

Microscope X-Y Stage Positioning Application

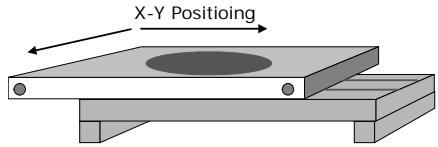
Improving motion positioning with dual-loop control and S-curve motion

Application Challenge: Maximize accuracy, smoothness, and speed

Microscope x-y stages need fast, smooth, and accurate motion for highest performance. In addition, we want to use the most cost effective hardware that can get the job done. What control techniques are available to achieve these goals?

Application considerations:

Feature/Function	Units
Number of Axis:	2 independent servo motors
Motion mode:	Multi-axis point-to-point
Control architecture:	Chip or card-based



Motion Control Solution

The diagram on page two shows an all-in-one motion card design utilizing a Magellan® motion control IC. This card connects to two motors and four encoders: one rotary encoder on each motor, and one linear encoder on each axis.

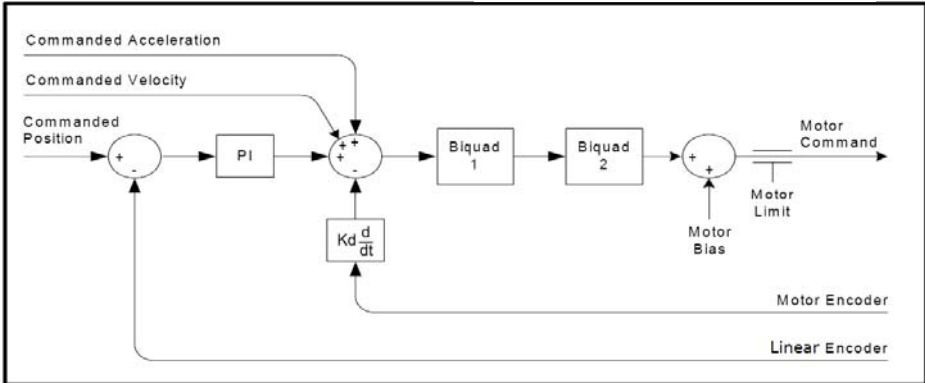
Motion control components:

Components	Specification	Description
Motors	Brushless DC motor w/ encoder feedback	Rotary encoder resolution needs to be high enough to allow for accurate velocity control. This depends on the ratio between rotary and linear position. 1,024 counts/rotation or less is typical.
Controller:	Custom designed card using Magellan® MC58420 IC and two IC-based Brushless DC motor amplifiers	<ul style="list-style-type: none"> Supports dual-loop control Supports S-curve velocity profile for smooth motion. Easy to tune using Pro-Motion® Axis Wizard setup software
X-Y Stage	Lead screw-based linear stage with linear encoders on each axis.	Linear encoders translate directly to the final positioning accuracy and should be at least twice the desired resolution required for the application.

Dual Encoder Configuration

To maximize positioning accuracy, a dual encoder configuration (dual-loop control) is used. This powerful technique allows one encoder (on the motor) to be used to stabilize the motion, while the second (on the stage) is used for positioning accuracy, with all of the control details handled by the Magellan chip. Dual-loop corrects automatically for mechanical errors from backlash, lead screw or table assembly non-linearities.

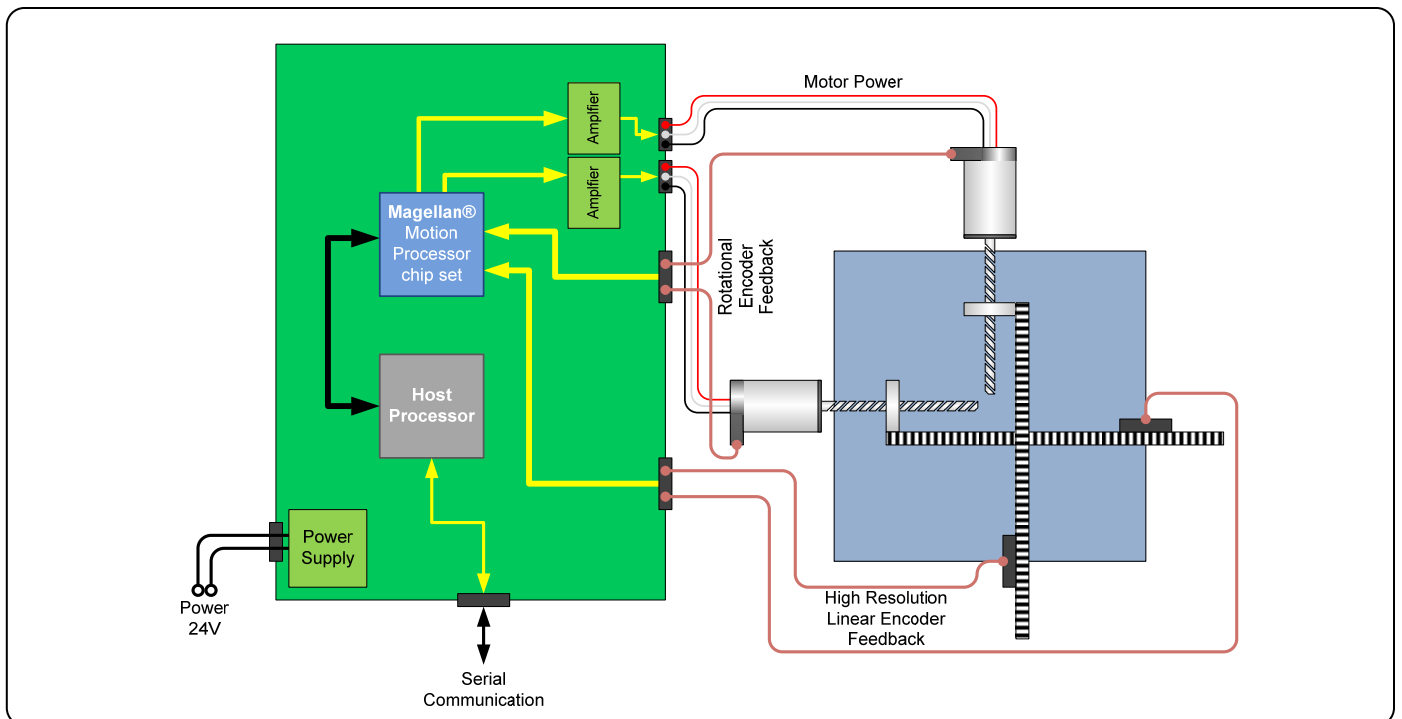
Dual encoder configuration diagram



S-Curve Motion Profiling for reduced vibration

Adding S-curve motion profiles can substantially reduce vibration over trapezoidal profiles. Often, only a small amount of "S" (transition between acceleration and no acceleration) can substantially reduce induced vibration. The form of the s-curve will depend on the desired performance required. For X-Y stages that involve liquid transfers or fragile material that should not be jostled, it would be appropriate to choose an s-curve profile that spreads the acceleration transitions out as far as possible, thereby maximizing smoothness of motion. Other loads can use a shorter "S" period. Magellan can also provide trapezoidal, velocity contouring, and electronic gearing motion profiles as alternatives to s-curve profiles.

X-Y stage motion control card diagram



The figure above illustrates the motion control card and connections needed to implement a precision X-Y stage controller. This system could also have been constructed using other PMD products such as a Prodigy® motion card. Contact your PMD representative for more information.

The **Magellan®** Family of Motion Control ICs provides high performance chip-based motion control for multiple motor types. Magellan motion control ICs are available in 1, 2, 3, and 4-axis versions. They are designed for demanding and precise applications such as this microscope X-Y stage application and other scientific instrumentation challenges.



Contact our customer support team at +1 781 674 9860 for more information including details on Developer's Kits and application support. We would like to assist you in improving your motion system.