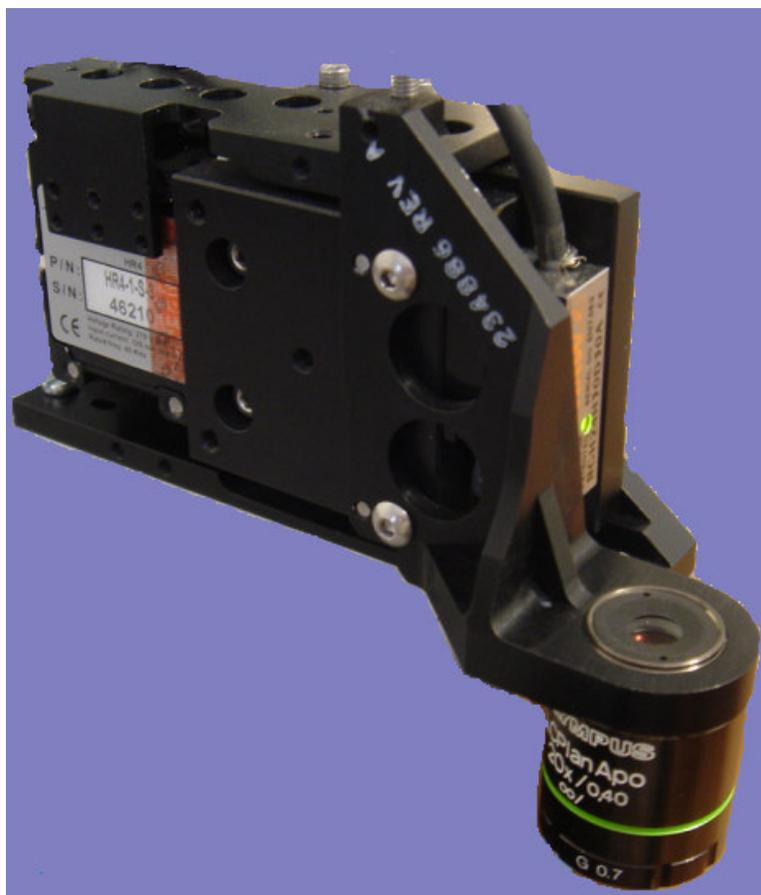


Accelerated Life Test Report for Nanomotion Auto Focusing Z-Stage



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Test Objective

Due to the increase in demand for Nanomotion components and motion systems for use within auto-focus applications, a test was established to investigate and demonstrate the reliability and long-term performance stability of an Auto Focus Z-Stage driven by a standard Nanomotion HR4 motor.

Test Setup

1. The test unit is a Z-stage used within an actual auto-focusing application (see Figures 1 and 2). The test stage is an actual production unit with a 250 gram payload (400 gram total moving load).
2. The stage used in this test is a standard Nanomotion FB50-020 (with 20 mm travel), driven by a standard HR4 motor, using a 50 nm resolution optical encoder.
3. The amplifier used in this experiment is a Nanomotion AB5-HR-E4.
4. The Servo Controller used is a Galil DMC-1425, with standard firmware, running at a 4 kHz servo update rate.

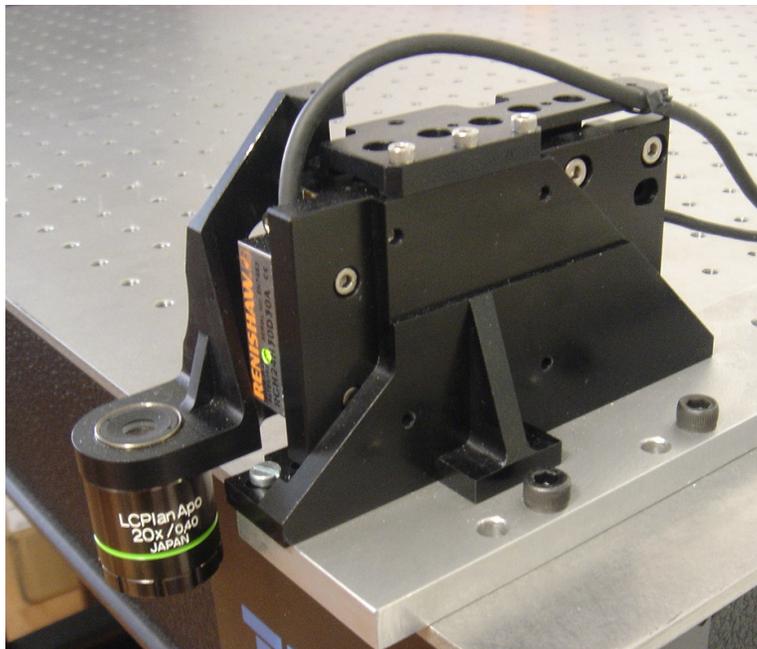


Figure 1 - Test Setup (view 1)

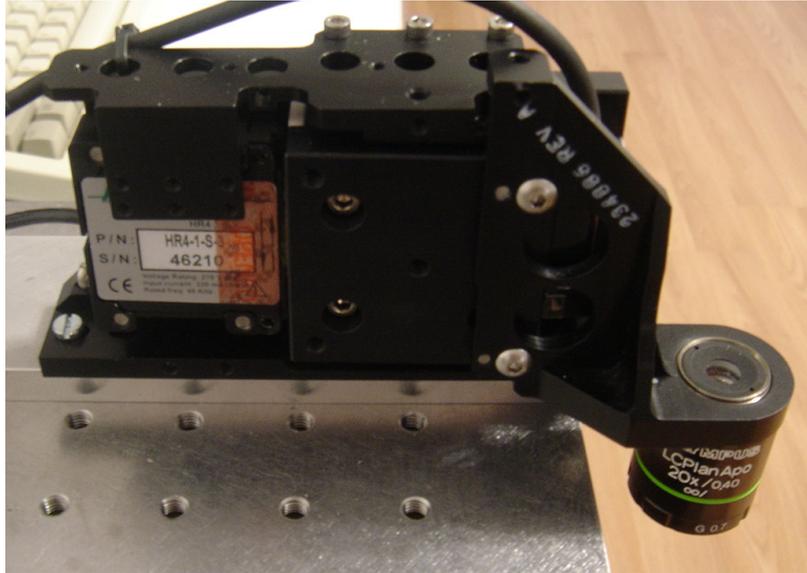


Figure 2 - Test Setup (view 2)

Test Profile

1. One cycle = staircase of 5 steps up, followed by 5 steps down.
2. Step size = 500nm (10 encoder counts.)
3. The stage dwells at the top and bottom of the staircase.
4. Once every 20 cycles a longer linear move is executed.
5. Once every 5000 cycles, a conditioning cycle (full travel) is executed.

Performance Criteria

1. Settling time \leq 100 msec.
2. Position error after settling \leq 250 nm (5 counts).

Test Progress

1. The test began on November 14, 2007, and has been running continuously without stop 24/7. The experiment is still running.
2. As of April 25, 2008, a total of **35,484,810** steps have been accumulated.
3. In this particular application, the expected usage is 57,600 steps/day. Therefore, this particular test truly represents 616 days of actual life.
4. **Note:** No changes were made to the tuning parameters throughout the test.



Observations

1. The typical error count measured over 50,000 cycles is 4, yielding an error rate of 0.008%.
2. The motor case temperature is consistently cool to the touch.
3. Current consumption is constant within the 0.34A to 0.36A range.
4. System operation is quiet.
5. Motor performance is well within specifications. See Figure 3 for data taken after approximately 4.86 million cycles, and Figure 4 for data taken after 35.48 million cycles.

Conclusions

This test clearly demonstrates the ability of Nanomotion's motors to function reliably and with exceptional long-term stability within the most demanding, state-of-the-art Auto-Focusing applications.

For more information about this experiment, please contact Nadir Nimrod at nadir@nanomotion.com.

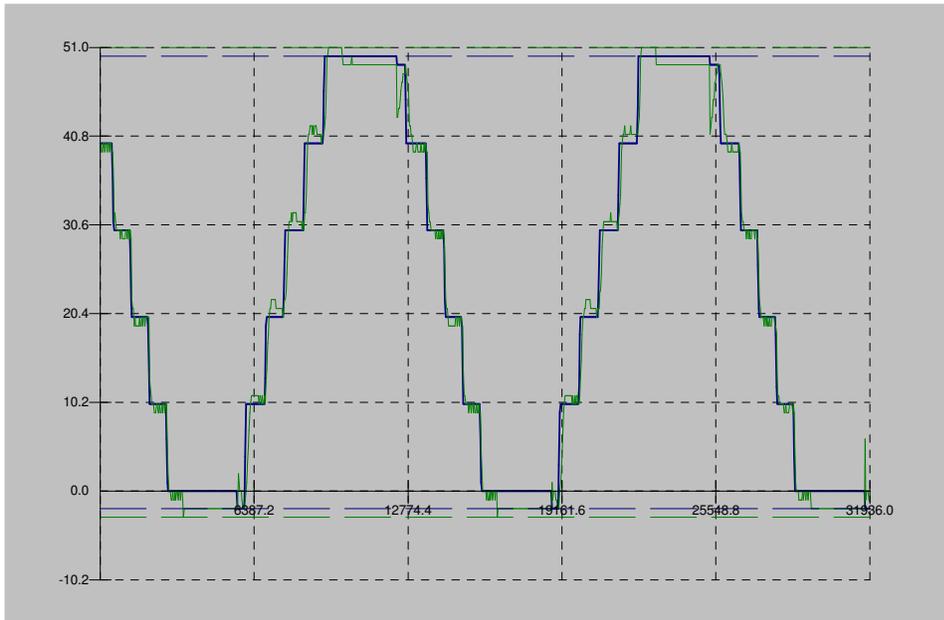


Figure 3 - Commanded and Actual Position Plots after 4,860,010 Steps

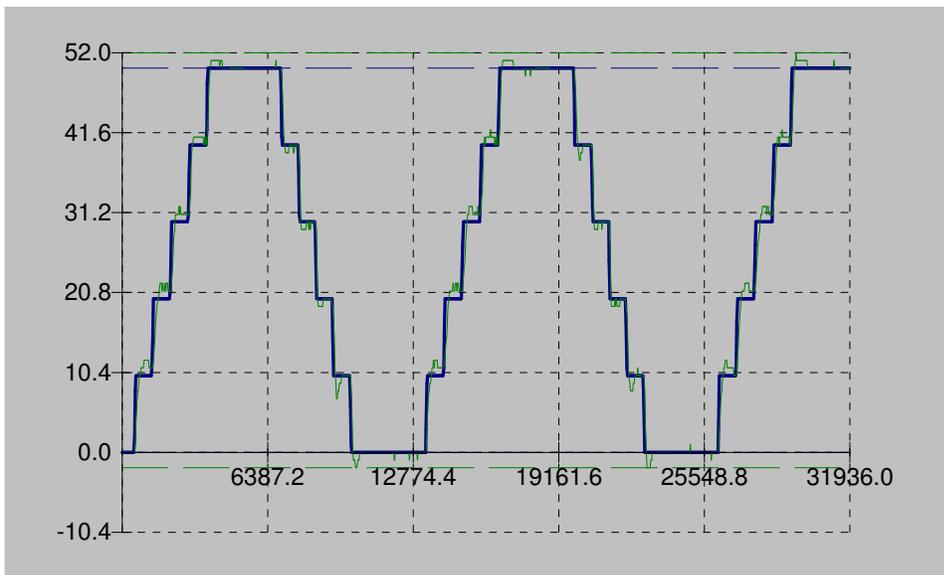


Figure 4 - Commanded and Actual Position Plots after 35,484,810 Steps