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## Command Sequencing during Power Up/Down, Operation, and Motor Connection/Disconnection

**APPLICABILITY:** Series 45, 47, 52 Linear Servo Amplifier (all models)

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The command sequencing as described in this Application Note, needs to be followed in order to protect the amplifier output stage from being over stressed by power up/down transients, turning off brake with command present, or motor connection/disconnection. Such over stressing can result in damaged and possibly burned output transistors. For additional protection, see Application Note AN-0022, Supplementary Fuse Protection.

The Brake command is used to protect the amplifier output stage from the transients described in the preceding paragraph. When the Brake is ON, the command input is set to a logic "1" the top half of the power output bridge is turned off, and the bottom half is turned on, shorting the motor windings together. This input overrides all the other logic input and current commands. When the Brake is OFF, the output bridge is normally biased at half the supply voltage. Therefore, with the Brake OFF, switching the +Vs Power Bus supply on and off can cause significant current transients. This can occur due to the uncontrolled state of the power stage regulation circuits during the power supply transient rise or fall time. If the Brake is not applied, significant potential differences can be developed between the three phases as the power supply voltage rises or falls, or if the motor windings are relay switched or plugged/unplugged.

The following is the Power Up/Down Sequence:

### TO POWER UP

1. Set Brake command to ON (logic 1).
2. Set Enable/Reset input to Reset (disable) state (logic 1). Switch S1 on the PCB, is in series with this input, and can be used to perform this function as well.
3. Set analog input differential command to 0 volts.
4. Apply +Vs Power Bus Supply. LED1 and LED2 should be illuminated.
5. Set Brake command to OFF and wait 50ms minimum, 150ms nominal, to allow phase output voltages to stabilize at  $+Vs \div 2$ . LED2 should be off.
6. Set Enable/Reset input to Enable state (logic 0). LED1 should be off.
7. Apply analog input voltage commands and motor should respond.

#### TO POWER DOWN

8. Set analog input command to 0 volts. (Preferred but not critical).
9. Set Enable/Reset input to Reset (disable) state. LED1 should be on.
10. Set Brake command to ON and wait 50ms minimum, 150ms nominal, to allow phase output voltages to reach 0V. LED2 should be on.
11. Turn off the +Vs Power Bus Supply.

The following is the Command Sequence during operation:

#### TO BEGIN MOTION

Follow steps 5 - 7 above. Step 5 is optional.

#### TO END MOTION

Follow steps 8 - 10 above. Step 10 is optional.

If the motor is to be connected or disconnected while the power is on, the following Sequence should be adhered to:

#### TO DISCONNECT MOTOR

1. Set analog input command to 0 volts. (Preferred but not critical).
2. Set Enable/Reset input to Reset (disable) state. LED1 should be on.
3. Set Brake command to ON (logic 1) and wait 50ms minimum, 150ms nominal, to allow phase output voltages to reach 0V. LED2 should be on.
4. Disconnect motor.

#### TO CONNECT MOTOR

1. Set Brake command to ON (logic 1).
2. Set Enable/Reset input to Reset (disable) state (logic 1). Switch S1 on the PCB, is in series with this input, and can be used to perform this function as well.
3. Set analog input differential command to 0 volts.
4. Connect motor.
5. Set Brake command OFF and wait 50ms minimum, 150ms nominal, to allow phase output voltages to stabilize at  $+Vs \div 2$ . LED2 should be off.
6. Set Enable/Reset input to Enable state (logic 0). LED1 should be off.
7. Apply analog input voltage commands and motor should respond.

**WARNING:** Verify that the +Vs Power Bus Supply has decayed to 0 VDC before installing or removing the Servo Amplifier.

**WARNING:** Applying brake during high speed motor operation can damage amplifier.

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