

A background technical drawing of a mechanical assembly, showing various parts and dimensions in white lines on a dark grey background. Dimensions include 55, 33, 12.5, 17.1, 54.5, 231.5, 18, 8.8, 10, 30, 25, 30, 10, 20, 20, 19, and 12.5.

**SOFT LANDING**

Press & Hold

Switch from position to velocity servo

Friction

Impact Point

ACCELERATING

DECELERATING

Switch from velocity servo to force control

1. Monitor coil current at point of switch
2. Set force control with same current
3. Ramp current up

# MOVING COIL ACTUATORS

*The ability to do work and verify its accuracy at the same time.*

# SMAC Product Overview

## Cylinder



**CAL12**  
Stroke [mm]: 10  
Force [N]: 1.5



**CAL36**  
Stroke [mm]: 15, 25, 50  
Force [N]: 12 - 18



**CAL75**  
Stroke [mm]: 15, 25, 50  
Force [N]: 25 - 90

## Linear & Linear/Rotary Actuators



**LCA25**  
Stroke [mm]: 10 up to 200  
Force [N]: 8 - 22



**LCA50**  
Stroke [mm]: 25  
Force [N]: 40, 50



**LAL15 / LAR15**  
Stroke [mm]: 15  
Force [N]: 5



**LAL20 / LAR20**  
Stroke [mm]: 10, 15, 25  
Force [N]: 8, 7, 5



**LAR31**  
Stroke [mm]: 17, 27, 31  
Force [N]: 14, 12, 11



**LAL35 / LAR35**  
Stroke [mm]: 25, 50, 100  
Force [N]: 12, 10, 6



**LAL55 / LAR55**  
Stroke [mm]: 50, 100, 150  
Force [N]: 25, 16, 13



**LAL95 / LAR95**  
Stroke [mm]: 15, 50  
Force [N]: 100, 60



**LAL300**  
Stroke [mm]: 50  
Force [N]: 202

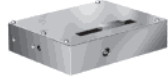


**LAL500**  
Stroke [mm]: 25, 50  
Force [N]: 500

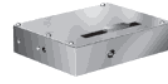
## Linear Slide Actuators



**LCS25**  
Stroke [mm]: 10  
Force [N]: 8, 12



**LAS15**  
Stroke [mm]: 15  
Force [N]: 5



**LAS20**  
Stroke [mm]: 10, 15, 25  
Force [N]: 8, 7, 5



**LASW20**  
Stroke [mm]: 11  
Force [N]: 8



**LAS35**  
Stroke [mm]: 25, 50, 100  
Force [N]: 12, 10, 6



**LAS55**  
Stroke [mm]: 50, 100, 150  
Force [N]: 25, 16, 13



**LAS95**  
Stroke [mm]: 15, 50  
Force [N]: 100, 60

## Grippers



**GRP20**  
Stroke [mm]: 10  
Force [N]: 8



**GRP35**  
Stroke [mm]: 30  
Force [N]: 25



**GRP50**  
Stroke [mm]: 30  
Force [N]: 45

## XY Stages



**LXY15**  
Stroke [mm]: 15  
Force [N]: 22



**LXY25**  
Stroke [mm]: 25  
Force [N]: 42



**LXYM15**  
Stroke [mm]: 15  
Force [N]: 14 - 27

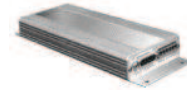
## Controllers & Amplifier



**LCC-10 (LCC-11)**  
Single axis brushless controller



**LAC-1**  
Single axis controller



**LAC-25**  
2 axis controller with built in amplifier



**LAC-15/LAC-20**  
Single or double axis brushless controller.



**LAC-45**  
4 axis controller with built in amp



**MAAC4-7**  
Multi axes [4] Galil based controller



**Built-in Controller**



**LAA-5**  
Amplifier for 1 axis



**LAD-1**  
Smart drive for 1 axis

# The SMAC Advantages

- Absolute control over: force, position, acceleration and velocity
- Direct drive actuator, therefore a very high degree of accuracy & repeatability
- Integrated position measuring system with glass scale and optical reader head (no wear)
- Very long lifetime due to oversized linear guides
- Force measurement through monitoring of current
- Digital and analog in/output channels
- Ability to switch between operations - force, position and velocity mode - at any time
- Extremely high acceleration and velocity
- Unique “Soft-Land” function

## Programmable Features

The actuator is totally programmable for force, acceleration and velocity, and can operate in three different modes:

**Force Mode:** Force Mode is open loop, using no feed back from the encoder. The actual position is still monitored but has no effect upon the output.

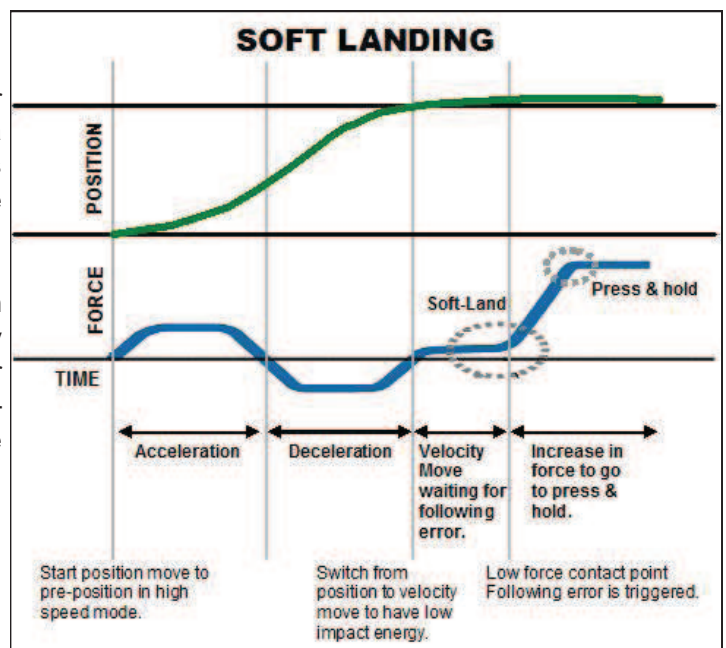
**Velocity Mode:** Velocity Mode allows the actuating rod to be moved with a given velocity, acceleration, force and direction. Typically used for a “Soft-Land” routine.

**Position Mode:** Position Mode will allow the actuating rod to be moved to various positions along the stroke using acceleration, velocity and force. It is possible to perform absolute, relative and “learned position” moves.

## What is a Soft-Land?

The “Soft-Land” is a routine which allows the actuator rod or gripper jaw to land on the surface of a component with a low programmed force. This is particularly useful for handling delicate or high value components.

The routine consists of a controlled low force approach in velocity mode, whilst the position error is constantly monitored. Once contact is made the position error builds up until a pre-programmed figure is reached - resulting in the rod maintaining position on the surface of the component.



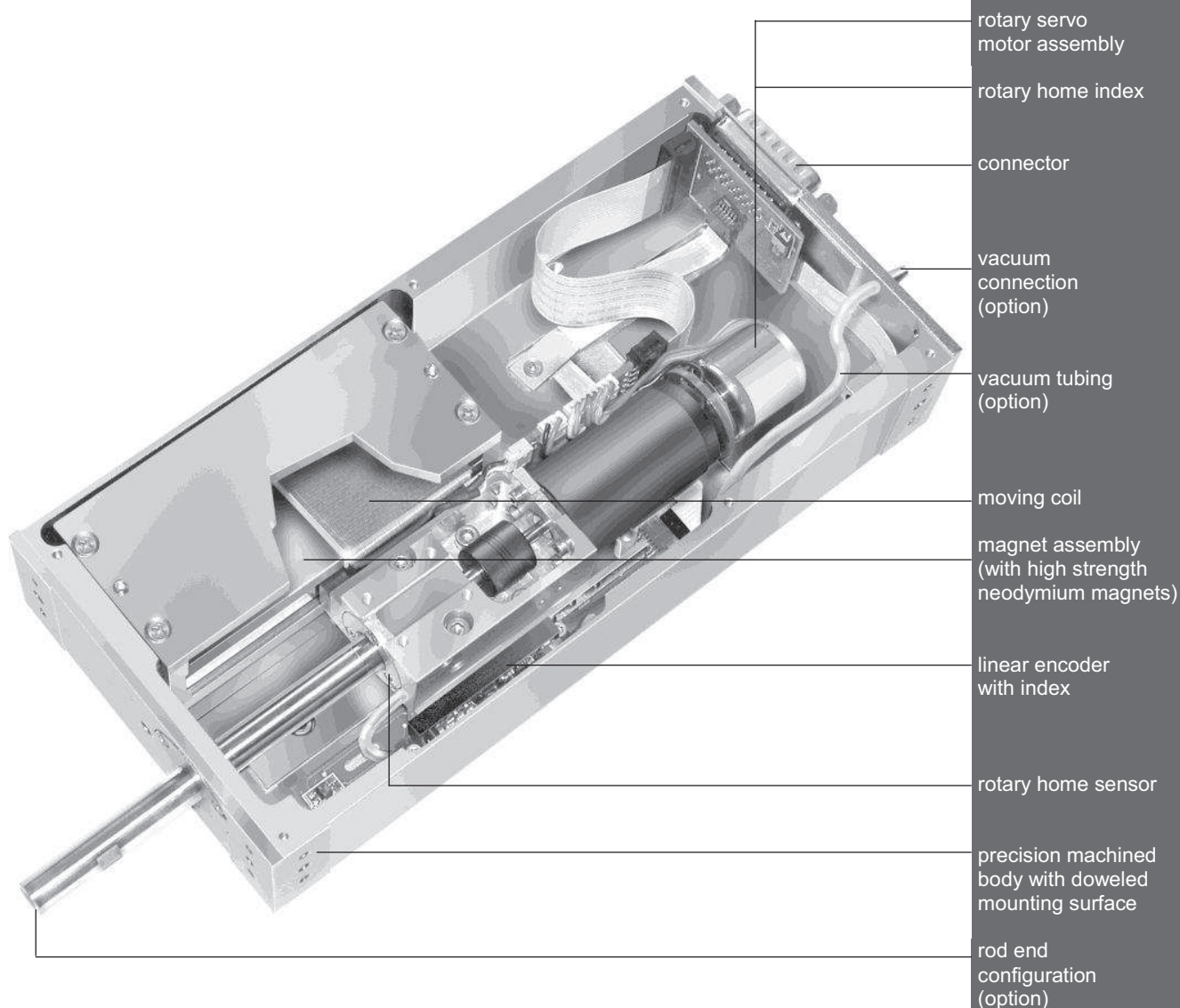
# Linear and Linear / Rotary Moving Coil Actuators

## Linear:

- Stroke up to 200mm, force up to 500N, position encoder resolution 5 $\mu$ m standard, 1 and 0.1 $\mu$ m option for most actuators.
- Programmable force, position, acceleration and velocity.

## Rotary:

- Multi-turn servo motor, torque up to 1Nm (Gearbox), velocity up to 5000 rpm, resolution up to 50,000 increments per revolution.
- Programmable force, position, acceleration and velocity.



# Moving Coil Technology (Voice Coil)

At the heart of all SMAC actuators is the moving coil, also described as a voice coil actuator. The essential principle is the same as you will find in any permanent magnet loudspeaker. The coil is enclosed in a magnet housing, and by passing a current through the coil, a magnetic field is generated.

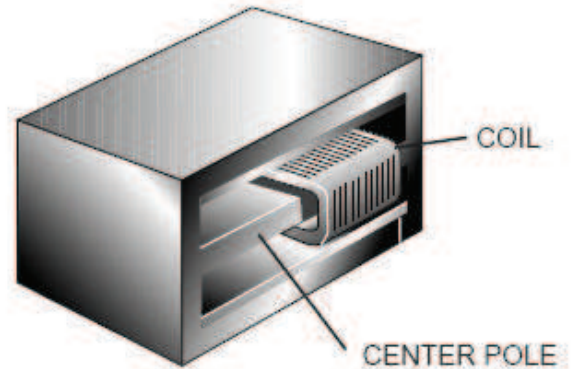
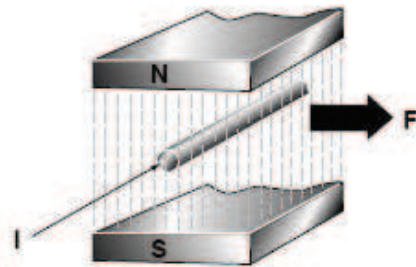
The amount of force generated is governed by the equation

$$F \propto N I B$$

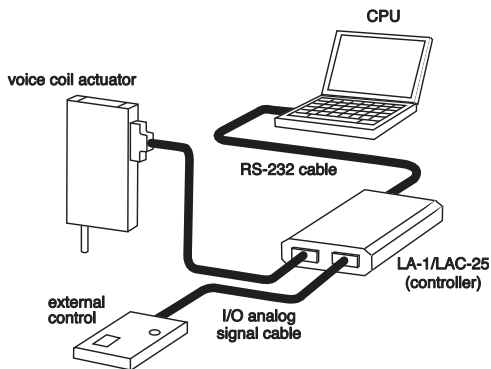
where;

- F** is the force generated
- N** is the number of turns in the winding (Constant)
- I** is the current flowing through the winding and
- B** is the magnetic flux (Constant)

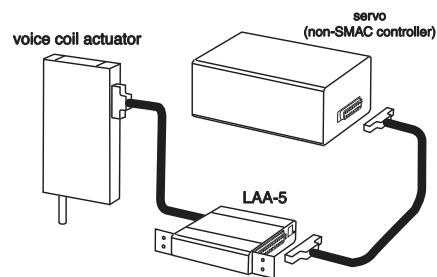
Therefore, doubling **I (current)** doubles **F (Force)**.



## Hardware Configuration



Hardware with SMAC Controllers



Hardware with SMAC Amplifier

# Part Numbering System

	MODEL					SERIES					STROKE			VOLT		ENCODER		SHAFT	VACUUM	SPRING	*** Cable	*** Mounting	MOD				
<b>CYLINDER</b>	<b>C</b>	<b>A</b>	<b>L</b>	<b>3</b>	<b>6</b>	<b>0</b>	<b>2</b>	<b>5</b>																			
<b>LINEAR</b>	<b>L</b>	<b>A</b>	<b>L</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>																		
<b>LINEAR/ ROTARY</b>	<b>L</b>	<b>C</b>	<b>A</b>	<b>2</b>	<b>5</b>	<b>0</b>	<b>1</b>	<b>0</b>																			
<b>SLIDE</b>	<b>L</b>	<b>A</b>	<b>S</b>	<b>5</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>																		
<b>XY TABLE</b>	<b>L</b>	<b>X</b>	<b>Y</b>						<b>3</b>																		
<b>GRIPPER</b>	<b>G</b>	<b>R</b>	<b>P</b>						<b>5</b>																		

<b>1</b>	= 24 volt 6 coil *
<b>3</b>	= 48 volt 6 coil *
<b>5</b>	= 24 volt single coil
<b>6</b>	= 24 volt double coil**
<b>7</b>	= 48 volt single coil
<b>8</b>	= 48 volt double coil**
<b>1</b>	= 1.0µm
<b>2</b>	= 0.1 µm**
<b>3</b>	= 0.05µm**
<b>5</b>	= 5.0µm
<b>7</b>	= 20µm
<b>B</b>	= BLANK (standard)
<b>F</b>	= FEMALE
<b>M</b>	= MALE
<b>C</b>	= CUSTOM
<b>V</b>	= VACUUM
<b>S</b>	= SPRING
<b>3</b>	= Flying Lead
<b>5</b>	= Pigtail
<b>A</b>	= Front Mount
<b>B</b>	= Base Mount

**Part Number Examples:**

**LAL20-010-55**

LAL20 linear slide, 10mm stroke, 24volt single coil,  
5 micron encoder.

**LAL300-050-85-F**

LAL300 linear actuator, 50mm stroke, 48volt double coil  
5 micron encoder, female rod end.

**LAR55-100-75-MS-MOD674**

LAR55 linear/rotary actuator, 100mm stroke, 48 volt single coil,  
5 micron encoder, male thread, spring,  
mod 674 specification.

**CAL36-015-55F3A**

CAL36 electric cylinder, 36mm dia., 15mm stroke, 24volt single coil,  
5 micron encoder, female shaft end, flying lead and front mount

\*LCA series only  
\*\*Check availability  
\*\*\* CA and LCA series only

**NOTES:**

- Series will not have leading zeros (e.g. LAL95).
- Stroke must include zeros (e.g. 050).
- Spring must be specified as full return or counterbalance, payload and orientation (vertical or horizontal).

# Linear Actuators

	Voltage [DC]	Size: LxWxH [mm]	Stroke [mm]	Maximum Force [N]	Continue us Force [N]	Force Constant [N/A]	Moving Mass [kg]	Weight [kg]
LCA25-010-5	24	55x70x25	10	8	3	6	0.04	0.27
LCA25-010-7	48	55x70x25	10	12	5	8	0.04	0.27
LCA25-010-1	24	60x115x25	10	18	7	13	0.08	0.5
LCA25-010-3	48	60x115x25	10	22	9	14.5	0.08	0.5
LCA25-025-1	24	60x130x25	25	18	7	13	0.08	0.55
LCA25-025-3	48	60x130x25	25	22	9	14.5	0.08	0.55
LCA25-050-1	24	60x155x25	50	18	7	13	0.08	TBV
LCA25-050-3	48	60x155x25	50	22	9	14.5	0.08	TBV
LCA25-100-1	24	60x205x25	100	18	7	13	0.08	TBV
LCA25-100-3	48	60x205x25	100	22	9	14.5	0.08	TBV
LCA25-150-1	24	60x255x25	150	18	7	13	0.08	TBV
LCA25-150-3	48	60x255x25	150	22	9	14.5	0.08	TBV
LCA25-200-6	24	60x310x25	200	18	7	13	0.08	TBV
LCA25-200-8	48	60x310x25	200	22	9	14.5	0.08	TBV
LCA50-025-5	24	100x125x50	25	40	16	30	0.335	2.157
LCA50-025-7	48	100x125x50	25	50	20	40	0.335	2.157
LAL15-015-5	24	120x58x15	15	5	2	2.7	0.05	0.23
LAL20-010-5	24	65x85x20	10	8	3.2	5.5	0.07	0.30
LAL20-015-5	24	65x115x20	15	7	2.8	5	0.07	0.34
LAL20-015-6	24	65x115x20	15	12	4.8	5.8	0.08	0.34
LAL20-025-5	24	65x115x20	25	5.4	2	3.4	0.08	0.36
LAL35-025-6	24	135x90x35	25	31.5	12.6	15.5	0.19	1.06
LAL35-025-7	48	135x90x35	25	18	7	10	0.12	0.95
LAL35-050-5	24	135x90x35	50	10	4	7	0.13	1.1
LAL35-050-7	48	135x90x35	50	12.5	5	10	0.13	1.1
LAL35-100-5	24	135x90x35	100	6	2.4	3.5	0.1	1.7
LAL55-050-5	24	250x110x55	50	25	10	19	0.3	3
LAL55-050-7	48	250x110x55	50	40	16	24.5	0.3	3
LAL55-100-5	24	250x110x55	100	16	6.4	13	0.3	3.8
LAL55-100-7	48	250x110x55	100	25	10	17	0.3	3.8
LAL55-150-5	24	250x110x55	150	13	5	10	0.4	4.5
LAL55-150-7	48	250x110x55	150	19.5	8	12.5	0.4	4.5
LAL95-015-7	48	90x70x95	15	84	33	53	0.25	2.2
LAL95-015-8	48	147x70x95	15	195	78	60	0.5	4
LAL95-025-8	48	180x70x95	25	162	65	52	0.58	3.75
LAL95-050-7	48	147x70x95	50	65	26	41	0.25	3
LAL300-050-8	48	210x85x120	50	202	80	86	0.8	8.8
LAL500-025-8	48	300x140x200	25	500	200	166	1.6	26.5
LAL500-050-8	48	300x140x200	50	500	200	100	1.6	26.5



LCA25



LCA50



LAL15



LAL20



LAL35



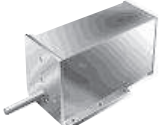
LAL55



LAL95



LAL300



LAL500

**NOTE: SMAC requires that all units must be operated at less than 40% maximum duty cycle. Please see page 15 or user manual for further explanation on how to calculate duty cycle.**

We manufacture actuators to suit our customers' requirements. Please call us if you do not find the right actuator in this list. Linear actuators are also available as linear slides (LAS series).

**Options & Modifications (Consult factory for availability):**

- Linear encoder resolutions: 5µm standard (20µm standard for LCA25) , 1µm and 0.1µm optional for most units. Consult factory for availability.
- Shaft ends: Male, Female, Blank and Custom (check availability of custom option)
- Return spring: Prevents the shaft from dropping during vertical operation when power is cut.
- Vacuum: Vacuum through the shaft or on the shaft for pick and place applications.
- Extended nose bushing: For tighter shaft run-out and higher side load onto the shaft.
- Increase of maximum force & acceleration: 48 volt coil and double coil options are available for some units with 24 volt single coil.
- Increase of force accuracy & lifetime: Extra long life linear guide / Low friction linear guide

Specifications subject to change.

# Linear & Rotary Actuators

	Voltage [DC]	Size: LxWxH [mm]	Stroke [mm]	Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]	Weight [kg]	Maximum Torque* [Nm]	Rotary type	Rotary Encoder Resolution	Velocity* [rpm]
LAR15-015-5	24	120x58x15	15	5	2	2.7	0.095	0.25	0.008	direct	20K	500
LAR20-015-5	24	115x65x20	15	7	2.8	5	0.09	0.41	0.008	direct	20K	500
LAR31-017-5	24	140x77.25x35	17	14	5.6	10	0.22	0.85	0.066	direct	20K	500
LAR31-027-5	24	140x77.25x35	27	12	4.8	7	0.2	0.85	0.066	direct	20K	500
LAR31-031-5	24	140x77x35	31	11	4	7	0.19	0.84	0.06	Direct	40.98K	2000
LAR35-025-5	24	190x90x35	25	12	4.8	7	0.14	1.2	0.085	direct	20K	500 - 5000
LAR35-050-5	24	190x90x35	50	10	4	7	0.29	1.4	0.085	direct	20K	500 - 5000
LAR55-050-5	24	250x110x55	50	25	10	19	0.5	3.1	0.2 - 2.5	direct or gear box	2K-28K	500 - 5000
LAR55-050-7	48	250x110x55	50	40	16	27	0.31	2.8	0.2 - 2.5		2K-28K	500 - 5000
LAR55-100-5	24	250x250x55	100	16	6.4	13	0.5	3.85	0.2 - 2.5		2K-28K	500 - 5000
LAR55-100-7	48	250x250x55	100	25	10	18	0.5	3.85	0.2 - 2.5		2K-28K	500 - 5000
LAR95-015-7	48	304x90x115	15	84	33	53	0.9	3.5	0.2 - 4.5		2K-132K	75 - 5000
LAR95-050-7	48	304x90x115	50	65	26	41	0.9	4.2	0.2 - 4.5		2K-132K	75 - 5000
LAR300-050-8	48	284x85x160	50	202	80	86	1	9.5	0.2 - 4.5		2K-132K	75 - 5000



**LAR15**



**LAR20**



**LAR31**



**LAR35**



**LAR55**



**LAR95**



**LAR300**

**NOTE: SMAC requires that all units must be operated at less than 40% maximum duty cycle. Please see page 15 or user manual for further explanation on how to calculate duty cycle.**

We manufacture actuators to suit our customers' requirements. Please call us if you do not find the right actuator in this list.

## Options & Modifications (Consult factory for availability):

Linear encoder resolutions: 5µm standard, 1µm and 0.1µm optional for most units. Consult factory for availability.

Shaft ends: Male, Female, Blank and Custom (check availability of custom option)

Return spring: Prevents the shaft from dropping during vertical operation when power is cut.

Vacuum: For pick and place applications

Extended nose bushing: For tighter shaft run-out and higher side load onto the shaft.

Increase of maximum force and acceleration: 48 volt coil and double coil options are available for some units with 24 volt single coil.

Increase of torque/gear ratio: Alternative geared motors are available for some units.

Rotary encoder resolution: Consult factory for higher resolution.

Increase of force accuracy & lifetime: Extra long life linear guide  
Low friction linear guide

\* Torque and velocity can vary based on your specific application.

# Linear Slide Actuators

	Voltage [DC]	Size: LxMxH [mm]	Stroke [mm]	Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]	Weight [kg]
LCS25-010-5	24	55x70x25	10	8	3	6	0.04	0.27
LCS25-010-7	48	55x70x25	10	12	3	8	0.04	0.27
LAS15-015-5	24	120x58x15	15	5	2	2.7	0.05	0.23
LAS20-010-5	24	85x65x20	10	8	3.2	5.5	0.07	0.34
LAS20-015-5	24	65x115x20	15	7	2.8	5	0.07	0.34
LAS20W-015-6	24	75x135x20	15	12	4.8	5.8	0.122	0.54
LAS20-025-5	24	85x65x20	25	5.5	2	2.8	0.07	0.34
LASW20-011-5	24	85x75x23	11	8	3.2	5.5	0.07	0.3
LAS35-025-6	24	135x90x35	25	31.5	12.6	15.5	0.19	1.06
LAS35-025-7	48	150x90x35	25	18	7	10	0.15	0.95
LAS35-050-5	24	135x90x35	50	10	4	7	0.13	1.1
LAS35-050-7	48	135x90x35	50	12.5	5	10	0.13	1.1
LAS35-100-5	24	135x90x35	100	6	2.4	3.5	0.13	1.7
LAS35-100-7	48	135x90x35	100	7.5	3	5	0.1	1.3
LAS55-050-5	24	250x110x55	50	25	10	19	0.3	3
LAS55-050-7	48	250x110x55	50	40	16	24.5	0.31	3
LAS55-100-5	24	250x110x55	100	16	6.4	13	0.3	3.8
LAS55-100-7	48	250x110x55	100	35	10	19	0.31	3.8
LAS55-150-5	24	250x110x55	150	13	5	10	0.4	4.5
LAS55-150-7	48	250x110x55	150	19.5	8	13	0.31	4.58
LAS95-015-7	48	90x70x95	15	84	33	53	0.25	2.1
LAS95-015-8	48	147x70x95	15	195	78	60	0.5	4
LAS95-025-8	48	180x70x95	25	162	65	52	0.5	3.78
LAS95-050-7	48	147x70x95	50	65	26	41	0.25	3
LAS300-050-8	48	210x85x120	50	202	80	86	0.8	8.8



**LAS15**



**LAS20**



**LASW20**



**LAS35**



**LAS55**



**LAS95**

**NOTE: SMAC requires that all units must be operated at less than 40% maximum duty cycle. Please see page 15 or user manual for further explanation on how to calculate duty cycle.**

We manufacture actuators to suit our customers' requirements. Please call us if you do not find the right actuator in this list.

## Options & Modifications (Consult factory for availability):

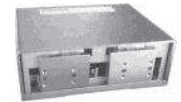
- Linear encoder resolutions: 5µm standard (20µm standard for LCS25) , 1µm and 0.1µm optional for most units. Consult factory for availability.
- Return spring: Prevents the shaft from dropping during vertical operation when power is cut.
- Increase of maximum force & acceleration: 48 volt coil and double coil options are available for some units with 24 volt single coil.
- Increase of force accuracy & lifetime: Extra long life linear guide  
Low friction linear guide

# Grippers

	Voltage [DC]	Size: LxWxH [mm]	Stroke per Axis [mm]	Axis 1				Axis 2				Weight [kg]	Maximum Opening
				Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]	Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]		
GRP20-010-5	24	80x90x23	5	8	3.2	5.5	0.065	8	3.2	5.5	0.065	0.5	10
GRP35-030-5	24	93x110x38	15	25	10	17	0.1	25	10	17	0.1	1.5	30
GRP50-030-7	48	90x125x55	15	45	18	22.5	0.47	45	18	22.5	0.47	2.5	30



**GRP20**



**GRP35**



**GRP50**

**NOTE: SMAC requires that all units must be operated at less than 40% maximum duty cycle. Please see page 15 or user manual for further explanation on how to calculate.**

We manufacture actuators to our suit our customers' requirements. Please call us if you do not find the right actuator in this list.

### Options & Modifications (Consult factory for availability):

- Linear encoder resolutions: GRP20: 1µm standard and 0.1µm optional.  
GRP35 & GRP50: 5µm standard, 1µm and 0.1µm optional.
- Increase of the maximum force & acceleration: 48 volt coil and double coil options are available for some units with 24 volt single coil.
- Increase of the force accuracy & lifetime: Extra long life linear guide  
Low friction linear guide

# XY Stages

	Voltage [DC]	Size: LxWxH [mm]	Stroke per Axis [mm]	Axis 1				Axis 2				Weight [kg]
				Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]	Maximum Force [N]	Continuous Force [N]	Force Constant [N/A]	Moving Mass [kg]	
LXY15-015-7	48	111x112x86	15	22	11	13	0.13	25	12	12	0.22	1.65
LXY25-025-8	48	125x125x65	25	42	17	14	0.19	42	17	14	1.5	3.2
LXYM15-015	24/48	230x242.5x55	15	14.7/24.5	5.9/9.8	12.7	0.36	16.4/27.4	6.6/11	13	0.51	2.7



**LXY15**



**LXY25**



**LXYM 15**

**NOTE: SMAC requires that all units must be operated at less than 40% maximum duty cycle. Please see page 15 or user manual for further explanation on how to calculate.**

We manufacture actuators to suit our customers' requirements. Please call us if you do not find the right actuator in this list.

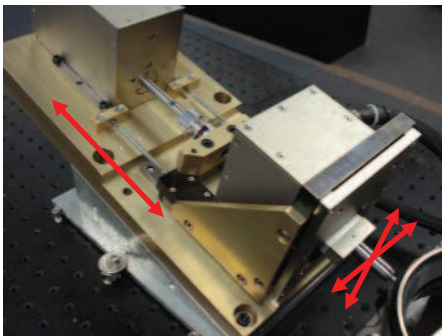
### Options & Modifications (Consult factory for availability):

- Linear encoder resolutions: 5µm standard, 1µm and 0.1µm optional for most units. Consult factory for availability.
- Increase of maximum force & acceleration: 48 volt coil and double coil options are available for some units with 24 volt single coil.

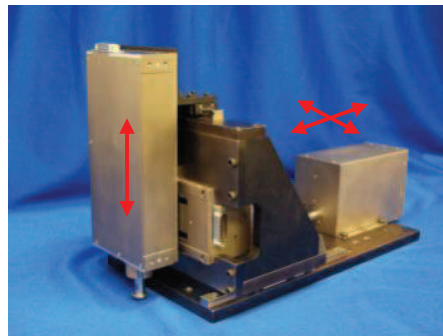
# Multi-Axis System

SMAC is pleased to introduce its range of multi-axis control solutions. These systems are able to learn and follow a 3D contour or motion path, with a high degree of speed, precision, accuracy and repeatability. All combinations of SMAC actuators can be used: linear, linear/rotary, linear slide, and XY stage axis.

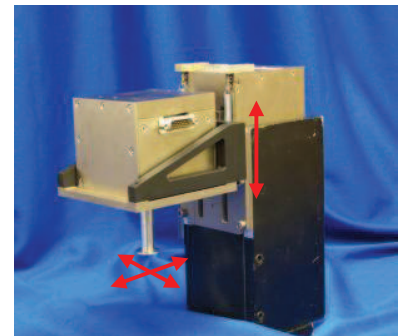
Ideal applications are measuring and testing (QC), dispensing (Bonding), machining (CNC), scoring and cutting, to name a few. SMAC multi-axis 3D systems are unique - they enable total programmability of speed, position and force all at the same time with an exceptional degree of accuracy and repeatability. SMAC multi-axis systems offer a wide range of solutions with a number of highly flexible control interfaces.



LXY15 & LAL95



LAL35, LAL95 & LAS95

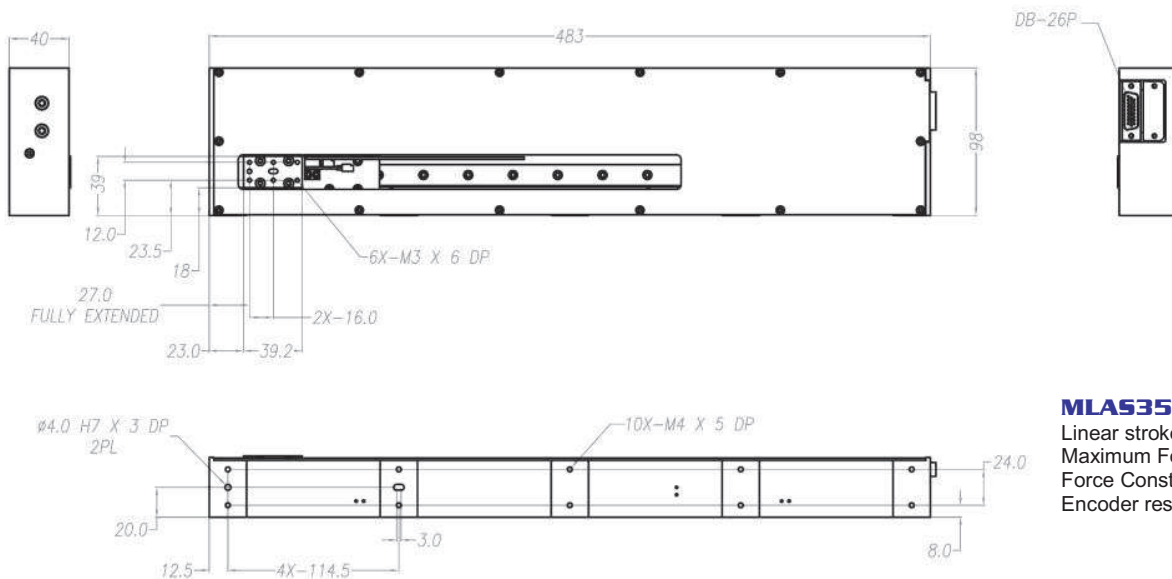


LXY15 & LAS95

# Multipole Actuators

These actuators are equipped with several coils and magnets. This allows us to increase the stroke up to 600mm and increases the acceleration up to 10G. A typical application for the multipole actuator is the transport of a smaller actuator, and can achieve very short cycle times with pick & place applications.

Please contact our technical office for further information on multipole actuators.



## MLA535-250

Linear stroke [mm]: 250  
 Maximum Force [N]: 60  
 Force Constant [N/A]: 11  
 Encoder resolution [ $\mu$ m]: 5

## Cable Chart for the LCA series Actuator

	Single Axis Controller	Single Axis Controller	Amplifier	Smart Driver
Actuator	LCC-10	LAC-1	LAA-5	LAD-1
LCA25 Single or Double Coil	Flying lead type or MAH-LOD26-03 for pigtail type	Flying lead type or CAH-LOD26-03 for pigtail type	Flying lead type or CAH-LAD26-03 for pigtail type	Flying lead type or CAH-LSD26-03 for pigtail type
LCA50 Single or Double Coil				
LCA25 6 Coil		N/A	N/A	N/A
LCA50 6 Coil				

## Cable Chart for the LA series Actuator

	Single Axis Controller	Dual Axis Controller		Amplifier	Smart Driver
Actuator	LAC-1	LAC-20	LAC-25	LAA-5	LAD-1
LAL15 (*1)	LAH-LOD26-03			LAH-LAD26-03	LAH-LSD26-03
LAL20	LAH-LOD26-03			LAH-LAD26-03	LAH-LSD26-03
LAL35	LAH-LOD26-03			LAH-LAD26-03	LAH-LSD26-03
LAL55	LAH-LOD-03			LAH-LAD-03	LAH-LSD-03
LAL95	LAH-LOD26-03			LAH-LAD26-03	LAH-LSD26-03
LAL300	LAH-LOD-03			LAH-LAD-03	LAH-LSD-03
LAL500	LAH-LOD-03			LAH-LAD-03	LAH-LSD-03
LAR15 (*1)		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	LAH-RSD26-03
LAR20		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	LAH-RSD26-03
LAR31					
LAR35		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	LAH-RSD26-03
LAR37					
LAR55		LAT-25C-0005-03	LAH-RTD-03	LAH-RAD-03	LAH-RSD-03
LAR95		LAT-25C-0005-03	LAH-RTD-03	LAH-RAD-03	LAH-RSD-03
LAR300		LAT-25C-0005-03	LAH-RTD-03	LAH-RAD-03	LAH-RSD-03
2 x LAL15(*1)		LAT-26C-0003-03	LAH-LTD26-03		
2 x LAL20		LAT-26C-0003-03	LAH-LTD26-03		
2 x LAL35		LAT-26C-0003-03	LAH-LTD26-03		
2 x LAL55		LAT-25C-0003-03	LAH-LTD-03		
2 x LAL95		LAT-26C-0003-03	LAH-LTD26-03		
2 x LAL300		LAT-25C-0003-03	LAH-LTD-03		
2 x LAL500		LAT-25C-0003-03	LAH-LTD-03		
GRP20		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	
GRP35		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	
GRP50 (*2)		LAT-26C-0005-03	LAH-RTD26-03	LAH-RAD26-03	
LXY15			LAH-GRP26-03	LAA-GRP26-03	
LXY25			LAH-GRP26-03	LAA-GRP26-03	
LXYM15			LAH-GRP26-03	LAA-GRP26-03	

All cables are 3m standard, optional lengths are available from 1 to 10m.  
Superflex is available as an option. Suitable for robotic applications.

\*1 Requires LAH-PT30-25 (Jumper to 25 pin cable) or LAH-PT30-26 (Jumper to 26 pin cable) as supplement.

\*2 Old type of GRP50 requires LAH-GRP26-03 cable.

# Controllers / Amplifiers

SMAC supplies a range of single and multi axis controllers together with stand alone amplifiers and stepper driven driver. Controllers are programmed by mnemonic type command instructions via an RS-232 interface into NVRAM. They require no supplementary software.



## LCC-10 (LCC-11)

Single axis brushless controller  
Built-in amplifier  
Easy expansion to multi-axis

**Mode:**

- Position
- Velocity
- Force

10 bit analogue output  
(16 bit option available as  
Model # LCC-11)  
1 Port per axis  
RS232 up to 115200 bps  
CAN bus 2.0B up to 1MB/s



## LAC-20

Double axis brushless controller  
Built-in amplifier  
Easy expansion to multi-axis

**Mode:**

- Position
- Velocity
- Force
- Step/Direction

1 Port per axis  
RS232 up to 115200 bps  
CAN bus 2.0B up to 1MB/s



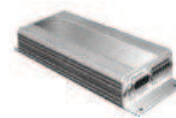
## LAC-1

Single axis controller  
Built-in amplifier

**Mode:**

- Position
- Velocity
- Force

8 input/8 output TTL general purpose I/O's  
RS232 Interface  
3 analog INPUT



## LAC-25

2 axis controller  
Built-in amplifier

**Mode:**

- Position
- Velocity
- Force
- Gearing

Independent or coordinated 2 axis motion  
4 input/4 output  
Opto-isolated general purpose I/O's  
2 analog input/output  
RS232 Interface



## LAC-45

4 axis controller  
Built-in amplifier

**Mode:**

- Position
- Velocity
- Force
- Gearing

Independent or coordinated 4 axis motion  
8 input/8 output  
Opto-isolated general purpose I/O's  
6 analog input/4 analog output  
RS232 Interface



## MAAC4-7

4 axis controller brushed/brushless  
Integrated high end amplifier  
Advanced math capability  
Circular interpolation  
Teach path function  
Additional controllers can be added to work together on systems requiring more than 4 axes.



## LAA-5

Single axis amplifier  
+/- 10 Volt input  
3 Amp output



## LAD-1

Smart Driver for single axis  
stepper input to servo output  
RS232 Interface



## MIOE-8/8

Expansive I/O modular  
8 input/8 output  
Opto-isolated general purpose I/O



## Built-in Controller

Consult factory for available actuator

# Installation Guideline

## Duty cycle

SMAC requires that all units must be operated at less than 40% maximum duty cycle. This does not apply to CA series and can be calculated as follows:

$\% \text{ of max force applied} \times \% \text{ of cycle time it is applied} = \% \text{ duty cycle}$

For example:

- 100% force x 40% of cycle time = 40% duty cycle.
- 60% force x 50% of cycle time = 30% duty cycle.
- 40% force x 100% of cycle time = 40% duty cycle.

Recommendation from SMAC is that the duty cycle must not be exceeded over a one second time period.

NOTE: Failure to observe this duty cycle recommendation may result in the actuator sustaining damage through overloading. Overloading will overheat the coil and may cause deformation or an impact on the magnet housing.

All CA series units must be operated at less than below suggested duty cycle (%).

	24V	48V
CAL12	80%	40%
CAL36	80%	40%
CAL75	80%	40%

## Continuous Force

Peak force applied for duration shorter than 0.4 sec. in one second interval.

(force mode): 40% of peak force, continuous

## Force Mode

The specified current may be applied continuously to generate the desired force. However, the recommended continuous force limit should be set in the control program.

In vertical operation, the actuator rod will drop when power is cut off. The rod in a lowered position may be damaged by other moving parts in the machine. A return spring (optional feature) will keep the rod raised. A safety lock-out should be installed in the machine program to confirm the rod location before another interfering component can be moved.

SMAC actuators are equipped with these safety features:

- Limit switches: indicate end-of-stroke
- Index line/home position: used to monitor absolute position
- Breakaway shaft (optional)

## Safety Considerations

Unintentional full force may be applied continuously under the following conditions:

- missed target position
- excessive friction
- equipment malfunction, i.e. jam

If left undetected, this can cause destruction of the coil in some units. A servo program should perform the following checks regularly:

- Re-home: to assure target position has not shifted beyond end of stroke
- Time-outs: to shut power down within 10 seconds of error detection
- Following Error Limits: software safety
- Check limit switches
- Check temperature sensor

## Mounting

If the actuator is mounted vertically, the shaft drops down when the actuator is powerless. It is possible that other moving parts of the machine may damage the actuator at this position.

A return spring would hold the actuator in an upper position when it is powerless.

A safety function in your machine should check the actuator's current position before other components may move into the working area of the actuator.

# Individual Modifications

Many of our standard actuators listed on previous pages are compatible with both add-on options and modifications. In addition to the standard vacuum and spring option SMAC can offer the following modifications subject to approval by the factory.

## Linear Guide Options

Increased rigidity and side load tolerance can be gained by using a higher specification "wide guide". Additionally, in force sensitive applications we can fit a low friction guide.

## Double Coil

Integrating an extra coil can enhance both force and acceleration.

## Custom Nose-Bush

An extended nose bush with increased side load tolerance are available on many models. We can also offer scraper and wiper seals around the shaft to protect the bearings from excessive wear in harsh environments.

## Custom Shafts

In addition to the standard male/female rod ends we can also offer options such as "breakaway" shafts and custom shaft diameters.

## 10µm T.I.R.

Total indicator run-out under 10µm is available on several linear/rotary models.

## Rotary

Increased torque/gear ratio can be gained by using alternative geared motors or direct drive motors.

Higher rotary encoder resolutions are optional. Please consult factory for availability.

If a longer life rotary is required, then we can fit a brushless rotary motor.

## Flying Lead

Instead of the standard chassis connector we can offer a flying lead option. The flying lead is standard for all the CA series actuators, except the CAL35 series.

## Cable Options

Whenever an SMAC actuator is mounted to any 3rd party device such as a gantry or multi-axis robot, SMAC strongly recommends that a superflex cable is used. Cable lengths with a standard of 3 meters up to a maximum of 10 meters can be offered.



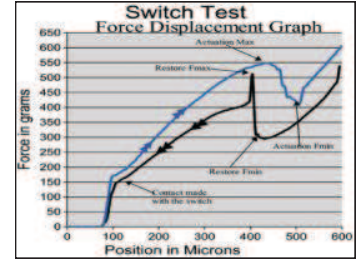
# Sample Applications

## Switch Test



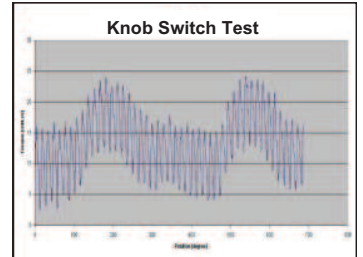
### Application Examples

- Automotive switch test
- Cell phone keypads, membrane keypads
- Touch screens
- Valves, sensors and relays
- PC Keyboards, ATM keypads
- Springs, door latches, etc...

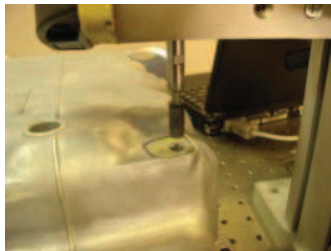


### The SMAC Advantage

- Verify hysteresis and switch differential
- Accurate simulation of human motion profiles
- Combined force and position measurement
- High speed life testing
- 1,000,000 cycles in 8 hours
- QA reporting functions to verify 100% test

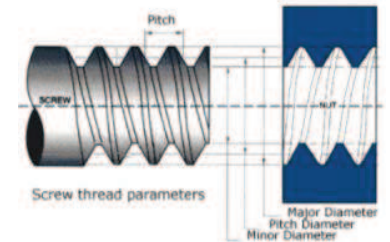


## 100% Automated Thread Check



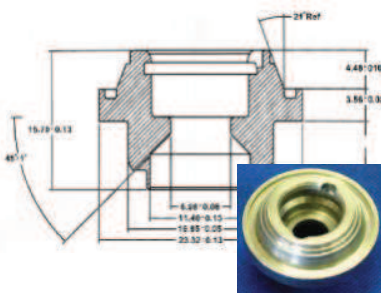
### Verification of:

- Oversized / undersized thread
- Number of threads
- Cross thread
- Thread depth
- No thread or dislocated thread
- Pitch measurement
- Shallow / blocked hole



Increase of torque/gear ratio or higher rotary encoder resolutions are available.

## Measuring, Bore Gauging and Groove Inspection



- Airbag components
- Fuel Injector Plug
- Assembly part inside the fuel injector
- XYZ-Mini CMM
- Internal and External Diameter Gauging
- Height Gauging
- Thickness Gauging
- Multiple Point Gauging

Resolution: 5µm (0.0002 inch) to 0.05µm (1.968x10<sup>-7</sup> inch)



- Verifying the depth and diameter of 50µm x 50µm small pockets in a drum for cigarette manufacturing.

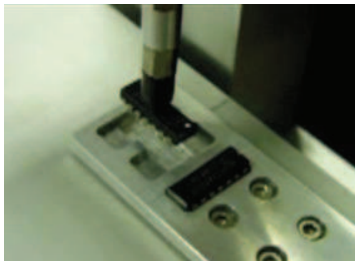
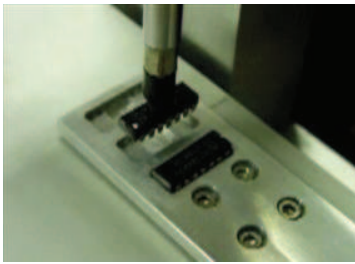
### Problem:

The previous inspection system included a vision system that measured the diameter of each hole but not the depth. The depth could only be verified by manual spot checks.

### SMAC Advantage:

- Precision & contact measuring; the previous system could only measure diameter, but not the depth.
- Fully automate the verification process

## Pick & Place



### Problem:

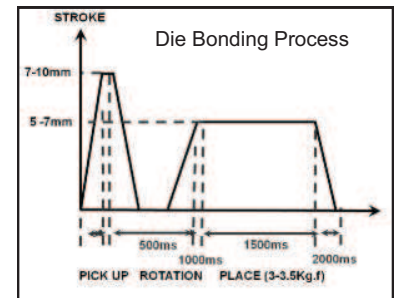
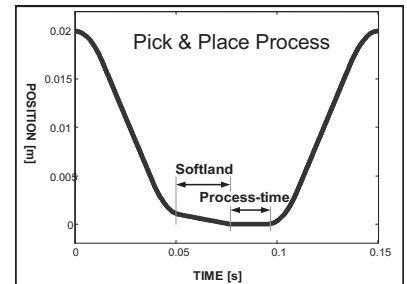
- Different pick up height due to mechanical tolerances
- Low throughput of the machine
- Position accuracy – linear and rotary
- Constant force for positioning needed

### SMAC Solution:

- Finding the chip surface with the Soft-Land function to avoid damages on the parts
- High speed positioning with a direct drive system
- High resolution positioning up to 0.1 micron
- Up to 50000 counts/revolution - 0.007 degrees
- Controlled precise force
- Shaft run-out 20µm standard. (>10micron option)
- Accurate repeatable positioning at +/- 2 encoder counts
- Programmable force/torque, position and velocity in all axes

### Pick & Place Application Examples

- Die bonding
- Smart Card (IC chip mounting)
- Gauging & sorting parts
- Handling small and fragile components



## Tapping



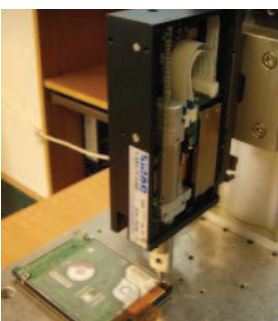
### Application

0.38mm Diameter Smart Tapping for a watch manufacture by using LAR35-050-55F  
The diameter of the part is about 3.5mm and the hole to tap is about 0.38mm.

### Key Features

- Precise force control
- Soft-Land capability
- Precise position control
- Verify thread as the part being tapped.

## Screw Driver



Application image with a LAR31 series linear rotary actuator

### Application

Simplifying the disc drive assembly system by replacing three devices with one linear rotary actuator.

### Problem:

- Difficult to keep precise height alignment at pick and place locations.
- The manual tuning since the end of stroke is a physical adjustment and not programmable.
- The rotary axis is not able to determine position or the linear movement, thus neither the pitch, the number of rotations nor the first thread CCW can be confirmed.
- The cost of the combination, an electric screw driver attached with 2 pneumatic slide, can run up to US\$10,000.

### The SMAC Advantage

- SMAC linear rotary electric actuator is an all in one, off the shelf solution.
- A long stroke with fast approach.
- Soft-Landing function at both linear and rotary positions.
- Constant accurate force control while threading.
- Monitoring the torque and pitch verification: Good, shallow, cross, or no threads as well as the precision of the thread are detected through linear position feedback.
- SMAC provides this at 50% less the cost of the previous method.

## Packaging



- **Cup dispensing:** High speed dispensing at **400+ per minute**. Replaces pneumatic cylinders for higher speed, longer life and quiet operation.
- **De-blistering:** Popping pills is the machine which automates dispensing of tablets from foil and plastic containers. Key points are speed, force control, stroke adjustment and noise.
- **Capping of bottles:** Cap rotates to engage slot. Detect and report no/obstructed nozzle. SMAC actuators can adjust force and torque, show the different quality check capabilities such as cap height, torque limit, force required to press in, and even check the clicks on child proof caps.
- **High Speed on the Fly Labeling:** The label applicator (SMAC actuator) matches the speed of the conveyor as the product through. Adjustable speed and height for the different kind of products and then Soft-Land with controlled force.
- **The Bottle/Carton Ejector for Filling Lines** - Programmable force & speed control adapt easily to different size of bottles and fill level. **Total out and back is 50ms, 1200/min.**
- **Parts Feeding:** 50,000 cycles/hour, 24/7 operation.

## Glass



### Measuring Thickness of Thin Flexible Glass

**Problem:** Accuracy of the current air cylinder, LVDT and force control system.

**Solution:** The customer used the Soft-Land feature of the SMAC LAL20 in conjunction with a load cell mounted on the rod of the SMAC actuator. The LAL20 is controlled by a dual-axis LAC25.

### Glass Grinding

**Problem:** The grinding process produces a 125µm finish with less than a 50µm variation. Damage to the glass at the beginning and end of the grinding cycle is caused by inadequate force control of the air cylinder which is driving the grind wheel. The force required is 2 to 4 Newtons, with a 5mm stroke.

**Solution:** Customer was able to land softly on the glass panel and provide a constant force using the "force mode" of the LAL55 at both beginning and end of the stroke.

### Glass Scoring (V-Cutting)

- Scoring Organic Light Emitting Display (OLED) which measures only 0.5mm thick by using CAL36 series of electric actuator. Precise force control of less than 0.05N required. Soft-Land capability and low friction are key.

### Glass Application Examples

- Glass cutting, de-burring, positioning
- Glass scoring (V-Cutting) for solar panels and LCDs
- Chamfering and bevelling
- Measuring surface profile

## Medical & Bio-Science



- Pull test on medical stent used in Catheters
- Automated screwing caps on a syringe
- Catheter Tube Welding
- Push/Pull testing of Hypodermic Needles
- Measuring cells height in two conditions, dry and saturated.
- Measuring the amount of wear on a knee replacement plate over x amount of time.
- Medical catheter assembly
- Soft contact lens moulding

## Welding

### Key Operation:

Applying even and consistent pressure for EDM assembly electronic-welding equipment.

### SMAC Advantage:

Precise control of the contact force to avoid damaging the parts.

Soft-landing profile uses a high speed approach to save time.

Precise and repeatable positioning.

## Scanning

### Key Operation:

Moving camera/micro scope lens to focus material for inspection or analyse

### SMAC Advantage:

Accurate and repeatable force control and positioning with sub-micron resolution.

Compact size.

Easy set up and programming.