



Permanent Magnet Solenoids (Self Holding)

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PERMANENT MAGNET (Self Holding) SOLENOIDS

1. Design and Features

The permanent magnet solenoids (also known as magnetic latching or self holding solenoids) is a product line of linear open frame solenoids that utilize the advantages of a high performance permanent magnet. The principle of operation is similar to all linear solenoids. When the coil is energized, the plunger moves toward the pole piece. The advantage of the PM solenoid is that once energized and plunger movement has occurred, the plunger will remain in the energized position without any further electrical power input. This "holding" feature is accomplished because the permanent magnet creates a magnetic latching field that maintains the plunger in the closed or energized position. There are two types of PM solenoid configurations: one is a single direction holding design and the other is a two direction holding design. The one direction design uses a PM to hold the solenoid in the energized position, Fig 1. The two direction design uses a PM that can hold the enclosed plunger in two different positions at both ends of the stroke. This is effected by the use of two separate coils and pole pieces, Fig 2.

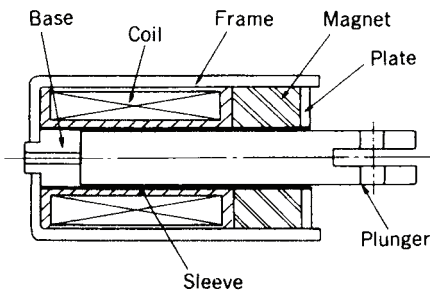


Fig. 1 One Direction

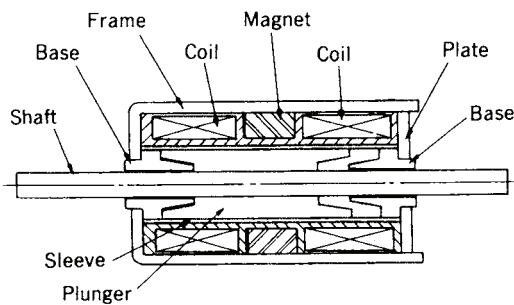


Fig. 2 Two Direction

2. Stroke, Force and Holding Force

The PM type solenoids can be used in both short and long stroke applications. As such, the pole piece designs are both conical and flat depending upon the performance requirements. To improve efficiency, the solenoid stroke should be minimized in the application.

3. Operational Considerations

A) Temperature

The coil data for the permanent magnet solenoid shows the values at ambient temperature 20° C and a duty cycle of 25% (SH2LC0524 is duty cycle 10%). The solenoid coil can operate at temperatures up to 105°C. Most applications using PM solenoids are intermittent applications (as the permanent magnet is used for holding). Please note the maximum on time to prevent potential thermal damage.

B) Operation

The PM solenoid is different than traditional solenoids, in that electrical polarity is important to obtain proper operation. The lead wires from the coil are color coded and must be wired to the appropriate electrical connections (plus and minus terminals). With current flowing in one direction (when energizing the solenoid) the coils magnetic field and the permanent magnet field are additive. To release the solenoid from the "hold" position, the coil field has to cancel the permanent magnet field, thus current has to flow in the opposite direction to the pull in current flow.

C) Return Spring

In a one direction design it is advantageous to use a return spring to prevent inadvertent plunger "pull in" that could be caused by the magnetic field from the permanent magnet.

D) Plunger and Shaft Modifications

It is not recommended that the customer modify the plunger or shaft, as the shafts are manufactured and plated at the factory. Any special configurations can be supplied. Please consult the factory for details.

E) Handling

The permanent magnet solenoid utilizes a permanent magnet that will attract metal particles and care must be taken to prevent these particles from becoming "attached" to the solenoid.

PERMANENT MAGNET (Self Holding) SOLENOIDS

F) Installation of Solenoid

The PM type solenoid uses tapped holes for mounting in the frame.

Caution needs to be observed that the mounting screws used to attach these solenoids are the correct length so as not to damage the coil.

4. General Characteristics

Insulation class	Class A (105° C) Lead wire class A (105° C)
Dielectric strength	AC 1000V 50/60 Hz 1 min. (at normal temperature and normal humidity)
Insulation resistance	More than 100 Mohm at DC 500V megger (at normal temperature and normal humidity)
Expected life	200,000 cycles (Solenoid cycle life is very dependent upon side load, frequency of use, and environmental conditions. Cycle life tests should be performed by the customer.)

5. How to Select a Solenoid

Before selecting a permanent magnetic solenoid, the following information must be determined :

A) Attraction Force and Holding Force

The actual force required for both "pull in" and "holding" in the application should be increased using a safety factor multiplier of 1.5 to arrive at the force value that should be used in your specification.

B) Duty Cycle

Most applications using PM solenoids are intermittent applications (as the permanent magnet is used for holding), the duty cycle for each solenoid is shown in the catalog. Please note the maximum on time to prevent potential thermal damage.

C) Stroke

The stroke for a one direction PM solenoid is determined by application requirements. For a two direction PM solenoid the stroke is determined by the solenoid selected.

D) Operating Voltage

Operating DC voltage is determined by the application and voltage available.

After determining these specifications, one can find the correct size solenoid for the application, using the force-stroke characteristic tables and graphs. The coil data is also shown for different sizes of magnet wire. If the exact operating voltage is not in the coil data table, please consult the factory for details. Note: In a one direction PM solenoid, to "release" the PM field so that the plunger can return to the de-energized position the appropriate level of reverse current must be applied to the coil. The data for this "release" current is shown in the coil data given for each size solenoid.

To determine the force output of the solenoid after temperature rise, please use the amp-turn force graphs (page 112) after calculating the amp-turns.

6. Ordering Information

- When ordering a permanent magnet solenoid, the correct part number needs to be determined, from the catalog information.
- Example of a complete part number.
SHILC0524-06 (One direction holding, conical face type and 6V coil)
SH2LC0730-12 (Two direction holding, conical face type and 12V coil)

7. Labeling

For permanent magnet solenoids the part number labeling is as follows:

A) Standard Solenoid (no modifications).

The solenoid label will have the part number and the date code (which identifies the year and week of manufacture).

Example : SHILC0524-06 9401

Solenoid Size (Type No.) ————|

Date Code (year and week) ————|

B) Special Configuration (required for any modification to a standard design)

Any change from the standard catalog design requires that a custom part number be assigned, which will also include the date code of manufacture.

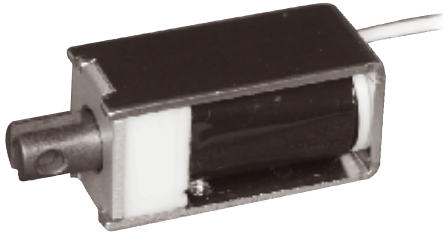
Example : M94015SH 9401

Special Part Number ————|

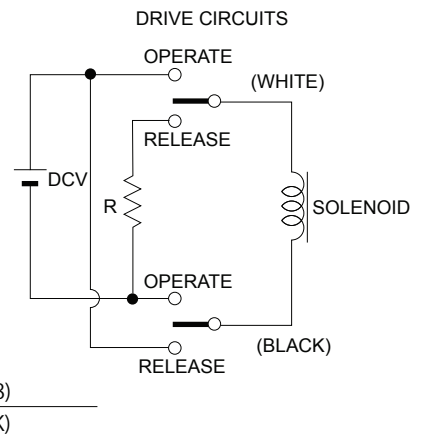
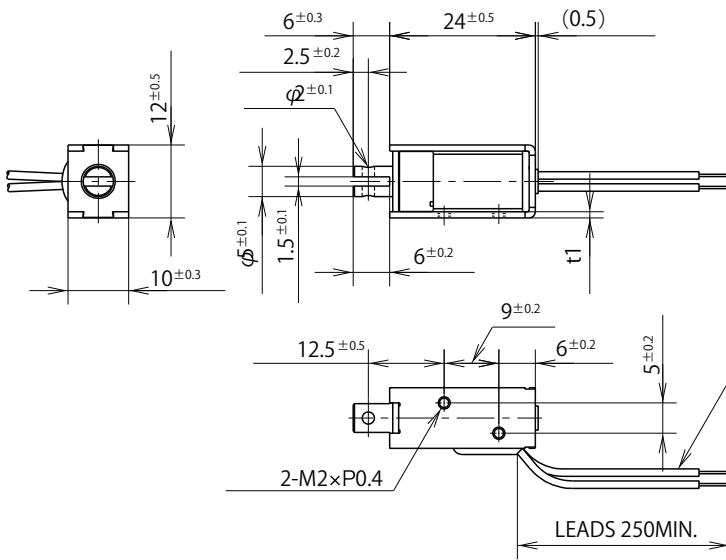
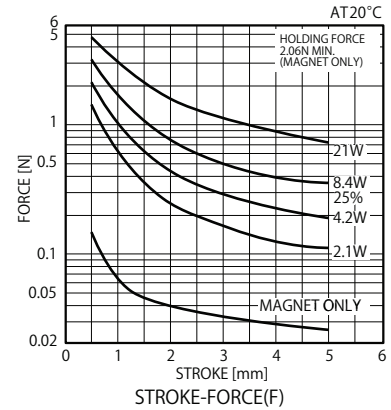
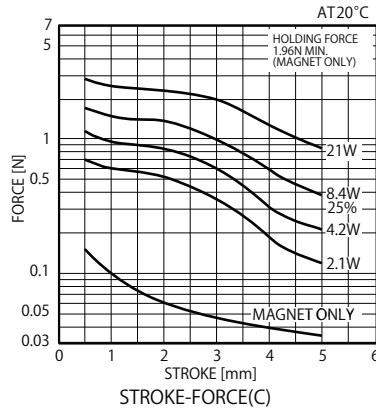
Date Code (year and week) ————|

SH1LC0524,SH1LF0524 PERMANENT MAGNET SOLENOID

UNIT : mm
SHOWN ENERGIZED



WEIGHT : 14g
PLUNGER: 3.3g



COIL DATA

without heat sink

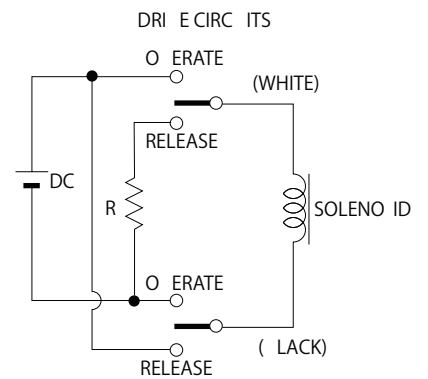
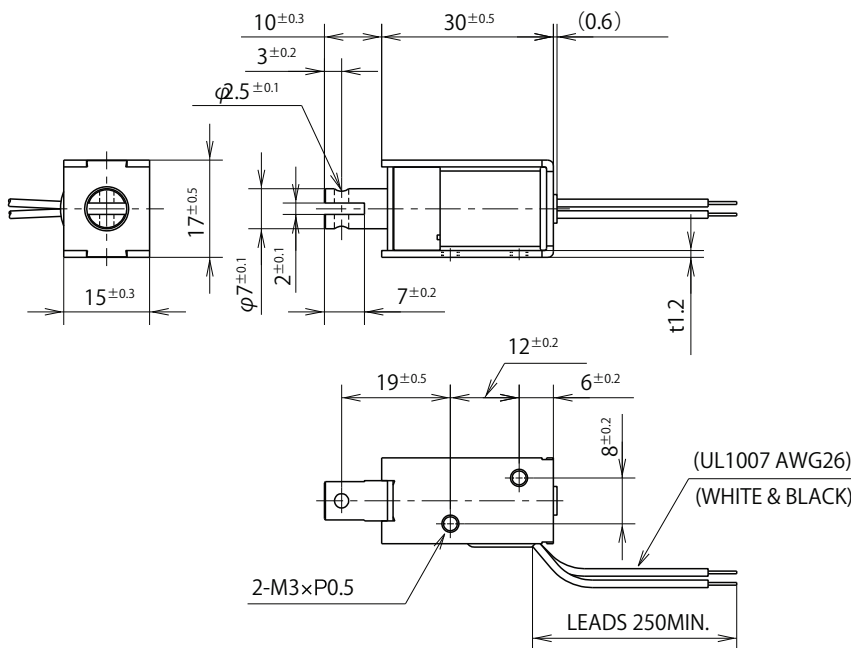
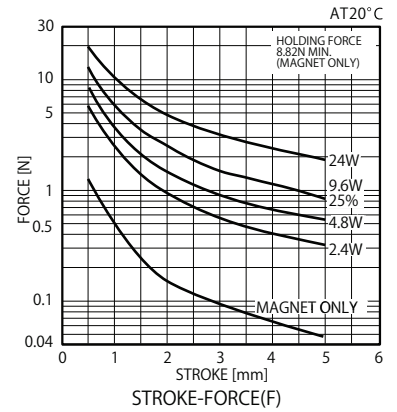
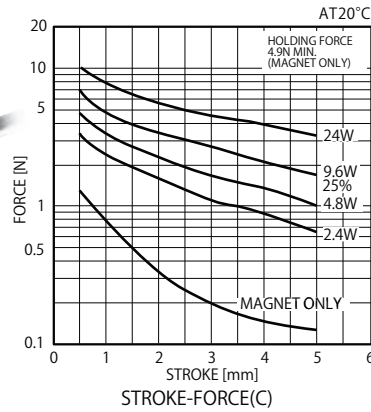
	duty cycle $\Rightarrow \frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		25% or less	release current (reference)
	MAX. "on" time in seconds		5	
	watts at 20°C		8.4	
	ampere-turns at 20°C		452	
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC	ampere
SH1LC0524-06 SH1LF0524-06	4.3	340	6	360mA
SH1LC0524-12 SH1LF0524-12	17.1	630	12	200mA
SH1LC0524-24 SH1LF0524-24	68.6	1260	24	100mA

SH1LC0730,SH1LF0730 PERMANENT MAGNET SOLENOID

UNIT : mm
SHOWN ENERGIZED



WEIGHT : 38g
PLUNGER: 9.2g



COIL DATA

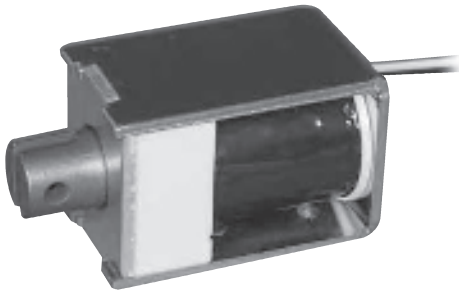
without heat sink

	duty cycle = $\frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		25% or less	release current (reference)
	MAX. "on" time in seconds		10	
	watts at 20°C		9.6	
	ampere-turns at 20°C		614	
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC	ampere
SH1LC0730-06 SH1LF0730-06	3.8	385	6	650mA
SH1LC0730-12 SH1LF0730-12	15	780	12	320mA
SH1LC0730-24 SH1LF0730-24	60	1530	24	160mA

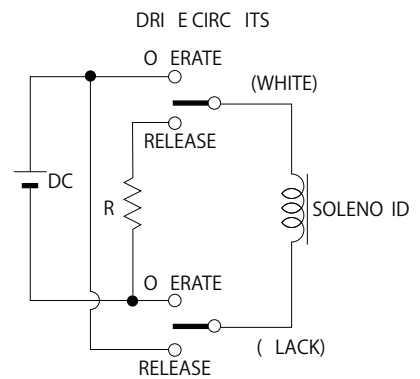
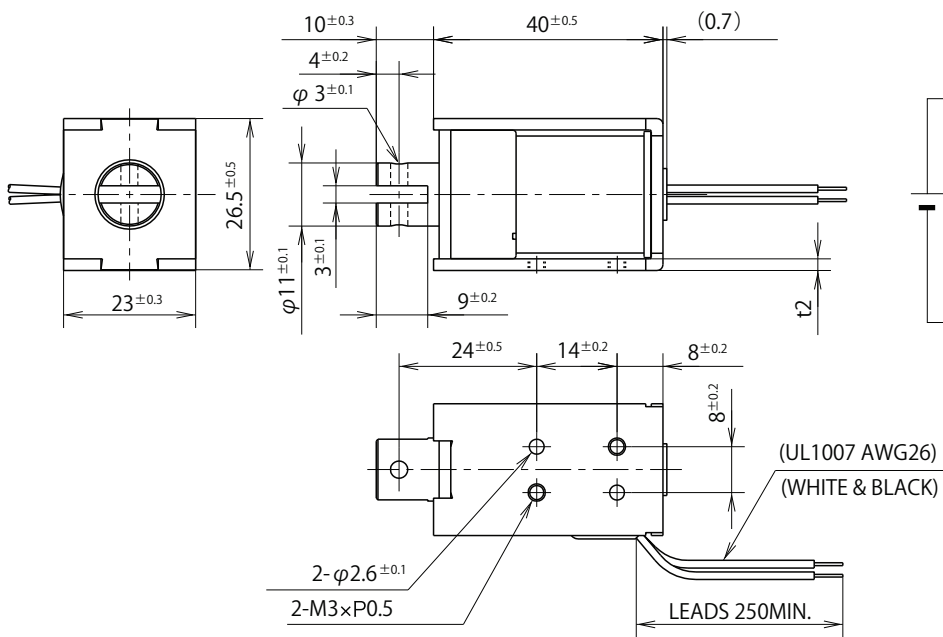
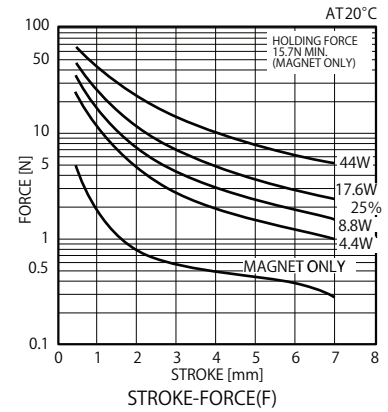
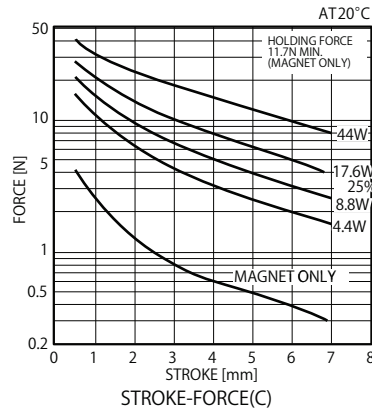
Permanent Magnet(Self Holding) Solenoids

SH1LC1140,SH1LF1140 PERMANENT MAGNET SOLENOID

UNIT : mm
SHOWN ENERGIZED



WEIGHT : 120g
PLUNGER: 28g



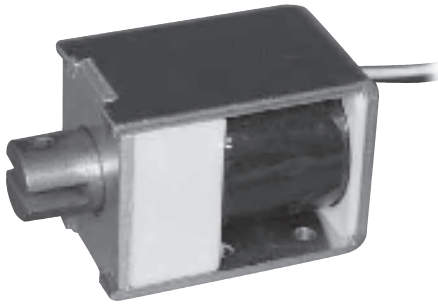
COIL DATA

without heat sink

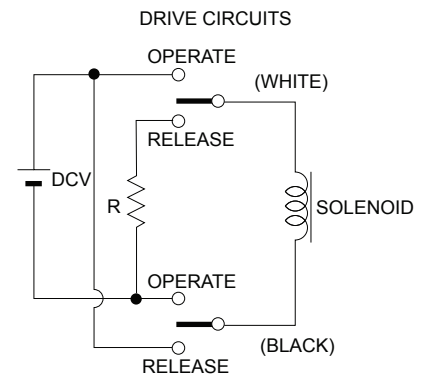
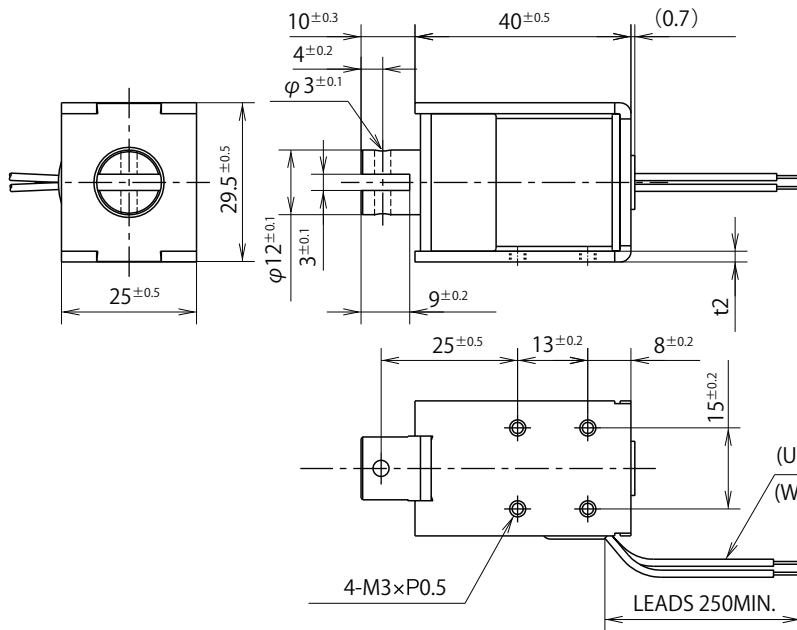
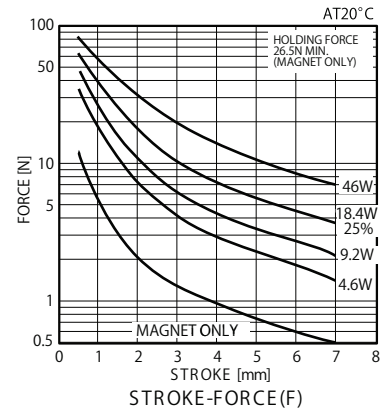
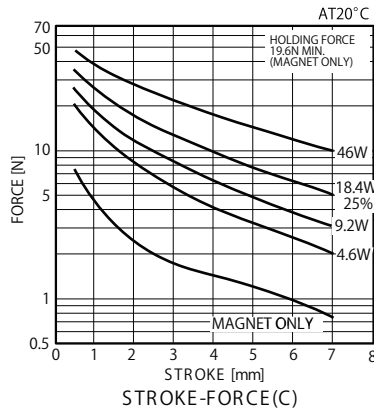
	duty cycle $\Rightarrow \frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		25% or less	release current (reference)
	MAX. "on" time in seconds		20	
	watts at 20°C		17.6	
	ampere-turns at 20°C		968	
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC	ampere
SH1LC1140-06 SH1LF1140-06	2.1	340	6	1060mA
SH1LC1140-12 SH1LF1140-12	8.2	640	12	560mA
SH1LC1140-24 SH1LF1140-24	32.7	1360	24	260mA

SH1LC1240,SH1LF1240 PERMANENT MAGNET SOLENOID

UNIT : mm
SHOWN ENERGIZED



WEIGHT : 145g
PLUNGER: 34g



COIL DATA

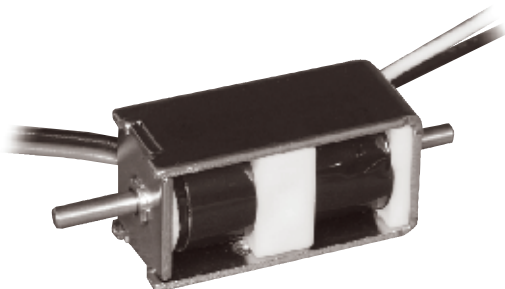
without heat sink

	duty cycle = $\frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		25% or less	
	MAX. "on" time in seconds		20	
	watts at 20°C		18.4	
	ampere-turns at 20°C		979	
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC	ampere
SH1LC1240-06 SH1LF1240-06	2.0	320	6	1620mA
SH1LC1240-12 SH1LF1240-12	7.8	630	12	820mA
SH1LC1240-24 SH1LF1240-24	31.3	1315	24	400mA

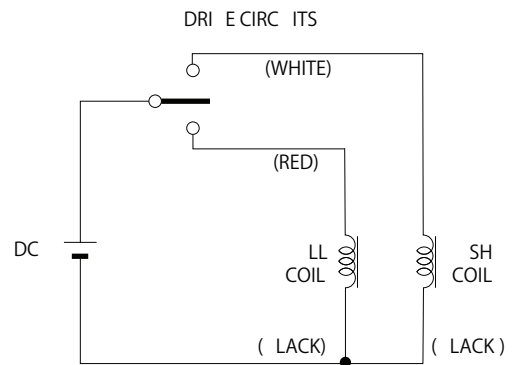
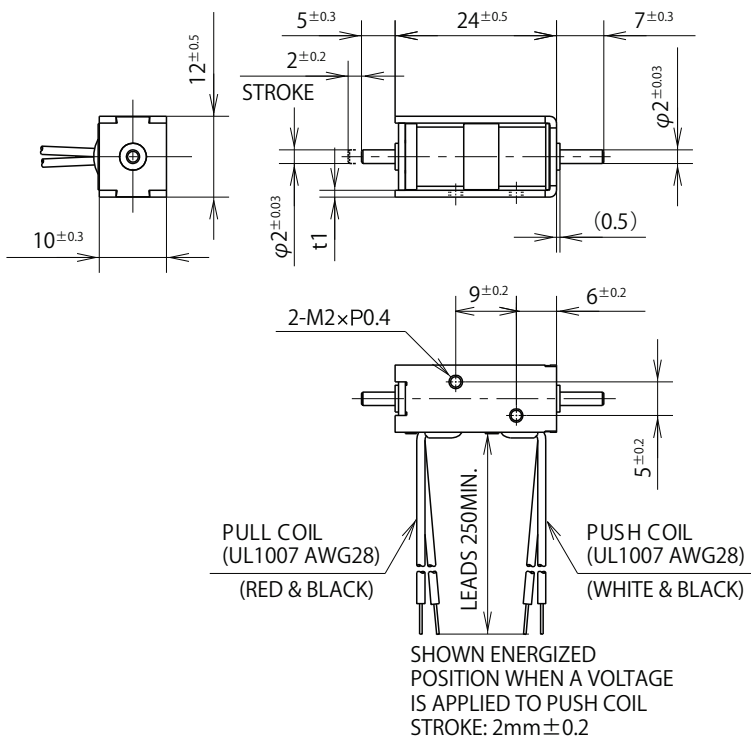
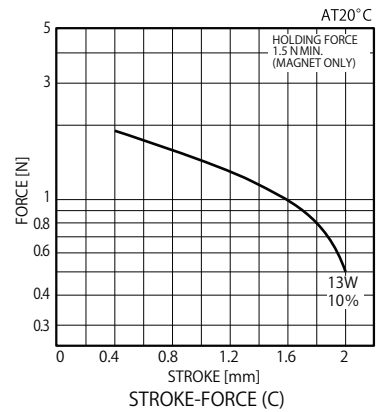
Permanent Magnet(Self Holding) Solenoids

SH2LC0524 PERMANENT MAGNET SOLENOID

UNIT : mm



WEIGHT : 15g
PLUNGER: 3g



COIL DATA

without heat sink

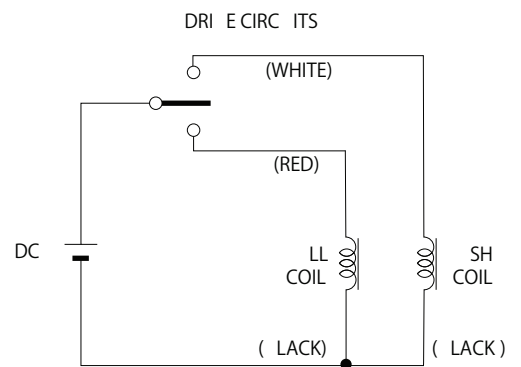
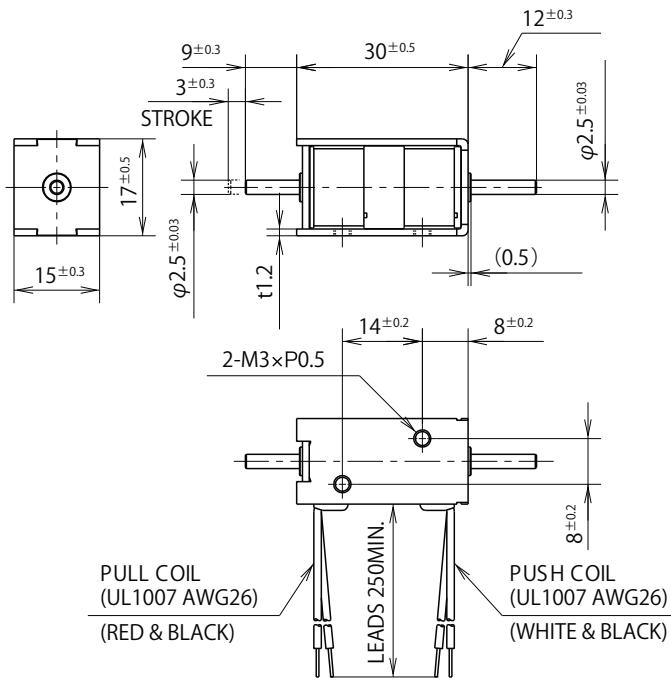
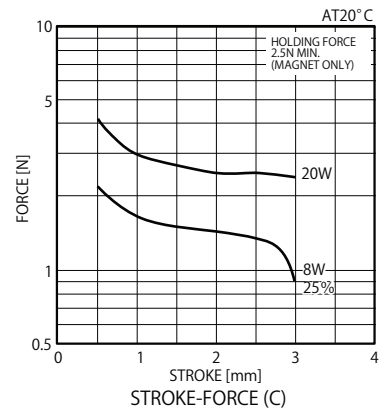
	duty cycle = $\frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		10% or less
	MAX. "on" time in seconds		1
	watts at 20°C		13
	ampere-turns at 20°C		364
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC
SH2LC0524-06	2.8	166	6
SH2LC0524-12	11.1	345	12
SH2LC0524-24	44.3	670	24

SH2LC0730 PERMANENT MAGNET SOLENOID

UNIT : mm



WEIGHT : 35g
PLUNGER: 7g



SHOWN ENERGIZED POSITION WHEN A VOLTAGE IS APPLIED TO PUSH COIL
STROKE: 3mm ± 0.3

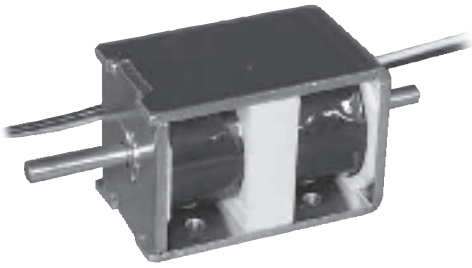
COIL DATA

		without heat sink	
	duty cycle = $\frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$	10% or less	
	MAX. "on" time in seconds	2	
	watts at 20°C	8	
	ampere-turns at 20°C	368	
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC
SH2LC0730-06	4.5	285	6
SH2LC0730-12	18	540	12
SH2LC0730-24	72	1100	24

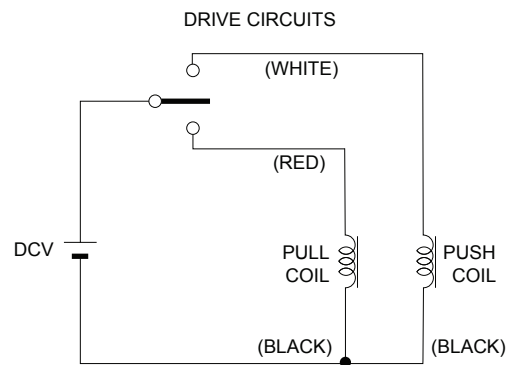
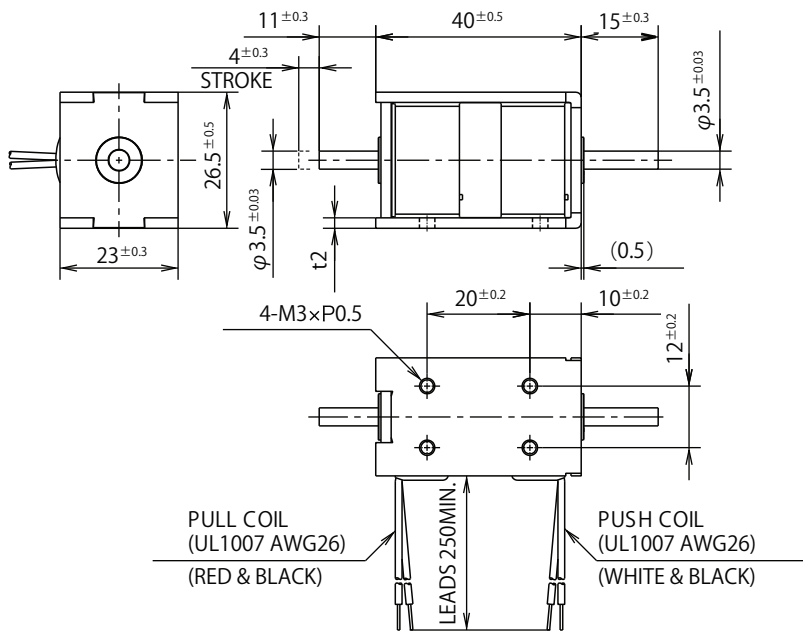
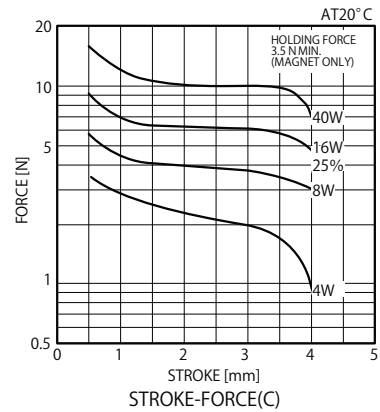
Permanent Magnet(Self Holding) Solenoids

SH2LC1140 PERMANENT MAGNET SOLENOID

UNIT : mm



WEIGHT : 115g
PLUNGER: 21g



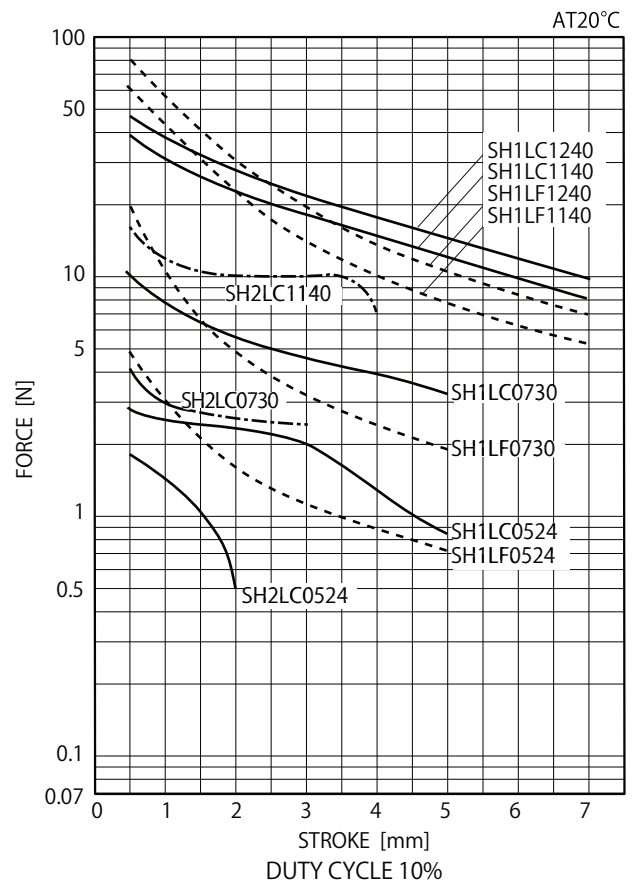
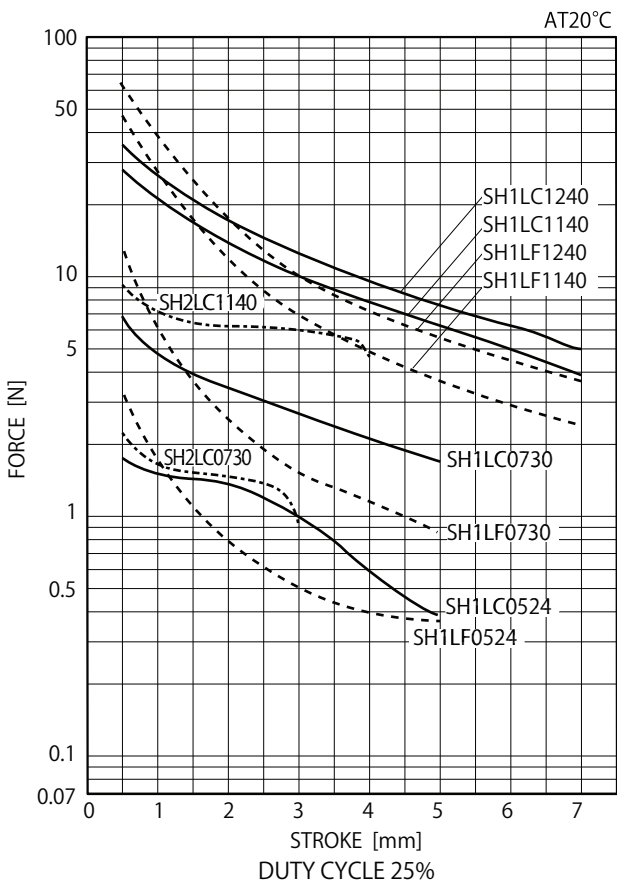
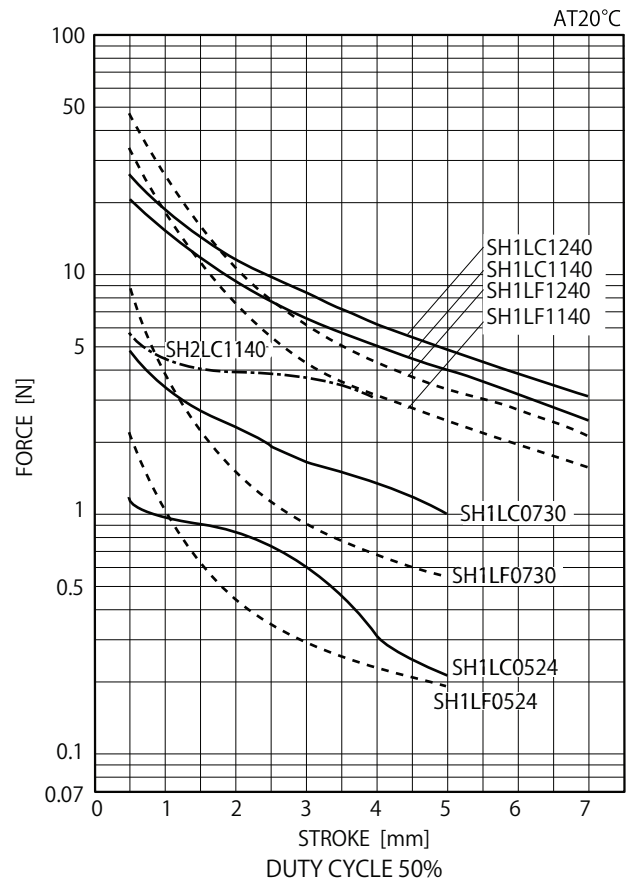
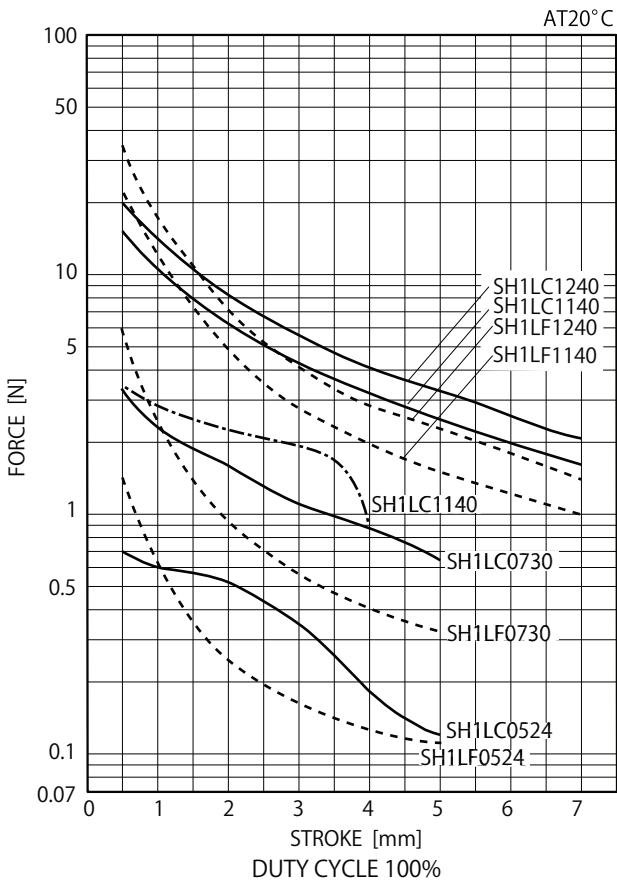
SHOWN ENERGIZED POSITION WHEN A VOLTAGE IS APPLIED TO PUSH COIL
STROKE: $4\text{mm} \pm 0.3$

COIL DATA

without heat sink

	duty cycle = $\frac{\text{"on" time}}{\text{"on" time} + \text{"off" time}} \times 100\%$		10% or less
	MAX. "on" time in seconds		3
	watts at 20°C		16
	ampere-turns at 20°C		691
type no.	resistance $\Omega \pm 10\%$ (at 20°C)	no. turns	volts DC
SH2LC1140-06	2.3	265	6
SH2LC1140-12	9	525	12
SH2LC1140-24	36	1025	24

CHARACTERISTICS TABLE FOR PERMANENT MAGNET SOLENOIDS



PERMANENT MAGNET SOLENOIDS AMPERE-TURN v.s. FORCE

PERFORMANCE CURVES
ARE AT 20°C

