NANOMUSCLE

Advanced Miniature Motion

70 Gram HS/HE Linear Actuator

Features

- Silent operation
- Affordable miniature motion
- Integrated digital controller
- Integrated power drivers
- Built-in limit-stop detection
- Suitable for battery powered equipment

Benefits

- Eliminates mechanical and electrical noise
- Affordable for high volume makers of consumer devices
- Compatible with complex as well as simple external systems
- Reduces overall system cost and time to market
- Allows seamless integration with a digital system
- Ideal for use with portable consumer devices

The best way to evaluate NanoMuscle products is by purchasing our demonstration kit. Order yours today!

Images SI Inc.
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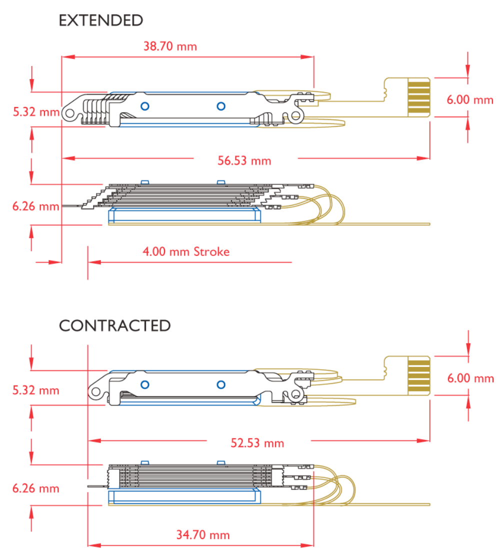
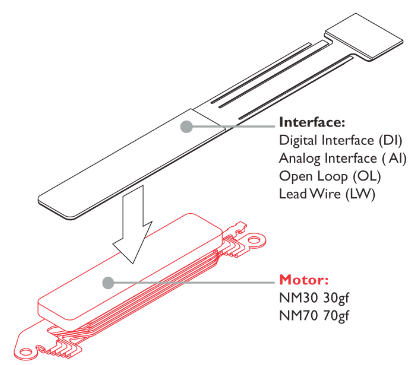
NM70 v.1.0 rev.A

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





Both a NanoMuscle Motor and an Interface must be selected to make a complete actuator system. When selecting an appropriate actuator, please refer to the data sheets for both the NanoMuscle Motors and Interfaces.

Specifications

Rated Voltage	
HS	4.0 V @ 470 mA
HE	3.5 V @ 410 mA
Resistance	8.5 Ω
Stroke	4.0 mm
Rated Load	70 g
Weight	1.1 g
Cycle Life	1,000,000+
Optimal Ambient Temperature	-70°C — +75°C

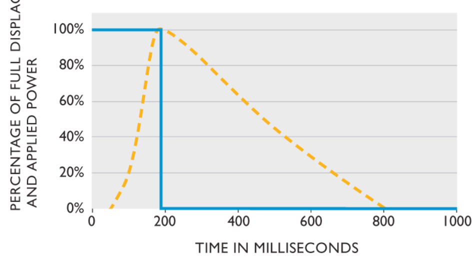
PERFORMANCE DATA CHARTS. Note: A return or extension force is required for each Motor.

Displacement

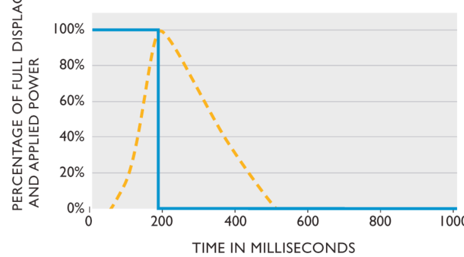
POSITION

POWER

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



Speed

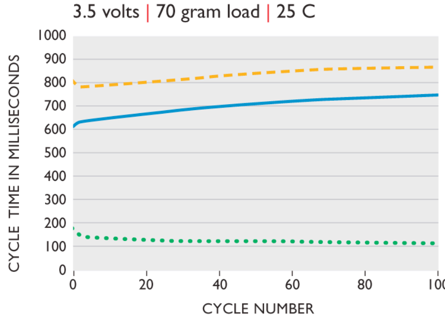
As the Motor cycles continuously, the cycle time increases until the unit reaches thermal equilibrium. The thermal equilibrium point varies with the ambient temperature and application.

CYCLE TIME (MS)

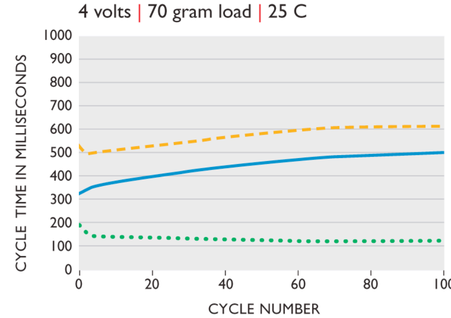
EXTENSION TIME (MS)

CONTRACTION TIME (MS)

NM-70 High Efficiency
Cycle Time vs Number of Completed Cycles
3.5 volts | 70 gram load | 25 C

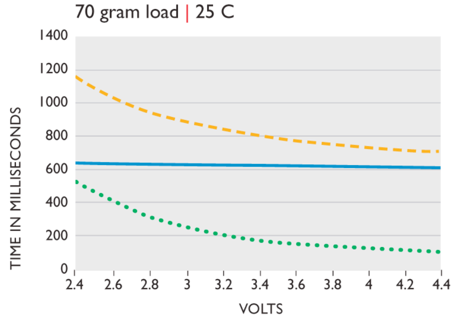


NM-70 High Speed
Cycle Time vs Number of Completed Cycles
4 volts | 70 gram load | 25 C

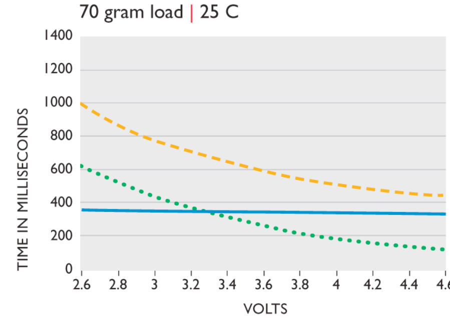


Increasing the applied voltage heats the device more quickly enabling the device to cycle faster.

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

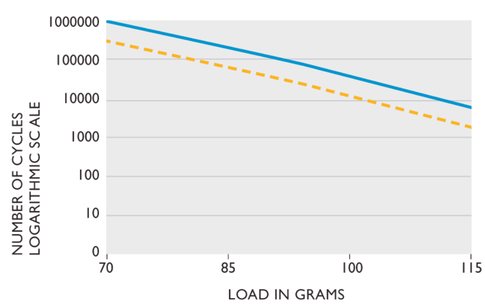


Load & Temperature

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.

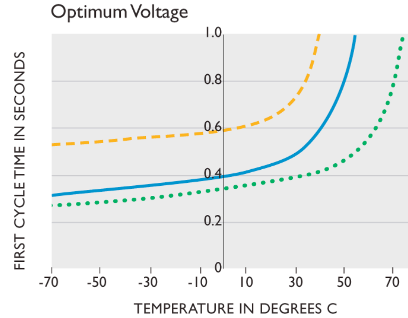
NM-70 High Efficiency/Speed
Load vs Cycle Life



ECONOMY GRADE

COMMERCIAL GRADE

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



LOW RETURN FORCE

MEDIUM RETURN FORCE

VERY HIGH RETURN FORCE

NANOMUSCLE

Advanced Linear Motion

Digital Integrated Interface (DI)

Features and Benefits

- No external components required
- Built in contraction and extension indicator signals
- Seamless integration into a digital environment without external components
- Interfaces with a wide variety of control voltages and microprocessors
- Built-in circuitry protects against overheating when Motor is in the fully contracted position
- Integrated power driver simplifies design efforts

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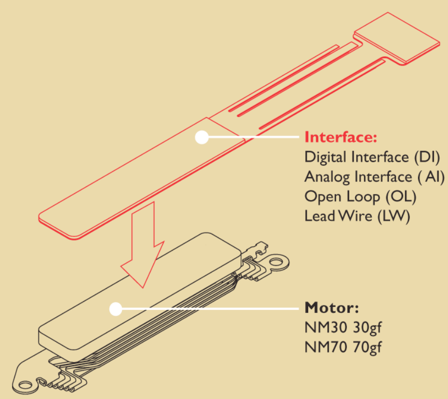
NMDI v.1.0 rev.A

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.



Both a NanoMuscle Motor and an Interface must be selected to make a complete actuator system. When selecting an appropriate actuator, please refer to the data sheets for both the NanoMuscle Motors and Interfaces.

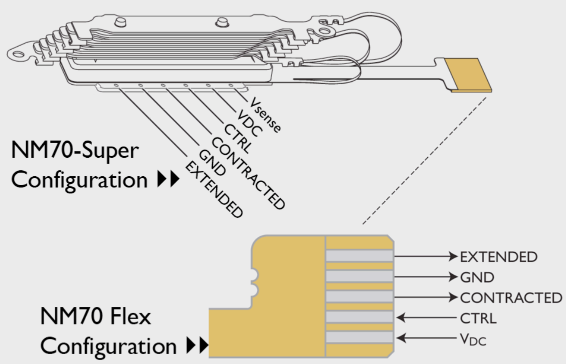
How Does It Work?

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.

NANOMUSCLE

Digital Integrated Interface



Circuit Pinout

Terminal	Description	I/O
EXTENDED	Signal indicating status of full extension	O
CONTRACTED	Signal indicating status of full contraction	O
CTRL	Logic signal controlling contraction	I
V_{DC}	Applied Voltage	I
GND	Ground	

Note: The top and bottom plates of the Motor are at voltage potential V_{DC}

Electrical Characteristics

Note: EXTENDED and CONTRACTED lines must be terminated with external pull-down resistors.

Motor Position	EXTENDED	CONTRACTED
Fully Extended	V_{DC}	O
Intermediate	O	O
Fully Contracted	O	V_{DC}

CTRL	Actuator
CTRL < 1V	OFF
CTRL > 2.5V	ON

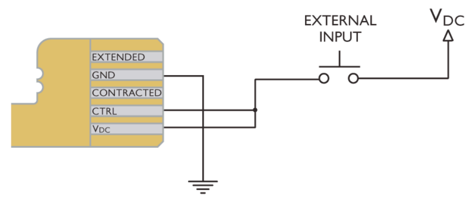
Specifications

NM30 Maximum Continuous Applied Voltage	$V_{DC\,MAX}$	20 V
NM70 Maximum CTRL Voltage	$CTRL_{MAX}$	12V

Typical Configurations

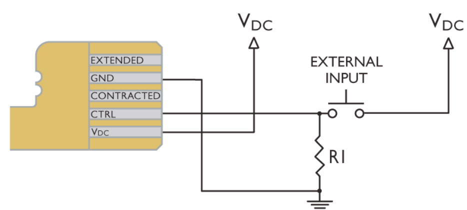
SIMPLE ON/OFF SWITCH 1

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.



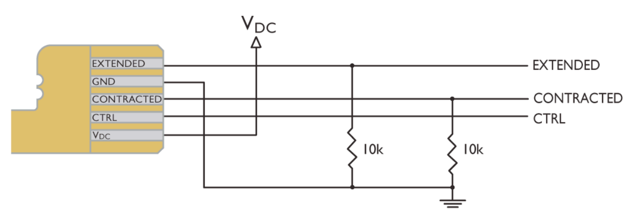
SIMPLE ON/OFF SWITCH 2

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.



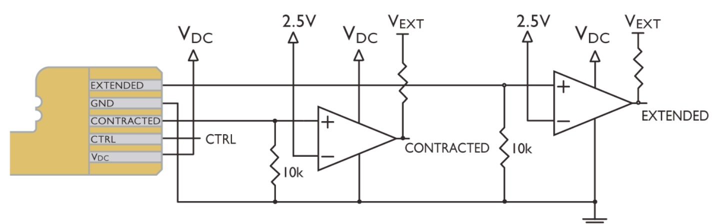
DIGITAL CONTROL WITH HIGH VOLTAGE V+

When CNTRL >2.5V, the Motor contracts, and the CONTRACTED line is pulled to V_{DC}. If an external return force, such as a spring or weight extends the Motor, the EXTENDED signal is pulled to V_{DC}, 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, V_{EXT}. The comparators are open collector devices.



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