
MOTOR ØT 3
B + 2
B − 1
300V
J3
RESET
MODE 2
MOTOR TEMP
RESET IN
COMMON
FAULT
INHIBIT
LIMIT −
LIMIT +
ABS CURRENT
COMMON
MODE 1
COMMON
SIGNAL 2+
SIGNAL 1−
SIGNAL 1+
J2
OVER TEMP
OVER VOLT
LS/ECB
HS/ECB
RUN
8015-1002
REV
C79
HS/ECB ADJUST
LS/ECB ADJUST
THERMAL SWITCH
TEST POINTS
HS/ECB(10A/V) 1
LS/ECB(10A/V) 2
ABS CURRENT(10A/V) 3
COMMAND ØR 4
DRIVE R 5
COMMAND ØS 6
DRIVE S 7
COMMAND ØT 8
DRIVE T 9
MOTOR TEMP 10
−15VDC 11
+5VDC 12
+15VDC 13
COMMON 14
RV3: ØR BALANCE
RV4: ØS BALANCE
RV5: ØT BALANCE
ITEM | GLENTEK PART NUMBER | MATERIAL DESCRIPTION | UNIT | QUANTITY
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
TITLE: BRUSHLESS POWER AMPLIFIER INSTALLATION ASSEMBLY
MODEL: SMA8715
DRAWN BY S.A.S. DATE 18JUN99
CHECKED BY K.B. APPROVED BY C.V.
SIZE C DRAWING NUMBER 8715-1031-000 REV A
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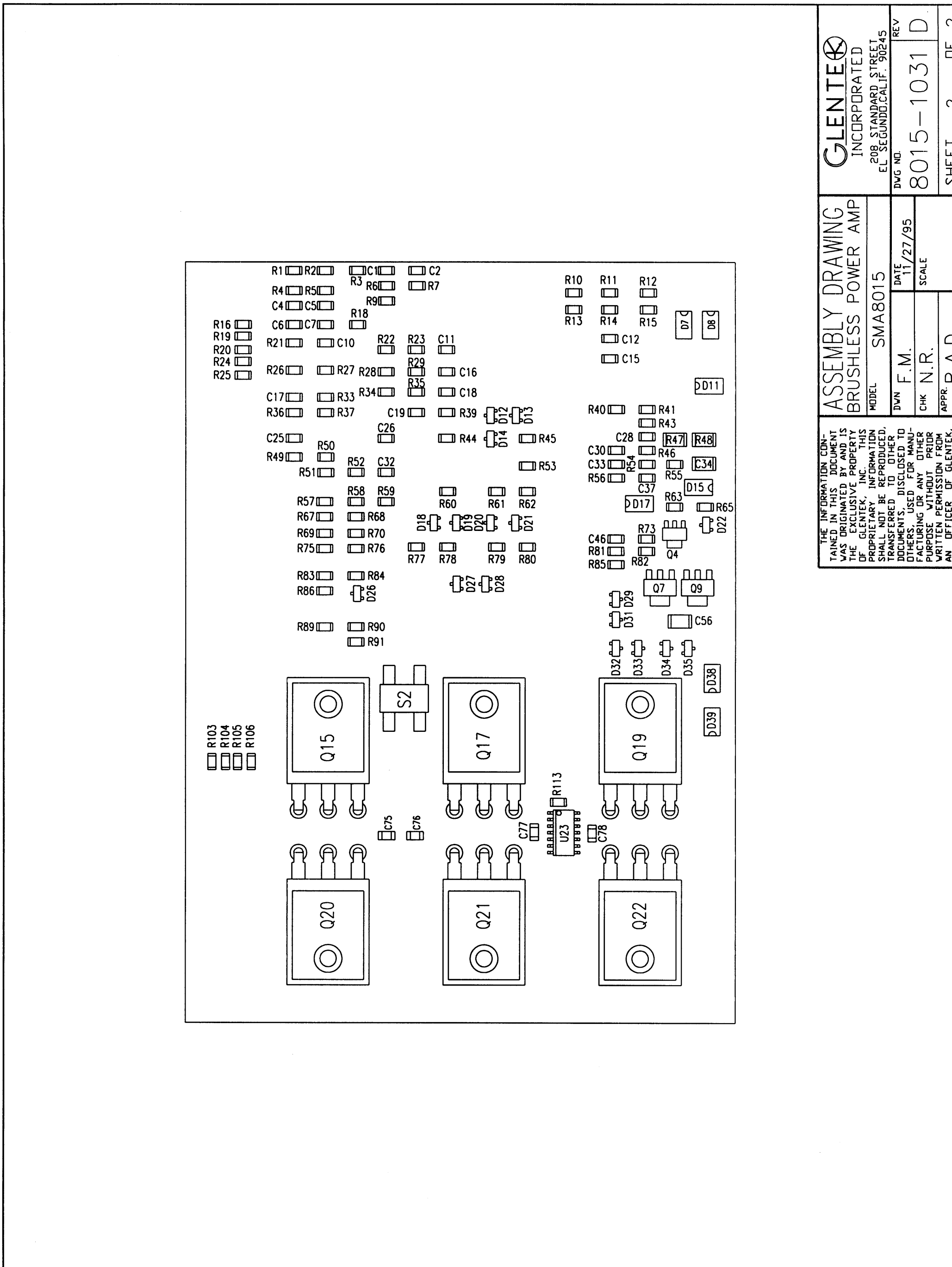
GLENTEK
INCORPORATED
208 STANDARD STREET
EL SEGUNDO,CALIF. 90245
DWG NO.
8015-1031
REV
D
SHEET 2 OF 2
ASSEMBLY DRAWING
BRUSHLESS POWER AMP
MODEL
SMA8015
DATE
11/27/95
SCALE
DWN F.M.
CHK N.R.
APPR. R.A.D.
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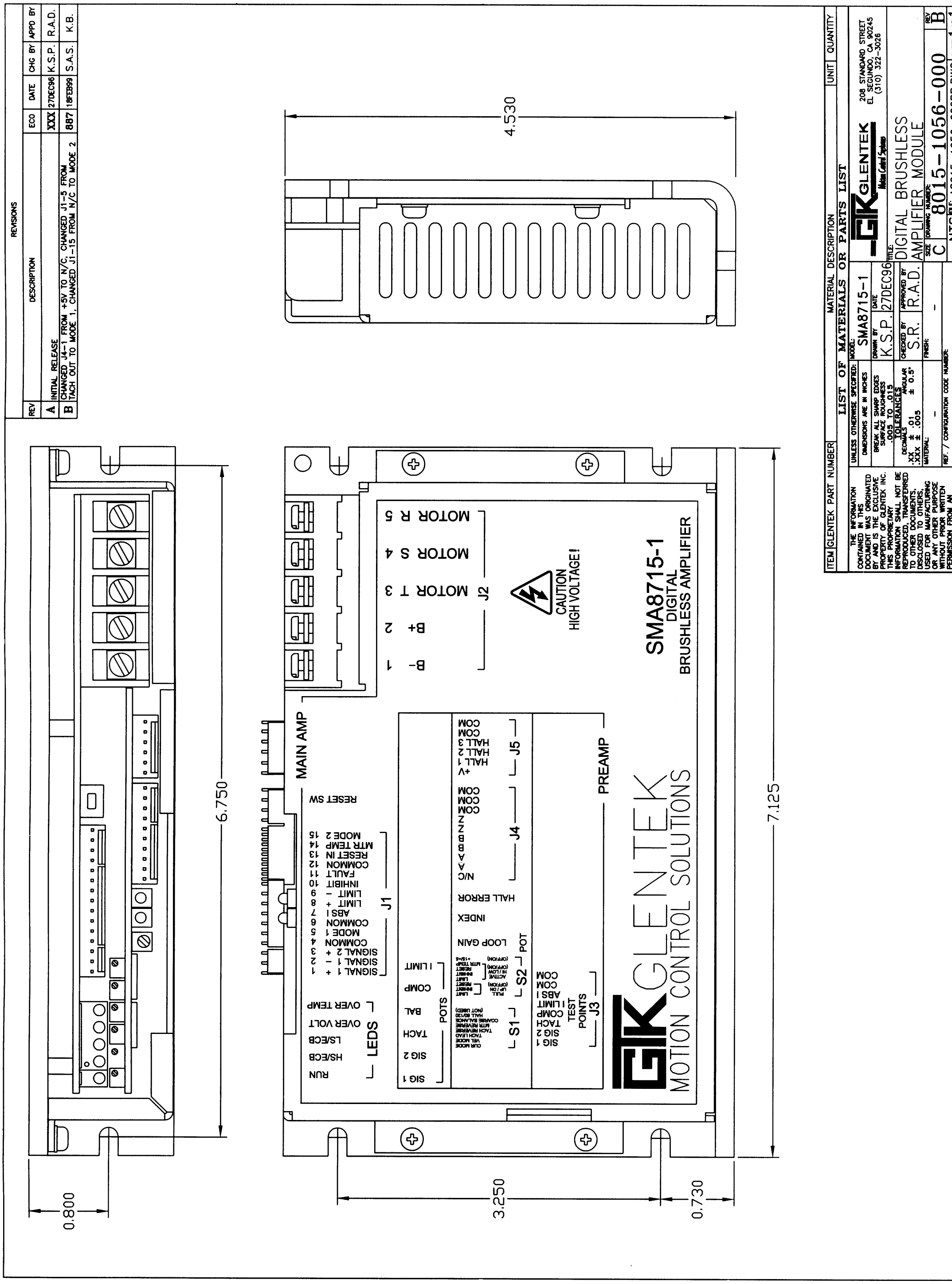
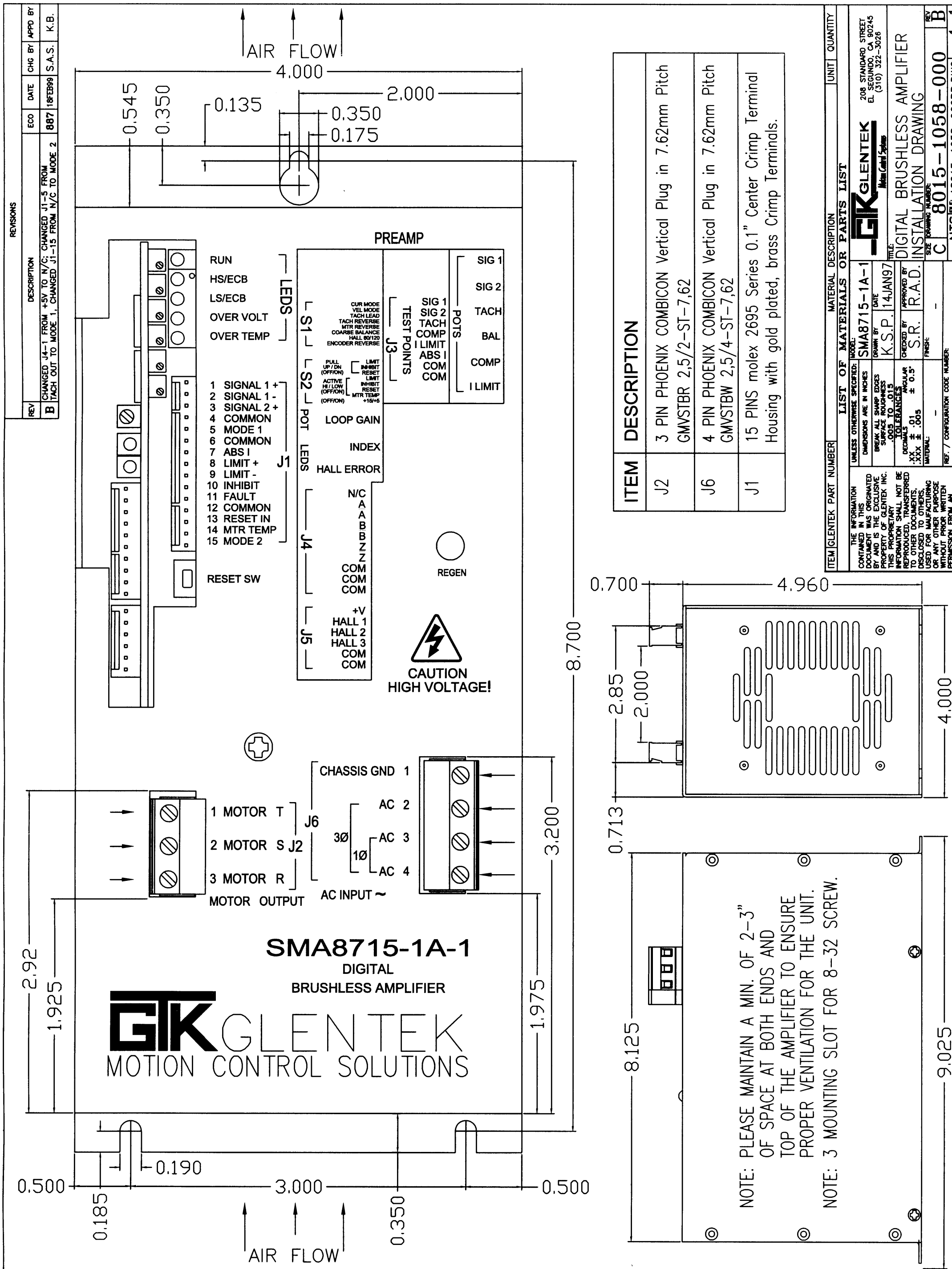
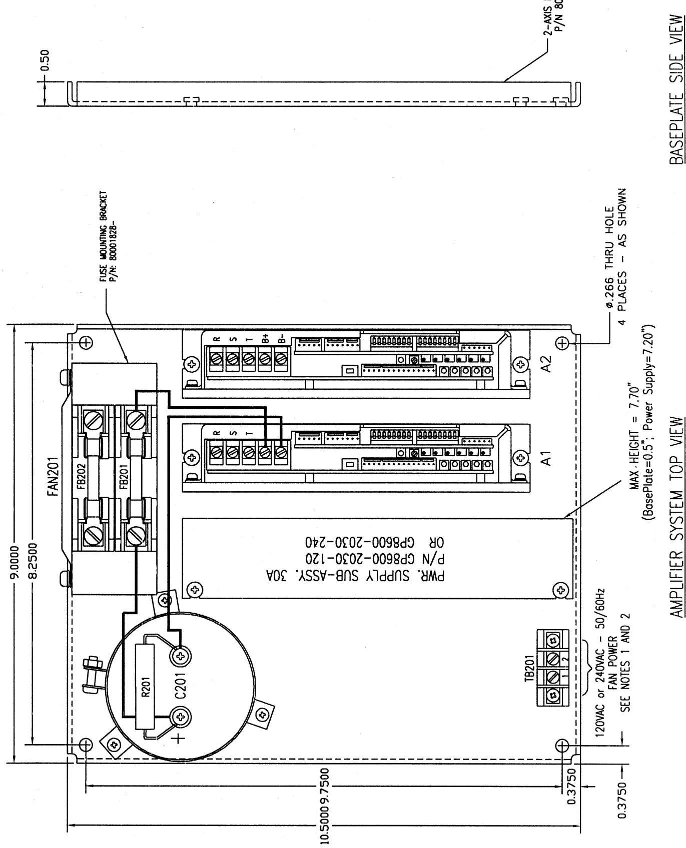

4.530
6.750
7.125
3.250
0.800
0.730
SMA8715-1
DIGITAL
BRUSHLESS AMPLIFIER
CAUTION
HIGH VOLTAGE!
MOTOR R 5
MOTOR S 4
MOTOR T 3
B+ 2
B- 1
J2
MAIN AMP
PREAMP
RESET SW
J1
J4
J5
J3
LEDS
POTS
RUN
HS/ECB
LS/ECB
OVER VOLT
OVER TEMP
SIG 1
SIG 2
TACH
BAL
COMP
I LIMIT
LOOP GAIN
INDEX
HALL ERROR
TEST POINTS
GLENTEK
MOTION CONTROL SOLUTIONS
REVISIONS
INITIAL RELEASE
LIST OF MATERIALS OR PARTS LIST
SMA8715-1
DIGITAL BRUSHLESS AMPLIFIER MODULE
8015-1056-000
208 STANDARD STREET
EL SEGUNDO, CA 90245
(310) 322-3026
A8015-1056-000RB.DWG


AIR FLOW
4.000
2.000
0.545
0.350
0.135
0.350
0.175
PREAMP
RUN
HS/ECB
LS/ECB
OVER VOLT
OVER TEMP
LEDS
S1
S2
TEST POINTS
J3
SIG 1
SIG 2
TACH
COMP
I LIMIT
ABS I
COM
COM
POTS
SIG 1
SIG 2
TACH
BAL
COMP
I LIMIT
1 SIGNAL 1 +
2 SIGNAL 1 -
3 SIGNAL 2 +
4 COMMON
5 MODE 1
6 COMMON
7 ABS I
8 LIMIT +
9 LIMIT -
10 INHIBIT
11 FAULT
12 COMMON
13 RESET IN
14 MTR TEMP
15 MODE 2
J1
POT
LEDS
LOOP GAIN
INDEX
HALL ERROR
N/C
A
A
B
B
Z
Z
COM
COM
COM
J4
+V
HALL 1
HALL 2
HALL 3
COM
COM
J5
RESET SW
REGEN
CAUTION
HIGH VOLTAGE!
8.700
CHASSIS GND 1
AC 2
AC 3
AC 4
3Ø
1Ø
AC INPUT ~
1 MOTOR T
2 MOTOR S
3 MOTOR R
J6
J2
MOTOR OUTPUT
3.200
SMA8715-1A-1
DIGITAL
BRUSHLESS AMPLIFIER
GLENTEK
MOTION CONTROL SOLUTIONS
2.92
1.925
1.975
0.190
0.500
3.000
0.500
0.185
0.350
AIR FLOW
0.700
4.960
2.85
2.000
4.000
0.713
8.125
9.025
NOTE: PLEASE MAINTAIN A MIN. OF 2-3" OF SPACE AT BOTH ENDS AND TOP OF THE AMPLIFIER TO ENSURE PROPER VENTILATION FOR THE UNIT.
NOTE: 3 MOUNTING SLOT FOR 8-32 SCREW.
ITEM | DESCRIPTION
J2 | 3 PIN PHOENIX COMBICON Vertical Plug in 7.62mm Pitch GMVSTBR 2,5/2-ST-7,62
J6 | 4 PIN PHOENIX COMBICON Vertical Plug in 7.62mm Pitch GMVSTBW 2,5/4-ST-7,62
J1 | 15 PINS molex 2695 Series 0.1" Center Crimp Terminal Housing with gold plated, brass Crimp Terminals.
REVISIONS
REV | DESCRIPTION | ECO | DATE | CHG BY | APPD BY
B | CHANGED J4-1 FROM +5V TO N/C; CHANGED J1-5 FROM TACH OUT TO MODE 1, CHANGED J1-15 FROM N/C TO MODE 2 | 887 | 18FEB99 | S.A.S. | K.B.
LIST OF MATERIALS OR PARTS LIST
GLENTEK
208 STANDARD STREET EL SEGUNDO, CA 90245 (310) 322-3026
DIGITAL BRUSHLESS AMPLIFIER INSTALLATION DRAWING
SMA8715-1A-1
K.S.P. 14JAN97
S.R. R.A.D.
C 8015-1058-000 B
NTS A8015-1058-000RB.DWG SHEET 1 OF 1



WIRING INFORMATION:

1. MAIN POWER: Refer to the 30A power supply sub-assembly drawing (drawing# 8600-2030) of the operation & service manual.
2. FAN POWER: TB201.
3. INDIVIDUAL AMPLIFIER: Refer to chapter 4 of the operation & service manual.

NOTES:

1. 120VAC OPERATION: 120VAC FANS, R201=10KOHM-10W, C201=6000MFD-250VDC AND GP8600-2030-120 POWER SUPPLY SUB-ASSEMBLY.
2. 240VAC OPERATION: 240VAC FANS, R201=20KOHM-10W, C201=3600MFD-450VDC AND GP8600-2030-240 POWER SUPPLY SUB-ASSEMBLY.
3. Use shielded cable for command signal.
4. Wiring to Amplifier A1 is typical for Amplifier A2.
5. Never ground the outputs of the amplifiers.

QTY	PART NO.	DESCRIPTION	MATERIAL	ITEM
2	FB201-202	BUSSMANN FUSE BLOCK BM6031SQ		10
1	TB201	MAGNUM 2 PIN CONNECTOR		9
1	80001828-	DOUBLE FUSE MOUNTING BRACKET		8
2	F201-202	Littelfuse KLK 20A fuse or Limitron KTK 20A fuse		7
1	FAN201	FAN, 120VAC or 240VAC - 50/60Hz		6
1	80001823-	REDUCED SIZE 2-AXIS BASEPLATE		5
1	GP8600-2030	PWR. SUPPLY SUB-ASSEMBLY 30A		4
2	A1 - A2	SMA8X15 Amplifier Module		3
1	R201	Resistor, 10Kohm, 10W / 20Kohm, 10W		2
1	C201	Cap., 6000MFD-250VDC/3600MFD-450VDC		1

LIST OF MATERIAL OR PARTS LIST

SYM	REVISIONS	DATE	APPROVED

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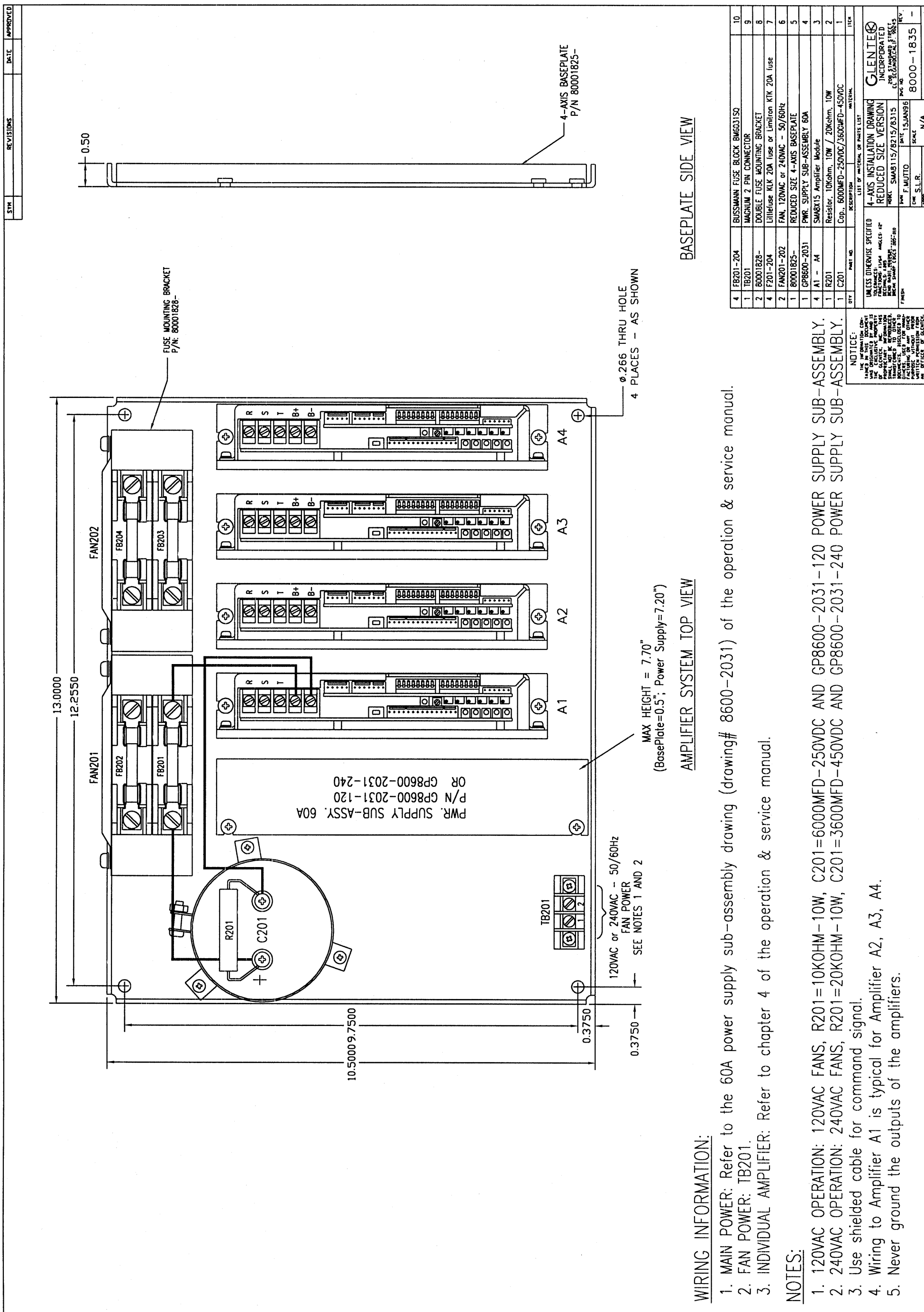
UNLESS OTHERWISE SPECIFIED

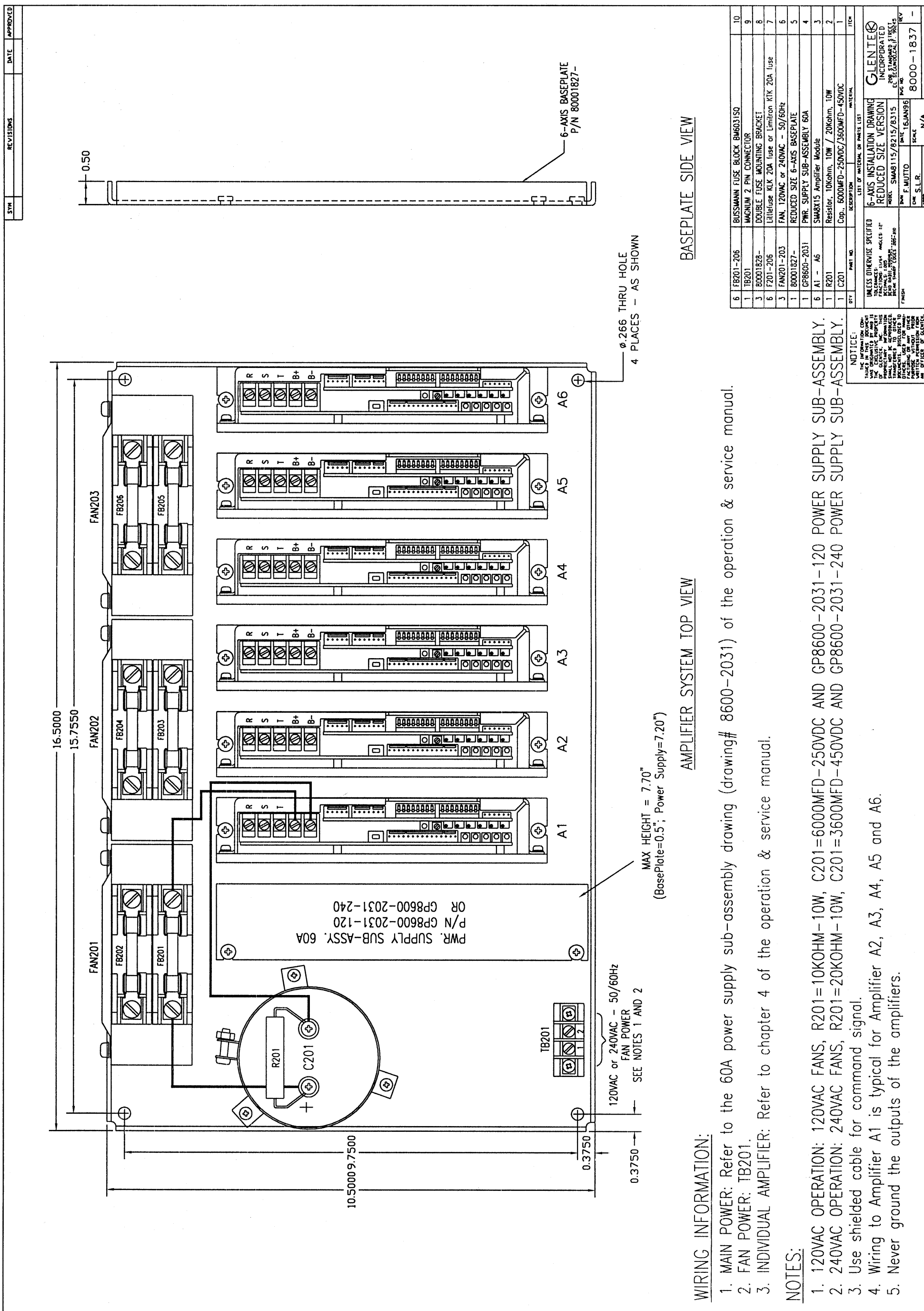
2-AXIS INSTALLATION DRAWING
REDUCED SIZE VERSION

MODEL: SMA8115/8215/8315

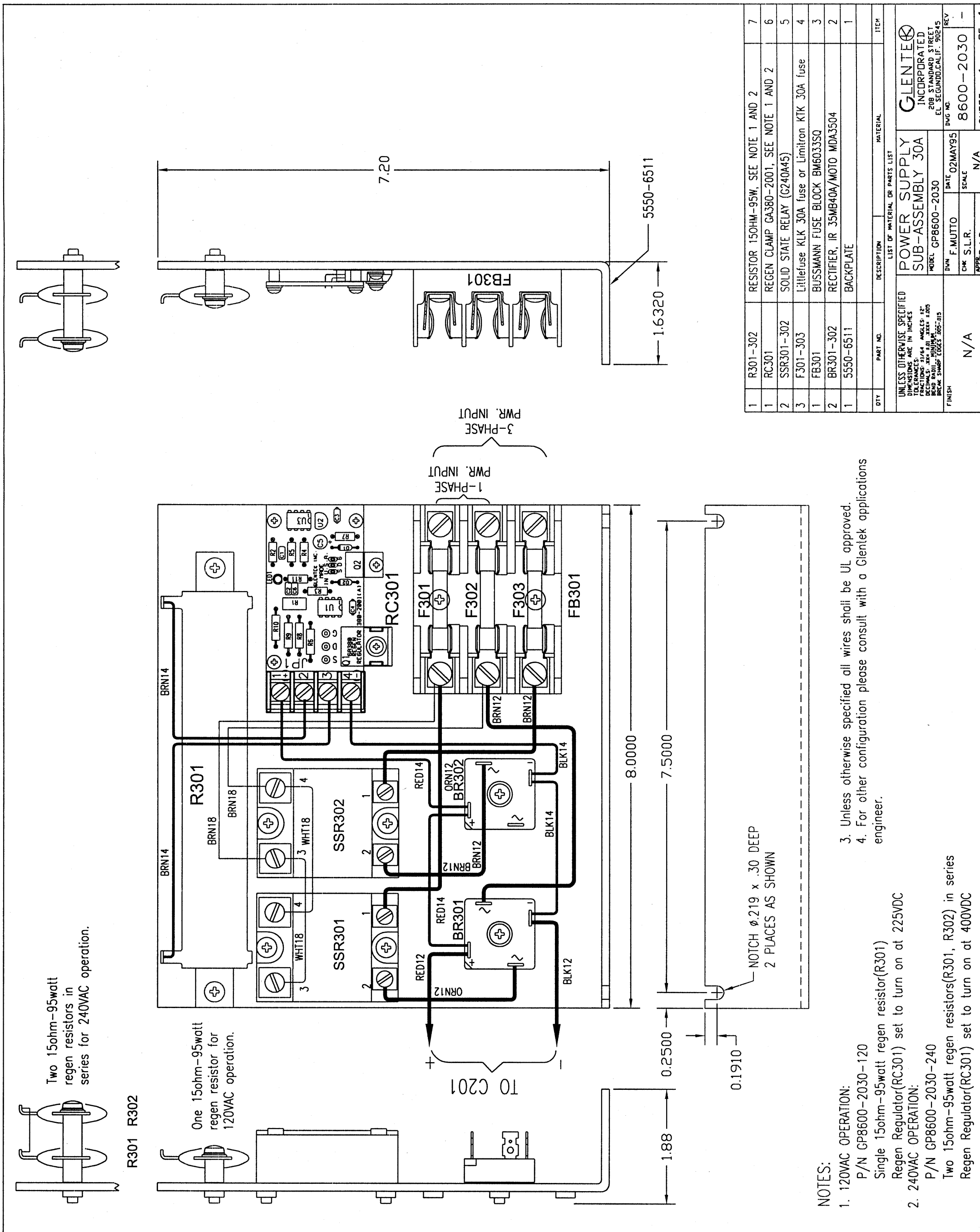
GLENTEK INCORPORATED, 208 STANDARD STREET, EL SEGUNDO, CALIF. 90245

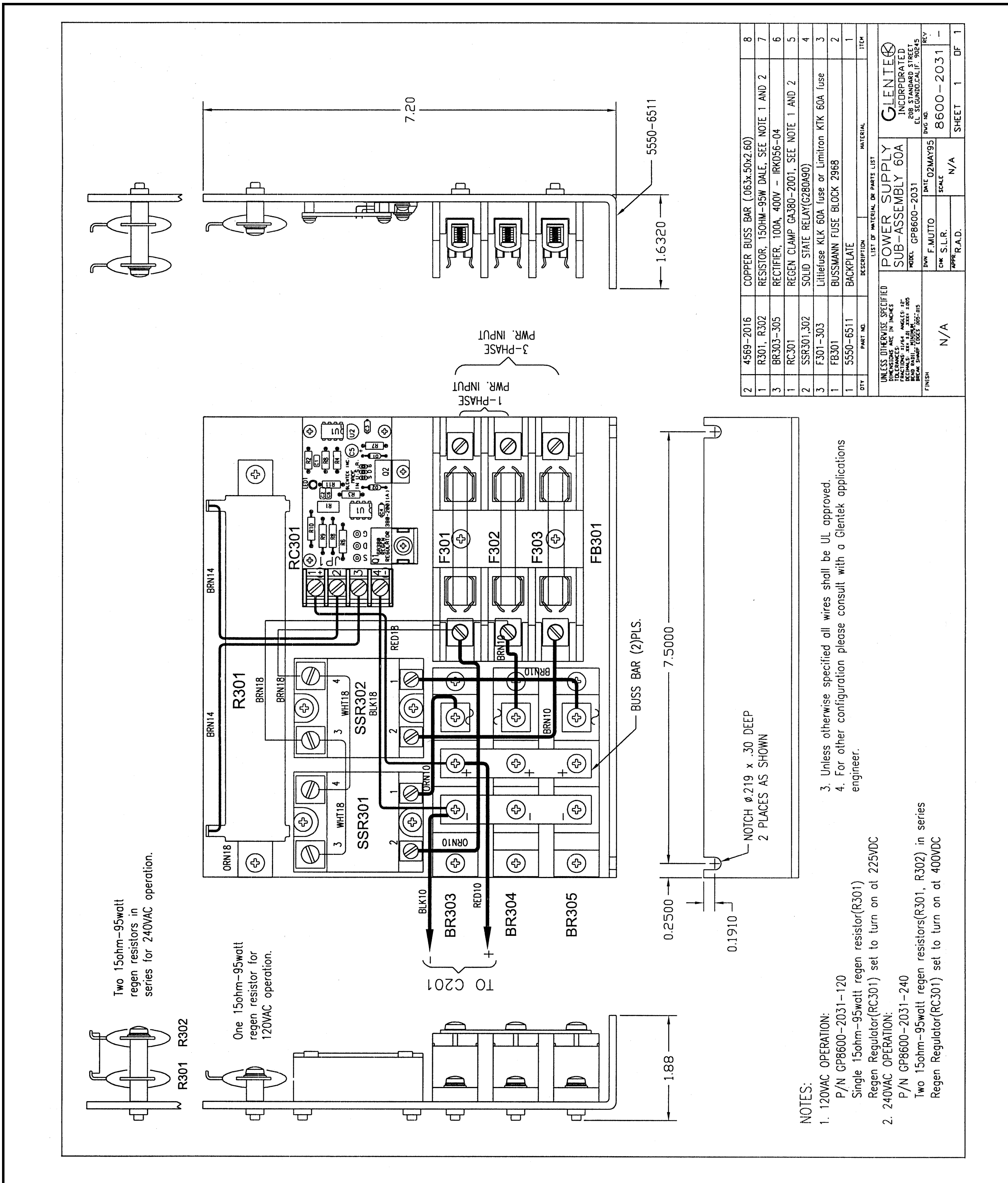
DWN	F.MUTTO	DATE	1/12/96	DWG NO.	8000-1833	REV	-
CHK	S.L.R.	SCALE	N/A	SHEET	1	OF	1
APPR	R.A.D.						


13.0000
12.2550
10.5000
9.7500
0.3750
0.3750
0.50
FAN201
FAN202
FB201
FB202
FB203
FB204
FUSE MOUNTING BRACKET P/N: 80001828-
R201
C201
PWR. SUPPLY SUB-ASSY. 60A
P/N GP8600-2031-120
OR GP8600-2031-240
R
S
T
B+
B-
A1
A2
A3
A4
TB201
120VAC or 240VAC - 50/60Hz
FAN POWER
SEE NOTES 1 AND 2
MAX HEIGHT = 7.70"
(BasePlate=0.5"; Power Supply=7.20")
ø.266 THRU HOLE
4 PLACES - AS SHOWN
4-AXIS BASEPLATE
P/N 80001825-
AMPLIFIER SYSTEM TOP VIEW
BASEPLATE SIDE VIEW
WIRING INFORMATION:
1. MAIN POWER: Refer to the 60A power supply sub-assembly drawing (drawing# 8600-2031) of the operation & service manual.
2. FAN POWER: TB201.
3. INDIVIDUAL AMPLIFIER: Refer to chapter 4 of the operation & service manual.
NOTES:
1. 120VAC OPERATION: 120VAC FANS, R201=10KOHM-10W, C201=6000MFD-250VDC AND GP8600-2031-120 POWER SUPPLY SUB-ASSEMBLY.
2. 240VAC OPERATION: 240VAC FANS, R201=20KOHM-10W, C201=3600MFD-450VDC AND GP8600-2031-240 POWER SUPPLY SUB-ASSEMBLY.
3. Use shielded cable for command signal.
4. Wiring to Amplifier A1 is typical for Amplifier A2, A3, A4.
5. Never ground the outputs of the amplifiers.
SYM
REVISIONS
DATE
APPROVED
4 FB201-204 BUSSMANN FUSE BLOCK BM6031SQ 10
1 TB201 MAGNUM 2 PIN CONNECTOR 9
2 80001828- DOUBLE FUSE MOUNTING BRACKET 8
4 F201-204 Littlefuse KLK 20A fuse or Limitron KTK 20A fuse 7
2 FAN201-202 FAN, 120VAC or 240VAC - 50/60Hz 6
1 80001825- REDUCED SIZE 4-AXIS BASEPLATE 5
1 GP8600-2031 PWR. SUPPLY SUB-ASSEMBLY 60A 4
4 A1 - A4 SMA8X15 Amplifier Module 3
1 R201 Resistor, 10Kohm, 10W / 20Kohm, 10W 2
1 C201 Cap., 6000MFD-250VDC/3600MFD-450VDC 1
QTY
PART NO.
DESCRIPTION
MATERIAL
ITEM
LIST OF MATERIAL OR PARTS LIST
NOTICE:
UNLESS OTHERWISE SPECIFIED
4-AXIS INSTALLATION DRAWING
REDUCED SIZE VERSION
SMA8115/8215/8315
GLENTEK INCORPORATED
F.MUTTO
15JAN96
S.L.R.
R.A.D.
N/A
8000-1835
SHEET 1 OF 1



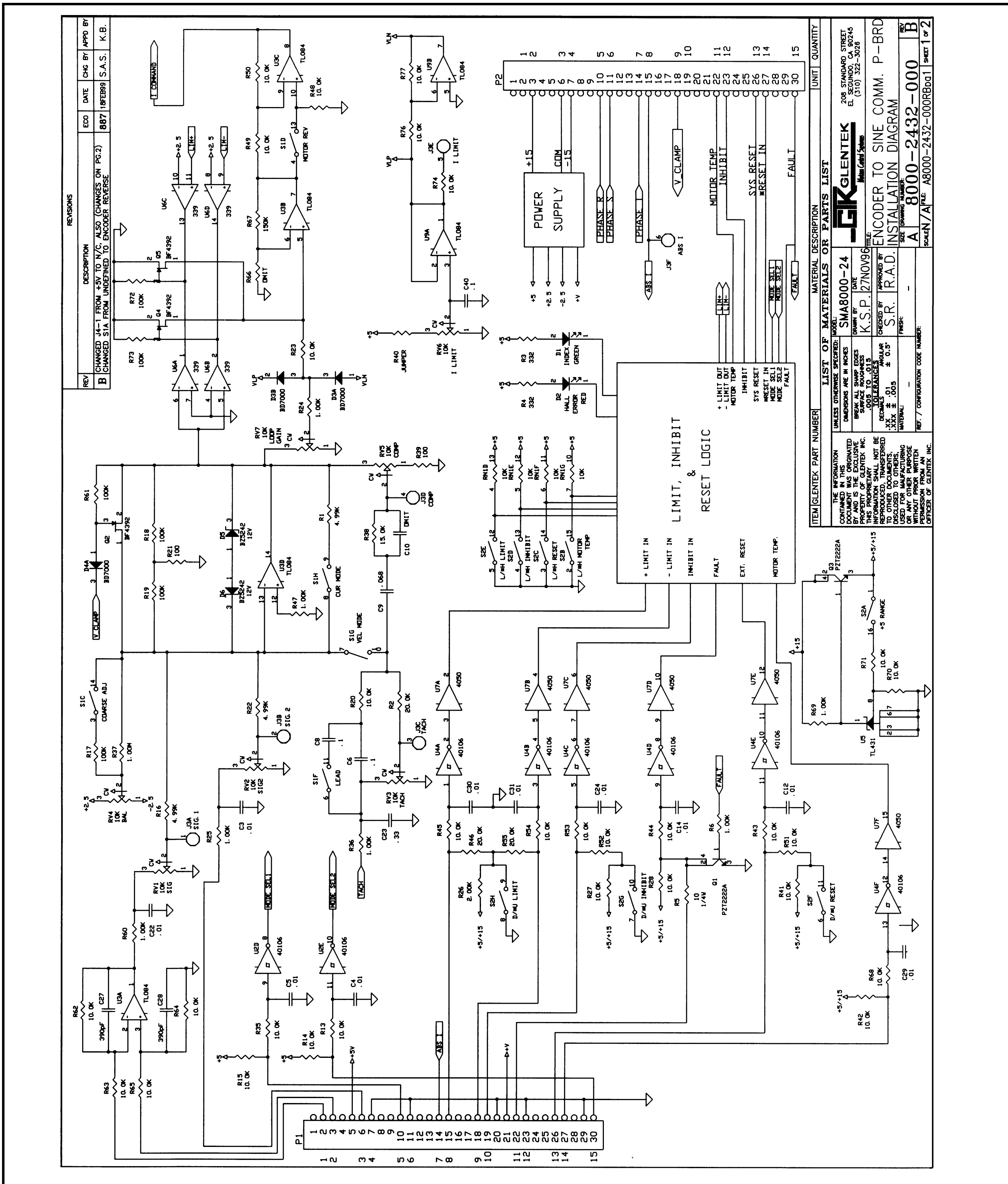
BASEPLATE SIDE VIEW
6-AXIS BASEPLATE P/N 80001827-
0.50
AMPLIFIER SYSTEM TOP VIEW
ø.266 THRU HOLE 4 PLACES - AS SHOWN
A1
A2
A3
A4
A5
A6
R S T B+ B-
FAN201
FAN202
FAN203
FB201
FB202
FB203
FB204
FB205
FB206
PWR. SUPPLY SUB-ASSY. 60A
P/N GP8600-2031-120
OR GP8600-2031-240
MAX HEIGHT = 7.70" (BasePlate=0.5"; Power Supply=7.20")
TB201
120VAC or 240VAC - 50/60Hz FAN POWER SEE NOTES 1 AND 2
R201
C201
16.5000
15.7550
10.5000
9.7500
0.3750
0.3750
WIRING INFORMATION:
1. MAIN POWER: Refer to the 60A power supply sub-assembly drawing (drawing# 8600-2031) of the operation & service manual.
2. FAN POWER: TB201.
3. INDIVIDUAL AMPLIFIER: Refer to chapter 4 of the operation & service manual.
NOTES:
1. 120VAC OPERATION: 120VAC FANS, R201=10KOHM-10W, C201=6000MFD-250VDC AND GP8600-2031-120 POWER SUPPLY SUB-ASSEMBLY.
2. 240VAC OPERATION: 240VAC FANS, R201=20KOHM-10W, C201=3600MFD-450VDC AND GP8600-2031-240 POWER SUPPLY SUB-ASSEMBLY.
3. Use shielded cable for command signal.
4. Wiring to Amplifier A1 is typical for Amplifier A2, A3, A4, A5 and A6.
5. Never ground the outputs of the amplifiers.
6 FB201-206 BUSSMANN FUSE BLOCK BM6031SQ 10
1 TB201 MAGNUM 2 PIN CONNECTOR 9
3 80001828- DOUBLE FUSE MOUNTING BRACKET 8
6 F201-206 Littelfuse KLK 20A fuse or Limitron KTK 20A fuse 7
3 FAN201-203 FAN, 120VAC or 240VAC - 50/60Hz 6
1 80001827- REDUCED SIZE 6-AXIS BASEPLATE 5
1 GP8600-2031 PWR. SUPPLY SUB-ASSEMBLY 60A 4
6 A1 - A6 SMA8X15 Amplifier Module 3
1 R201 Resistor, 10Kohm, 10W / 20Kohm, 10W 2
1 C201 Cap., 6000MFD-250VDC/3600MFD-450VDC 1
QTY PART NO. DESCRIPTION MATERIAL ITEM
LIST OF MATERIAL OR PARTS LIST
6-AXIS INSTALLATION DRAWING REDUCED SIZE VERSION
MODEL SMA8115/8215/8315
DWN F.MUTTO DATE 16JAN96
CHK S.L.R. SCALE N/A
APPR. R.A.D.
GLENTEK INCORPORATED 208 STANDARD STREET EL SEGUNDO, CALIF. 90245
DWG NO. 8000-1837 REV -
SHEET 1 OF 1

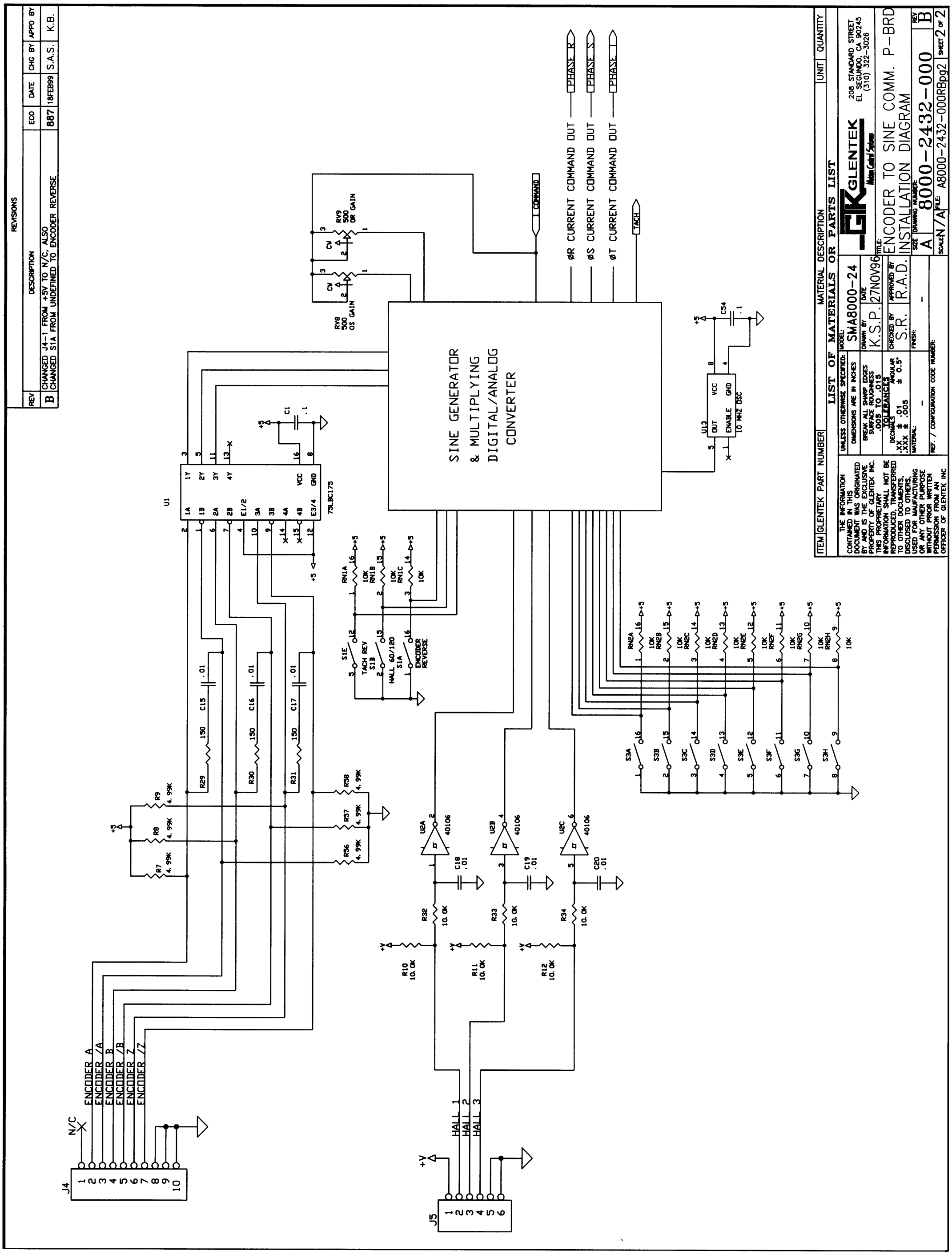

7.20
5550-6511
1.6320
FB301
3-PHASE PWR. INPUT
1-PHASE PWR. INPUT
RC301
F301
F302
F303
FB301
R301
SSR302
SSR301
BR302
BR301
BRN14
BRN18
WHT18
RED14
RED12
ORN12
BRN12
BLK14
BLK12
8.0000
7.5000
0.2500
0.1910
1.88
NOTCH ø.219 x .30 DEEP
2 PLACES AS SHOWN
TO C201
Two 15ohm-95watt regen resistors in series for 240VAC operation.
One 15ohm-95watt regen resistor for 120VAC operation.
R301 R302
NOTES:
1. 120VAC OPERATION:
P/N GP8600-2030-120
Single 15ohm-95watt regen resistor(R301)
Regen Regulator(RC301) set to turn on at 225VDC
2. 240VAC OPERATION:
P/N GP8600-2030-240
Two 15ohm-95watt regen resistors(R301, R302) in series
Regen Regulator(RC301) set to turn on at 400VDC
3. Unless otherwise specified all wires shall be UL approved.
4. For other configuration please consult with a Glentek applications engineer.
7 1 R301-302 RESISTOR 15OHM-95W, SEE NOTE 1 AND 2
6 1 RC301 REGEN CLAMP GA380-2001, SEE NOTE 1 AND 2
5 2 SSR301-302 SOLID STATE RELAY (G240A45)
4 3 F301-303 Littlefuse KLK 30A fuse or Limitron KTK 30A fuse
3 1 FB301 BUSSMANN FUSE BLOCK BM6033SQ
2 2 BR301-302 RECTIFIER, IR 35MB40A/MOTO MDA3504
1 1 5550-6511 BACKPLATE
QTY PART NO. DESCRIPTION MATERIAL ITEM
LIST OF MATERIAL OR PARTS LIST
POWER SUPPLY SUB-ASSEMBLY 30A
MODEL GP8600-2030
GLENTEK INCORPORATED
208 STANDARD STREET EL SEGUNDO, CALIF. 90245
DWN F.MUTTO DATE 02MAY95
CHK S.L.R. SCALE N/A
APPR R.A.D.
DWG NO. 8600-2030 REV -
SHEET 1 OF 1
FINISH N/A

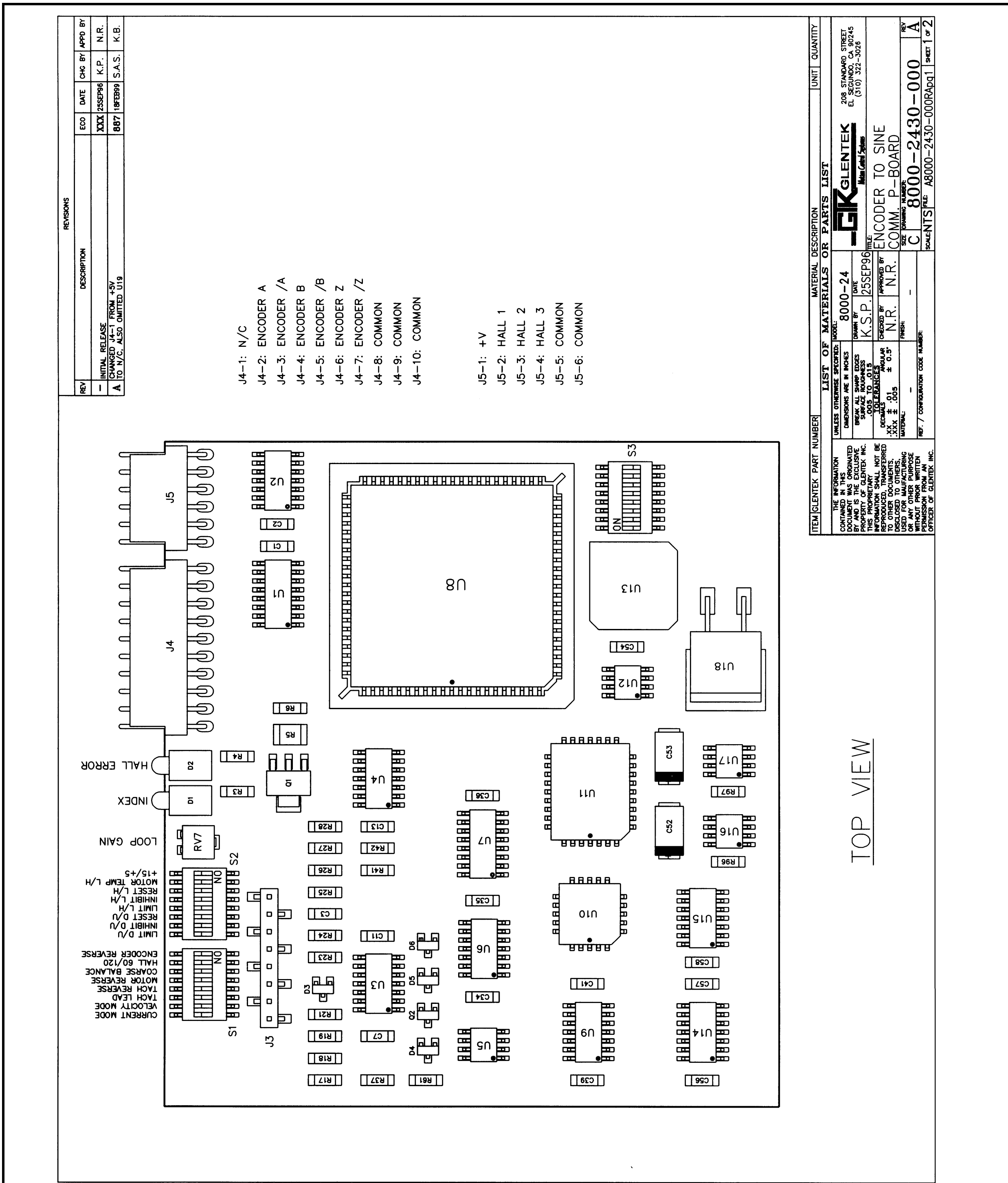

7.20
5550-6511
1.6320
3-PHASE PWR. INPUT
1-PHASE PWR. INPUT
RC301
F301
F302
F303
FB301
R301
SSR302
SSR301
BRN14
BRN18
BRN10
ORN18
ORN10
RED18
RED10
BLK18
BLK10
WHT18
BUSS BAR (2)PLS.
7.5000
NOTCH ø.219 x .30 DEEP
2 PLACES AS SHOWN
0.2500
0.1910
BR303
BR304
BR305
TO C201
1.88
R301
R302
Two 15ohm-95watt regen resistors in series for 240VAC operation.
One 15ohm-95watt regen resistor for 120VAC operation.
8 2 4569-2016 COPPER BUSS BAR (.063x.50x2.60)
7 1 R301, R302 RESISTOR, 15OHM-95W DALE, SEE NOTE 1 AND 2
6 3 BR303-305 RECTIFIER, 100A, 400V - IRKD56-04
5 1 RC301 REGEN CLAMP GA380-2001, SEE NOTE 1 AND 2
4 2 SSR301,302 SOLID STATE RELAY(G280A90)
3 3 F301-303 Littlefuse KLK 60A fuse or Limitron KTK 60A fuse
2 1 FB301 BUSSMANN FUSE BLOCK 2968
1 1 5550-6511 BACKPLATE
ITEM QTY PART NO. DESCRIPTION MATERIAL
LIST OF MATERIAL OR PARTS LIST
POWER SUPPLY SUB-ASSEMBLY 60A
GLENTEK INCORPORATED 208 STANDARD STREET EL SEGUNDO, CALIF. 90245
MODEL GP8600-2031
DWN F.MUTTO
CHK S.L.R.
APPR. R.A.D.
DATE 02MAY95
SCALE N/A
DWG NO. 8600-2031
REV -
SHEET 1 OF 1
FINISH N/A
NOTES:
1. 120VAC OPERATION:
P/N GP8600-2031-120
Single 15ohm-95watt regen resistor(R301)
Regen Regulator(RC301) set to turn on at 225VDC
2. 240VAC OPERATION:
P/N GP8600-2031-240
Two 15ohm-95watt regen resistors(R301, R302) in series
Regen Regulator(RC301) set to turn on at 400VDC
3. Unless otherwise specified all wires shall be UL approved.
4. For other configuration please consult with a Glentek applications engineer.

Appendix B

Personality Module


LIMIT, INHIBIT & RESET LOGIC
POWER SUPPLY
LIST OF MATERIALS OR PARTS LIST
GLENTEK
208 STANDARD STREET
EL SEGUNDO, CA 90245
(310) 322-3026
SMA8000-24
K.S.P.
27NOV96
R.A.D.
S.R.
ENCODER TO SINE COMM. P-BRD
INSTALLATION DIAGRAM
8000-2432-000
A8000-2432-000RBpa1


SINE GENERATOR
& MULTIPLYING
DIGITAL/ANALOG
CONVERTER
ENCODER TO SINE COMM. P-BRD
INSTALLATION DIAGRAM
8000-2432-000
GLENTEK
SMA8000-24
LIST OF MATERIALS OR PARTS LIST
REVISIONS
CHANGED J4-1 FROM +5V TO N/C, ALSO CHANGED S1A FROM UNDEFINED TO ENCODER REVERSE
ØR CURRENT COMMAND OUT
ØS CURRENT COMMAND OUT
ØT CURRENT COMMAND OUT
PHASE R
PHASE S
PHASE T
ENCODER A
ENCODER /A
ENCODER B
ENCODER /B
ENCODER Z
ENCODER /Z
HALL 1
HALL 2
HALL 3
J4
J5


REVISIONS
REV | DESCRIPTION | ECO | DATE | CHG BY | APPD BY
– | INITIAL RELEASE | XXX | 25SEP96 | K.P. | N.R.
A | CHANGED J4-1 FROM +5V TO N/C, ALSO OMITTED U19 | 887 | 18FEB99 | S.A.S. | K.B.
J4-1: N/C
J4-2: ENCODER A
J4-3: ENCODER /A
J4-4: ENCODER B
J4-5: ENCODER /B
J4-6: ENCODER Z
J4-7: ENCODER /Z
J4-8: COMMON
J4-9: COMMON
J4-10: COMMON
J5-1: +V
J5-2: HALL 1
J5-3: HALL 2
J5-4: HALL 3
J5-5: COMMON
J5-6: COMMON
HALL ERROR
INDEX
LOOP GAIN
+15/+5
MOTOR TEMP L/H
RESET L/H
INHIBIT L/H
LIMIT L/H
RESET D/U
INHIBIT D/U
LIMIT D/U
ENCODER REVERSE
HALL 60/120
COARSE BALANCE
MOTOR REVERSE
TACH REVERSE
TACH LEAD
VELOCITY MODE
CURRENT MODE
J5
J4
J3
S1
S2
S3
ON
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
RV7
TOP VIEW
ITEM | GLENTEK PART NUMBER | MATERIAL DESCRIPTION | UNIT | QUANTITY
LIST OF MATERIALS OR PARTS LIST
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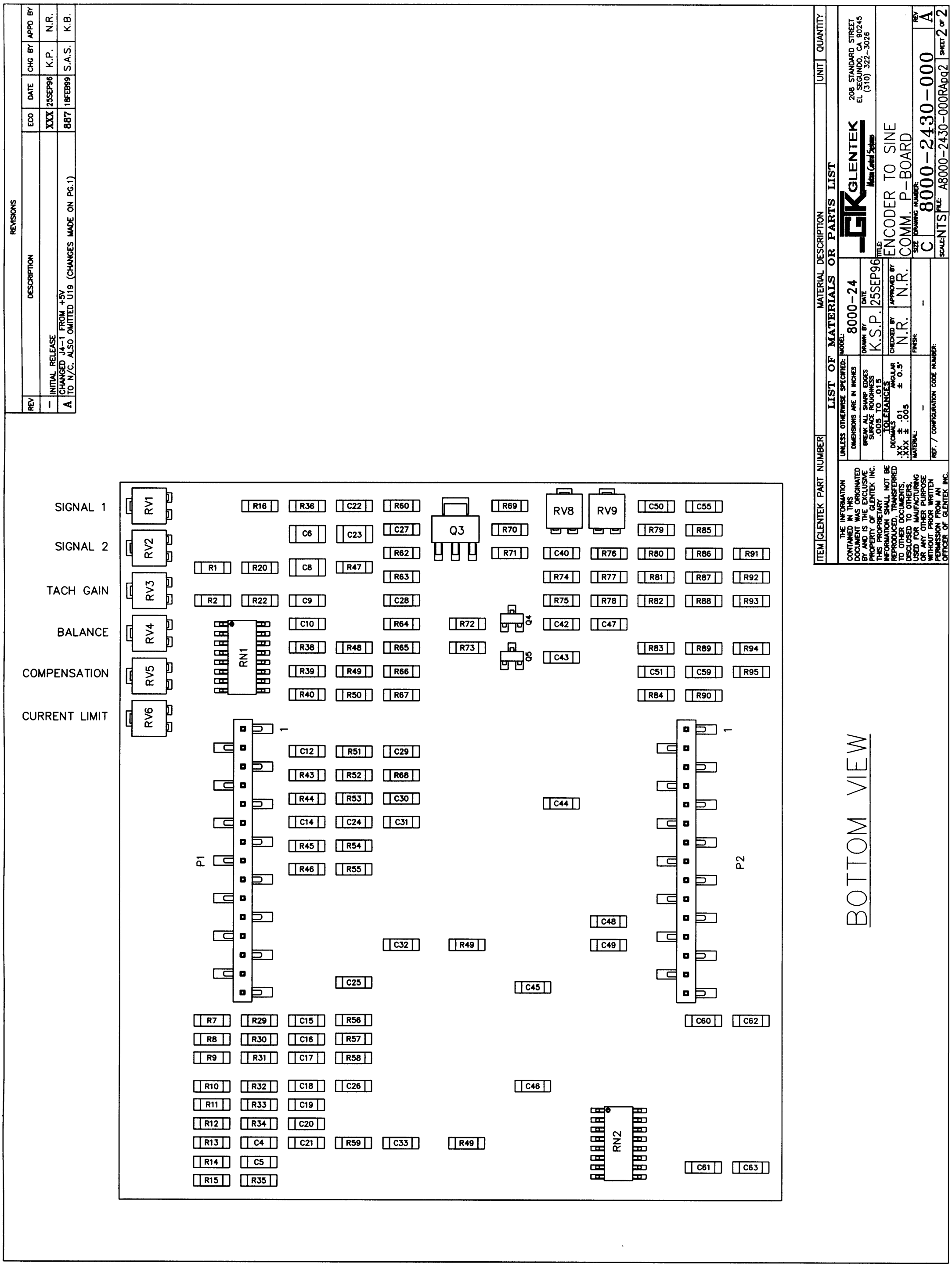
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
BREAK ALL SHARP EDGES SURFACE ROUGHNESS .005 TO .015
TOLERANCES DECIMALS .XX ± .01 .XXX ± .005 ANGULAR ± 0.5°
MATERIAL: –
REF. / CONFIGURATION CODE NUMBER:
MODEL: 8000-24
DRAWN BY K.S.P.
DATE 25SEP96
CHECKED BY N.R.
APPROVED BY N.R.
FINISH: –
GLENTEK Motion Control Systems
208 STANDARD STREET EL SEGUNDO, CA 90245 (310) 322-3026
TITLE: ENCODER TO SINE COMM. P-BOARD
SIZE C
DRAWING NUMBER: 8000-2430-000
REV A
SCALE: NTS
FILE: A8000-2430-000RApg1
SHEET 1 OF 2


SIGNAL 1
SIGNAL 2
TACH GAIN
BALANCE
COMPENSATION
CURRENT LIMIT
RV1
RV2
RV3
RV4
RV5
RV6
RV8
RV9
Q3
RN1
RN2
P1
P2
BOTTOM VIEW
REVISIONS
INITIAL RELEASE
CHANGED J4-1 FROM +5V TO N/C, ALSO OMITTED U19 (CHANGES MADE ON PG.1)
LIST OF MATERIALS OR PARTS LIST
GLENTEK
208 STANDARD STREET EL SEGUNDO, CA 90245 (310) 322-3026
ENCODER TO SINE COMM. P-BOARD
8000-24
K.S.P.
25SEP96
N.R.
8000-2430-000
A8000-2430-000RApg2
SHEET 2 OF 2

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.

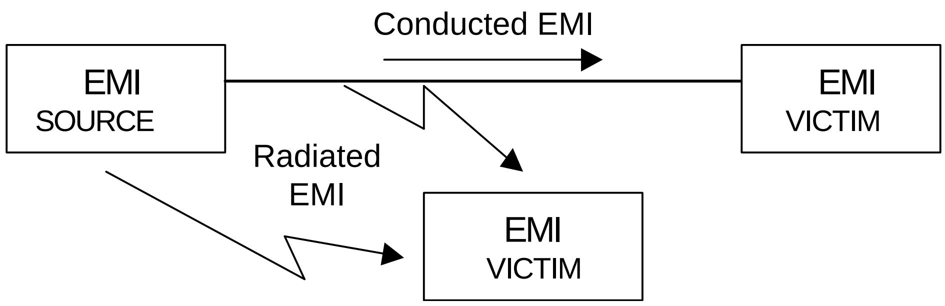


Figure 1 - EMI Source-Victim Model

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.

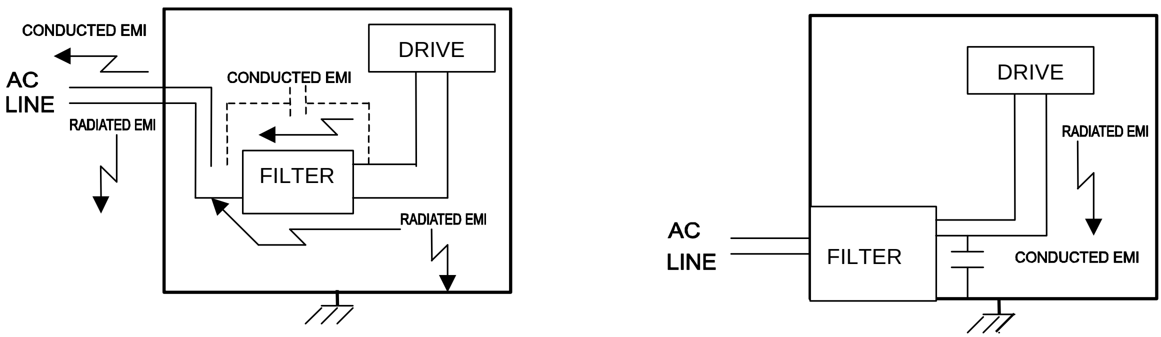
AC Line Filter Selection

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.

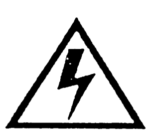
The filter must be mounted close to the drive-input terminals, particularly with higher frequency emissions *(5-30* MHz). If the distance exceeds 600mm (2 feet), a strap should be used to connect the drive and filter, rather than a wire.

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



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.

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.

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.

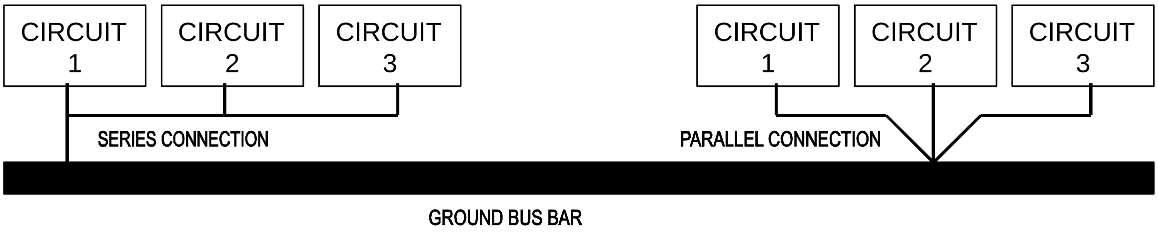
The only reasonable filtering at the drive output terminals is the use of inductance. Capacitors would slow the output switching and deteriorate the drive performance. A common mode choke can be used to reduce the HF voltage at the drive output. This will reduce emission coupling through the drive back 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.

EUROPEAN UNION DECLARATION OF INCORPORATION MOTION CONTROL SYSTEMS

Classified as Components of Machinery

Model Series SMA8715

Council Directive 89/392/EEC Machinery Directive

The Products cited below and their accessories comply with the following Safety of Machinery Standards when installed and operated in accordance with the Instructions provided in the Operation & Installation Manuals. The products are declared to comply by virtue of Design Third Party Evaluations and Testing. EMC Testing and Product Safety Evaluations and Risk Assessments were conducted by NATIONAL TECHNICAL SYSTEMS, an independent Nationally Recognized Test Laboratory, located in Fullerton, CA 92631, USA.

As components of Machinery, please be advised that:

1. These are not individually classified as machinery within the scope of directive 89/392/EEC.
2. These are intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by directive 89/392/EEC, as amended.
3. As such, do therefore not in every respect comply with the provisions of directive 89/392/EEC.

SAFETY STANDARDS

EN60292 - 2	Safety of Machinery – Basic Principals	
EN60204	Electrical Equipment of Industrial Machines	
	Collateral Test Standards, Specified by EN60204	
EN50011:1991	Emissions Limits for Industrial, Scientific	Class A
	And Medical (ISM) RF Equipment	Conducted and Radiated
EN61000-4-2	Electrostatic Discharge Immunity	Level 2
EN61000-4-3	Radiated Emission Immunity	Level 2
EN61000-4-4	Electric Fast Transients Burst	Level 3

Manufacturers Name:	GLENTEK INC.
Manufacturers Address:	208 Standard Street, El Segundo, CA 90245, USA
Description of Equipment:	Motion Control Systems including Amplifiers and Servo Motors
Model Number(s):	SMA8715, SMA8715HP. The above amplifier modules packaged in the following configurations: -1, -1A-1, -2A-1, -2A-2, -4A-3, -4A-4, -6A-5, -6A-6, -3U-1 and all power supply configurations: 00, 01, 02, 03.

The undersigned hereby declares that the equipment specified above conforms to the noted Directives and Standards in accordance with "The Machinery Directives". Refer to Technical Construction File GTK 99408.

MANUFACTURER

Helen M. Vasak

HELEN M. VASAK
SECRETARY-TREASURER

4-19-99
Prepared By: National Technical Systems, Fullerton, CA
Confirmed By: Chuck Helton, Director of Product Safety

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 #: 8715-1040-000 (A)
DATE: 18 June 1999

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