OPERATION
&
SERVICE MANUAL

Torque-Switch Series®

Model SMA8715

Brushless Amplifier System

GLENTEK
"Solutions for Motion Control"
Table of Contents

Introduction........................................................................................................6

Chapter One: Description, Features and Specifications

1.1 Description ..................................................................................................... 7
   1.1.1 Standard Encoder to Sine Mode ............................................................... 7
   1.1.2 Twang Mode ............................................................................................. 7

1.2 Features ........................................................................................................... 7
   1.2.1 Single Amplifier Module (SMA8715-1) ..................................................... 7
   1.2.2 Stand Alone One Axis Amplifier (SMA8715-1A-1) ................................. 9
   1.2.3 Multi-Axis Power Supply ........................................................................ 9

1.3 Specifications ................................................................................................. 10
   1.3.1 Single Amplifier Module (SMA8715-1) ..................................................... 10
      1.3.1.1 Input and Output Power .................................................................. 10
      1.3.1.2 Signal Inputs ..................................................................................... 10
      1.3.1.3 Digital Inputs .................................................................................... 11
      1.3.1.4 System ............................................................................................. 11
      1.3.1.5 Outputs ........................................................................................... 11
   1.3.2 Stand Alone One Axis Amplifier (SMA8715-1A-1) ................................. 11
   1.3.3 Multi-Axis Power Supply ........................................................................ 11
      1.3.3.1 Input and Output Power .................................................................. 12
   1.3.4 Mechanical ............................................................................................... 12

Chapter Two: Theory of Operation

2.1 Current Mode vs Velocity Mode ................................................................. 13
2.2 Protection Circuit ......................................................................................... 13

Chapter Three: Model Numbering

3.1 Introduction ..................................................................................................... 14
3.2 Single Module ................................................................................................. 15
3.3 Multi Axis Amplifier ..................................................................................... 15
3.4 Stand Alone Amplifier .................................................................................. 16

Chapter Four: Installation Procedure
4.1 Introduction......................................................................................17
4.2 Mounting..........................................................................................17
4.3 Wiring ..............................................................................................17
    4.3.1 RFI/EMI and Wiring Technique..................................................17
    4.3.2 Wire Size and Type ...................................................................18
    4.3.3 Connector Size and Type ..............................................................18
        4.3.3.1 The Power Connector of the Single Amplifier Modules ...18
        4.3.3.2 The Signal Connector ............................................................19
        4.3.3.3 The Power and Motor Connector of the Stand Alone Amplifier..19
4.4 Single Amplifier Module Connections(SMA8715-1) ..........................20
    4.4.1 Buss and Motor Connections - J2 .............................................20
    4.4.2 Signal Connections for the Encoder to Sine Mode Amplifier - J1...20
    4.4.3 Signal Connections for the Encoder to Sine Mode Pre-amp ..........21
4.5 Stand Alone Amplifier Connectins (SMA8715-1A-1)........................21
    4.5.1 Motor Connections - J2 ...............................................................21
    4.5.2 Power Connections - J6 ...............................................................22
4.6 Multi Axis Power Supply Connections ..............................................22

**Chapter Five: Start Up and Adjustment Procedure**

5.1 Introduction......................................................................................23
5.2 Logic Input Configuration.................................................................23
5.3 Encoder to Sine Mode Amplifier Configuration .................................23
    5.3.1 +15V/+5V Logic Level Configuration ......................................24
    5.3.2 Standard Configuration for Encoder to Sine Velocity Mode and Current Mode ...........................................................................24
    5.3.3 Tach Lead .................................................................................24
    5.3.4 Tach - Reverse Configuration ...................................................24
    5.3.5 Motor - Reverse Configuration ..................................................24
    5.3.6 Coarse Balance ........................................................................24
    5.3.7 Hall 60/120 ..............................................................................25
    5.3.8 Encoder - Reverse Configuration .............................................25
    5.3.9 Rotary Motor (S3) Settings .......................................................25
    5.3.10 Linear Motor (S3) Settings .......................................................25
    5.3.11 Trap Only - Forced Hall .........................................................26
    5.3.12 Range .....................................................................................26
    5.3.13 Encoder Configuration .............................................................26

**Chapter Six: Start Up and Calibration**

6.1 Introduction......................................................................................28
TABLE OF CONTENTS

6.2 Initial Start Up .................................................................................. 28
6.3 Phasing Procedures ........................................................................ 28
6.4 Encoder to Sine Mode Amplifier Calibration ..................................... 30
   6.4.1 Encoder to Sine Mode Amplifier Calibration Procedure - Velocity Mode .... 30
   6.4.2 Encoder to Sine Mode Amplifier Calibration Procedure - Current Mode .... 32
6.5 Calibration Setup Record .................................................................. 33

Chapter Seven: Maintenance, Repair and Warranty

7.1 Maintenance .................................................................................... 34
7.2 Amplifier Faults ............................................................................... 34
   7.2.1 Table of Fault LED Conditions.......................................................... 34
   7.2.2 Under Voltage Fault .......................................................................... 35
   7.2.3 Motor Over Temp Fault ...................................................................... 35
   7.2.4 High Speed Electronic Circuit Breaker (HS/ECB) Fault ..................... 35
   7.2.5 Low-Speed Electronic Circuit Breaker (LS/ECB) Fault ..................... 35
   7.2.6 Over Temp Fault ................................................................................ 36
   7.2.7 Over Voltage Fault ............................................................................ 36
   7.2.8 Hall Error Fault .................................................................................. 36
   7.2.9 Resetting A Fault ............................................................................... 36
7.3 Amplifier Failure ................................................................................ 37
7.4 Factory Repair ................................................................................... 37
7.5 Warranty .......................................................................................... 38

Appendix A: Amplifier Drawings

SMA8015 Brushless Power Board Installation Schematic
   (8715-1030) ........................................................................................ 40
SMA8015 Brushless Power Board Assembly Drawing
   (8715-1031) ........................................................................................ 41 - 42
SMA8715-1 Encoder to Sine Single Amplifier Module
   Installation (8015-1056) ................................................................. 43
SMA8715-1A-1 Encoder to Sine Stand Alone Amplifier
   Installation(8015-1058) ................................................................. 44
SMA8X15-2A-2 2-axis Installation Drawing (8000-1833) ..................... 45
SMA8X15-4A-4 4-axis Installation Drawing (8000-1835) ..................... 46
SMA8X15-6A-6 6-axis Installation Drawing (8000-1837) ..................... 47
GP8600-2030 30A Power Supply Assembly Drawing (8600-2030) ...... 48
GP8600-2031 60A Power Supply Assembly Drawing (8600-2031) ...... 49
Appendix B: Personality Module (Pre-Amp)

SMA8715 Encoder to Sine Mode Installation Schematic (8000-2432) ....51 - 52  
SMA8715 Encoder to Sine Mode Assembly Drawing (8000-2430) .......53 - 54

Appendix C: European Union EMC Directives

Electromagnetic Compatibility Guidelines For Machine Design ............56- 64
CE Certification ....................................................................................... .65  

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.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide operating</td>
<td>70-350 VDC. buss voltage:</td>
</tr>
<tr>
<td>Complete isolation:</td>
<td>Complete isolation from input to output.</td>
</tr>
<tr>
<td>Dual signal inputs:</td>
<td>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.</td>
</tr>
<tr>
<td>Dual mode operation:</td>
<td>The standard amplifier may be configured for velocity (RPM) control or current (torque) control.</td>
</tr>
<tr>
<td>Current limit:</td>
<td>Maximum motor current is adjustable.</td>
</tr>
<tr>
<td>Silent operation:</td>
<td>Carrier frequency is 20KHz.</td>
</tr>
<tr>
<td>Short circuit protection:</td>
<td>Complete short circuit and ground fault protection.</td>
</tr>
<tr>
<td>LED diagnostics:</td>
<td>Red LED(S) illuminate to display various fault conditions and a green LED illuminates to indicate normal operating conditions.</td>
</tr>
<tr>
<td>Frequency response:</td>
<td>750 Hz minimum.</td>
</tr>
<tr>
<td>(Velocity Loop)</td>
<td></td>
</tr>
<tr>
<td>Frequency response:</td>
<td>2 KHz minimum.</td>
</tr>
<tr>
<td>(Current Loop)</td>
<td></td>
</tr>
<tr>
<td>Digital limit/enable Inputs:</td>
<td>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.</td>
</tr>
<tr>
<td>Tachometer output:</td>
<td>DC output proportional to motor RPM.</td>
</tr>
<tr>
<td>Fault input/output:</td>
<td>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</td>
</tr>
</tbody>
</table>
shut down all amplifiers should any amplifier have a fault.

<table>
<thead>
<tr>
<th>Manual and external fault reset:</th>
<th>Push button and a separate input is provided to reset the amplifier after a fault.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Speed Electronic Circuit Breaker (HS/ECB):</td>
<td>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)</td>
</tr>
<tr>
<td>Low-Speed Electronic Circuit Breaker (LS/ECB):</td>
<td>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).</td>
</tr>
<tr>
<td>Over/under voltage and over temperature:</td>
<td>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.)</td>
</tr>
<tr>
<td>Multi-axis chassis:</td>
<td>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.</td>
</tr>
</tbody>
</table>

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 °F (50 °C) maximum. Forced air cooling.

1.3.1 Single Amplifier Module (SMA8715-1):

<table>
<thead>
<tr>
<th>Input Power/ Buss Voltage(B+)</th>
<th>Output Power (current)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>R.M.S.</td>
</tr>
<tr>
<td></td>
<td>R.M.S.</td>
</tr>
<tr>
<td>120VAC/170VDC</td>
<td>15A</td>
</tr>
<tr>
<td></td>
<td>20A</td>
</tr>
<tr>
<td>240VAC/340VDC</td>
<td>10A</td>
</tr>
<tr>
<td></td>
<td>15A</td>
</tr>
</tbody>
</table>

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.

1.3.1.1 Input and Output Power:
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/ °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

<table>
<thead>
<tr>
<th>Amplifier Model</th>
<th>Signal Input</th>
<th>Maximum Voltage (VDC)</th>
<th>Minimum Impedance W</th>
<th>Velocity Gain Amp./Volt</th>
<th>Current Gain Amp./Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>8715</td>
<td>Differential</td>
<td>13</td>
<td>10,000</td>
<td>15,000(min.)</td>
<td>0-5</td>
</tr>
<tr>
<td>8715</td>
<td>Single-ended</td>
<td>±13</td>
<td>10,000</td>
<td>15,000(min.)</td>
<td>0-5</td>
</tr>
</tbody>
</table>
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 amplifier 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.

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

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 Control 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 bus (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**
- **Power Rating**
  - Omit = Standard (15A cont., 25A peak)
  - HP = High Power (20A cont., 40A peak)
- **Custom Configuration Code**
  (This is assigned at the factory and is a permanent model number)

3.3 Multi Axis Amplifier:

**SMA8715XX - YYY - A - _ - ZZ**

- **Amplifier Model Number**
- **Power Rating**
  - Omit = Standard (15A cont., 25A peak)
  - HP = High Power (20A cont., 40A peak)
- **Custom Configuration Code**
  for the amplifier modules
- **Maximum number of amplifier modules the baseplate will hold.**
  - 2 = 2 axis baseplate
  - 4 = 4 axis baseplate
  - 6 = 6 axis baseplate
- **Power Supply Configuration Code**
  - 00=110-130VAC
  - 01=208-240VAC
  - 02=SPECIAL
- **The total number of amplifier modules mounted on the baseplate**
3.4 Stand Alone Amplifier:

**SMA8715XX - YYY - 1A - 1 - ZZ**

- Amplifier Model Number
- Power Rating
  - Omit = Standard (15A cont., 25A peak)
  - HP = High Power (20A cont., 40A peak)
- Custom Configuration Code for the amplifier module
- Stand alone amplifier designator
- 1 amplifier module mounted

**Power Supply Configuration Code**
- 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 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

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Terminal</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B -</td>
<td>J2-1</td>
<td>DC Buss -</td>
</tr>
<tr>
<td>B +</td>
<td>J2-2</td>
<td>DC Buss+</td>
</tr>
<tr>
<td>MOTOR T</td>
<td>J2-3</td>
<td>Phase T of the motor.</td>
</tr>
<tr>
<td>MOTOR S</td>
<td>J2-4</td>
<td>Phase S of the motor.</td>
</tr>
<tr>
<td>MOTOR R</td>
<td>J2-5</td>
<td>Phase R of the motor.</td>
</tr>
</tbody>
</table>

### Signal Name SMA8715 Terminal Notes

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

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Terminal</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Encoder Input (J4):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/C</td>
<td>J4-A</td>
<td>No Connection</td>
</tr>
<tr>
<td>A</td>
<td>J4-B</td>
<td>Phase A signal input.</td>
</tr>
<tr>
<td>A</td>
<td>J4-C</td>
<td>Negative phase A signal input.</td>
</tr>
<tr>
<td>B</td>
<td>J4-D</td>
<td>Phase B signal input.</td>
</tr>
<tr>
<td>B</td>
<td>J4-E</td>
<td>Negative phase B signal input.</td>
</tr>
<tr>
<td>Z</td>
<td>J4-F</td>
<td>Phase Z signal input.</td>
</tr>
<tr>
<td>Z</td>
<td>J4-G</td>
<td>Negative phase Z signal input.</td>
</tr>
<tr>
<td>COM</td>
<td>J4-H</td>
<td>Common for Encoder.</td>
</tr>
<tr>
<td>COM</td>
<td>J4-I</td>
<td>Common for Encoder.</td>
</tr>
<tr>
<td>COM</td>
<td>J4-J</td>
<td>Common for Encoder.</td>
</tr>
<tr>
<td><strong>Hall Sensor Input (J5):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+V</td>
<td>J5-A</td>
<td>+VDC for Hall Effect Sensors</td>
</tr>
<tr>
<td>HALL 1</td>
<td>J5-B</td>
<td>Hall Sensor 1. Check motor data for phasing</td>
</tr>
<tr>
<td>HALL 2</td>
<td>J5-C</td>
<td>Hall Sensor 2. Check motor data for phasing</td>
</tr>
<tr>
<td>HALL 3</td>
<td>J5-D</td>
<td>Hall Sensor 3. Check motor data for phasing</td>
</tr>
<tr>
<td>COM</td>
<td>J5-E</td>
<td>Common for Hall Sensors</td>
</tr>
<tr>
<td>COM</td>
<td>J5-F</td>
<td>Common for Hall Sensors</td>
</tr>
</tbody>
</table>

### 4.4.1 Buss and Motor Connections - J2:

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Terminal</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTOR T</td>
<td>J2-1</td>
<td>Motor phase T</td>
</tr>
<tr>
<td>MOTOR S</td>
<td>J2-2</td>
<td>Motor phase S</td>
</tr>
<tr>
<td>MOTOR R</td>
<td>J2-3</td>
<td>Motor phase R</td>
</tr>
</tbody>
</table>
4.4.3 Signal connections for the Encoder to Sine Mode Pre-amp:

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Terminal</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>J6-1</td>
<td>Chassis ground.</td>
</tr>
<tr>
<td>AC</td>
<td>J6-2</td>
<td>AC power input. (Omit for single-phase input)</td>
</tr>
<tr>
<td>AC</td>
<td>J6-3</td>
<td>AC power input.</td>
</tr>
<tr>
<td>AC</td>
<td>J6-4</td>
<td>AC power input.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th></th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
<th>Type D</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMIT±</td>
<td>S2-8 - OFF</td>
<td>S2-8 - ON</td>
<td>S2-8 - OFF</td>
<td>S2-8 - ON</td>
</tr>
<tr>
<td></td>
<td>S2-5 - ON</td>
<td>S2-5 - OFF</td>
<td>S2-5 - OFF</td>
<td>S2-5 - ON</td>
</tr>
<tr>
<td>INHIBIT</td>
<td>S2-7 - OFF</td>
<td>S2-7 - ON</td>
<td>S2-7 - OFF</td>
<td>S2-7 - ON</td>
</tr>
<tr>
<td></td>
<td>S2-4 - ON</td>
<td>S2-4 - OFF</td>
<td>S2-4 - OFF</td>
<td>S2-4 - ON</td>
</tr>
<tr>
<td>RESET IN</td>
<td>S2-6 - OFF</td>
<td>S2-6 - ON</td>
<td>S2-6 - OFF</td>
<td>S2-6 - ON</td>
</tr>
<tr>
<td></td>
<td>S2-3 - ON</td>
<td>S2-3 - OFF</td>
<td>S2-3 - OFF</td>
<td>S2-3 - ON</td>
</tr>
<tr>
<td>MTR TEMP</td>
<td>S2-2 - ON</td>
<td>not available</td>
<td>S2-2 - OFF</td>
<td>not available</td>
</tr>
<tr>
<td>FAULT</td>
<td>standard</td>
<td>not available</td>
<td>not available</td>
<td>not available</td>
</tr>
</tbody>
</table>
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:

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.

<table>
<thead>
<tr>
<th>Dip Switch (S3)</th>
<th>Name</th>
<th>(DEFAULT) SETTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3-1</td>
<td>CPLD SETTING</td>
<td>(See 5.3.13)</td>
</tr>
<tr>
<td>S3-2</td>
<td>CPLD SETTING</td>
<td>(See 5.3.13)</td>
</tr>
<tr>
<td>S3-3</td>
<td>CPLD SETTING</td>
<td>(See 5.3.13)</td>
</tr>
<tr>
<td>S3-4</td>
<td>CPLD SETTING</td>
<td>(See 5.3.13)</td>
</tr>
<tr>
<td>S3-5</td>
<td>CPLD SETTING</td>
<td>(See 5.3.13)</td>
</tr>
<tr>
<td>S3-6</td>
<td>TACH PULSE WIDTH SETTING</td>
<td>FACTORY SET</td>
</tr>
<tr>
<td>S3-7</td>
<td>TACH PULSE WIDTH SETTING</td>
<td>FACTORY SET</td>
</tr>
<tr>
<td>S3-8</td>
<td>TACH PULSE WIDTH SETTING</td>
<td>FACTORY SET</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dip Switch (S3)</th>
<th>Name</th>
<th>(DEFAULT) SETTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3-1</td>
<td>N/A</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-2</td>
<td>TRAP ONLY (FORCED HALL)</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-3</td>
<td>N/A</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-4</td>
<td>N/A</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-5</td>
<td>RANGE</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-6</td>
<td>N/A</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-7</td>
<td>N/A</td>
<td>OFF</td>
</tr>
<tr>
<td>S3-8</td>
<td>N/A</td>
<td>OFF</td>
</tr>
</tbody>
</table>
### 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:

<table>
<thead>
<tr>
<th>POLES</th>
<th>ENCODER</th>
<th>S3-1</th>
<th>S3-2</th>
<th>S3-3</th>
<th>S3-4</th>
<th>S3-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>500</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>512</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>625</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>1024</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>1250</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>2000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>2048</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>2500</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>4000</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>4096</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>1000</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>1024</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>1250</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>2000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>2048</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>2500</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>4000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>4096</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>5000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>8000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>8192</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>6</td>
<td>500</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>512</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>625</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>1000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>1024</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>1250</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>2000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>2048</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>2500</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>
### 5.3.3 Tach Lead (Default: S1-6=OFF):

<table>
<thead>
<tr>
<th>POLES</th>
<th>ENCODER</th>
<th>S3-1</th>
<th>S3-2</th>
<th>S3-3</th>
<th>S3-4</th>
<th>S3-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>4000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>5000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>8000</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>8192</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>TRAP</td>
<td>X</td>
<td>X</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>INDEX</td>
<td>X</td>
<td>X</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>6</td>
<td>1250</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>2048</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>2500</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>4000</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>4096</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>8</td>
<td>1250</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>2000</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>2048</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>8</td>
<td>2500</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>4000</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>4096</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>5000</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>8000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>8192</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>10000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>16000</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>8</td>
<td>16384</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>12</td>
<td>625</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>1000</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>12</td>
<td>1024</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>
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°, 120°, 240°, and 300°. The 60°/300° and 120°/240° sensor spacing are identical except for the direction of motor rotation which results.

To configure the amplifiers for 60°/300° sensor configuration: S1-2 (ON).
To configure the amplifiers for 120°/240° 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 the SMA8715 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:

<table>
<thead>
<tr>
<th>Pots</th>
<th>Name of Port</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV1</td>
<td>SIG 1 (Differential Input Signal Gain)</td>
<td>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.</td>
</tr>
<tr>
<td>RV2</td>
<td>SIG 2 (Single-ended Input Signal Gain)</td>
<td>Same as Signal 1 input, except this is for single-ended input.</td>
</tr>
<tr>
<td>RV3</td>
<td>TACH (Tach Gain)</td>
<td>Used in conjunction with the compensation pot to set the system bandwidth. Not used in current mode. Shipped set at 100%. (full CW)</td>
</tr>
<tr>
<td>RV4</td>
<td>BAL (Balance)</td>
<td>Used to null any offsets in system.</td>
</tr>
<tr>
<td>RV5</td>
<td>COMP (Compensation)</td>
<td>Used in conjunction with the TACH pot to set the system bandwidth. Not used in current mode. Shipped set at full CW (minimum bandwidth).</td>
</tr>
<tr>
<td>RV6</td>
<td>I LIMIT (Current Limit)</td>
<td>Sets the maximum motor current. Shipped set at full CW (maximum current limit).</td>
</tr>
<tr>
<td>RV7</td>
<td>LOOP (Loop Gain)</td>
<td>Used to shut off uncalibrated amplifiers. When the loop gain is CCW, no current is delivered to the motor. Shipped set at full CCW.</td>
</tr>
</tbody>
</table>
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.

![Critically damped, One Hook Overshoot, Under and Over damped waveforms](image)

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.
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. 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

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

4. The encoder signals will also have to be “daisy chained” to the controller.
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 2\textsuperscript{nd} 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 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),

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

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.

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.
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
APPENDIX A: AMPLIFIER DRAWINGS

3. TEST POINTS ARE LOCATED ALONG J1.
2. CAPACITANCE IS IN MICROFARADS.
1. RESISTANCE IS IN OHMS.
NOTES: UNLESS SPECIFIED OTHERWISE

ON-BOARD POWER SUPPLY

S1 MANUAL RESET

POWER-ON RESET -

3V +15V -15V

LOW SPEED ECB

HIGHSPEED ECB

FAULT MONITORS AND CONTROL CIRCUITS

_BUSS OVER VOLTAGE DETECTOR

PERSONALITY MODULE:

ENCODER TO SINE DRIVE 8000-24

FAULT CURRENT MONITOR

PULSE WIDTH MODULATOR AND 3Ø DRIVE CIRCUITS
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.
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.
5. Never ground the outputs of the amplifiers.
Appendix B

Personality Module
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.
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 IEC801-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° 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

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
EN50011:1991 Emissions Limits for Industrial, Scientific and Medical (ISM) RF Equipment
Class A
EN61000-4-2 Conducted and Radiated
EN61000-4-3 Level 2
EN61000-4-4 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
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.