DO YOU REALLY NEED A LOW CURRENT AMPLIFIER TO DRIVE A LOW CURRENT MOTOR?

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Motivation
NSLS2 is standardized on Geo Brick LV 5A motor controller from Delta Tau, suitable to drive majority of stepper and servomotors. However, some instruments often have a combination of bigger and smaller motors with drive currents from several Amp to 100 mA. Using integrated or separate divers to control equipment is maintenance expensive, and at times impossible due to the tight spaces.

What are the limitations in customizing the 5A unit for driving low current motors?

Experimental Setup
The actual current was measured by Tektronix TCP0030A current probe and Tektronix MSO4054B oscilloscope giving 1mA resolution. Two Faulhaber steppers were driven in the open loop mode.

Current wave forms and Tuning

The 125mA motor has substantially higher holding torque, and thus higher torque constant, which acts as an extra coefficient to the PID controller. This causes fast current rise and the system goes into current decay mode. Indeed, decreasing current integral gain Ixx61 from 0.035 to 0.01 improves the wave form.

<table>
<thead>
<tr>
<th>SUT</th>
<th>Motor</th>
<th>Current</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFA-CC stage</td>
<td>UE1724SR</td>
<td>200 mA</td>
<td>Enc. 2,048 cts/rev</td>
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<tr>
<td>MFA-PP stage</td>
<td>UE16PP</td>
<td>250 mA</td>
<td>1 full step = 0.485 μm</td>
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<tr>
<td>Faulhaber mtr</td>
<td>AM2224-V-12-75</td>
<td>125 mA</td>
<td></td>
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<tr>
<td>Faulhaber mtr</td>
<td>AM1020-V-12-250</td>
<td>45 mA</td>
<td></td>
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References:

Conclusion
- GBLV 5A motor controller can be used for driving motors up to 45 mA/phase in an open loop.
- GBLV 5A motor controller can drive Newport MFA-PP at its rated speed 2.5 mm/sec.
- GBLV 5A can drive Newport MFA-CC stage in a closed loop at its rated speed 2.5 mm/sec.
- It is recommended to use a fuse box to protect the motor from possible current spikes, while determining the optimal parameters. The cost of the fuse box is ~$250 including parts and labor.