The NanoMuscle 70 Gram High Speed/High Efficiency Linear Actuator contracts when activated and requires a return force, such as a spring, to bring the actuator back to its initial configuration. In its extended configuration, the actuator is prepared to contract again. The NM70 offers low power consumption, and has a cycle life of well over 1,000,000 repetitions. All NanoMuscle Motors are available in Economy Grade or Commercial Grade versions. The Economy Grade version is designed for applications with less stringent cycle life and environmental tolerances.

Motor External Dimensions

This is a preliminary engineering release. The information contained herein is believed to be correct at time of printing, but the company reserves the right to change any specification without prior notice. The intellectual property described in this data sheet is covered by international patent applications, trademarks and copyright laws as appropriate.
**Perfomance Data Charts.** Note: A return or extension force is required for each motor.

### Displacement

- **Position**
- **Power**

### Speed

As the motor cycles continuously, the cycle time increases until the unit reaches thermal equilibrium. The thermal equilibrium point varies with the ambient temperature and application.

- **Cycle Time (ms)**
- **Extension Time (ms)**
- **Contraction Time (ms)**

Increasing the applied voltage heats the device more quickly enabling the device to cycle faster.

### Load & Temperature

**Load vs Cycle Life**

Note: higher cycle lives are achieved with decreased loads.

**Time vs Temperature**

Depending on the application, the cycle time of the Actuator will vary. The graph illustrates the behavior of the Actuator in three different applications with optimum applied voltage. In a number of applications, the actuator can cycle faster or at higher temperatures than indicated. Please contact NanoMuscle for more information.

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**NM-70 High Efficiency Position vs Time**

First Cycle | 70 gram load | 25°C | 3.5 volts

**NM-70 High Speed Position vs Time**

First Cycle | 70 gram load | 25°C | 4 volts

**NM-70 High Efficiency Cycle Time vs Number of Completed Cycles**

3.5 volts | 70 gram load | 25°C

**NM-70 High Speed Cycle Time vs Number of Completed Cycles**

4 volts | 70 gram load | 25°C

**NM-70 High Efficiency Voltage vs First Cycle Time**

70 gram load | 25°C

**NM-70 High Speed Voltage vs First Cycle Time**

70 gram load | 25°C

**NM-70 High Efficiency/Speed Load vs Cycle Life**

**NM-70 High Speed First Cycle Time vs Temperature Optimum Voltage**

- **Economy Grade**
- **Commercial Grade**
- **Low Return Force**
- **Medium Return Force**
- **Very High Return Force**
The NanoMuscle Digital Interface (DI) is the most sophisticated interface, and it is also the easiest to use. Its flexible circuit interface incorporates contraction and extension indicator signals in addition to a control line. The Digital Interface also features embedded electronics and sensors that comprise a closed loop system. The closed loop system eliminates the need for external components and allows the Motor to be controlled with a variety of external electronics ranging from a simple DC voltage supply to a microprocessor. With other NanoMuscle Interfaces, care must be taken to avoid overheating the device. The Digital Interface eliminates this concern by protecting the Motor from overheating when the device is fully contracted, which greatly simplifies designing with the Digital Interface.

How Does It Work?

The contraction of the NanoMuscle Motor is dependent on the temperature of the shape memory alloy (SMA) wires in the Motor. SMA wires are electrically resistive, and can be heated with application of a suitable voltage. Once the wires reach the necessary temperature, they start to contract, causing the NanoMuscle Motor to contract. The temperature at which the wires contract depends on the ambient temperature and the application. Any displacement, from a small movement to a full contraction of the device, can be achieved with the appropriate application of power and an input signal.

SMA wires contract when heated appropriately, but overheating the wires will destroy or overstress the Motor, greatly decreasing its longevity. Unlike other NanoMuscle Interfaces, the Digital Interface prevents the Motor from overheating by utilizing internal mechanical stops and an electrical feedback loop to prevent continuous application of power to the Motor when it is contracted.
Typical Configurations

SIMPLE ON/OFF SWITCH 1
When the FET is turned on, power is applied to the Motor. If the Motor is extended, it will contract. The FET should then be turned off to remove power from the device and prevent overheating. A return force, such as a spring or weight, is necessary to re-extend the device, preparing it to contract again. If no return force is present, the device will remain in the contracted position.

SIMPLE ON/OFF SWITCH 2
When the FET is turned on, power is applied to the Motor. If the Motor is extended, it will contract. The FET should then be turned off to remove power from the device and prevent overheating. A return force, such as a spring or weight, is necessary to re-extend the device, preparing it to contract again. If no return force is present, the device will remain in the contracted position.

DIGITAL CONTROL WITH HIGH VOLTAGE V+
When CNTRL > 2.5V, the Motor contracts, and the CONTRACTED line is pulled to VDC. If an external return force, such as a spring or weight extends the Motor, the EXTENDED signal is pulled to VDC, and the unit is prepared to contract once again. Pull-down resistors are necessary if the EXTENDED and CONTRACTED signals are to be monitored by an external controller.

DIGITAL CONTROL WITH LOGIC LEVEL V+
The outputs of the voltage comparators/ translators are pulled up to the logic voltage level of the external control electronics. This translates the EXTENDED and CONTRACTED output signal levels to that of the external control electronics, VExt. The comparators are open collector devices.

Note: for the NM70-Super Configuration, Vsense has slight voltage drop during actuation; don’t short.