New Scale Technologies

TECH NOTE
June 16, 2025

M3-LS-3.4 & M3-LS-1.8 Linear Smart Stages

Prevent or Recover from M3-LS Stage Jamming Caused by Physical Obstruction

Background

The patented SQUIGGLE® motor inside the smart stage rotates a fine-pitch precision screw to generate precision linear movements.
If a screw is driven into a physical obstruction the force required to back the screw off is greater than the initial driving force. This is due to the threaded surfaces binding when pressed into each other.

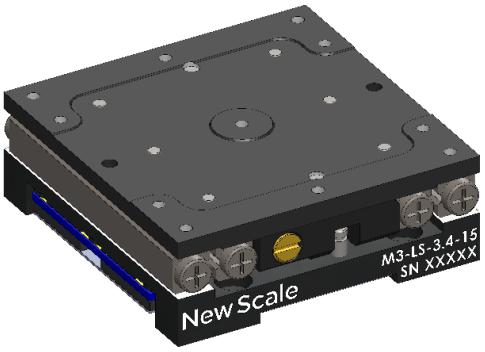

Figure 1. M3-LS-3.4-15 Linear Smart Stage

Prevent Jamming

When using a stage in an assembly for the first time or when determining travel limits run it at a slow speed. This reduces the chance that the stage will jam if it contacts an obstruction.
For a commanded move in a closed-loop operation, you have the option to enable stall detection and set a stall tolerance.

In New Scale Pathway™ Software, you can change these settings in the **Axis Attributes** tab, within the **Closed Loop** section. We recommend enabling stall detection and adjusting both the **Max Position Error** and **Max Incremental Error** parameters judiciously. Stall detection will stop a commanded move when a large error is detected; these errors can occur due to physical obstructions.

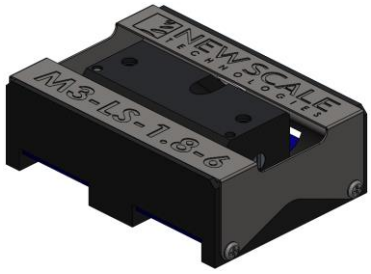

Figure 2. M3-LS-1.8-6 Linear Smart Stage

The Commands found in this Tech Note are described in greater detail in the M3-LS-3.4 and M3-LS-1.8 Command and Control Guides.

Enabling Stall Detection using Commands

It is recommended to query whether stall detection is enabled **before** sending a command to enable/disable stall detection. Stall detection is a NON-VOLATILE (NV) setting that is stored directly on the stages integrated controller, sending a command to enable/disable stall detection triggers a write to NV memory.

1. To query the stall enable and threshold status send the following command:
   `<41 R>`
   Where:

41	Stall Enable Set/Query Command
R	Return current stall enable and threshold status

2. Reply Example:
   `<41 1 0003E8 004E20>`
   Where:

41	Stall Enable Set/Query Command (**the reply is the same as the command would be to set these values**)

1	0 = Stall detection is Disabled 1 = Stall detection is Enabled
0003E8	Maximum following error • 3E8 hex is 1000 decimal, 1000 encoder counts is 500 µm. • If the following error reaches 500 µm, the motor is stopped.
004E20	Maximum incremental error • 4E20 hex is 20000 decimal. • If the sum of the following error reaches this threshold the motor is stopped.

3. The incremental stall threshold should be **no greater** than 20000. At 20k it takes ~1/4 second for the motor to detect a stall.
4. If a stall is detected, the stalled status flag will be set (bit 23 or 0x800000). The stall flag will remain set until the next closed loop move command is received.
    a. The stall flag is **not** cleared by performing a frequency sweep.
5. If stall detection is disabled sending **<41 1 0003E8 004E20>** will enable stall detection and apply the settings in the table above.

Recovering from a Jam

When the motor is jammed the increased stress on the motor body increases its resonant frequency. A frequency sweep can drive it at this higher frequency. Command for **LS-3.4** is **below** and **LS-1.8** on **next** page.

1. The following command for **LS-3.4** performs a 64-step frequency sweep in reverse where each step is 4 msec:
   <86 0 40 09C4 1 02AE>
   Where:

86	Frequency Sweep Command
0	0 = Reverse Direction (use this if the carriage jammed while running forward). 1 = Forward Direction (use this if the carriage jammed while running reverse).
40	Step Count • 40 hex is 64 decimal
09C4	Step Interval • 9C4 hex is 2500 decimal. • The timer resolution is 1.6 µsec, 1.6 x 2500 = 4000 µsec.
1	Period decrement (frequency increment) is 1 count
02AE	Center Period about which the sweep is performed • 2AE hex is 686 decimal. • The **LS-3.4** master oscillator is 80,000 kHz, 80,000 / 686 is 116.618 kHz.

2. The command above takes 64 x 4 msec or 256 msec to execute.
3. Repeat the command until the stages reported position indicates that it has backed away from the stall location by **over 1 mm**.

4. The following command for **LS-1.8** performs a 64-step frequency sweep in reverse where each step is 4 msec:
   <86 0 40 FA0 1 02DA>
   Where:

86	Frequency Sweep Command
0	0 = Reverse Direction (use this if the carriage jammed while running forward). 1 = Forward Direction (use this if the carriage jammed while running reverse).
40	Step Count • 40 hex is 64 decimal
FA0	Step Interval • FA0 hex is 4000 decimal. • The timer resolution is 1.0 µsec, 1 x 4000 = 4000 µsec.
1	Period decrement (frequency increment) is 1 count
02DA	Center Period about which the sweep is performed • 02DA hex is 730 decimal. • The **LS-1.8** master oscillator is 128,000 kHz, 128000 / 730 is 175.342 kHz.

5. The command above takes 64 x 4 msec or 256 msec to execute.
6. Repeat the command until the stages reported position indicates that it has backed away from the stall location by **over 1 mm**.

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