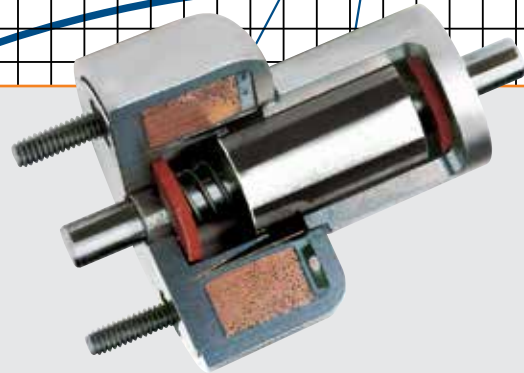
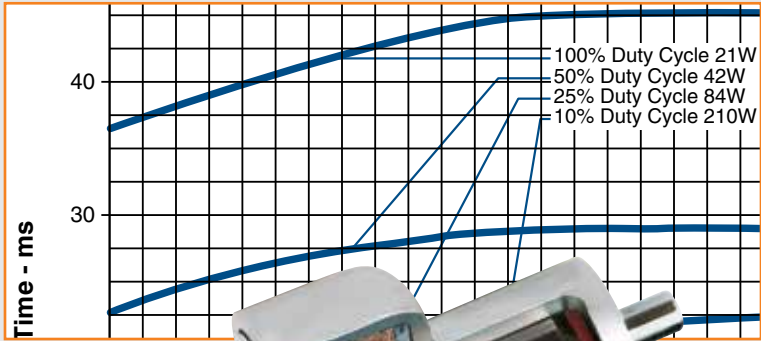


## Soft Shift<sup>®</sup> Linear Solenoids

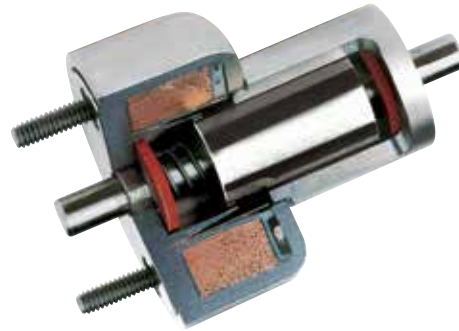


# Soft Shift® Solenoids

LINEAR Soft Shift®



- Variable positioning linear device
- Slow, smooth motion
- High starting force
- Quiet operation
- 10<sup>6</sup> actuation life rating



All catalogue products manufactured after April 1, 2006 are RoHS Compliant

Soft Shift solenoids have a unique construction which allows easy transition from snap action to variable position.

Using the same power, starting force is three to five times higher than standard solenoids at the fully de-energised position. This is advantageous for starting inertial loads or detented mechanisms, and for conserving electrical power.

In snap action applications, typical solenoids move to the end of the stroke within milliseconds, with a characteristic increase in ending force and acceleration. With the Soft Shift solenoid plunger, however, velocity can be controlled by ramping the input current for slow, noiseless operation.

For applications where variable positioning is desired, closed loop control can be accomplished by adding electronic controls. This gives accurate, repeatable action.

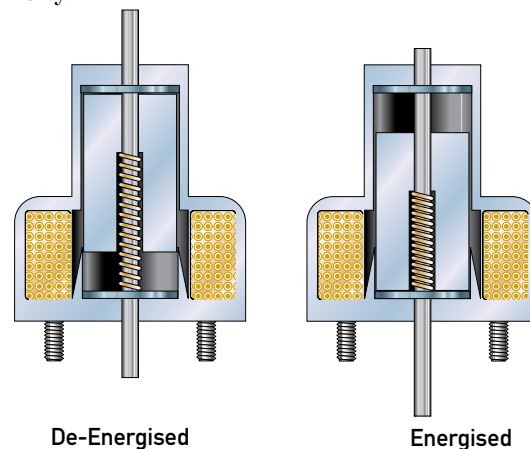
The essentially horizontal force curves prevent rapid acceleration at the end of the stroke, avoiding the excessive wear, noise and vibration that characterise standard solenoids. A Soft Shift solenoid can be a low-cost alternative to a linear stepping motor with a lead screw for up to and including a 10.7 mm stroke.

## Performance Curves

The performance curves in this section serve as guides to determine the solenoid size needed to produce a desired force at a given stroke, duty cycle, and power source. All curves were developed under the following standard test conditions: ambient temperature of 20°C, 65% relative humidity.

## Starting Force

When determining an application's force requirement, apply a 1.5 safety factor. For example: a load requiring 1.0 N of force should utilise a solenoid providing 1.0 N x 1.5 or 1.5 N of force.



# Soft Shift® Solenoids

## Duty Cycle

Duty cycle is determined by:  $ON\ time / (ON + OFF\ time)$ .

For example: a solenoid is actuated for 30 seconds, then off for 90 seconds.  $30\ sec\ ON / (30\ Sec\ ON + 90\ sec\ OFF) = 30/120 = 1/4$  or 25% duty cycle.

Ledex Soft Shift® solenoids are rated for various duty cycles ranging from continuous to 10% duty.

Note that maximum ON time for a particular application can be a factor which overrides the duty cycle rating. For example, at 25% duty cycle, the maximum ON time for a given Soft Shift solenoid is 36 seconds. If, however, the solenoid is operated at a cycle rate which enables the unit to return to ambient temperature between ON cycles, then the maximum ON time is extended somewhat. In the above example, this extended ON time is 44 seconds. Maximum ON time ratings are listed on the individual model specification pages.

## Life

When selecting a Soft Shift solenoid, as with any other solenoid style, it is important to consider the effects of heat on life. When used with a constant voltage supply, an increase in coil temperature reduces the work output and the life of the unit. Standard life is 10,000,000 operations.

## Power Requirements

Voltage applied to the solenoid must be matched to the coil wire size for proper operation. Solenoids are catalogued in coil awgs ranging from #25 up to #35 to accommodate your input power. Refer to the individual model specification pages for coil wire awg recommendations. Many other coil awg sizes are available. Please feel free to contact our application engineering department for availability.

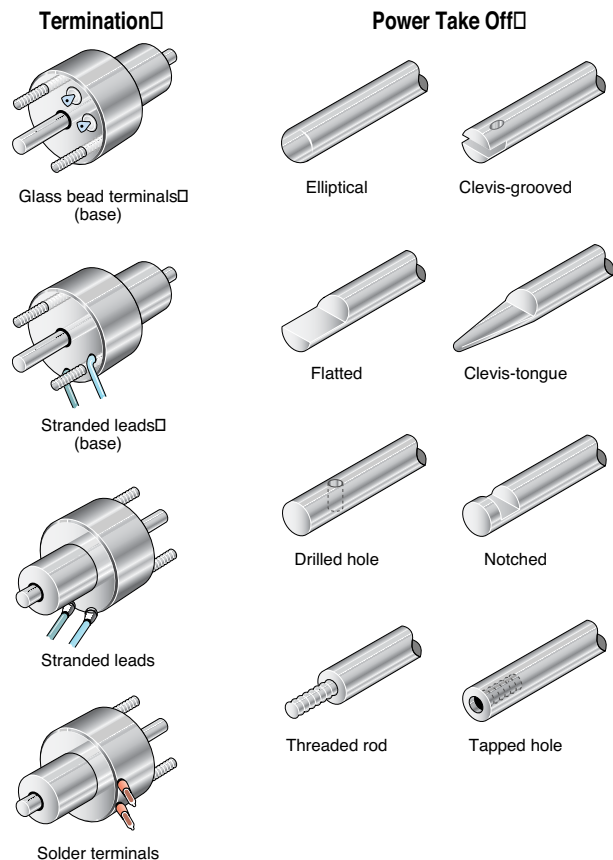
## Applications

Applications for the Soft Shift solenoid include office machinery, medical equipment, keypad testing, locking devices, motion control, hot water solar controllers, robotics, air dampers, optical shutter equipment, and a variety of other industrial applications as well as military uses.

Our catalogue versions are typically designed to utilise the maximum possible stroke capability for each size. Also, the force curves are essentially horizontal. This permits use in applications where quiet operation is a primary concern or where the load to be moved is sensitive to vibration or shock.

A medical fluid analyzer is a good example. The tubes through which fluids are flowing cannot withstand great shock. Excessive shock could cause breakage of the tubes which could then cause a leak of an infectious fluid, for example.

## Typical Examples of Custom Features



Soft Shift solenoids also contain cushion washers to aid quiet, shock-free operation. In addition, voltage can be applied slowly to take advantage of a slow energizing capability. The de-energizing part of the cycle is also controllable.

A Soft Shift solenoid is also a good choice for long life applications in that its two bearings de-sensitise the unit to side loading. The closed construction also keeps out contaminants, which makes it ideal for rugged applications.

## Options and Modified Designs

Even though many solenoid designs are in stock, our customers often require a product with unique features or performance capabilities. In fact, almost 80% of all solenoids that we make are either modified or custom built to meet our customers' exact application requirements.

So, if you don't find what you're looking for in the catalogue, give us a call to discuss your needs with one of our application engineers.

# Soft Shift® Selection

Soft Shift solenoids are available in five sizes. Use the selection overview chart to determine which size offers the desired performance and mechanical specifications. Refer to the individual size specification pages for complete performance and mechanical data.

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Soft Shift Selection Overview

Size	Package Dimensions (mm)		Maximum Stroke mm	Force (N) @ Maximum Stroke and Specified Duty Cycle			
	Dia.	Length		100%	50%	25%	10%
2EPM ●	28.6	25.3	4.1	4.45	6.23	8.9	16.46
3EPM	33.3	31.9	6.4	4.45	8.01	10.24	19.14
4EPM	39.7	37.4	7.6	8.90	13.35	19.14	33.38
5EPM	47.6	49.1	10.2	13.35	20.02	31.15	55.62
6EPM	57.2	56.2	10.7	31.15	42.72	71.20	131.28

All data is at 20°C coil temperature. Force outputs degrade with elevated temperatures.

● Well-suited for battery operation.



See the "Battery Operated Solenoids" section for complete information.

LINEAR Soft Shift®

## How to Use Soft Shift Performance Charts

- Select one of the four columns which provides the appropriate duty cycle. (For example 50%.)
- Reading down this column provides a variety of performance and electrical data including maximum on time, watts, and amp turns.
- Following down the column further into the VDC ratings, select the voltage which most closely matches your supply voltage. (For example, 12.5 for a 12 VDC power supply.)
- Read across (to the left) to select the awg suffix to complete the part number when ordering. (In this example using our 2EPM chart, 30 awg is required, thus to order, specify: 196655-030.)

## Performance

Maximum Duty Cycle	100%	50%	25%	10%		
Maximum ON Time (sec) when pulsed continuously	∞	100	36	7		
Maximum ON Time (sec) for single pulse	∞	162	44	8		
Watts (@ 20°C)	7	14	28	70		
Ampere Turns (@ 20°C)	425	602	849	1350		
Coil Data						
awg (0XX)	Resistance (@20°C)	# Turns	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
24	0.68	130	2.2	3.2	4.5	7.1
25	1.16	174	2.8	4.0	5.7	9.0
26	1.96	231	3.6	5.1	7.2	11.5
27	3.16	296	4.5	6.4	9.0	14.4
28	5.10	378	5.7	8.1	11.5	18.2
29	6.94	423	7.0	9.9	13.9	22.0
30	11.03	530	8.8	12.5	17.7	28.0
31	16.85	649	11.0	15.6	22.0	35.0
32	28.15	858	13.9	19.8	28.0	44.0
33	42.75	1036	17.5	25.0	35.0	56.0
34	69.56	1312	23.0	32.0	45.0	72.0
35	112.00	1674	29.0	40.0	57.0	91.0

Force values for reference only.

All specifications subject to change without notice.

# Soft Shift® Size 2EPM

Part Number: 196655-0XX

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Performance

Maximum Duty Cycle	100%	50%	25%	10%
Maximum ON Time (sec) when pulsed continuously <sup>1</sup>	∞	100	36	7
Maximum ON Time (sec) for single pulse <sup>2</sup>	∞	162	44	8
Watts (@ 20°C)	7	14	28	70
Ampere Turns (@ 20°C)	425	602	849	1350

### Coil Data

awg (0XX) <sup>3</sup>	Resistance (@20°C)	# Turns <sup>4</sup>	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
24	0.68	130	2.2	3.2	4.5	7.1
25	1.16	174	2.8	4.0	5.7	9.0
26	1.96	231	3.6	5.1	7.2	11.5
27	3.16	296	4.5	6.4	9.0	14.4
28	5.10	378	5.7	8.1	11.5	18.2
29	6.94	423	7.0	9.9	13.9	22.0
30	11.03	530	8.8	12.5	17.7	28.0
31	16.85	649	11.0	15.6	22.0	35.0
32	28.15	858	13.9	19.8	28.0	44.0
33	42.75	1036	17.5	25.0	35.0	56.0
34	69.56	1312	23.0	32.0	45.0	72.0
35	112.00	1674	29.0	40.0	57.0	91.0

- <sup>1</sup> Continuously pulsed at stated watts and duty cycle
- <sup>2</sup> Single pulse at stated watts (with coil at ambient room temperature 20°C)
- <sup>3</sup> Other coil awg sizes available — please consult factory
- <sup>4</sup> Reference number of turns

## Specifications

Stroke	4.06 ± 0.762 mm
Dielectric Strength	1000 VRMS
Recommended Minimum Heat Sink	Maximum watts dissipated by solenoid are based on an unrestricted flow of air at 20°C, with solenoid mounted on the equivalent of an aluminium plate measuring 85.7 mm square by 3.2 mm thick
Coil Resistance	±5% tolerance on all coil awg
Spring Rate	123.2 Nmm; 0.6 N ±30% preload reference
Weight	70.9 g
Dimensions	See page E10

## How to Order

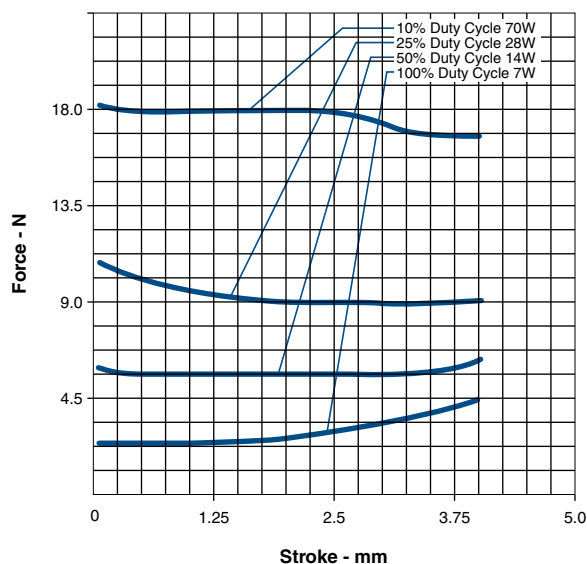
Add the coil awg number (0XX) to the part number (for example: to order a 25% duty cycle unit rated at 9 VDC, specify 196655-027).

Please see [www.lex.com](http://www.lex.com) (click on Stock Products tab) for our list of stock products available through our distributors.

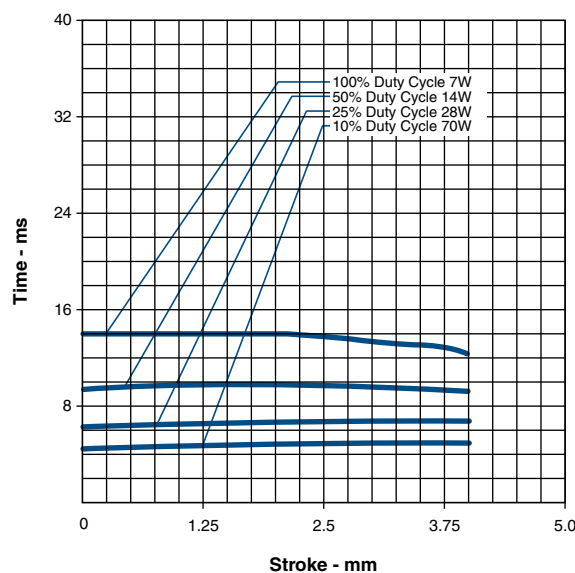
- Well-suited for battery operation. See the "Battery Operated Solenoids" section for complete information.



## Size 2EPM — Typical Force @ 20°C



## Size 2EPM — Typical Speed @ No Load, 20°C



Force values for reference only.

All specifications subject to change without notice.

# Soft Shift® Size 3EPM

Part Number: 196656-0XX

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Performance

Maximum Duty Cycle	100%	50%	25%	10%
Maximum ON Time (sec) when pulsed continuously <sup>1</sup>	∞	100	36	8
Maximum ON Time (sec) for single pulse <sup>2</sup>	∞	162	44	9
Watts (@ 20°C)	9	18	36	90
Ampere Turns (@ 20°C)	535	756	1070	1690

### Coil Data

awg (0XX) <sup>3</sup>	Resistance (@20°C)	# Turns <sup>4</sup>	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
23	0.70	145	2.6	3.7	5.2	8.2
24	1.18	192	3.3	4.6	6.6	10.4
25	1.97	252	4.2	5.9	8.4	13.2
26	3.26	328	5.3	7.5	10.6	16.8
27	5.04	405	6.7	9.4	13.3	21.0
28	8.02	510	8.4	11.9	16.8	27.0
29	12.21	627	10.4	14.7	21.0	33.0
30	19.20	780	13.2	18.6	26.0	42.0
31	31.84	1008	16.9	24.0	34.0	53.0
32	46.97	1215	21.0	29.0	41.0	65.0
33	75.30	1530	26.0	37.0	53.0	83.0

- <sup>1</sup> Continuously pulsed at stated watts and duty cycle
- <sup>2</sup> Single pulse at stated watts (with coil at ambient room temperature 20°C)
- <sup>3</sup> Other coil awg sizes available — please consult factory
- <sup>4</sup> Reference number of turns

## Specifications

Stroke	6.35 ± 0.762 mm
Dielectric Strength	1000 VRMS (23-27 awg); 1200 VRMS (28-33 awg)
Recommended Minimum Heat Sink	Maximum watts dissipated by solenoid are based on an unrestricted flow of air at 20°C, with solenoid mounted on the equivalent of an aluminium plate measuring 117.5 mm square by 3.2 mm thick
Coil Resistance	±5% tolerance on all coil awg
Spring Rate	82.5 Nmm: 1.0 N ±30% preload reference
Weight	113.4 g
Dimensions	See page E10

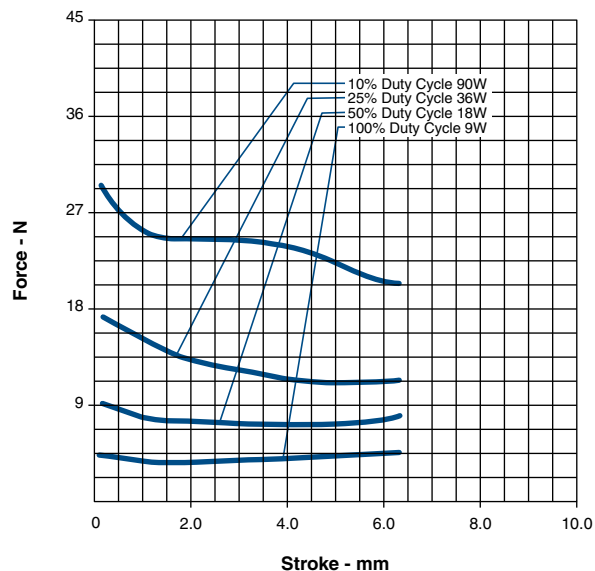
## How to Order

Add the coil awg number (0XX) to the part number (for example: to order a 25% duty cycle unit rated at 13.3 VDC, specify 196656-027).

Please see [www.ledex.com](http://www.ledex.com) (click on Stock Products tab) for our list of stock products available through our distributors.

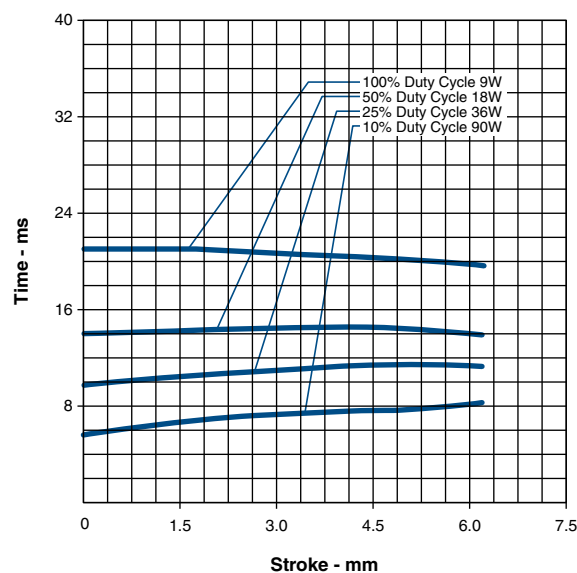
LINEAR Soft Shift®

## Size 3EPM — Typical Force @ 20°C



Force values for reference only.

## Size 3EPM — Typical Speed @ No Load, 20°C



All specifications subject to change without notice.

# Soft Shift® Size 4EPM

Part Number: 196657-0XX

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Performance

Maximum Duty Cycle	100%	50%	25%	10%
Maximum ON Time (sec) when pulsed continuously <sup>1</sup>	∞	100	36	9
Maximum ON Time (sec) for single pulse <sup>2</sup>	∞	162	44	10
Watts (@ 20°C)	12.5	25	50	125
Ampere Turns (@ 20°C)	714	1000	1425	2250

### Coil Data

awg (0XX) <sup>3</sup>	Resistance (@20°C)	# Turns <sup>4</sup>	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
23	1.59	266	4.3	6.0	8.5	13.4
24	2.20	301	5.2	7.3	10.4	16.4
25	3.54	384	6.6	9.2	13.1	21.0
26	5.67	486	8.3	11.7	16.6	26.0
27	8.76	600	10.4	14.6	21.0	33.0
28	13.80	748	13.2	18.5	26.0	42.0
29	22.60	975	16.6	23.0	33.0	52.0
30	34.80	1190	21.0	29.0	42.0	66.0
31	56.70	1520	27.0	37.0	53.0	84.0
32	88.30	1908	33.0	46.0	66.0	104.0
33	138.00	2360	42.0	59.0	83.0	132.0

- <sup>1</sup> Continuously pulsed at stated watts and duty cycle
- <sup>2</sup> Single pulse at stated watts (with coil at ambient room temperature 20°C)
- <sup>3</sup> Other coil awg sizes available — please consult factory
- <sup>4</sup> Reference number of turns

## Specifications

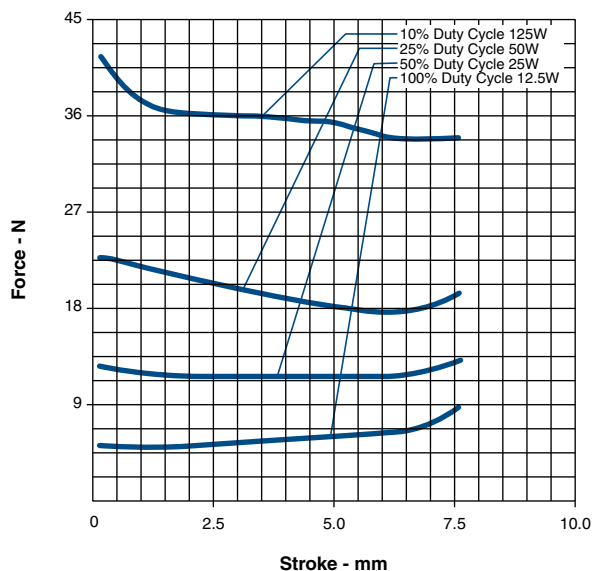
Stroke	7.62 ± 0.762 mm
Dielectric Strength	1000 VRMS (23-24 awg); 1200 VRMS (25-33 awg)
Recommended Minimum Heat Sink	Maximum watts dissipated by solenoid are based on an unrestricted flow of air at 20°C, with solenoid mounted on the equivalent of an aluminium plate measuring 158.8 mm square by 3.2 mm thick
Coil Resistance	±5% tolerance on all coil awg
Spring Rate	159.3 Nmm; 1.6 N ±30% preload reference
Weight	198.4 g
Dimensions	See page E10

## How to Order

Add the coil awg number (0XX) to the part number (for example: to order a 25% duty cycle unit rated at 21 VDC, specify 196657-027).

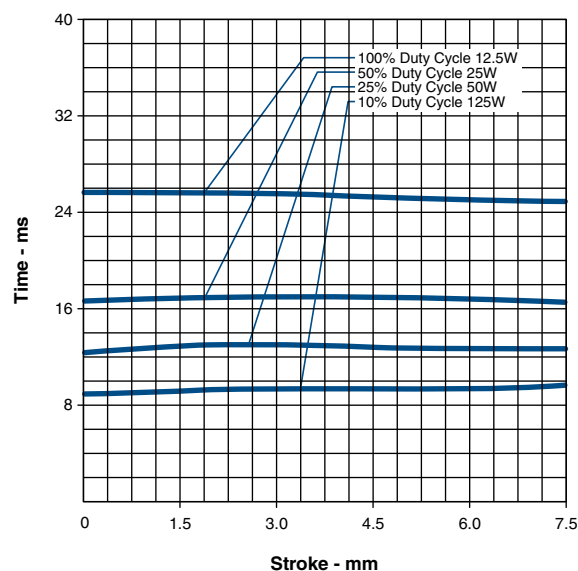
Please see [www.lex.com](http://www.lex.com) (click on Stock Products tab) for our list of stock products available through our distributors.

## Size 4EPM — Typical Force @ 20°C



Force values for reference only.

## Size 4EPM — Typical Speed @ No Load, 20°C



All specifications subject to change without notice.

# Soft Shift® Size 5EPM

Part Number: 196658-0XX

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Performance

Maximum Duty Cycle	100%	50%	25%	10%
Maximum ON Time (sec) when pulsed continuously <sup>1</sup>	∞	100	36	10
Maximum ON Time (sec) for single pulse <sup>2</sup>	∞	160	44	13
Watts (@ 20°C)	21	42	84	210
Ampere Turns (@ 20°C)	1015	1440	2030	3210

### Coil Data

awg (0XX) <sup>3</sup>	Resistance (@20°C)	# Turns <sup>4</sup>	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
23	2.70	384	7.2	10.1	14.3	23.0
24	4.30	486	9.0	12.7	18.0	28.0
25	6.66	590	11.5	16.2	23.0	36.0
26	10.30	737	14.0	20.0	28.0	44.0
27	15.70	900	17.7	25.0	35.0	56.0
28	26.60	1190	23.0	32.0	45.0	72.0
29	38.00	1380	28.0	40.0	56.0	89.0
30	62.10	1768	36.0	51.0	71.0	113.0
31	96.10	2166	45.0	64.0	90.0	143.0
32	157.00	2816	57.0	80.0	113.0	179.0
33	241.00	3432	71.0	101.0	143.0	226.0

- <sup>1</sup> Continuously pulsed at stated watts and duty cycle
- <sup>2</sup> Single pulse at stated watts (with coil at ambient room temperature 20°C)
- <sup>3</sup> Other coil awg sizes available — please consult factory
- <sup>4</sup> Reference number of turns

## Specifications

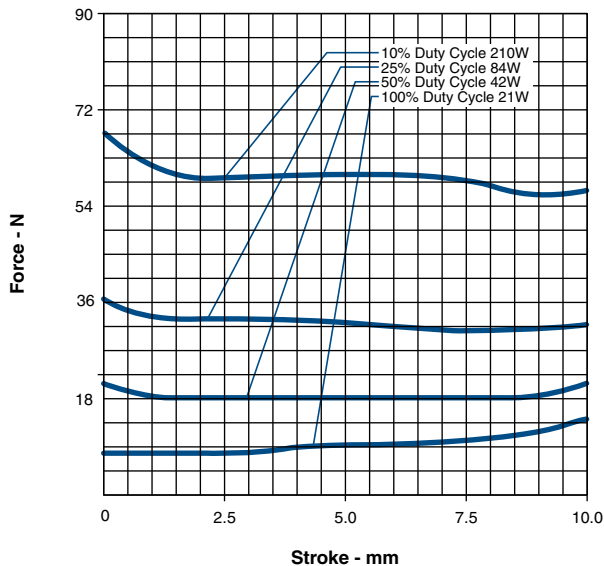
Stroke	0.400 ± 0.030 inches (10.16 ± 0.762 mm)
Dielectric Strength	1000 VRMS (23 awg); 1200 VRMS (24-33 awg)
Recommended Minimum Heat Sink	Maximum watts dissipated by solenoid are based on an unrestricted flow of air at 20°C, with solenoid mounted on the equivalent of an aluminium plate measuring 190.5 mm square by 3.2 mm thick
Coil Resistance	±5% tolerance on all coil awg
Spring Rate	498.3 Nmm; 2.0 N ±30% preload reference
Weight	340.2 g
Dimensions	See page E10

## How to Order

Add the coil awg number (0XX) to the part number (for example: to order a 25% duty cycle unit rated at 35 VDC, specify 196658-027).

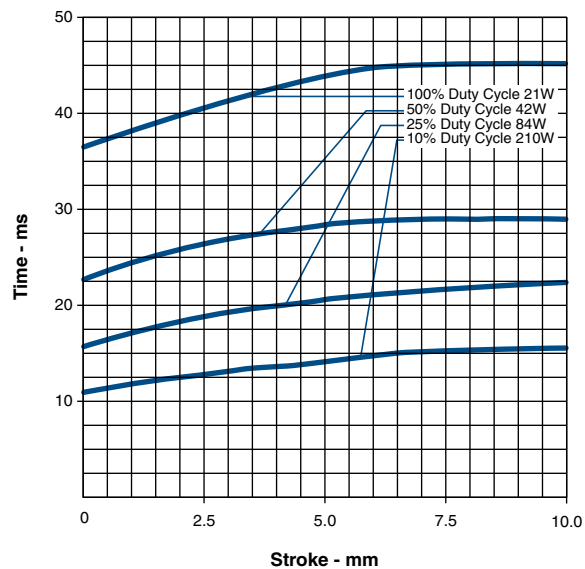
Please see [www.ledex.com](http://www.ledex.com) (click on Stock Products tab) for our list of stock products available through our distributors.

## Size 5EPM — Typical Force @ 20°C



Force values for reference only.

## Size 5EPM — Typical Speed @ No Load, 20°C



All specifications subject to change without notice.



# Soft Shift® Size 6EPM

Part Number: 196659-0XX

All catalogue products manufactured after April 1, 2006 are RoHS Compliant

## Performance

Maximum Duty Cycle	100%	50%	25%	10%
Maximum ON Time (sec) when pulsed continuously <sup>1</sup>	∞	87	36	13
Maximum ON Time (sec) for single pulse <sup>2</sup>	∞	140	44	16
Watts (@ 20°C)	32	64	128	320
Ampere Turns (@ 20°C)	1480	2080	2940	4620

Coil Data						
awg (0XX) <sup>3</sup>	Resistance (@20°C)	# Turns <sup>4</sup>	VDC (Nom)	VDC (Nom)	VDC (Nom)	VDC (Nom)
23	4.69	567	12.3	17.2	24.0	38.0
24	7.43	710	15.5	22.0	31.0	48.0
25	12.90	960	19.9	28.0	39.0	62.0
26	19.70	1170	25.0	35.0	49.0	78.0
27	32.00	1500	32.0	44.0	63.0	99.0
28	51.60	1904	40.0	56.0	79.0	125.0
29	74.40	2232	49.0	69.0	98.0	154.0
30	126.00	2940	63.0	89.0	126.0	198.0
31	195.00	3611	80.0	112.0	159.0	250.0
32	288.00	4350	98.0	138.0	195.0	306.0
33	427.00	5010	126.0	177.0	251.0	394.0

- <sup>1</sup> Continuously pulsed at stated watts and duty cycle
- <sup>2</sup> Single pulse at stated watts (with coil at ambient room temperature 20°C)
- <sup>3</sup> Other coil awg sizes available — please consult factory
- <sup>4</sup> Reference number of turns

## Specifications

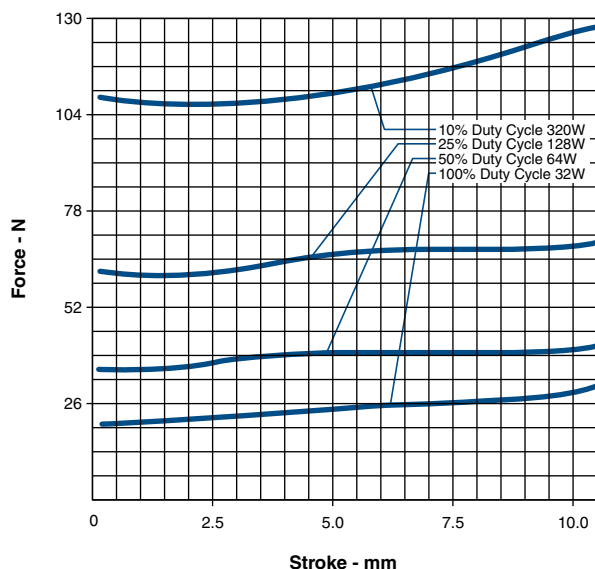
Stroke	10.67 ± 0.762 mm
Dielectric Strength	1200 VRMS (23-31 awg); 1500 VRMS (32-33 awg)
Recommended Minimum Heat Sink	Maximum watts dissipated by solenoid are based on an unrestricted flow of air at 20°C, with solenoid mounted on the equivalent of an aluminium plate measuring 314.3 mm square by 3.2 mm thick
Coil Resistance	±5% tolerance on all coil awg
Spring Rate	535.6 Nmm; 4.8 N ±30% preload reference
Weight	652 g
Dimensions	See page E10

## How to Order

Add the coil awg number (0XX) to the part number (for example: to order a 25% duty cycle unit rated at 63 VDC, specify 196659-027).

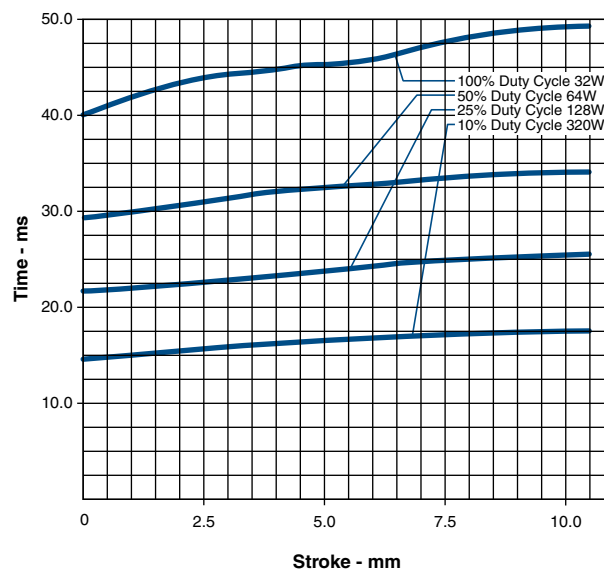
Please see [www.ledex.com](http://www.ledex.com) (click on Stock Products tab) for our list of stock products available through our distributors.

## Size 6EPM — Typical Force @ 20°C



Force values for reference only.

## Size 6EPM — Typical Speed @ No Load, 20°C



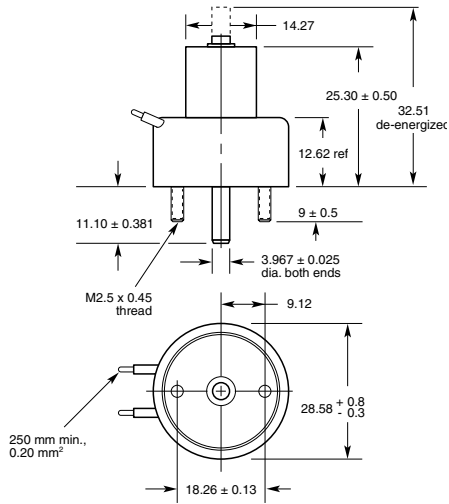
All specifications subject to change without notice.

# Soft Shift® Dimensions

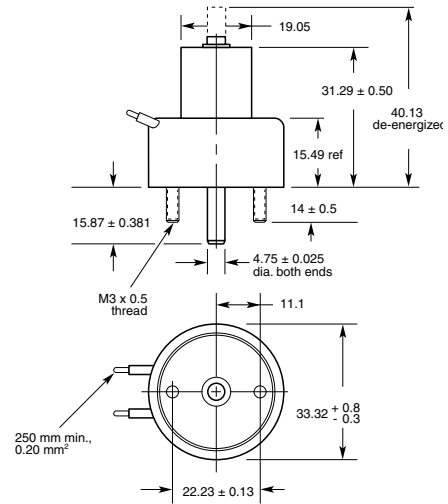
mm

All solenoids are illustrated in energised state

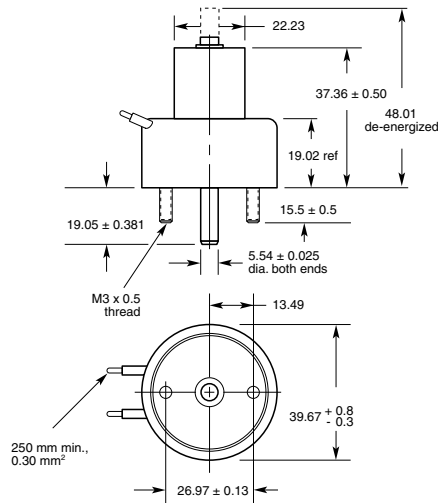
## Size 2EPM



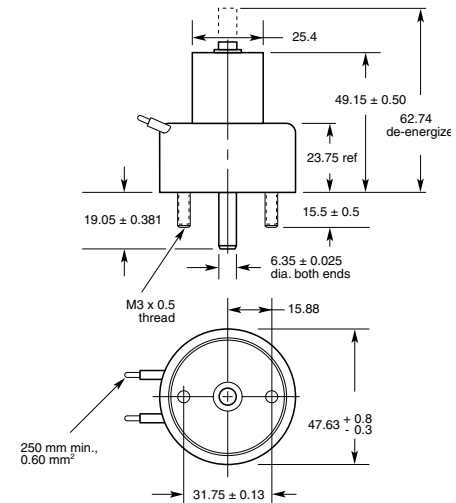
## Size 3EPM



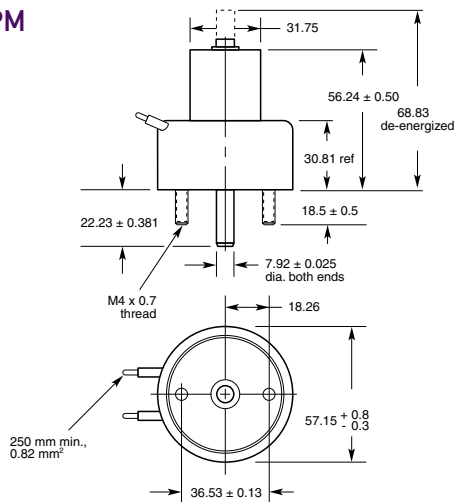
## Size 4EPM



## Size 5EPM



## Size 6EPM



All specifications subject to change without notice.