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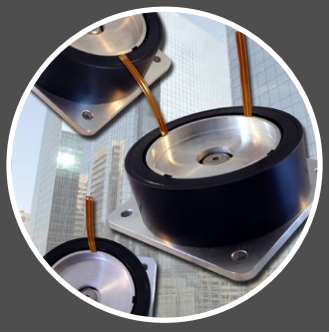
PRODUCT CATALOGUE



DESIGNED FOR LIFE

Content

Company History and Structure

Geeplus was formed in 2004 as a Management Buyout of the electromechanical products business of Densitron Technologies PLC. The buyout involved the acquisition of Densitron Control Systems Ltd as a going concern and of the electromechanical products elements of business conducted by Densitron in Japan and in the United States of America.

The business is headquartered in the United Kingdom and is structured with a holding company Geeplus Holdings Ltd which wholly owns the three operating companies Geeplus Europe Ltd, Geeplus Asia Ltd, and Gee Plus Inc.

The principal activities of Geeplus are the design, manufacture, marketing, and sales of small electromechanical actuators – devices which develop linear force or rotational torque when stimulated with an electrical impulse.

Geeplus Europe quality systems are certified to ISO9001, we strive continuously to eliminate causes of faults or variation in our products and processes. Wherever possible parts, processes, and fixtures are designed to ensure repeatable assembly without errors.

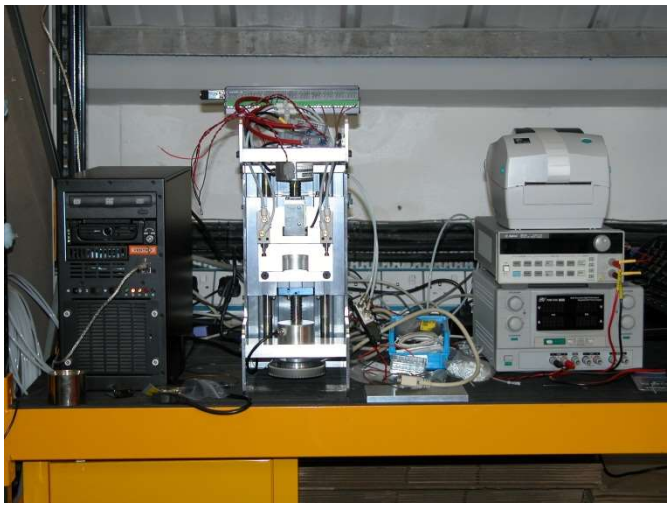
The main market for Geeplus products is in industrial and professional products, instrumentation and optical devices, medical, cash handling and security equipment. Our strength is in designing / supplying elegant and robust solutions for critical applications - those in which the consequences of device failure are very much greater than the cost of replacing the part. For regulating the flow and pressure of gases sustaining a patient in breathing systems, for counting and sorting banknotes, for deflecting or blocking laser beams, for sorting systems, or for access control, Geeplus has implemented designs for leading companies in all these areas.

We seek to visit customers early in the design process, in an era of e-communication we believe that face-to-face contact is important to understand our customer's business and applications, to get a sense of scale which is not conveyed in electronic communications, and to understand what functionality is really needed to achieve the desired end result in a user's application.

Typical applications have requirements ranging from 10's to 10k's of pieces per year.

Resources

Design resources are based in the UK with manufacturing either in the UK or in Asia as appropriate to the nature, the complexity, and the production volumes of the product concerned. Whilst offshore manufacturing can have cost benefits, consideration is also given to the quality control exercised by offshore suppliers, to their volume capabilities, production line layout, and to lead time and delivery logistics. We have a few key manufacturing partners who have invested steadily over many years in tooling, fixtures, design and test capabilities, and quality systems, and with whom we have a long history of developing successful designs.



We have designed and developed in-house test systems for characterising force and displacement behaviour of devices for several years, recent developments in this area include digital force transducers to reduce the noise inherent to analogue sensors (valuable for hysteresis measurement where hysteresis values may be <0.1% of measured force values).

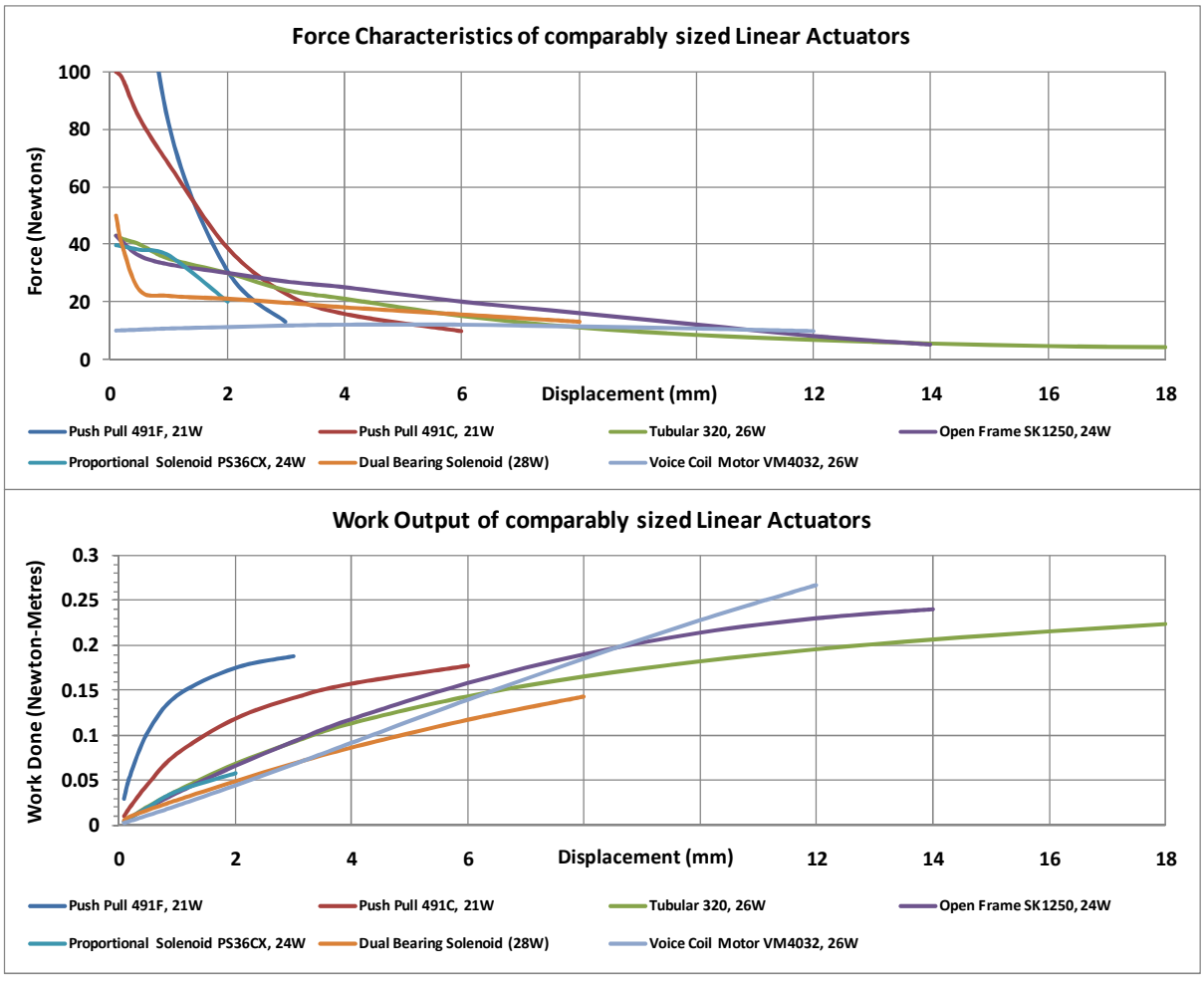
Geeplus has invested in key processes and resources to further our technical capabilities, recent additions include machining and measurement technology capable of machining bores with tolerances tighter than +/-1 micrometre, and cleanroom assembly area to exclude dust and contamination from sensitive assemblies. Currently we are developing over-moulding capabilities to facilitate encapsulation of fragile coil assemblies.

LINEAR ACTUATORS

There are many different factors that can influence the choice of a linear actuator, some of these are described, the selection process aims to identify the least expensive device which can satisfy requirements of the application.

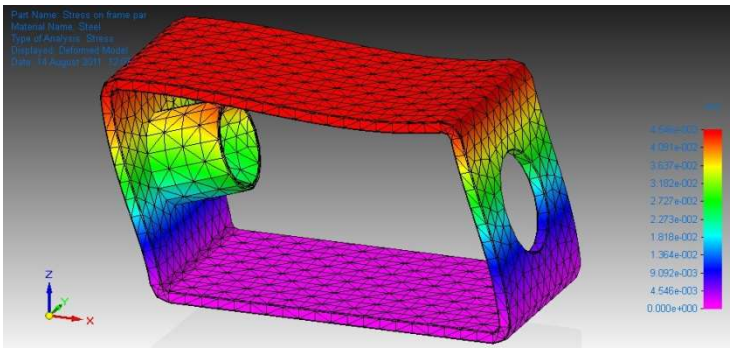
Controllability, Force Characteristic & Mechanical Work

The graphs below show the force vs displacement, and work vs displacement characteristics for actuators of different types with similar weight and power input. It is clear that for short displacement the push-pull solenoids produce much higher force than other types. The flat force characteristic of proportional solenoid and voice-coil motor lends itself to control of force or of position, rather than simple 'on-off' function. Work carried out by the voice coil is higher because it can drive in both directions, other solenoids require a spring to return in the other direction.

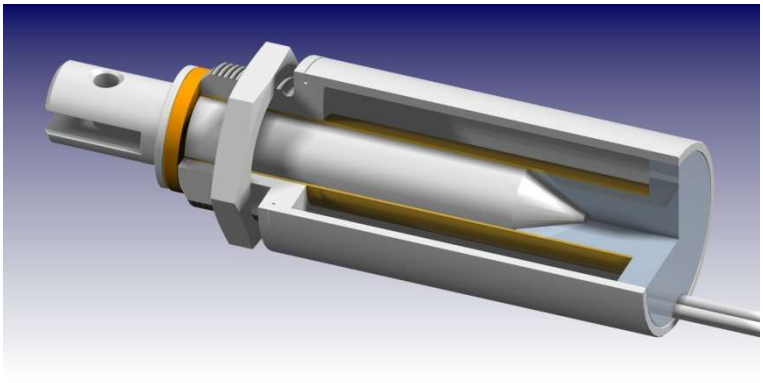


The high force developed by the push-pull solenoid in the energised position is due to the magnetic design, where at short displacement the radial flux in return path (which produces no force along the axis) is diverted to flow between the armature plate and case of the solenoid. The flux flow along this secondary flux path is parallel to the axis and contributes to the developed force. The large surface area of this secondary airgap also results in low reluctance of the magnetic circuit and increased magnetic flux, in combination these two effects result in more than twice approximately twice as much force being developed in the holding (0mm) position *[illustration or flux animation]*.

Life Expectancy

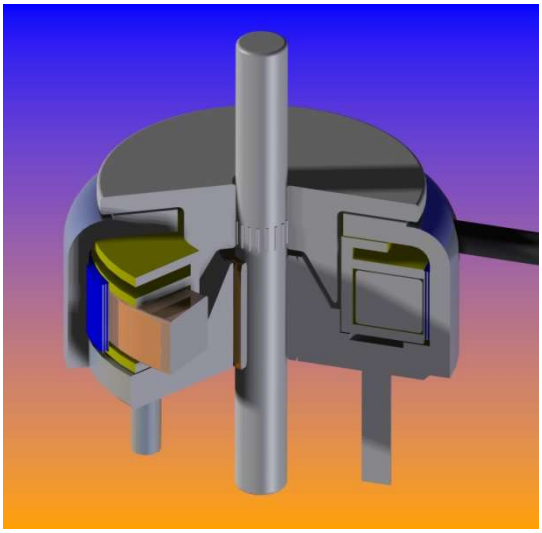


The life expectancy of a solenoid is affected by wear of sliding surfaces, and by fatigue and impact failure of component parts. For open-frame devices, life expectancy may be limited by fatigue of the steel frame which has limited rigidity, the image *[animation in powerpoint presentation]* shows in exaggerated form how the frame distorts when the plunger impacts the end stop of the solenoid, under repeated cycles the frame may fatigue and break, typically at the staked joints, or bends in the frame. This mode of failure is more likely to occur with large parts operating at high force and with heavy loads.



Both the open frame solenoid, and the tubular solenoid, employ a construction in which the plunger slides directly in the sleeve of the solenoid, which may be a brass or stainless steel sleeve, or in some cases the plunger may slide directly in the plastic coil former. The materials and surface finish of the bearing interface are performing many functions, and may not be optimum as bearing materials. Plunger and/or sleeve may be treated to reduce friction, treatments include

molybdenum disulphide, nickel plating, Teflon coating and other. These treatments can prolong life considerably to many millions of cycles.



The push-pull solenoid and voice coil motor utilise a separate shaft as bearing surface, and bushes of purpose made bearing material. These materials, and the finish of these surfaces are designed to withstand wear. In the case of the solenoid, the radial magnetic field between armature and stator results in some side-forces being developed which will aggravate wear. The voice coil develops very little side-force, so bearing loading (ignoring application forces) can be very small and result in very low friction and wear. Life expectancy can be 10's of millions, or even hundreds of millions of cycles.

Speed of Operation

The response speed of an actuator is limited by both electrical and mechanical factors.

When electrical power is applied to a device, it takes time for the current to increase due to inductance of the coil, this factor is commonly referred to as 'electrical time constant'. For most devices, the force developed is proportional to the energising current and the device will not start to move until the electromagnetic force is greater than the load force (return spring, friction, mass) – the time taken to reach this condition is sometimes referred to as 'time-to-engage'. These devices are not pure inductors, when the device begins to move the airgap may change, and 'back-emf' may influence behaviour.

For solenoids particularly the release characteristic may also be a limitation, as the airgap reduces (approaching the energised position), the inductance will increase. When the device is switched 'off' it may take more time for the current to decay due to higher inductance in this position.

Once the electromagnetic force overcomes the load force, the device will begin to move, and will accelerate at a rate determined by the excess force (over and above load resistance) and the load inertia (moving mass). These mechanical limitations are commonly characterised as 'mechanical time constant'. It should be noted however, that the force developed by most devices is not linear, most solenoids exhibit an exponential characteristic with force increasing as the device pulls in towards energised position, thus once the device starts to move, the airgap reduces, and force / acceleration increase.

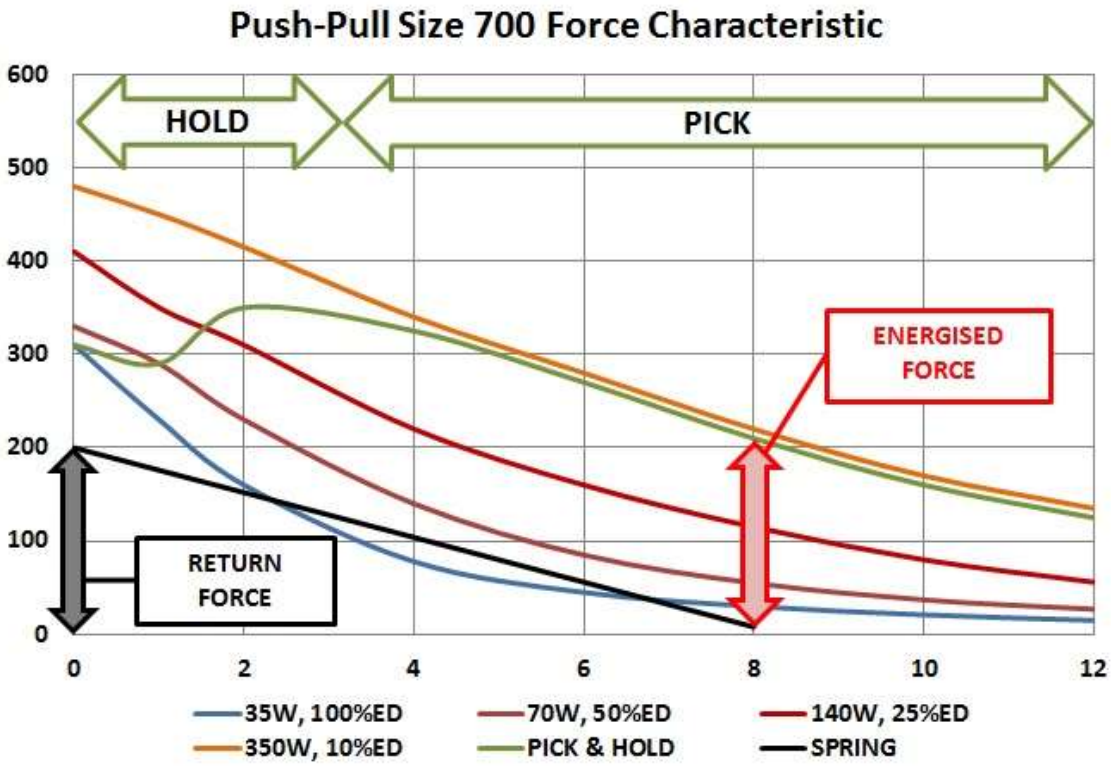
For solenoid devices in which the return force is provided by a spring, the spring force will subtract from the magnetic attraction force and reduce the excess force available to accelerate the load.

Electrical and mechanical factors interact, typically a device starts to move while current is still increasing, so not only is the force changing due to position, but also due to increasing current.

In order to achieve fastest possible response time, the following points need to be considered:

- Use a coil with low inductance, and a high excitation voltage, to minimise the electrical time constant
- Keep the moving mass of the load + solenoid armature as small as possible
- Maximise the starting force to obtain high initial acceleration. The graph illustrates how this works for the size 700 push-pull solenoid, in an implementation where starting force of >200N is achieved in both directions over 8mm displacement.
    - If a return spring is used, a rising rate spring with small extended force, and high compressed force will provide minimum load to the solenoid at start of 'energised' move, and will impart maximum force at start of the 'de-energised' move.
    - A high 'pick' current when the solenoid is first energised will allow high initial force and acceleration, this may then need to be reduced to avoid excessive power consumption and heat dissipation.

- If both the above measures are employed, the high holding force exhibited by the push-pull solenoid may be beneficial to hold the spring compressed with minimal excitation power. See technical note on ‘Pick and Hold’ for more details.



Latching (also known as bistable or self-holding) solenoids facilitate the same force and speed benefits that can be achieved through the use of a pick and hold drive configuration, but with simpler drive requirements. These devices also exhibit lower inductance in the energised position than conventional solenoids due to the properties of the permanent magnets employed in their construction. Latching solenoids are not generally suitable for use in applications requiring ‘fail-safe’ operation.

Summary of Characteristics of Linear Devices

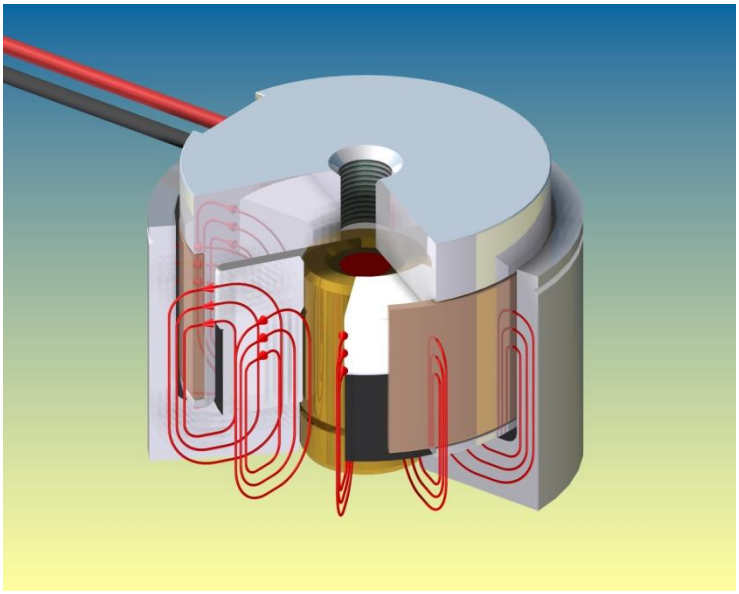
	Controllability	Displacement	Speed	Life Expectancy	Extended Force	Holding Force	Form Factor
VoiceCoil Motor	Best *(hysteresis typically <1% of force)*	>20mm	Fast - ability to drive in both directions, can accelerate >>100G	>100M cycles possible due to low side forces	Good linearity possible over working range		Large flexibility in shape possible
Proportional Solenoid	Second Best *(hysteresis typically <10% of force)*	<10mm		High - >10M cycles possible	Good linearity possible over working range		Usually cylindrical
Push Pull Solenoid		25mm	High speed possible in conjunction with 'Pick and Hold' drive	High - >10M cycles possible	High force possible with intermittent use, or in conjunction with 'Pick and Hold' drive	Highest after electromagnet	Cylindrical, short
Tubular Solenoid		>30mm		Moderate - >2M cycles typical	Good	Moderate	Cylindrical, long
Latching Solenoid		>10mm	Pulsed operation permits high power for high force and speed	<1M cycles	Moderate	Good	Cuboid
Open Frame Solenoid		>10mm		<1M cycles	Moderate	Poor	Cuboid
Electromagnet		<1mm	High inductance due to short airgap		Reduces very rapidly with increasing airgap	Highest	Cylindrical

VOICE COIL MOTORS

Voice Coil Motor Characteristics

Voice Coil Motors are highly controllable electrical actuators suitable for applications needing only limited displacement. They offer the following features:

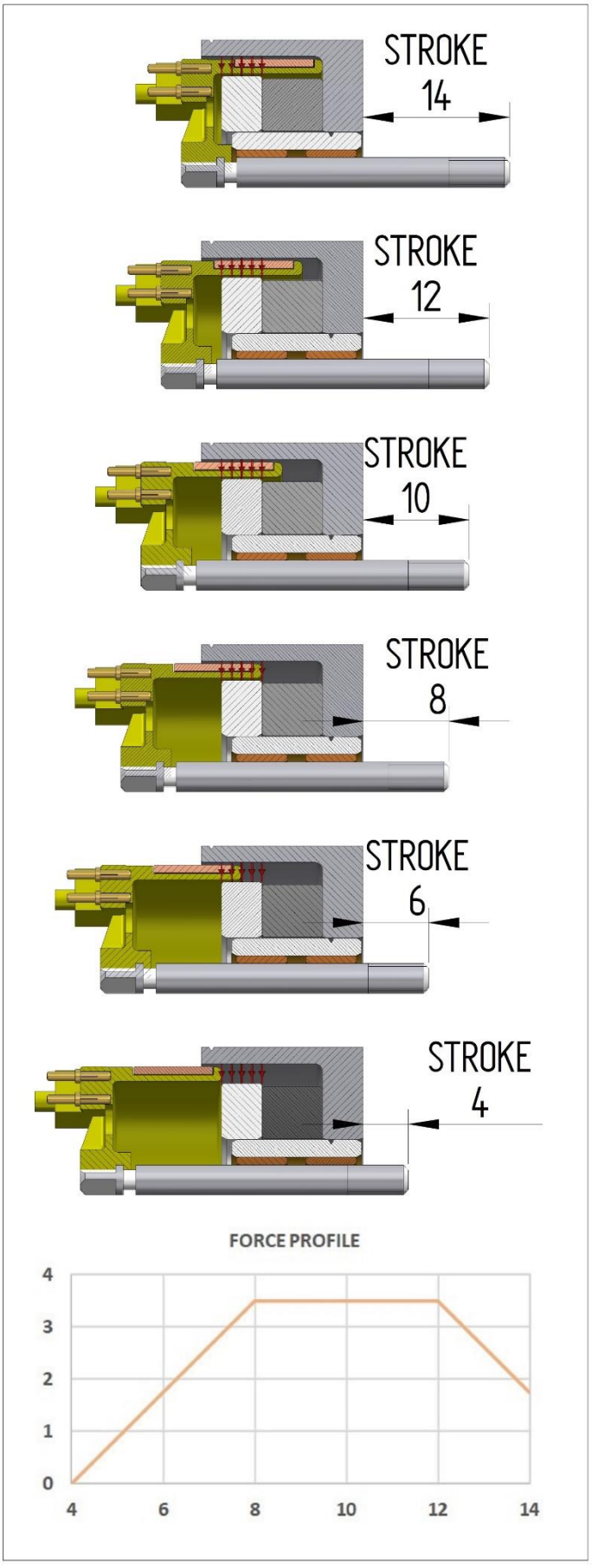
- Fast operation – Low electrical inductance, and low moving mass enable fast inflow of current and high acceleration. Acceleration of >500G is possible with custom devices
- Controllability – Force is proportional to applied current, and is uniform through a displacement that can be several 10's of mm or several 10's of degrees rotation
- Low hysteresis – The magnetic behaviour is free of hysteresis over typical operating areas, depending on the type of bearings used, very low hysteresis can be realised
- Reliability – side forces developed are negligible, so bearing loading can be very low to enable long life operation
- Simplicity – the voice coil motor is a single pole device requiring no commutation. Both the device itself, and the associated controller can be very simple and robust
- Flexible Configuration – the principle of operation lends itself to many different mechanical layouts allowing great flexibility in design of associated systems
- Flexible Production – Most product configurations can be produced without requiring tooling for prototypes, or for limited production volumes – product design needs to allow for manufacturing methods appropriate to customer volume requirements



Force Characteristics

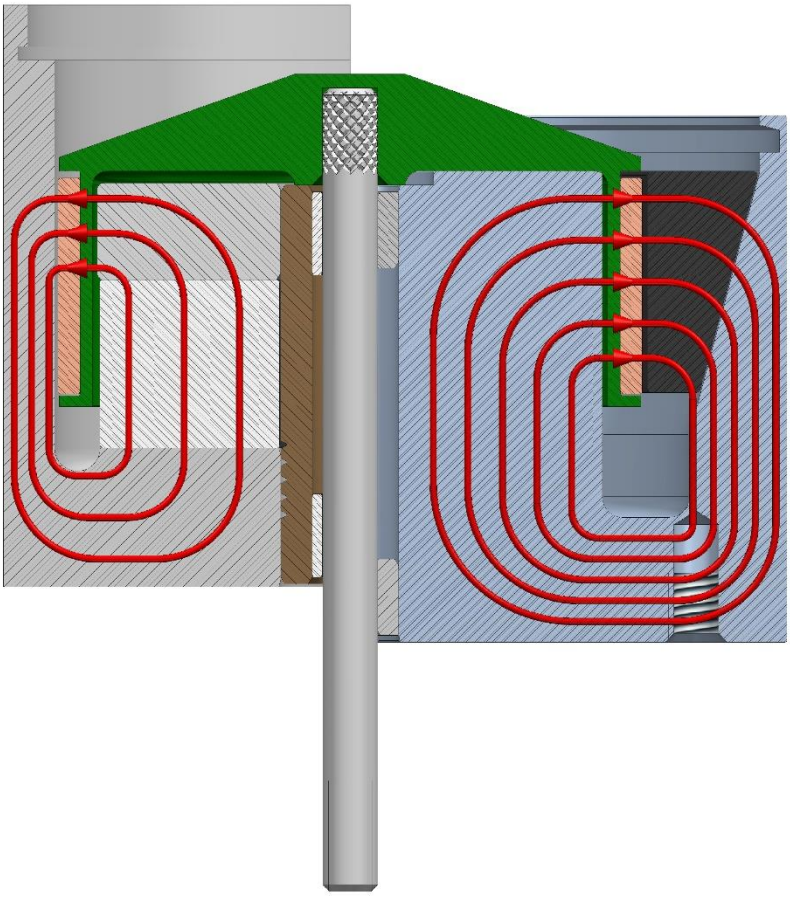
The typical force characteristic for a voice coil motor energised with constant excitation current is illustrated. In the bottom view (corresponding to stroke of 4 units), the coil of the device is outside the region of magnetic flux (denoted by the red arrows) and no force is developed. As the coil moves into the region of magnetic flux the force increases. When the coil is fully overlapped by the region of magnetic flux (Stroke between 8 and 12 units) the force is constant. The top picture (stroke of 14 units) shows a condition where the coil starts to move out of the region of magnetic flux again, and the force reduces again.

By modifying the geometry of the coil and of the magnetic flux assembly appropriately, it is possible to produce a device which develops a force characteristic which is flat over the operating stroke, or which increases, or decreases over the operating stroke.



Radial Magnet vs Sandwich Construction

Voice Coil Motors offered by Geeplus are manufactured with two different types of construction. The two alternatives are illustrated below for VM50 and VM6340 devices which both employ the same coil assembly.



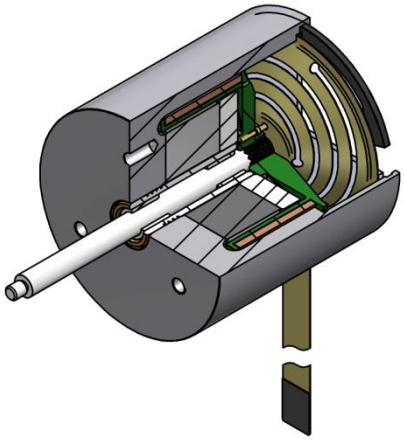
In both constructions the diameter and cross-section of the core of the device (inside the coil) is similar, in the sandwich construction used in the VM50 devices (LHS), an axially magnetised ring magnet is fitted in the steel pot, with a steel pole on top of this. A rare earth magnet will support a flux density a little more than 1 Tesla, this ultimately limits the total flux circulating in this device.

In the radial magnet construction used in the VM6340 (RHS), the core is made of magnetic steel which will support a magnetic flux density in the region of 1.6-1.8 Tesla, the higher flux allows a higher force to be developed with the same coil and excitation current. For a given force and displacement, the radial magnet construction enables a smaller and lighter coil assembly to be used with better dynamic performance.

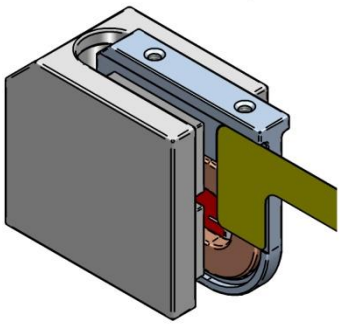
The rare earth magnets, and the layered coil winding are two of the biggest cost elements of a Voice Coil Motor, so the construction used and size of these parts have a big impact on cost and performance.

Custom Designs

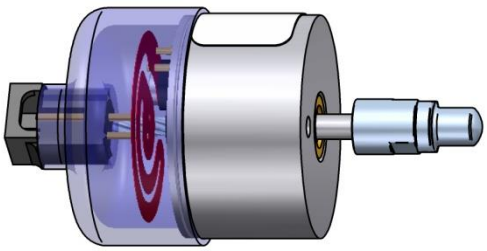
Custom designs can incorporate many different features including the following :



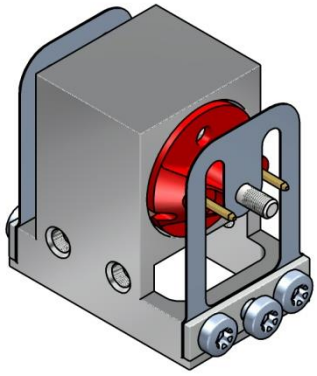
- Flexible circuit termination of the coil provides reliable electrical connection with repeatable low resistance to movement and low friction (hysteresis). Body is extended with end cover providing a sealed unit with easy electrical termination



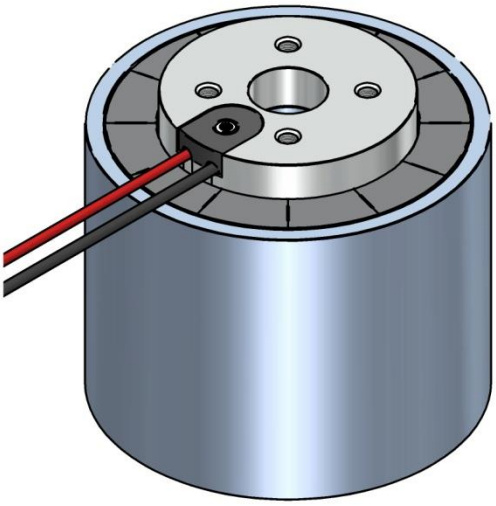
- Flat coil design allows pivoting motion and tolerance to some variation in position of the coil relative to magnet assembly.
- Flex circuit is used for easy termination

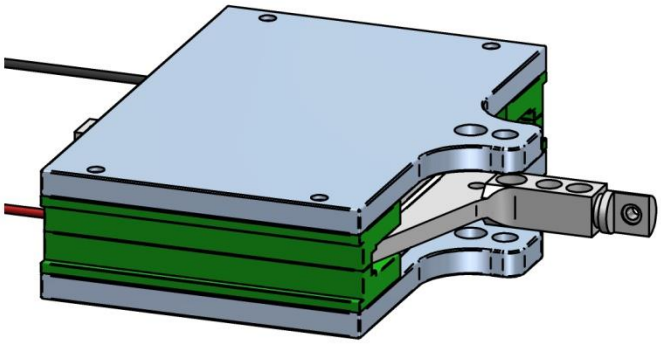


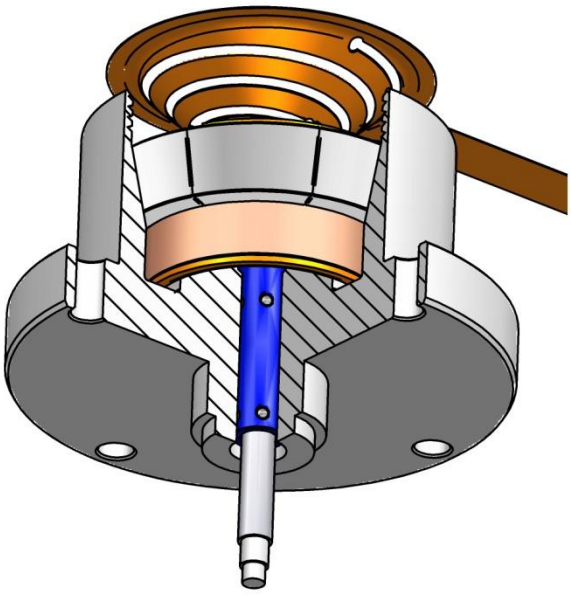
- End cover and flex circuit allow sealed unit with reliable, low-friction electrical connection. Connector allows easy installation and replacement.
- Special tip fitted to shaft



- Steel flexure guidance provides repeatable, friction-free guidance of the shaft with unlimited life expectancy

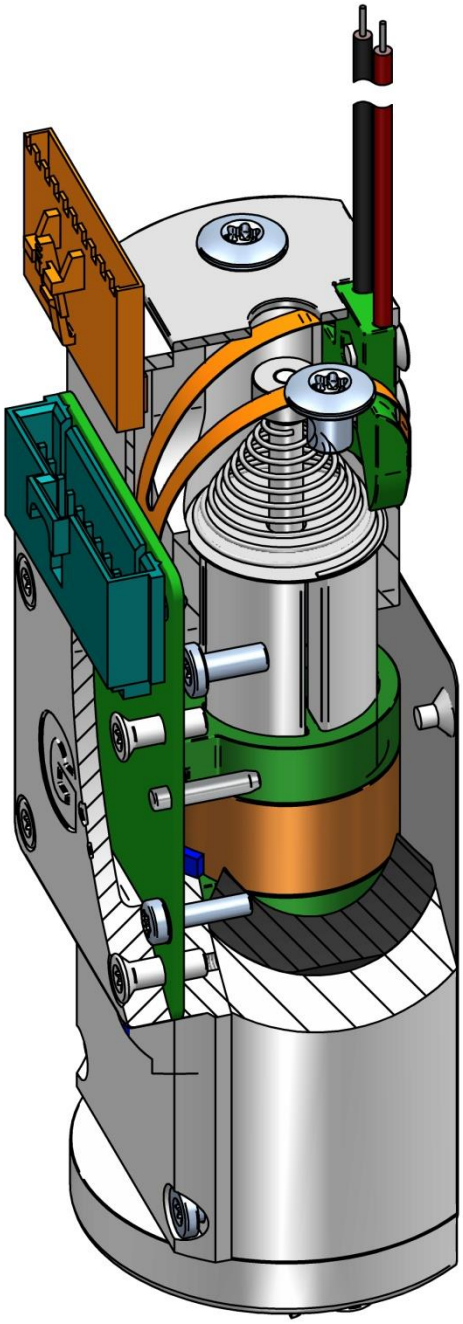






- Multiple poles for higher force and efficiency with reduced size and mass, use of multipole designs may be inappropriate to applications requiring large displacement
- Aluminium coil windings enable reduced moving mass for high acceleration, the flat design illustrated uses multiple poles and aluminium coil winding to achieve force capability >50N peak with coil mass <12g for acceleration capability >400G
- Rolling element bearings provide more precise guidance, and more repeatable friction behaviour when subjected to variable side loading, the part shown also employs flexible circuit termination and a focussed radial magnet assembly for higher force / mass and better dynamic performance

- Position encoder with resolution to <1µm for closed loop (servo) control
- Multiple coil and lightweight titanium shaft for high force / mass ratio
- Rolling element bearings for high precision, long life linear guidance
- Flex termination integrated within compact design



VM Series Description

Standard Voice Coil Motors of Geeplus VM series incorporate shafts and bearings to ensure accurate guidance of the coil assembly within the magnet assembly, and to facilitate easy installation in customer applications. For wear resistance and good surface finish along with required magnetic properties the shaft material is either stainless steel (hardenable stainless steel may be slightly magnetic and have a slight influence on the force characteristic, non-magnetic stainless steel is softer and more susceptible to damage) or titanium.

The magnet assembly of VM series is designed for good volumetric efficiency and useful linear stroke, these characteristics may be at the expense of some loss of linearity. High Energy Density magnets drive the material of the voice coil pot (housing) close to magnetic saturation to develop the strongest possible magnetic field. Custom designs can demonstrate better linearity at the expense of increased size / weight & cost.

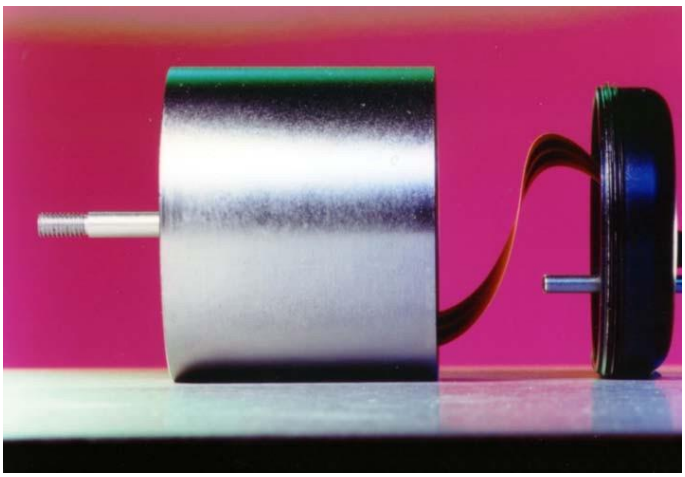
- Coils of standard VM series are normally designed to use the full depth of the pot assembly. This results in maximum mechanical work output capability, but may result in a force characteristic which is not ideally suited to a given application. The portion of the coil which lies outside the airgap field dissipates power (as heat) but develops no useful force.
- The linear range of a voice coil (the range within which developed force is >90% of peak force) will normally be roughly equal to the difference between the coil length, and the length of the pole.
- For maximum force, the coil length and pole length should be approximately equal in length, but the linear range with this configuration will be small.
- For best linearity, one of the coil and polepiece should be longer than the other by the linear range required. It is usually more cost effective to make the coil longer than the magnet assembly. Making the coil shorter than the polepiece can reduce moving mass and facilitate faster dynamic response, but this may require a more massive and expensive magnet assembly to produce a required force characteristic.

Mechanical Integrity

The design of VM series devices ensures good concentricity and mechanical integrity of the complete device. Accurate fixtures are used in assembly to control assembly dimensions, and coil assemblies are individually measured to ensure concentricity and clearance with the magnet assembly. All devices are designed to ensure that finite clearances are maintained throughout an operating range from 0ºC to 130ºC.

Electrical Termination

Connection to the moving coil of a voice coil motor must be implemented with care to ensure reliable operation. Flexible cable with many fine strands and Silicone Rubber insulation can provide reliable termination, care should be taken that the leads are mechanically secured to the moving assembly preferably at some distance from the soldered joints (solder fuses the strands together, and leads to large stresses being applied to the termination pins, or to fatigue adjacent to the fused portion of the wire). The leads should be carefully routed to minimise stress. A more consistent means of termination is to use a flexible circuit, this option is offered for several of the VM series devices (see picture).

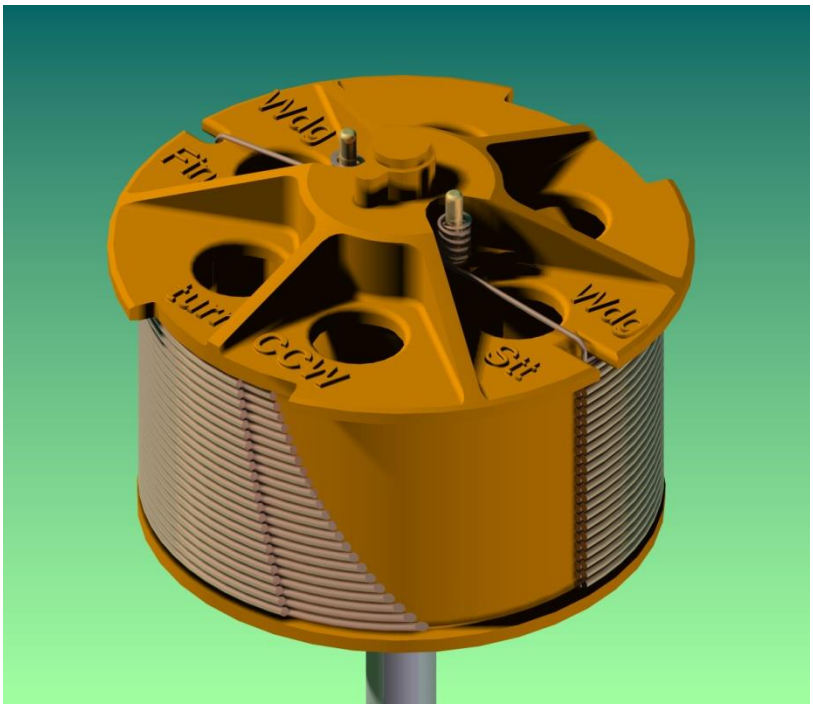


Performance Factors

Coil Packing - The coil of a voice coil motor needs to contain as much conductor material as possible within the available space in order to develop maximum force and efficiency. The goal is to achieve the maximum number of coil turns for a given space envelope and coil resistance.

Coil packing is defined as the cross sectional area of wire, divided by the total cross-sectional area of the winding space. It is determined by the shape of wire used for winding, and by the winding process itself.

The maximum possible utilisation is achieved where square or rectangular section wire is used, this can be packed with minimal voids between winding turns, and between winding turns and the coil former (if used).



If a coil is wound with round section wire, with good control of the winding process, an 'orthocyclic' winding can be produced, where each turn is packed tightly against the turns to either side, and turns on the subsequent layer are located in the groove formed by two turns of the layer below. Where the wires of one layer cross over the strands of the layer below, a 'high point' will be formed in the winding. This can be reduced by making the wall of the coil former thinner at this point. Production of a perfectly layered coil winding tends to be much slower, and more labour intensive / expensive than automated winding processes, and is a significant cost factor in the manufacture of voice coil motors. A tightly packed and perfectly layered winding produced using round section wire can achieve 95% of the packing density of a coil produced using square section wire.

Conductor Material

By default, coils are usually wound using copper wire, however there are cases where other conductor materials are used.

Silver wire can be used to obtain improved efficiency, the electrical conductivity of silver is approximately 3-4% higher than that of copper, so an efficiency improvement of 3-4% can be achieved. In most cases the cost penalty for using silver wire is prohibitive.

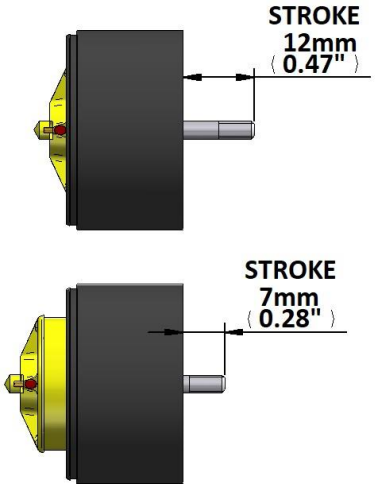
Aluminium wire can be used for highly dynamic applications where the load mass is very low, and where this permits higher acceleration. The electrical conductivity of aluminium is 60-70% of that of copper, so efficiency is reduced, but the reduction in mass is much greater than this. Aluminium wire can be

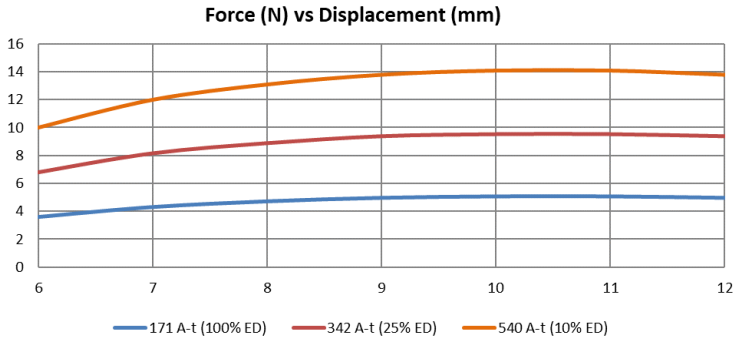
difficult to solder due to the formation of an oxide layer on the surface of the material.

Copper Covered Aluminium (CCAL) wire – this is an aluminium wire in which the aluminium core is electroplated with a thin layer of copper, prior to application of the insulating enamel. This is usually described as 10%CCAL or 15%CCAL, where the percentage is the proportion of copper by weight. This material has many of the weight benefits of aluminium wire, with the additional benefit of easy soldering.

Force vs Displacement Graphs

The way in which we describe stroke has changed compared to previous catalogues & data. This is now labelled on drawings and shown on graphs in relation to the shaft extension (for parts with a shaft), or to the overall length of the device. Measurement is normally made with the device pushing against a force sensor.





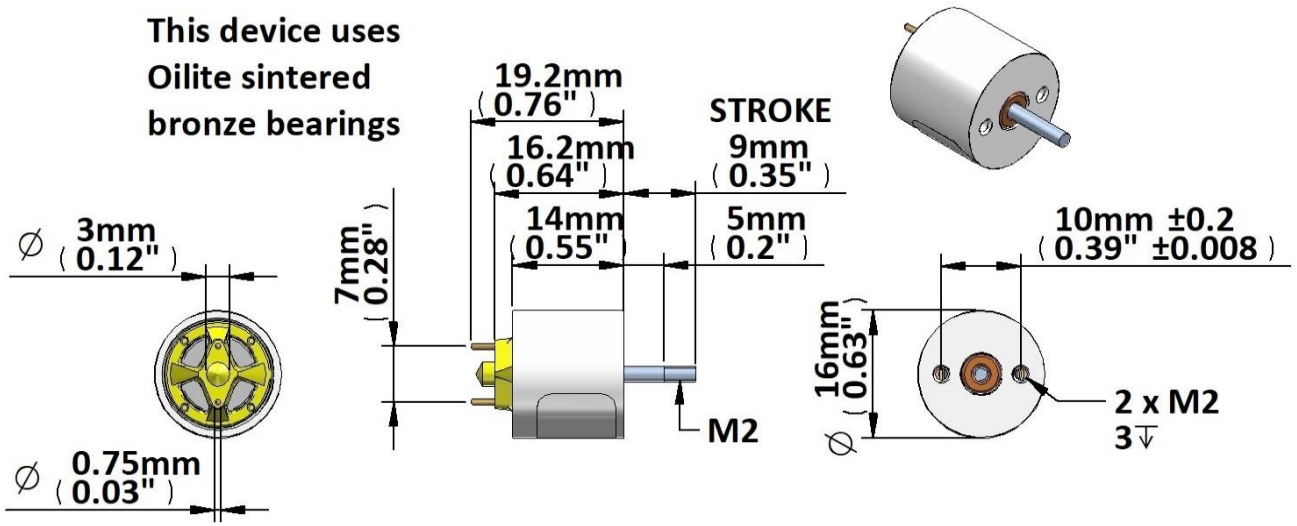
GEEPLUS VM1614

P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

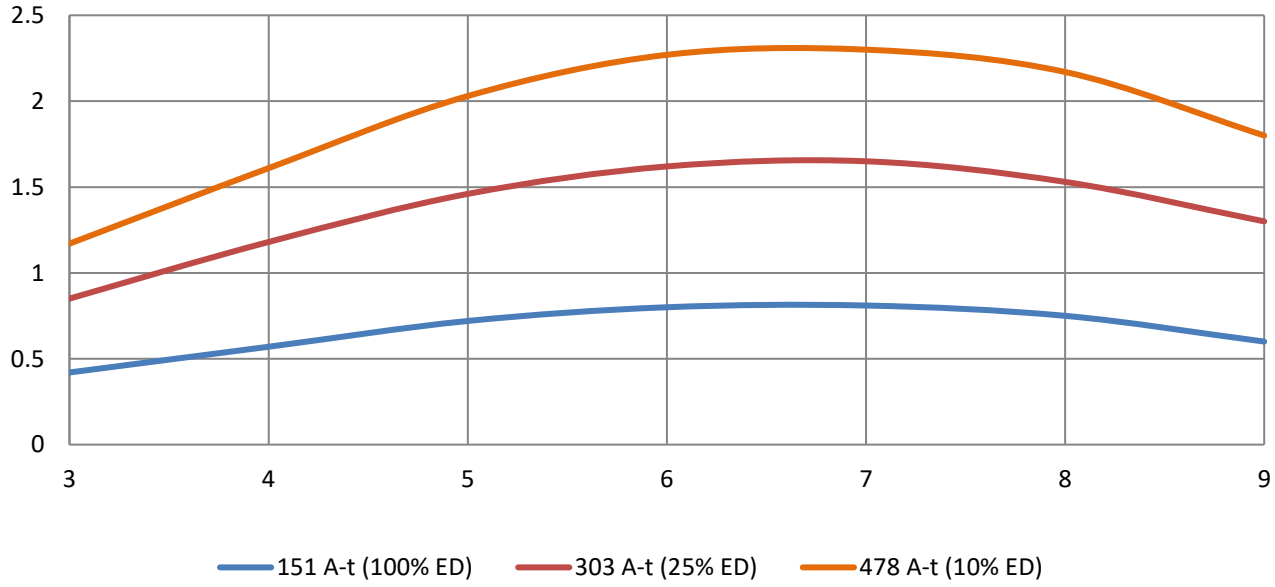
P_{100}	5 W	Total Mass	15 g
T_{max}	130 °C	Coil Mass	3 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM1614-200	2.6 Ω	0.2 mH	0.7 N/A	0.7 Vs/m	1172 mA
VM1614-180	3.5 Ω	0.3 mH	0.7 N/A	0.7 Vs/m	1010 mA
VM1614-125	15.0 Ω	0.8 mH	1.5 N/A	1.5 Vs/m	488 mA
VM1614-100	39.0 Ω	4.0 mH	2.4 N/A	2.4 Vs/m	303 mA

Max 'ON' time		Peak Force
100% ED	∞	0.8 N
50% ED	22 s	1.1 N
25% ED	9 s	1.7 N
10% ED	3 s	2.3 N



Force (N) vs Displacement (mm)

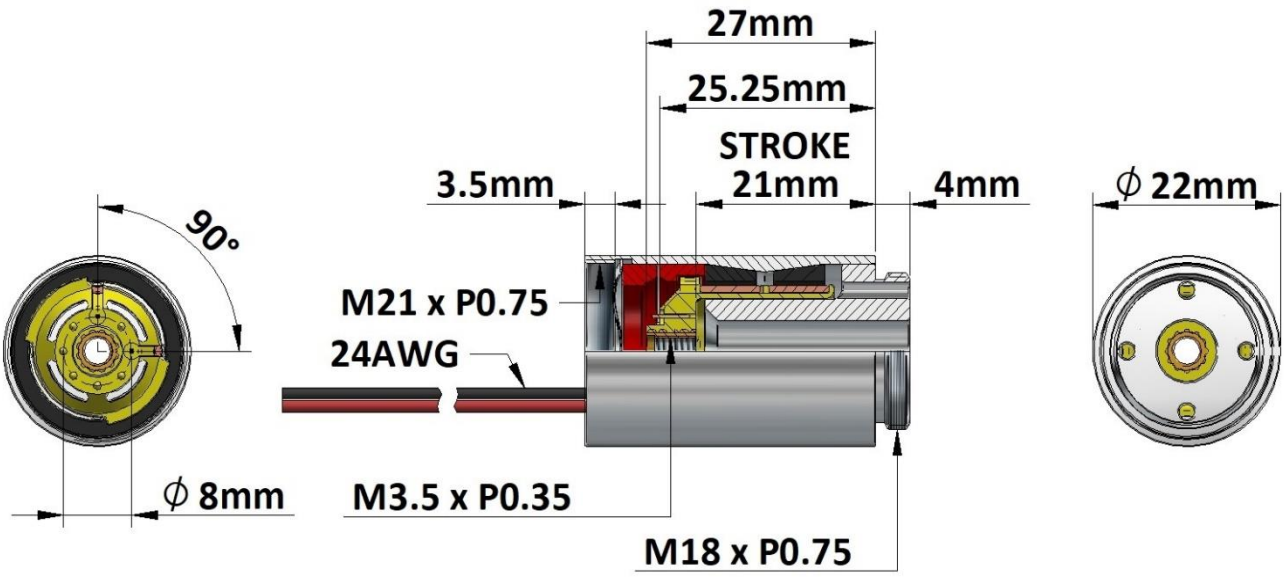


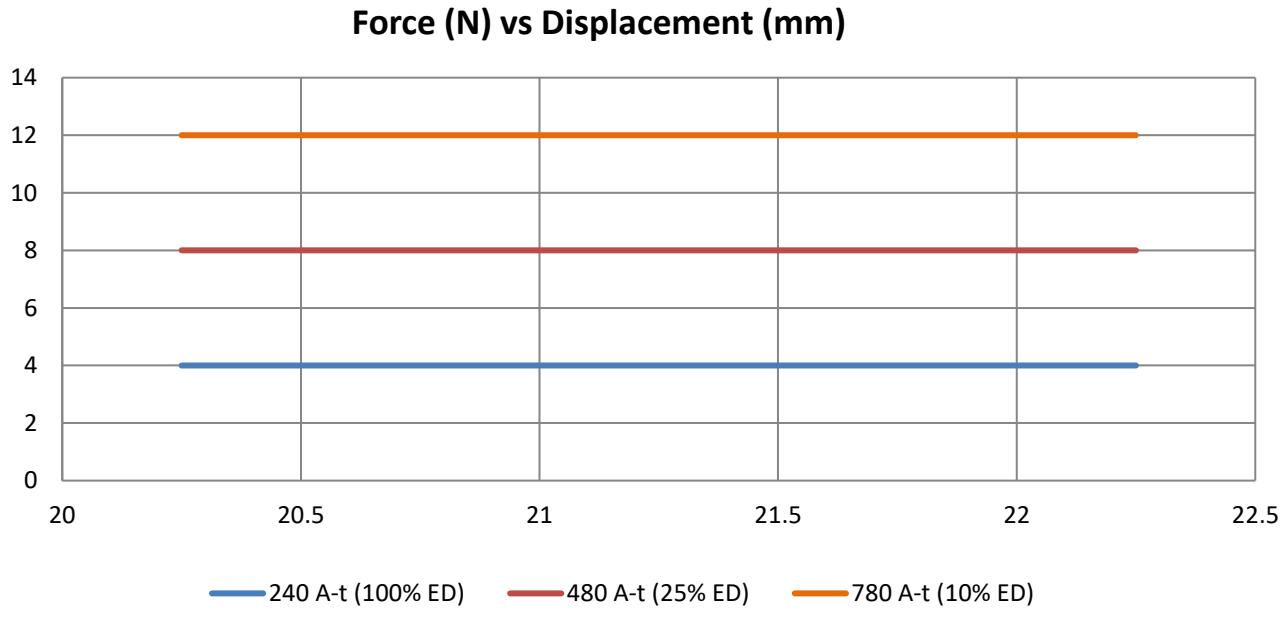
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	8 W	Total Mass	15 g
T_{max}	130 °C	Coil Mass	3 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM22P2-200	6.0 Ω	0.2 mH	0.0 N/A	0.0 Vs/m	976 mA

Max 'ON' time		Peak Force
100% ED	∞	4.0 N
50% ED	0 s	5.6 N
25% ED	0 s	8.0 N
10% ED	0 s	12.6 N





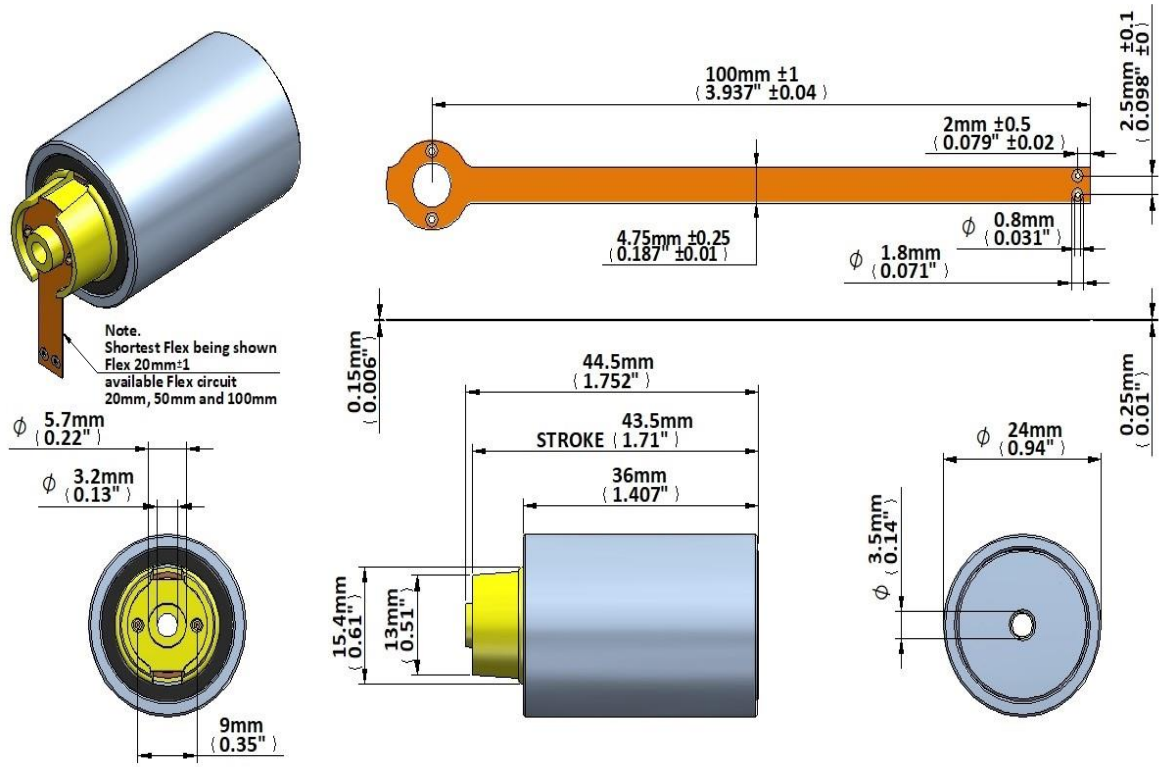
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	12.5 W	Total Mass	95 g
T_{max}	130 °C	Coil Mass	9 g

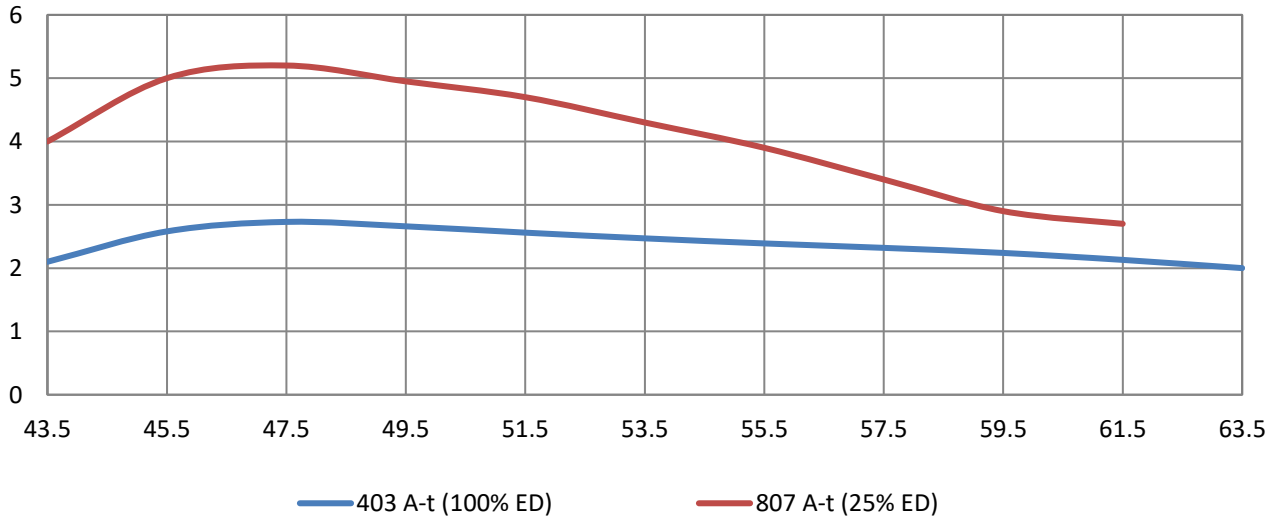
Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM2436-375	1.0 Ω	0.2 mH	0.7 N/A	0.7 Vs/m	2.99 A
VM2436-180	17.8 Ω	3.6 mH	2.9 N/A	2.9 Vs/m	708 mA
VM2436-112	107.0 Ω	22.0 mH	6.7 N/A	6.7 Vs/m	289 mA

Max 'ON' time		Peak Force
100% ED	∞	2.7 N
50% ED	22 s	3.8 N
25% ED	9 s	5.2 N
10% ED	3 s	7.5 N

DOES NOT INCLUDE BEARINGS. GUIDANCE SHOULD BE IMPLEMENTED IN APPLICATION. FLEX CIRCUIT 40-1039 FOR THIS PART CAN BE QUOTED ON REQUEST.



Force (N) vs Displacement (mm) [outwards direction]

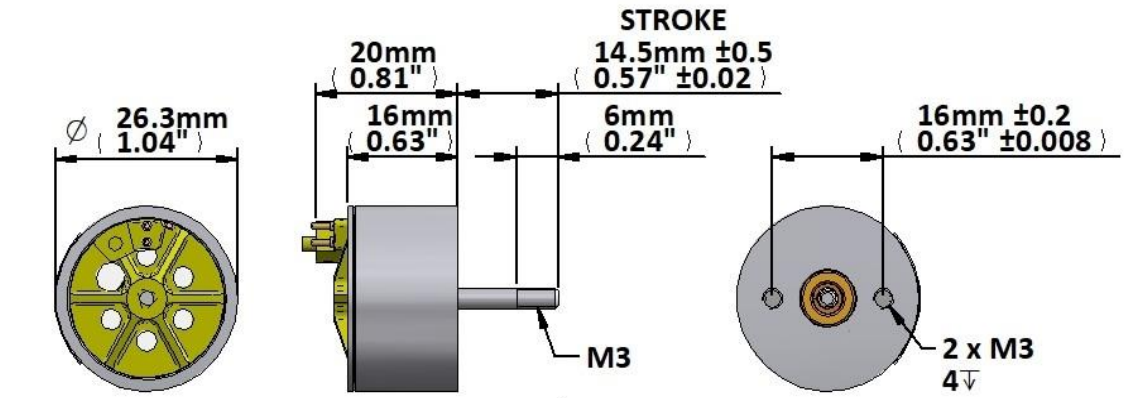


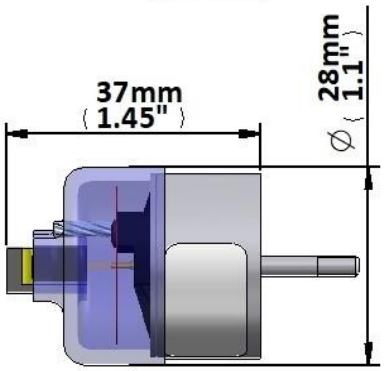
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	8 W	Total Mass	60 g
T_{max}	130 °C	Coil Mass	6 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM2xxx-180	9.6 Ω	1.3 mH	4 N/A	4 Vs/m	771 mA
VM2xxx-132	34.4 Ω	5.3 mH	8 N/A	8 Vs/m	407 mA
VM2xxx-112	55.0 Ω	7.3 mH	9 N/A	9 Vs/m	322 mA
VM2xxx-080	286.0 Ω	40.0 mH	21 N/A	21 Vs/m	141 mA

Max 'ON' time		Peak Force
100% ED	∞	3.4 N
50% ED	55 s	4.8 N
25% ED	12 s	7.0 N
10% ED	3 s	10.6 N

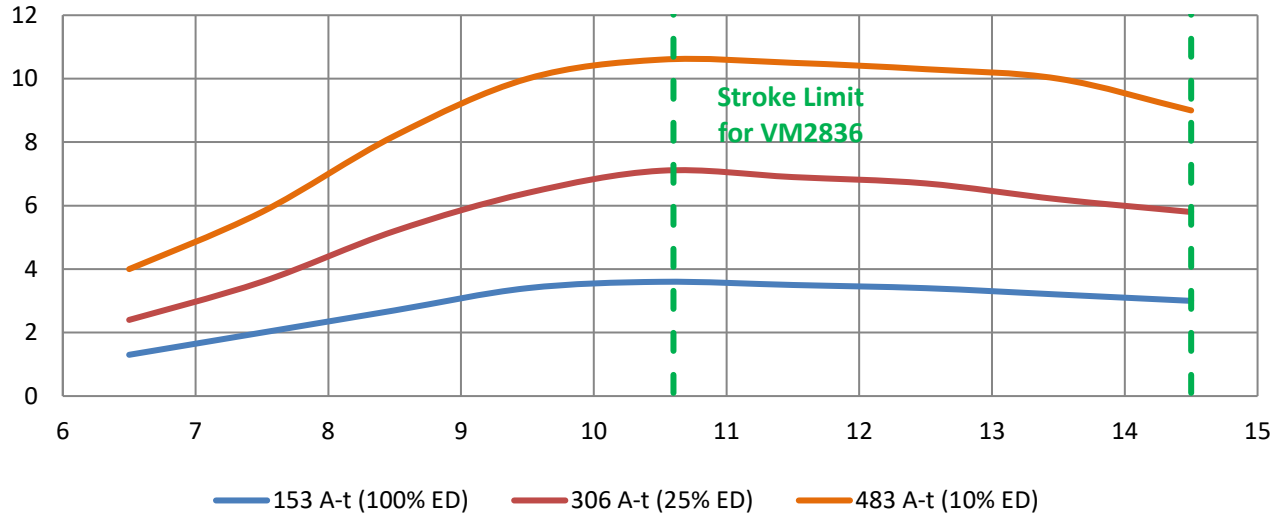




Mating connector is Molex type 70066 with crimps 70058 or equivalent

VM2836 incorporates cover & flex circuit termination, stroke must be limited to 4mm maximum.

Force (N) vs Displacement (mm)

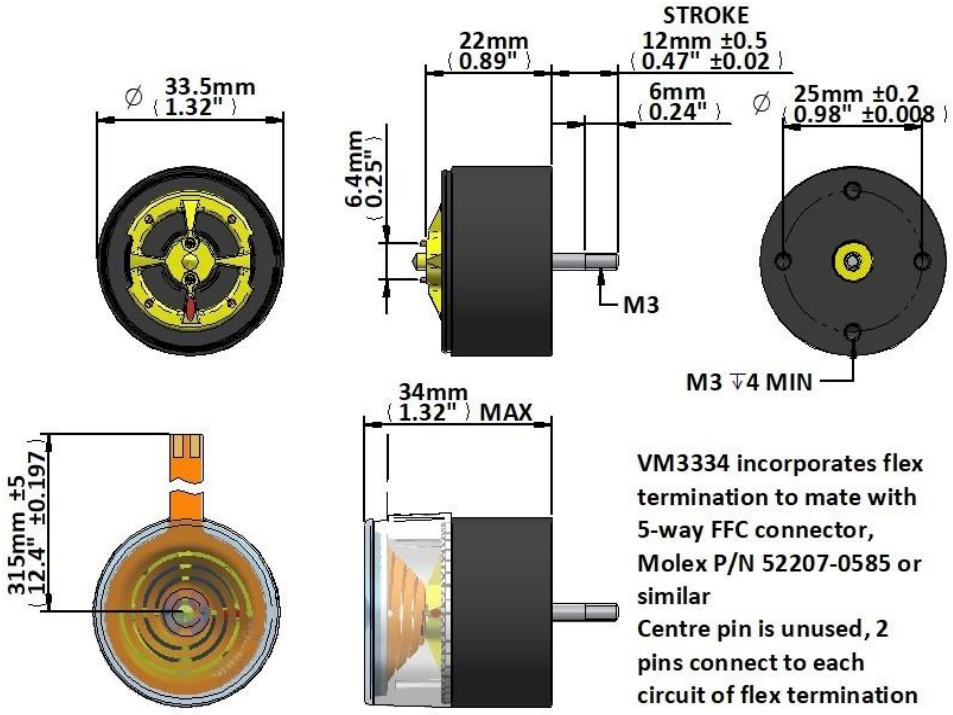


P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	8 W	Total Mass	140 g
T_{max}	130 °C	Coil Mass	7 g

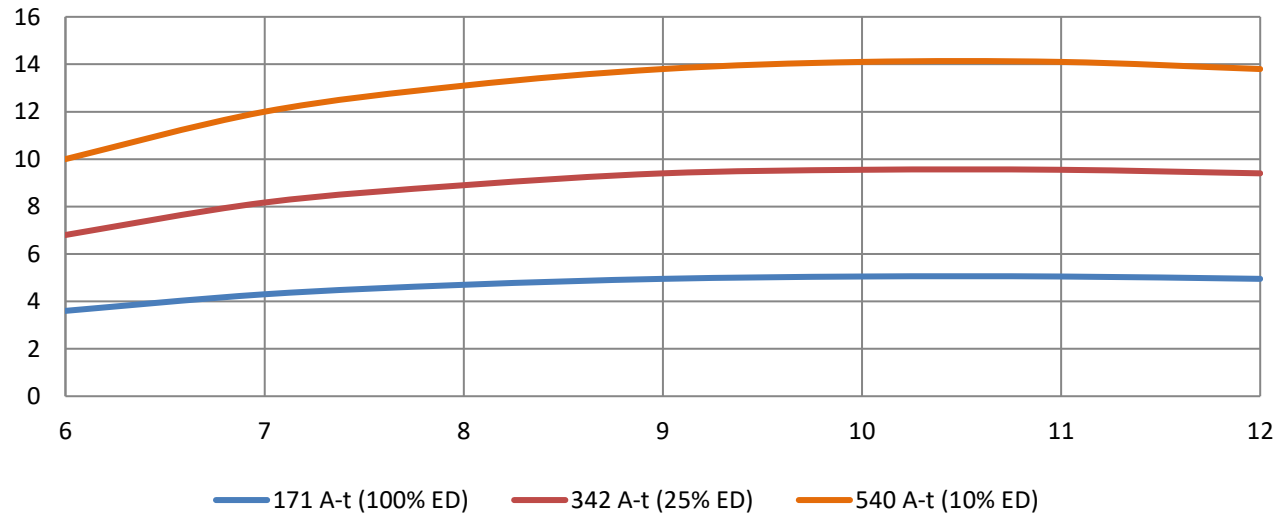
Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM33xx-315	1.0 Ω	0.2 mH	2 N/A	2 Vs/m	2.4 A
VM33xx-180	10.9 Ω	3.0 mH	6 N/A	6 Vs/m	724 mA
VM33xx-125	47.7 Ω	13.0 mH	13 N/A	13 Vs/m	346 mA
VM33xx-090	173.0 Ω	44.0 mH	24 N/A	24 Vs/m	182 mA

Max 'ON' time		Peak Force
100% ED	∞	5.0 N
50% ED	17 s	7.0 N
25% ED	6 s	9.5 N
10% ED	2 s	14.0 N



VM3334 incorporates flex termination to mate with 5-way FFC connector, Molex P/N 52207-0585 or similar
Centre pin is unused, 2 pins connect to each circuit of flex termination

Force (N) vs Displacement (mm)



P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

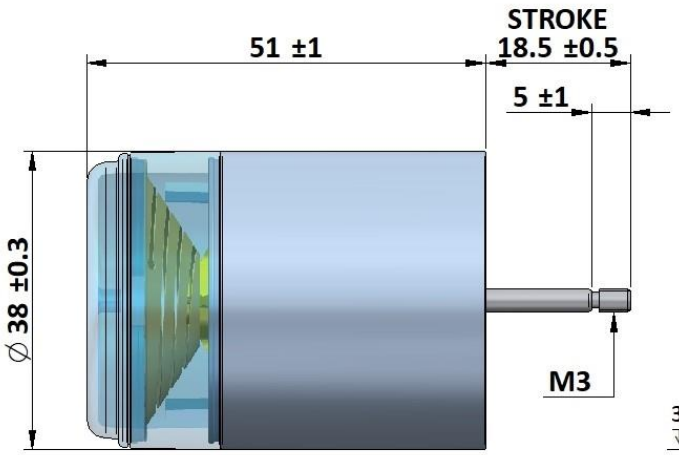
P_{100}	12.0 W	Total Mass	224 g
T_{max}	130 °C	Coil Mass	19 g

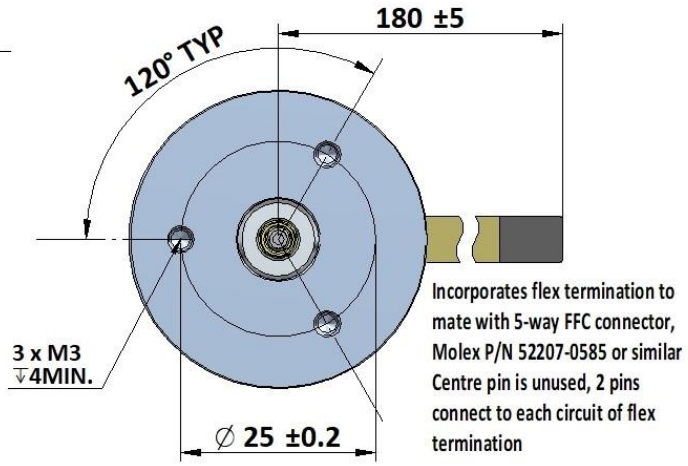
Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM3850RB-200	25.4 Ω	14.8 mH*	15.6 N/A	15.6 Vs/m	0.58 A
VM3850RB-265	8.2 Ω	4.8 mH*	8.8 N/A	0.0 Vs/m	1.02 A
VM3850RB-400	1.6 Ω	0.9 mH*	3.9 N/A	0.0 Vs/m	2.31 A

Max 'ON' time		Peak Force
100% ED	∞	9.0 N
50% ED	60 s	13.0 N
25% ED	26 s	17.3 N
10% ED	11 s	28.1 N

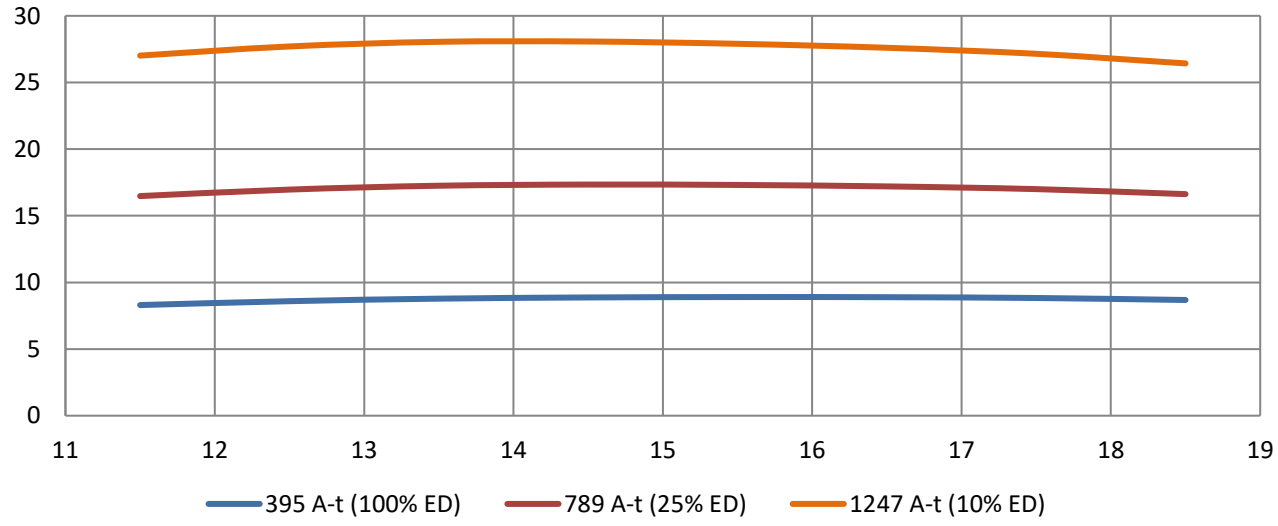
*Inductance is measured with the shaft fully extended at 1kHz and will reduce as the shaft moves in to the pot.

This device uses rolling bearings for lowest hysteresis





Force (N) vs Displacement (mm)

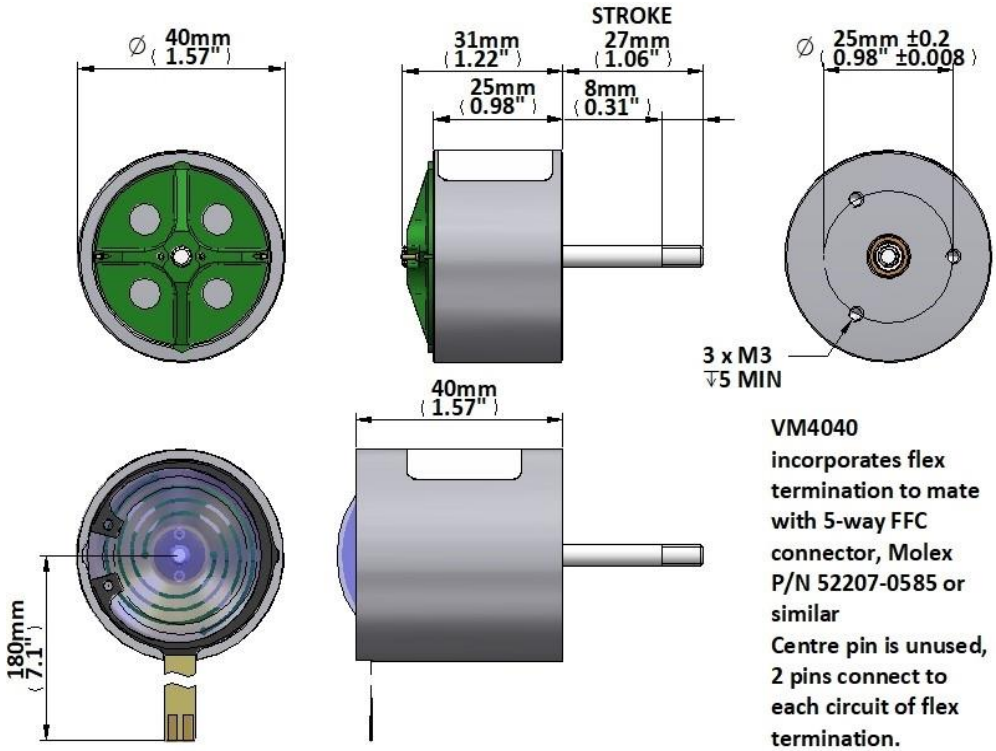


P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	16 W	Total Mass	230 g
T_{max}	130 °C	Coil Mass	25 g

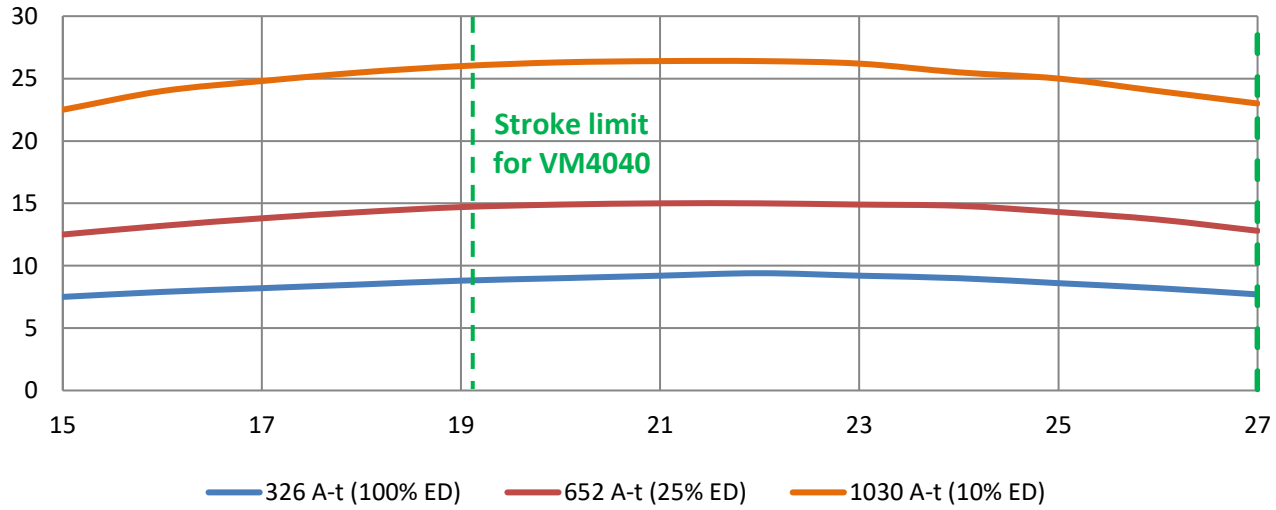
Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM40xx-315	4.3 Ω	1.5 mH	5 N/A	5 Vs/m	1.6 A
VM40xx-250	12.8 Ω	5.2 mH	10 N/A	10 Vs/m	0.9 A
VM40xx-200	26.0 Ω	7.8 mH	12 N/A	12 Vs/m	0.7 A

Max 'ON' time		Peak Force
100% ED	∞	9.0 N
50% ED	90 s	12.0 N
25% ED	28 s	15.0 N
10% ED	8 s	26.0 N



VM4040 incorporates flex termination to mate with 5-way FFC connector, Molex P/N 52207-0585 or similar
Centre pin is unused, 2 pins connect to each circuit of flex termination.

Force (N) vs Displacement (mm)

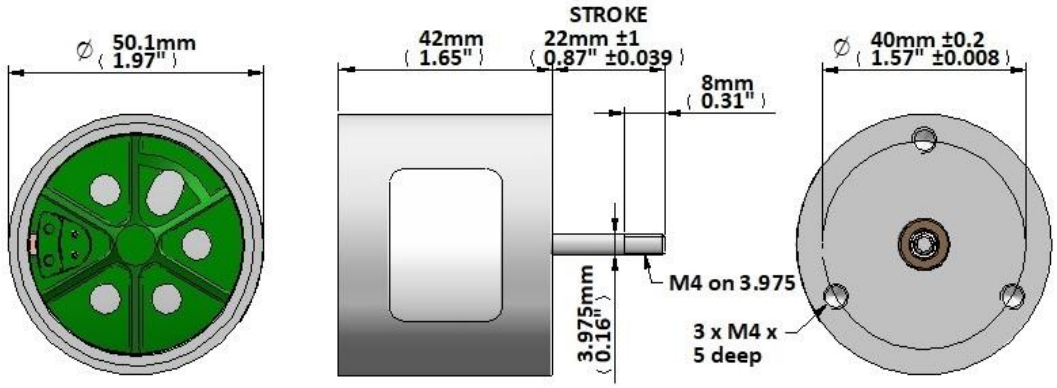


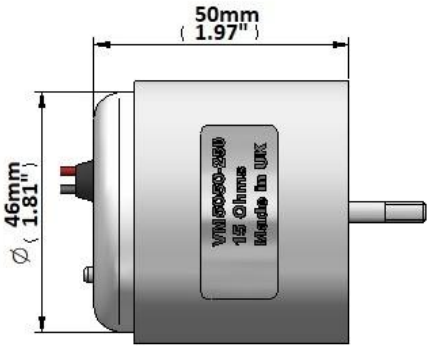
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	24 W	Total Mass	480 g
T_{max}	130 °C	Coil Mass	35 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM50xx-400	2.5 Ω	1.3 mH	7 N/A	7 Vs/m	2.6 A
VM50xx-250	15.0 Ω	5.6 mH	17 N/A	17 Vs/m	1.1 A
VM50xx-190	45.0 Ω	20.0 mH	30 N/A	30 Vs/m	0.6 A

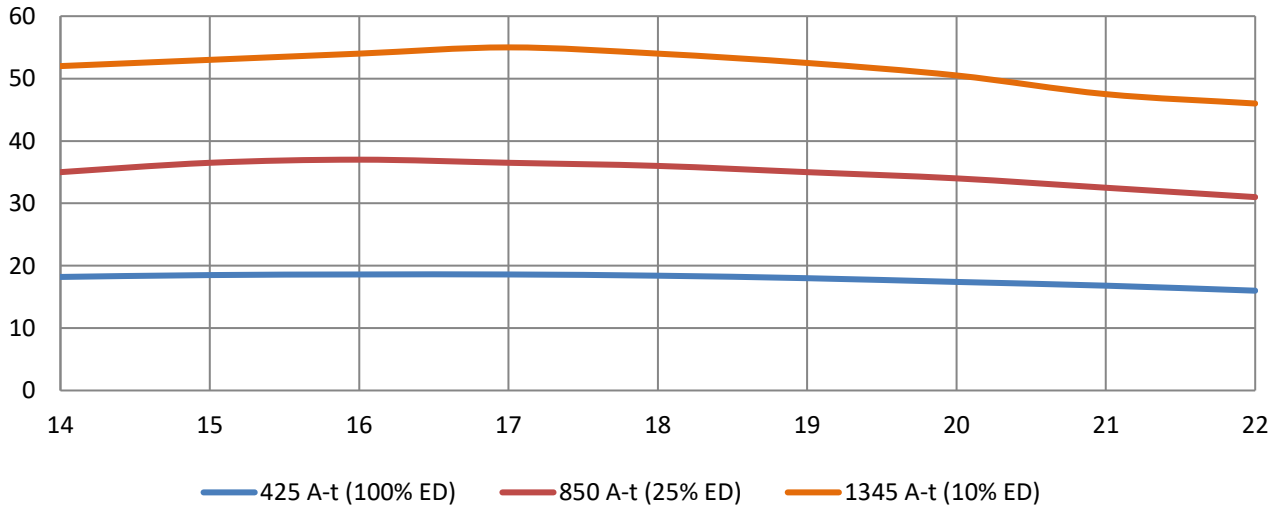
Max 'ON' time		Peak Force
100% ED	∞	19.0 N
50% ED	65 s	27.0 N
25% ED	12 s	37.0 N
10% ED	3 s	54.0 N





VM5050 incorporates end cover and flex circuit termination to coil with leadwires 24AWG, UL????, 300mm (12") minimum length. Stroke is limited to 8mm.

Force (N) vs Displacement (mm)

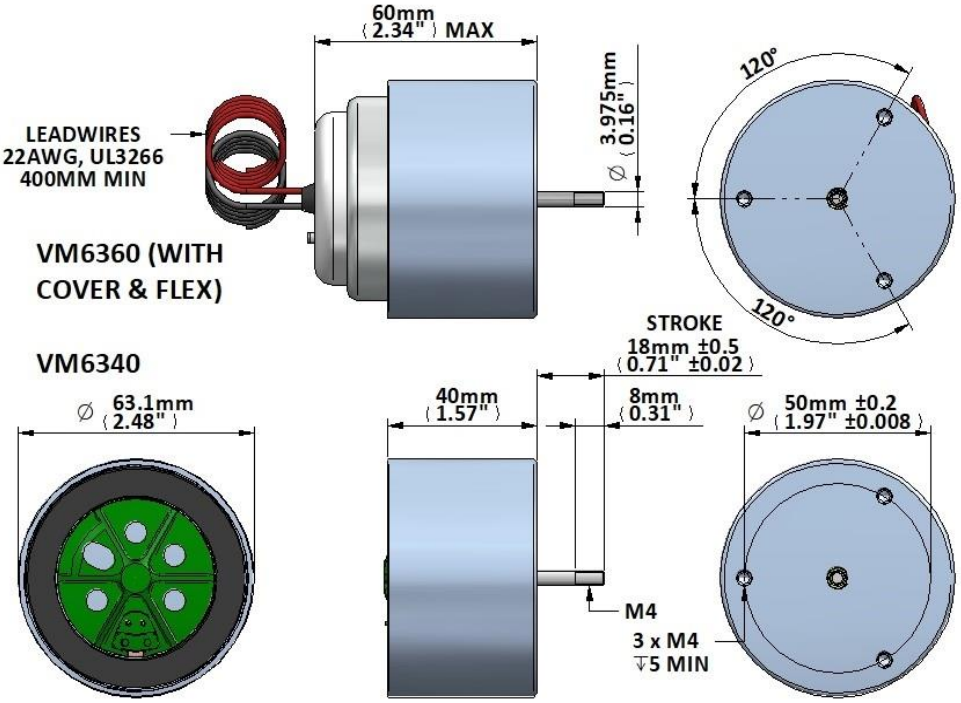


P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

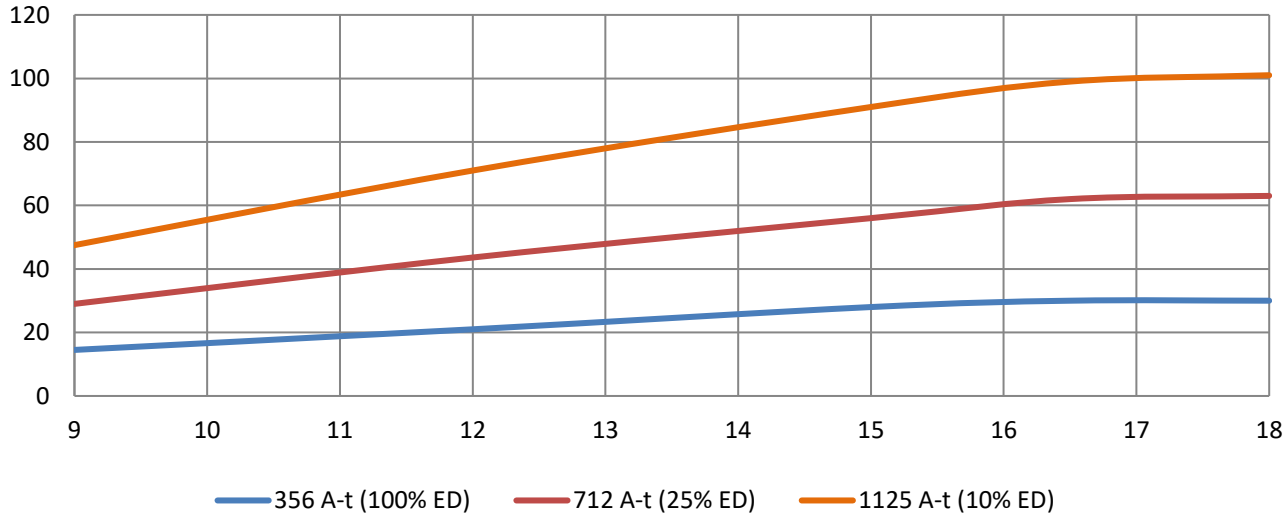
P_{100}	24 W	Total Mass	750 g
T_{max}	130 °C	Coil Mass	32 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM63xx-400	2.5 Ω	1.3 mH	11 N/A	11 Vs/m	2.6 A
VM63xx-250	15.3 Ω	7.8 mH	26 N/A	26 Vs/m	1.1 A
VM63xx-190	45.0 Ω	20.0 mH	47 N/A	47 Vs/m	0.6 A

Max 'ON' time		Peak Force
100% ED	∞	30.0 N
50% ED	65 s	45.0 N
25% ED	12 s	63.0 N
10% ED	3 s	101.0 N



Force (N) vs Displacement (mm)

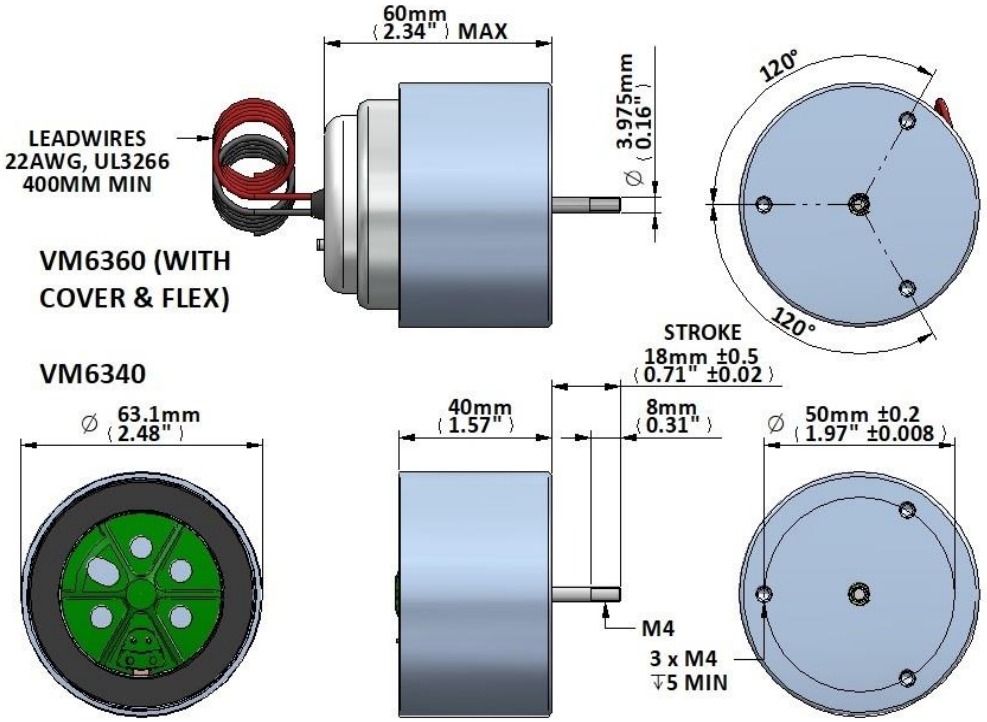


P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

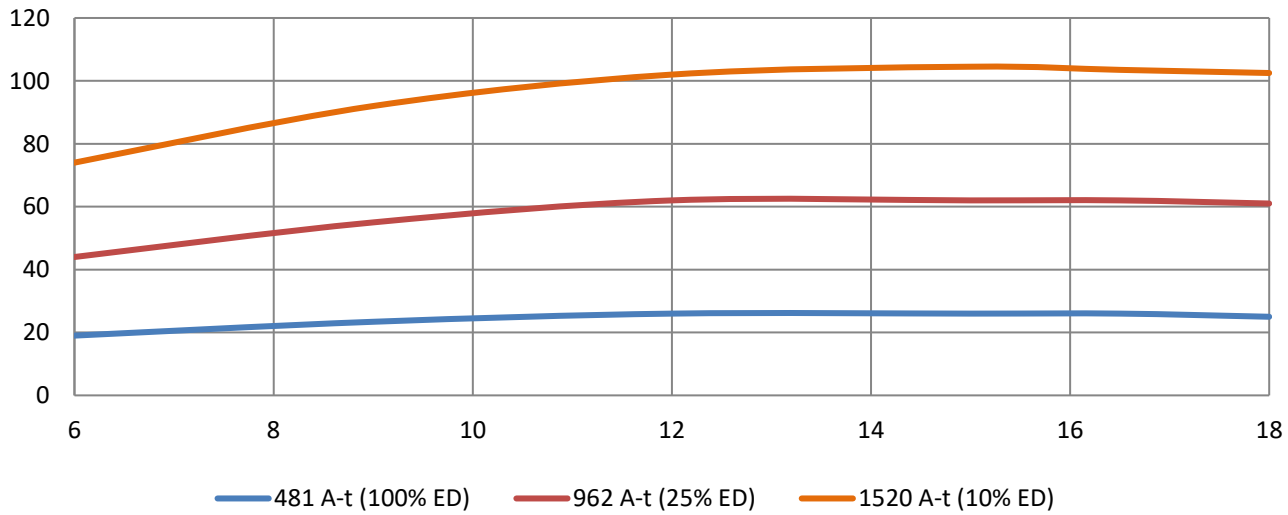
P_{100}	28 W	Total Mass	750 g
T_{max}	130 °C	Coil Mass	43 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM63xxL-400	3.7 Ω	1.8 mH	13 N/A	13 Vs/m	2.3 A
VM63xxL-250	22.0 Ω	10 mH	30 N/A	30 Vs/m	1.0 A
VM63xxL-190	67.0 Ω	31 mH	52 N/A	52 Vs/m	0.5 A

Max 'ON' time		Peak Force
100% ED	∞	29.0 N
50% ED	65 s	43.0 N
25% ED	12 s	62.0 N
10% ED	3 s	104.0 N



Force (N) vs Displacement (mm)



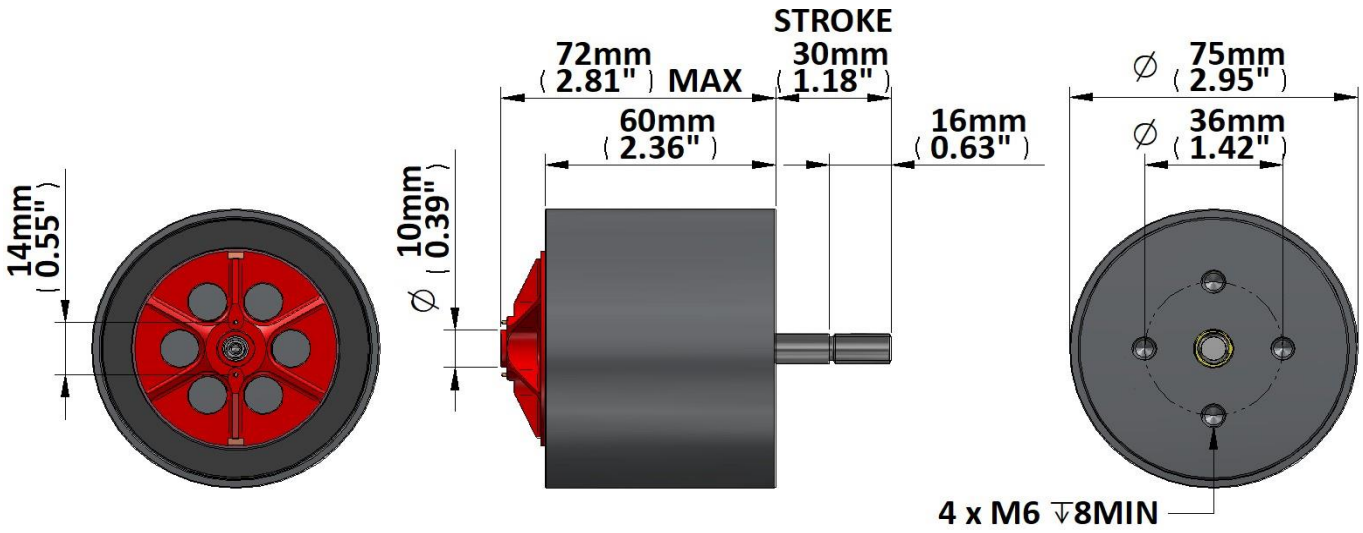
GEEPLUS VM75P2

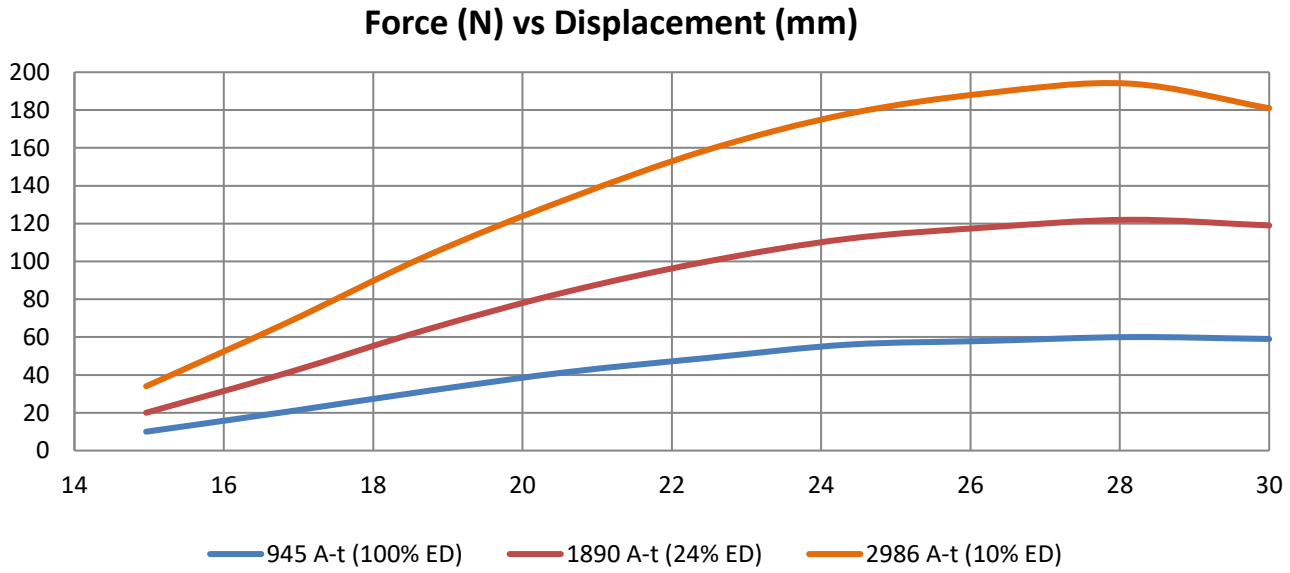
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	42 W	Mass	1700 g
T_{max}	130 °C	Coil Mass	160 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM75P2-375	17.1 Ω	30.0 mH	44 N/A	44 Vs/m	1.3 A
VM75P2-560	3.5 Ω	6.2 mH	20 N/A	20 Vs/m	2.9 A

Max 'ON' time		Peak Force
100% ED	∞	60 N
50% ED	240 s	85 N
25% ED	75 s	122 N
10% ED	15 s	194 N



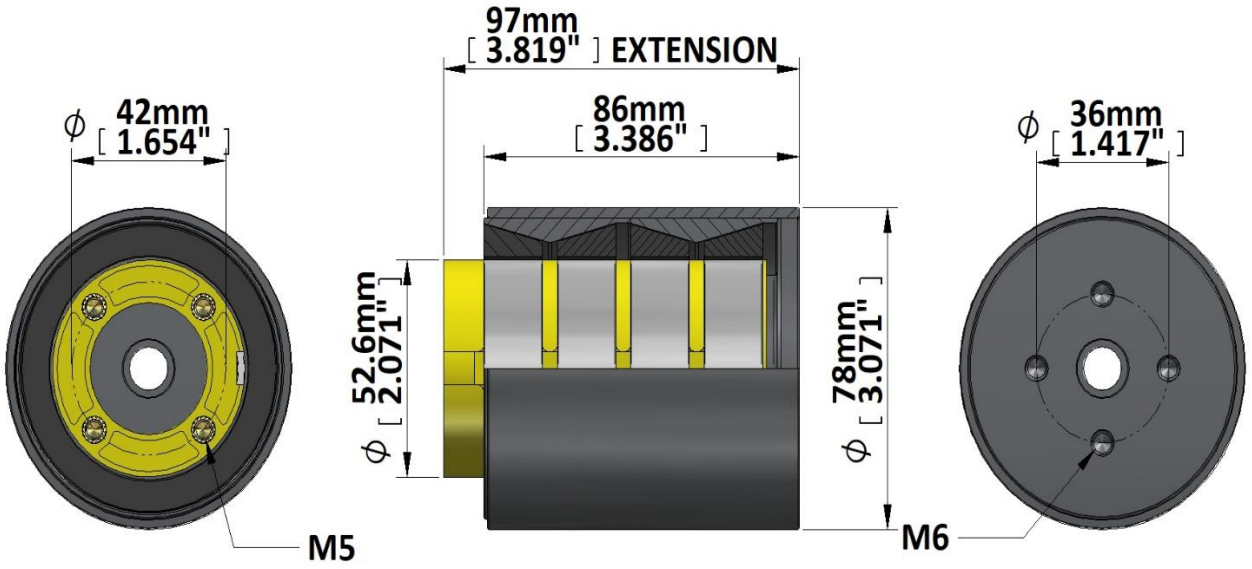


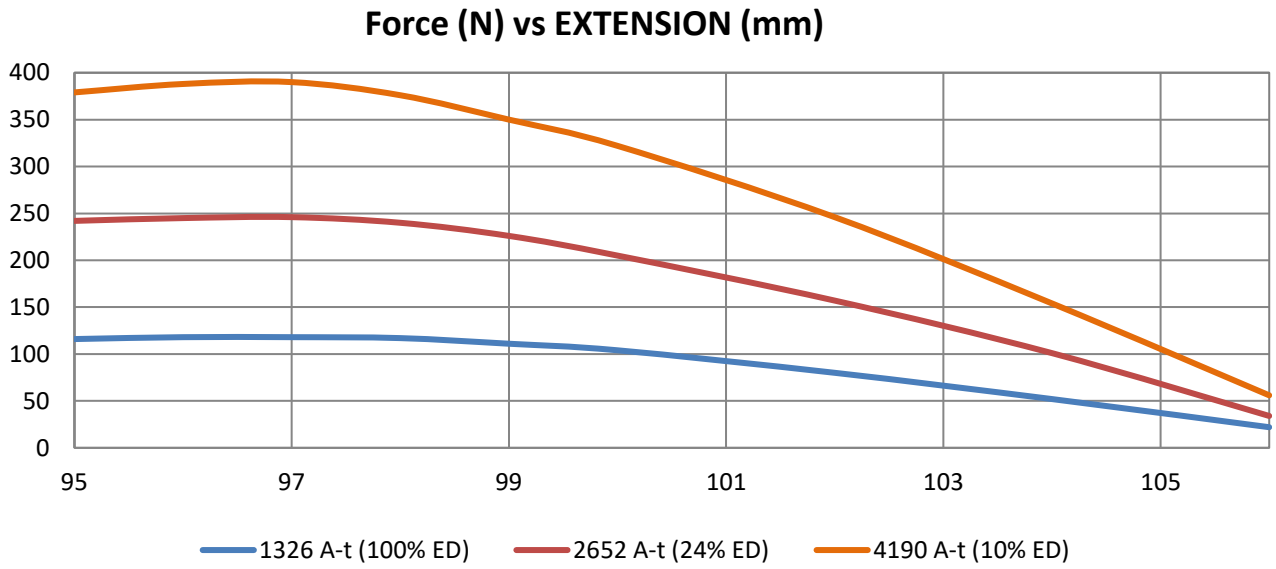
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

P_{100}	75 W	Mass	2800 g
T_{max}	130 °C	Coil Mass	175 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM78P4-530	5.8 Ω	2.4 mH	42 N/A	42 Vs/m	3.1 A
VM78P4-A530	8.9 Ω	2.4 mH	42 N/A	42 Vs/m	2.5 A

Max 'ON' time		Peak Force
100% ED	∞	118 N
50% ED	12 s	180 N
25% ED	36 s	246 N
10% ED	120 s	390 N





P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

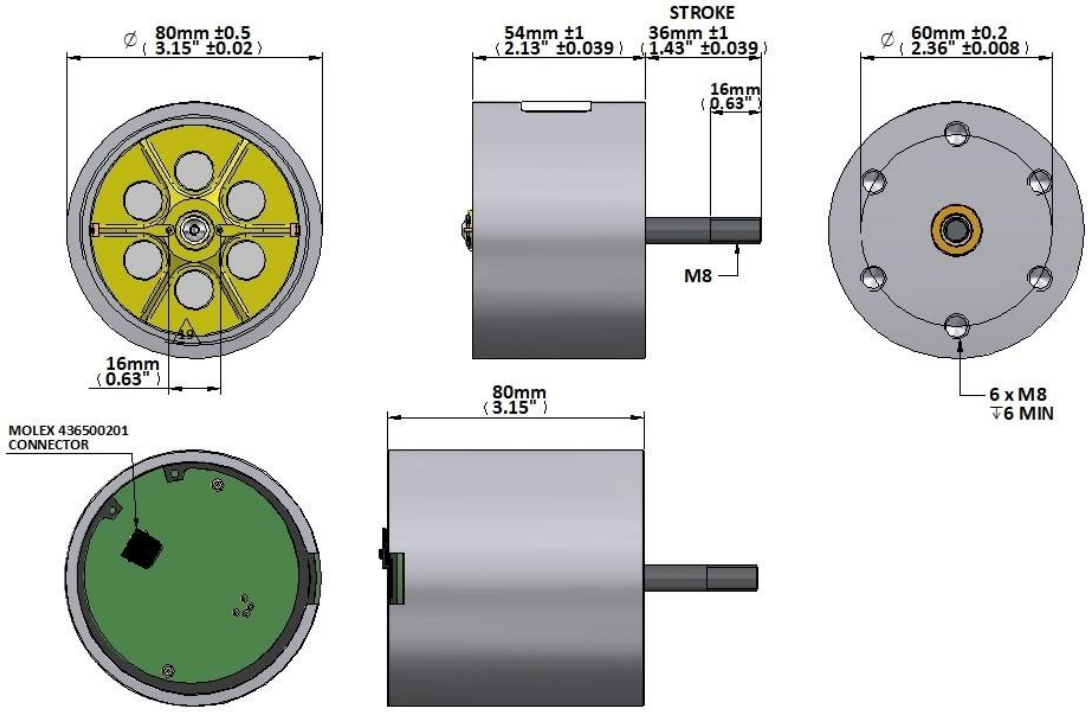
P_{100}	50 W
T_{max}	130 °C

VM8054 1.7kg / VM8080 2kg

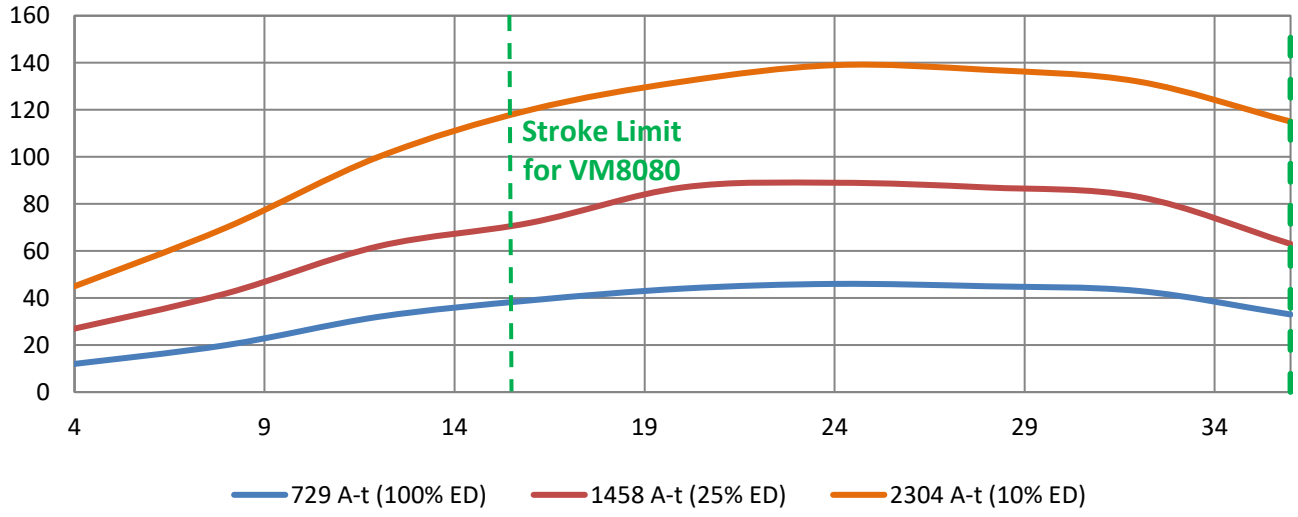
Coil Mass	150 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM80xx-630	2.3 Ω	1.8 mH	10 N/A	10 Vs/m	3.9 A
VM80xx-400	11.5 Ω	10.6 mH	24 N/A	24 Vs/m	1.8 A
VM80xx-250	85.0 Ω	77.0 mH	62 N/A	62 Vs/m	0.6 A

Max 'ON' time		Peak Force
100% ED	∞	43.0 N
50% ED	100 s	62.0 N
25% ED	100 s	85.0 N
10% ED	0 s	130.0 N



Force (N) vs Displacement (mm)

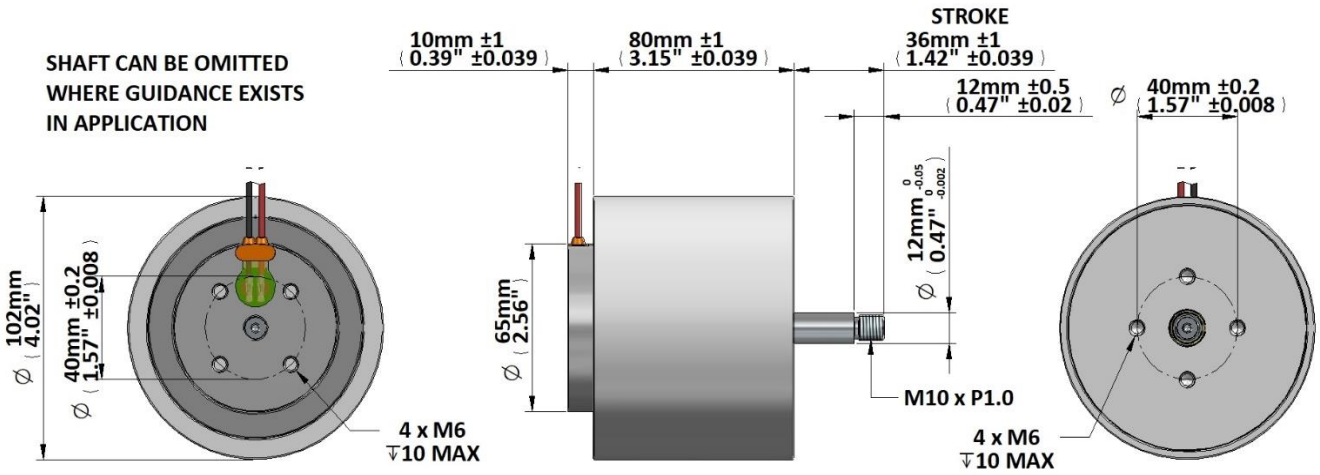


P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

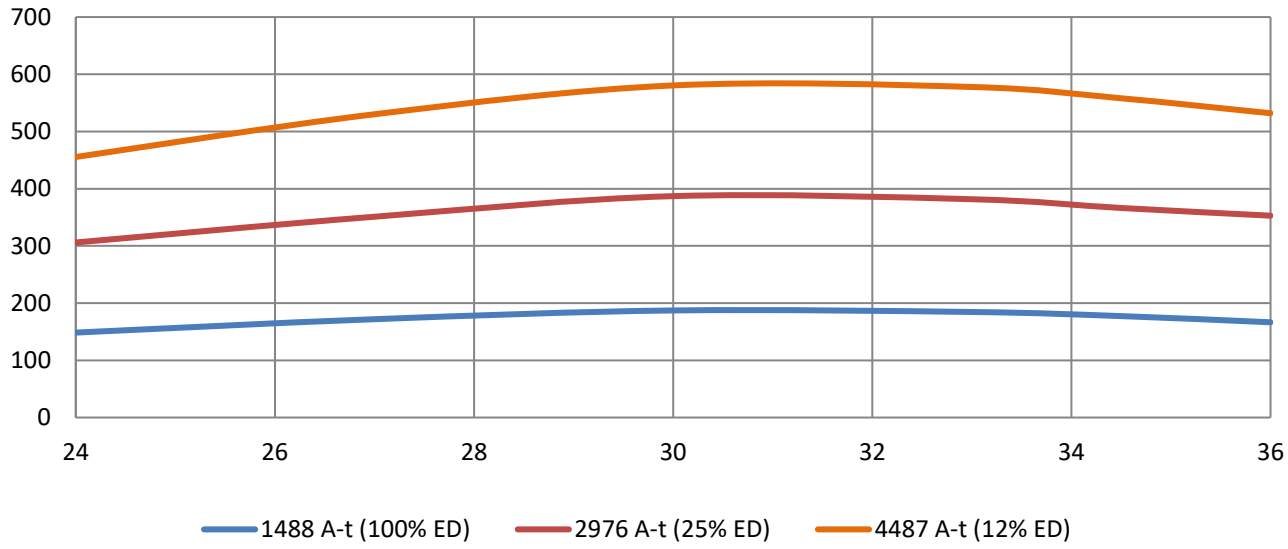
P_{100}	105 W	Total Mass	4200 g
T_{max}	130 °C	Coil Mass	430 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM102P2-710	2.1 Ω	0.6 mH	31 N/A	31 Vs/m	6.0 A
VM102P2-475	10.5 Ω	3.0 mH	70 N/A	70 Vs/m	2.7 A
VM102P2-355	33.4 Ω	9.5 mH	124 N/A	124 Vs/m	1.5 A

Max 'ON' time		Peak Force
100% ED	∞	187.2 N
50% ED	100 s	267.3 N
25% ED	35 s	387.0 N
10% ED	12 s	580.5 N



Force (N) vs Displacement (mm)



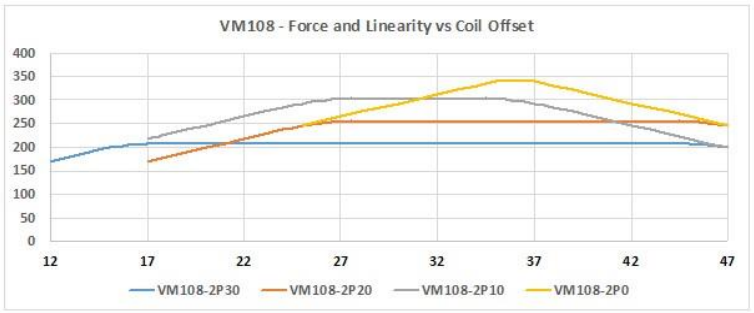
GEEPLUS VM108-2P30

P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

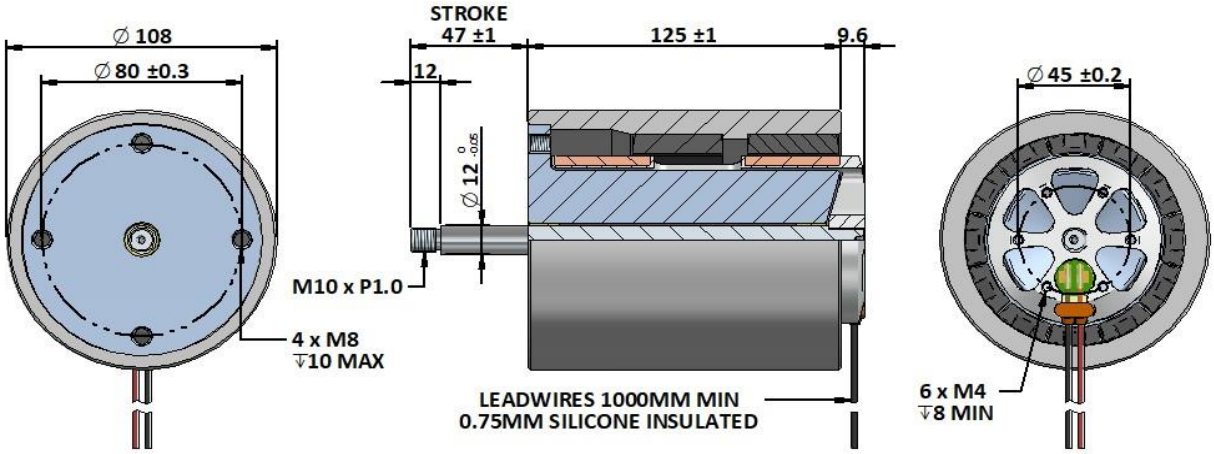
P_{100}	108 W	Total Mass	8 kg
T_{max}	120 °C	Coil Mass	750 g

Model No.	Resistance R_{20}	Inductance	Force Constant	Velocity Constant	Current I_{100}
VM108-2P30-1000	1.3 Ω	0.0 mH	25 N/A	25 Vs/m	7.7 A
VM108-2P30-670	6.4 Ω	0.0 mH	56 N/A	56 Vs/m	3.5 A
VM108-2P30-500	20.2 Ω	0.0 mH	99 N/A	99 Vs/m	2.0 A

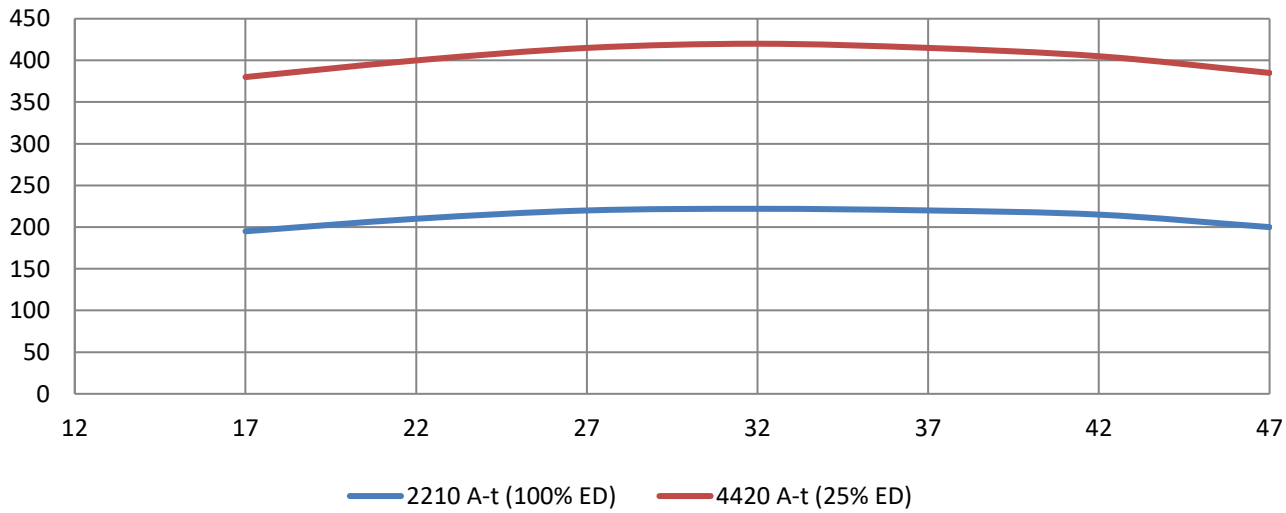
Max 'ON' time		Peak Force
100% ED	∞	230.0 N
50% ED	100 s	300.0 N
25% ED	35 s	440.0 N
10% ED	11 s	700.0 N



The VM108-2P voice coil motor can be configured with different coil geometry to provide more force over a shorter linear range. The graph gives an approximate indication of what is possible. Call Geeplus if other configuration is of interest



Force (N) vs Displacement (mm)

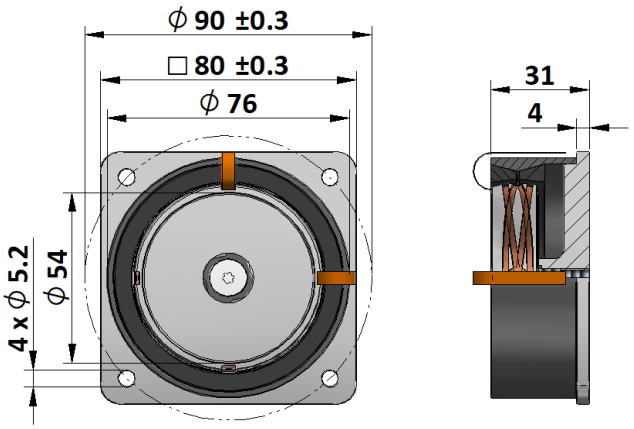


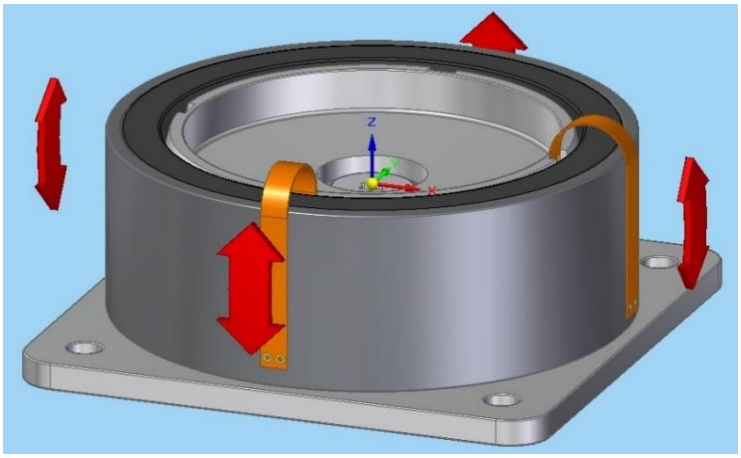
P_{100} is the continuous (100% ED) excitation power per coil at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C with both coils energised at equal power.

P_{100}	5 W	Total Mass	400 g
T_{max}	130 °C	Coil Mass	40 g

Model No.	Resistance R_{20}	Inductance	Torque Constant	Deflection Constant	Current I_{100}
VMXY80-400-200	3.5 Ω	0.2 mH	0.020 Nm/A	1.31 °/A	1.0 A
VMXY80-400-250	2.6 Ω	0.3 mH	0.016 Nm/A	1.06 °/A	1.2 A

Max 'ON' time		
100% ED	∞	0.02 Nm
50% ED	22 s	0.03 Nm
25% ED	9 s	0.04 Nm
10% ED	3 s	0.06 Nm



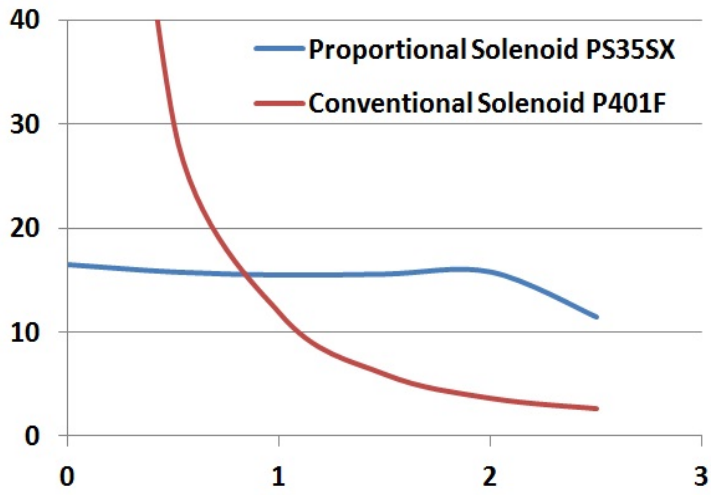


The VMXY80 voice coil actuator provides rotational deflection about 2 axes, intended for steering of optical beams or other application.
The moving element is supported on a steel flexure for frictionless movement.
The device has two coil pairs which develop torque about either the X or Y axis when energised.
Torque is proportional to the excitation current, and results in a deflection proportional to the excitation current.
The design of the device is scalable - smaller or larger devices with similar construction are possible subject to quantities being economically viable, however it should be noted that the 80mm diameter device is approaching the upper size limit for which radial magnets are available. Larger devices can be realised using segmented magnets, and may be more readily manufactured with square format.
The Part Number has the format VMXY80-XXX-YYY where the numbers XXX represent thickness of the supporting flexure in microns, and the numbers YYY represent core diameter of the coil wire in microns (so P/N VMXY80-400-250 has a flexure 0.400mm thick, and a coil wound with 0.250mm wire).

PROPORTIONAL & HYDRAULIC SOLENOIDS

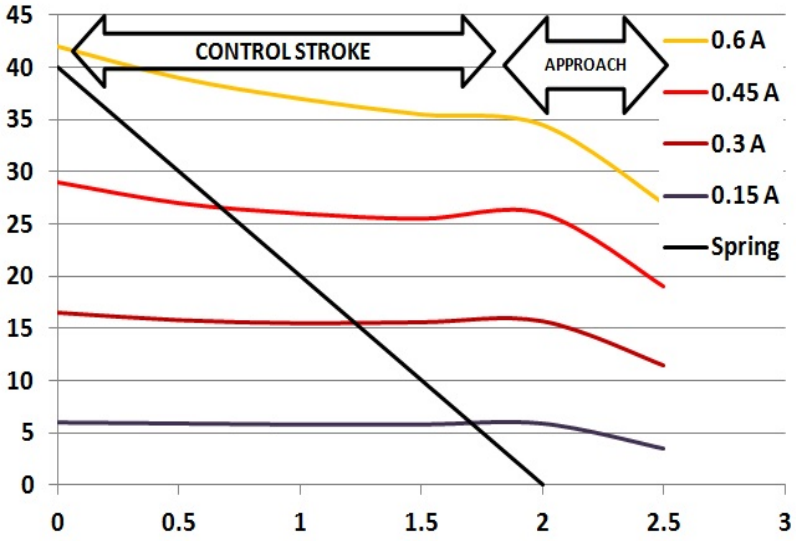
Proportional Solenoid

Most solenoids are simple 2-position ‘digital’ devices, the proportional solenoid however is an analogue device capable of incremental positioning. The design of the polepiece of the proportional solenoid results in a force being developed which is constant over some displacement (the ‘control stroke’), and which is proportional to the excitation current.



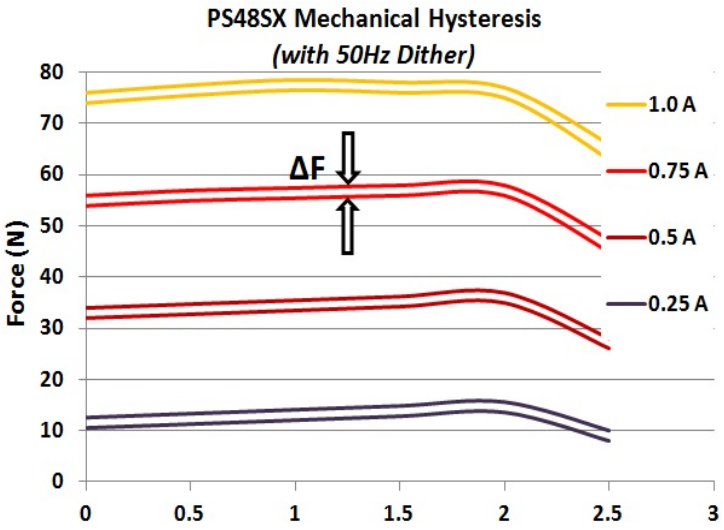
Proportional solenoids can be used to develop a force which is directly proportional to current, or with the addition of a rising-rate spring to extend to a position which is proportional to current.

As the excitation current increases, the force developed by the solenoid increases. The solenoid plunger pulls in until the magnetic force is balanced by the opposing spring force. As the current increases, it will pull in further to attain a new equilibrium position. In this way, a system is realised in which the position is proportional to the applied excitation current. As a simple analogy, increasing the current is like adding additional mass to a spring balance, as the mass increases, the spring is extended further until an equilibrium is reached.

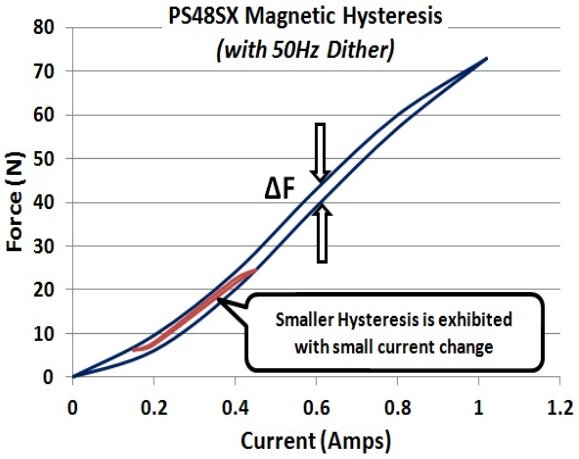


Hysteresis

The force characteristic for a proportional solenoid is typically shown as a pair of lines to take account of a property known as hysteresis. If the solenoid is tested by pushing the plunger against the direction in which force is developed, the measured force includes some friction which opposes the movement and adds to the developed force, if the plunger is then allowed to return in the direction of force the friction retards this movement and results in the measured force being less than the developed force, the difference between these two curves is a measure of (mostly *) mechanical hysteresis.



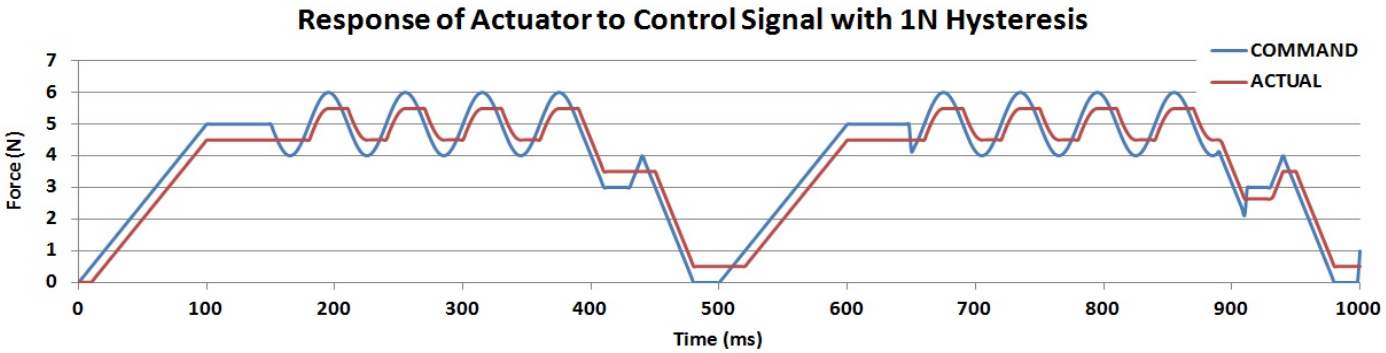
If the force developed by the solenoid is measured in a fixed position as the current is increased, another curve can be plotted which is a loop as shown, the force difference between upper and lower curves, in this case, represents (mostly *) magnetic hysteresis caused by losses in the magnetic steel material.



Hysteresis losses will limit the precision to which force or position can be accomplished using a proportional solenoid. Mechanical hysteresis will vary for different bearing types, for dry / maintenance free bearings it will typically be 10-20% of the developed force, for lubricated bearings, or for flexure supports it can be smaller.

*Note * - some care should be taken in describing these parameters as 'mechanical' or as 'magnetic' as the measurement of either will include some element of the other parameter.*

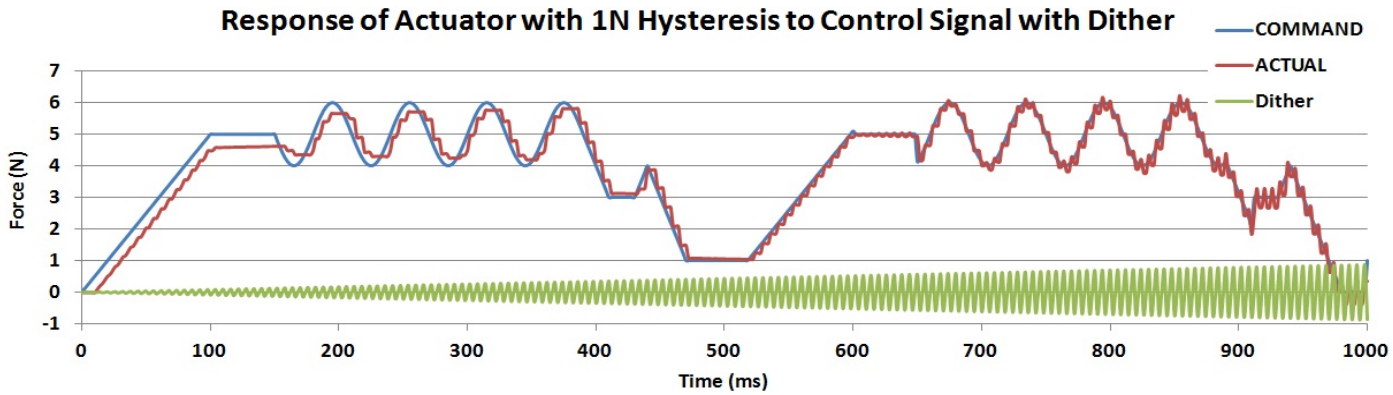
The effect of Hysteresis on the control of the solenoid is described with reference to the graph below.



The 'COMMAND' line represents the force developed by a perfect solenoid, without friction or magnetic hysteresis. The 'ACTUAL' line represents the force that would be measured in practice at the output shaft of the device.

Dither

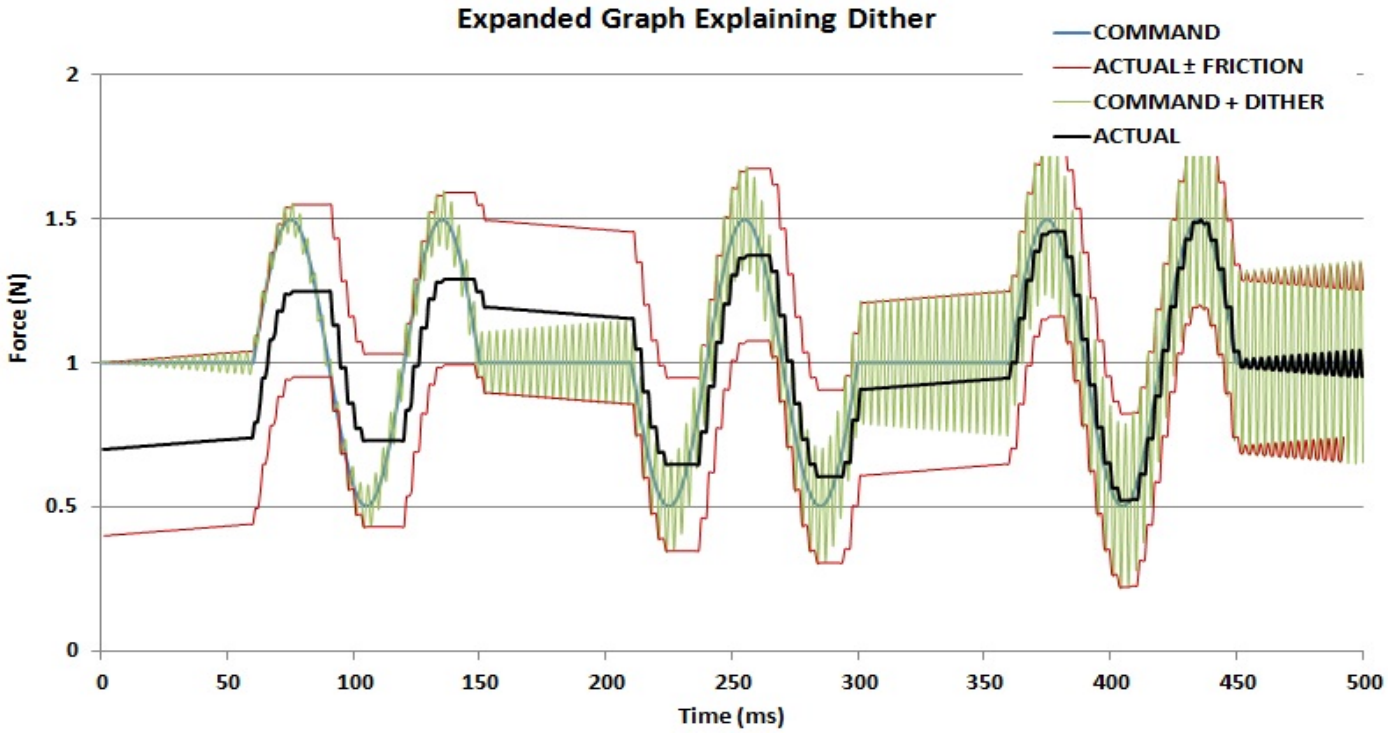
Dither is an electronic signal superimposed on the signal driving a proportional (or other) solenoid, which can mitigate some of the effects of hysteresis. An AC signal (the 'Dither' signal) is superimposed on the 'COMMAND' signal applied to the solenoid. The effect is shown in the graph below.



As the amplitude of the dither signal increases, the deviation of the 'ACTUAL' force from commanded value will reduce, reaching a minimum when the peak-to-peak amplitude of the dither signal corresponds to the solenoid hysteresis. If dither amplitude is increased further, the solenoid will begin to exhibit some oscillation about the commanded value.

Dither can be a very effective way to mitigate the effects of hysteresis, provided the amplitude and frequency can be matched to characteristics of the solenoid used.

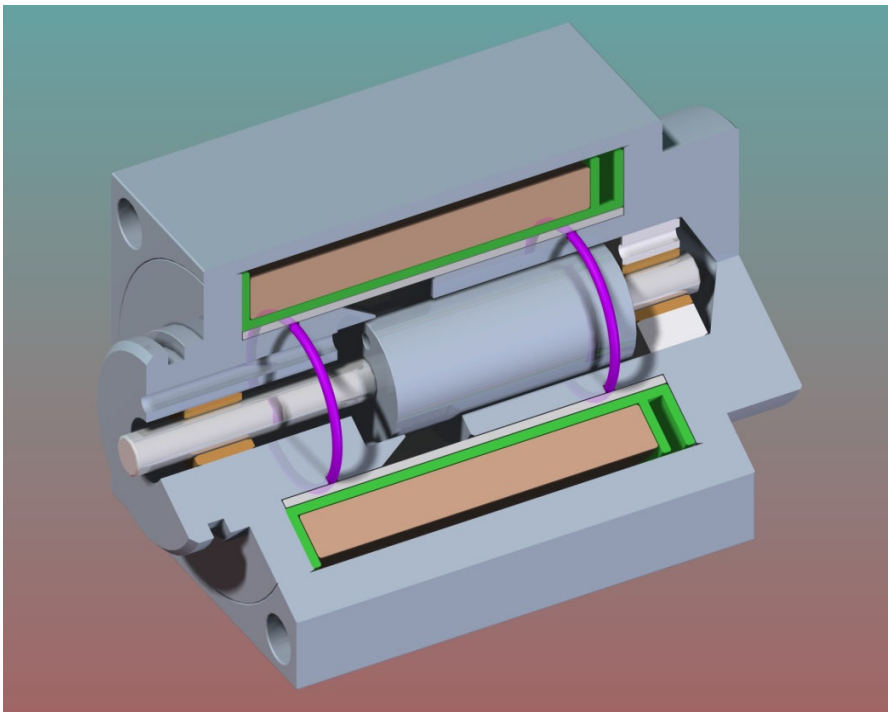
The way in which dither works may be better illustrated with reference to the graph below.



The two red lines represent the actual output force of the solenoid plus or minus friction (half of the hysteresis value). Without dither, the actual force will lag the 'commanded' force by this amount. As dither is added to the command signal. It causes the upper and lower values of the resultant signal to vary, as the signal increases, the 'high' value of the signal nudges the output force upwards, as the signal decreases the low value does this, with the result that the actual force or position more closely follows the commanded value. When the amplitude of the dither signal corresponds to the hysteresis value, the actual output will accurately follow the commanded value. If dither is increased more than this, the average value of the actual force will follow the commanded value, but will have an oscillating component corresponding to the frequency of dither.

Hydraulic Solenoid

Solenoids can be constructed with a sealed cavity connecting the mounting face of the solenoid to the base pole piece. The image shows a proportional solenoid which is constructed in this way. In this case the device is shown as having o-ring seals sealing the front and rear pole pieces into a metal tube, alternatively these may also be assembled using a welded, brazed, or glued construction to seal and fix the parts of the pressure assembly. Hydraulic solenoids can be used in oil filled environments such as automotive transmission, they can also be constructed for control of oil flow in hydraulic systems capable of operating at pressure of 45MPa / 6500PSI or more. The plunger and pole pieces typically incorporate channels to allow the free passage of fluid throughout the device. Because the fluid is able to flow around all moving parts of the assembly at equal pressure, the fluid pressure does not affect the force characteristics of the solenoid.

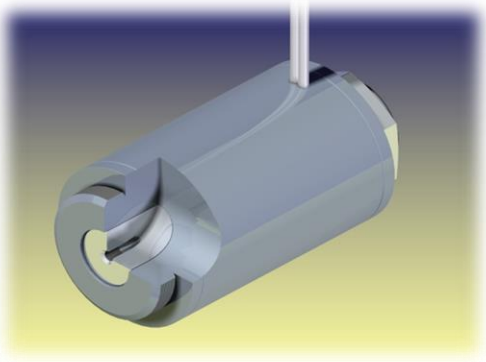


Most of the proportional solenoids shown in Geeplus data have hydraulic construction. Because these are normally protected by oil against corrosion these do not have plating or other corrosion protection of internal surfaces! These are normally filled with oil to make a pressure test at the end of production, so are protected by this against corrosion in transit and storage.

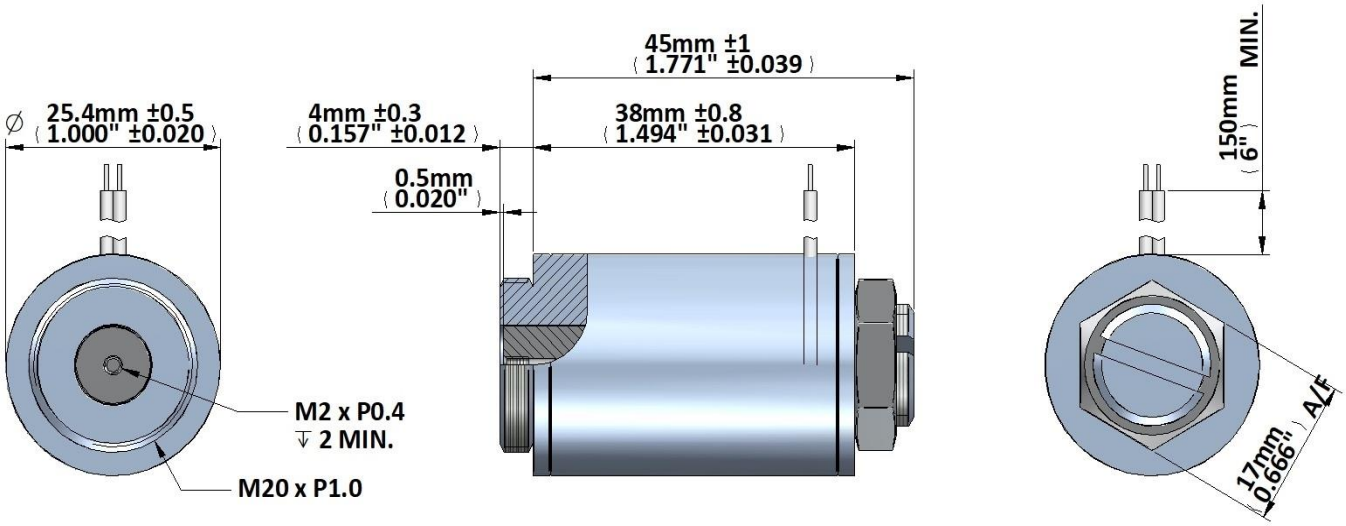
Hydraulic solenoids can be produced with either proportional, or with simple 2-position ‘ON-OFF’ function.

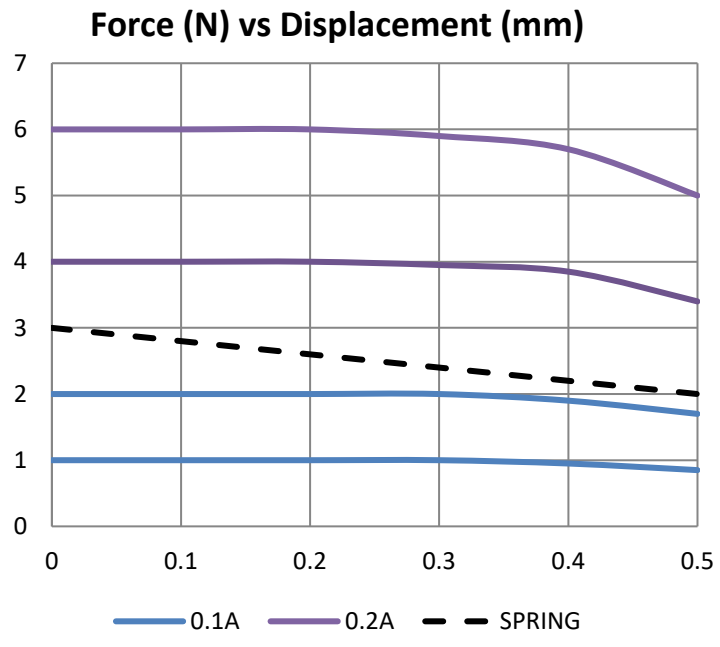
GEEPLUS PS26C

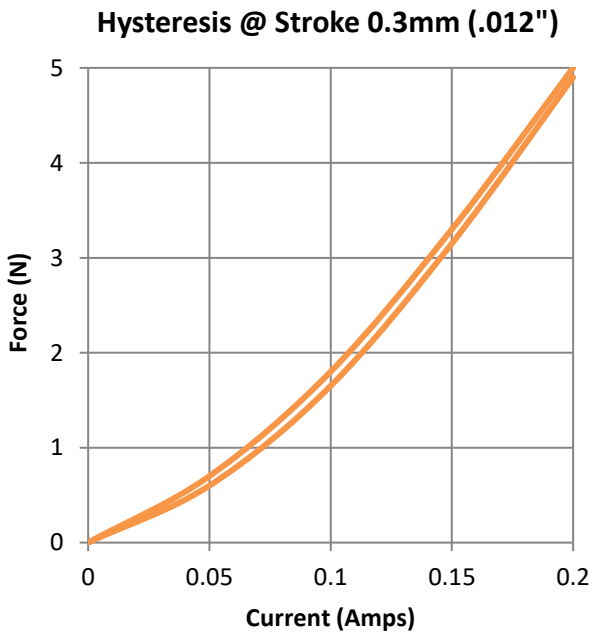
Specifications	
Parameter	**Value**
Rated Voltage	15 Volts
Current	0.2 Amps Max
Resistance	50 Ω
Nominal Power	2 Watts
Insulation Class	Class B (130°C)
Rated Pressure	0.35 MPa / 50PSI
Burst Pressure	1.03MPa / 150PSI
Dielectric Strength	AC 1000 V, 1 minute
Insulation Resistance	>100MΩ @ DC 500V



This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



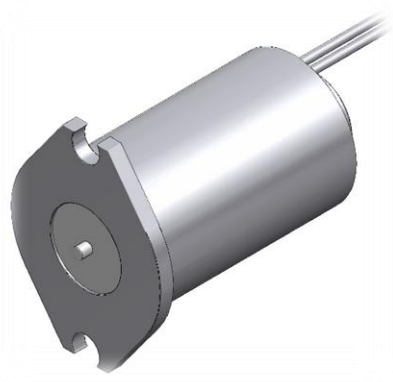




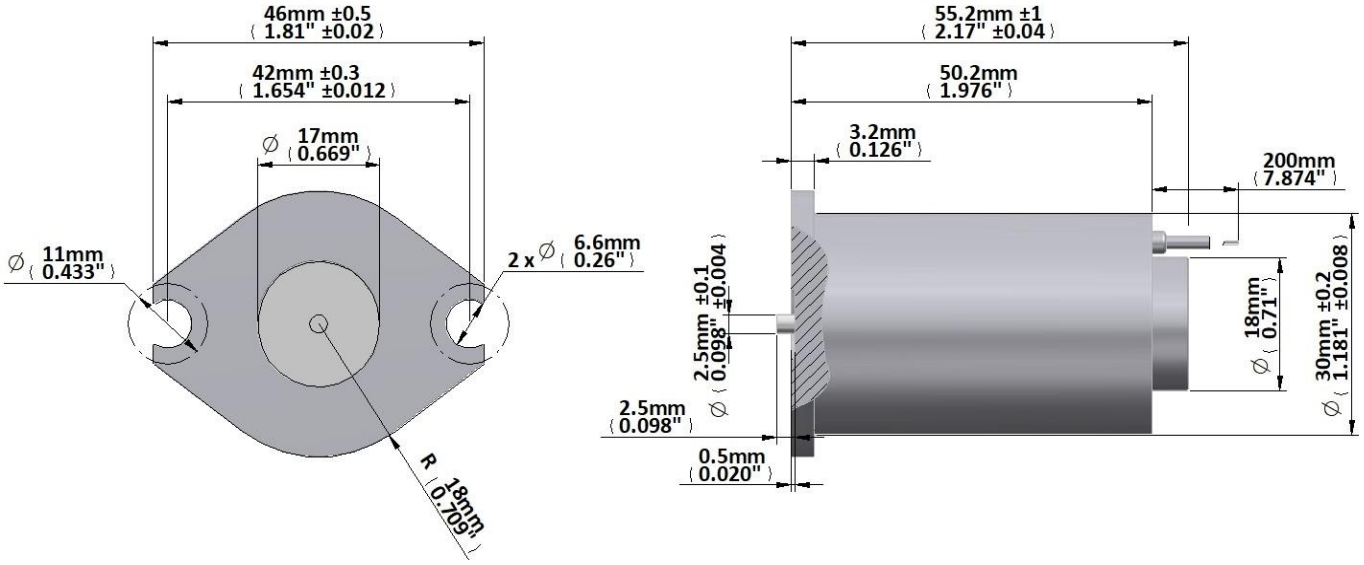
Representative Data Actual P/N, Dimensions and Data may vary from details shown

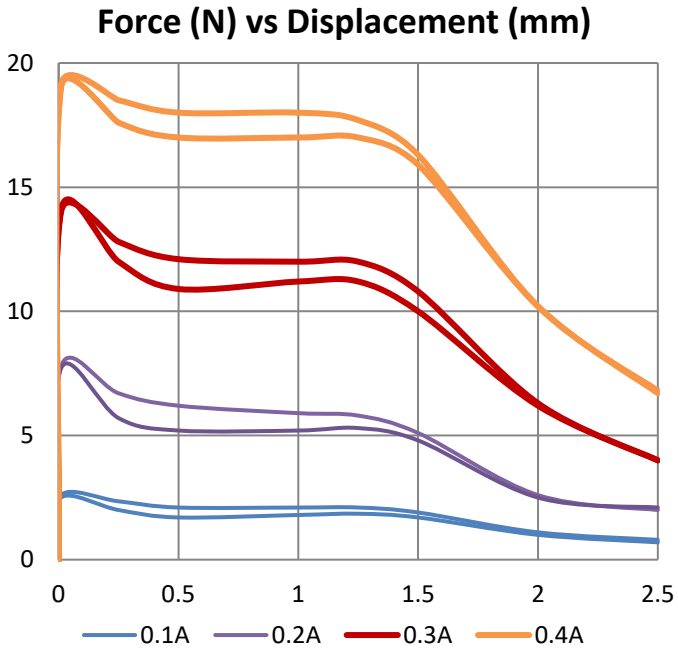
GEEPLUS PS30C-0102

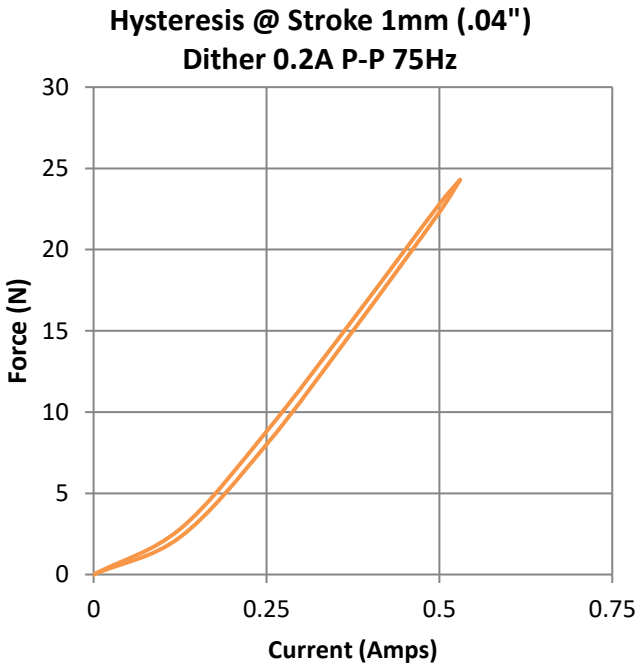
Specifications	
Parameter	**Value**
Rated Voltage	24 Volts
Current	0.4 (20°C)
Resistance	32 Ω
Nominal Power	5.1 Watts
Insulation Class	Class H (180°C)
Rated Pressure	1.0 Mpa
Burst Pressure	3.0 MPa
Dielectric Strength	AC 1000 V, 1 minute
Insulation Resistance	>100MΩ @ DC 500V
Mass	240g



This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



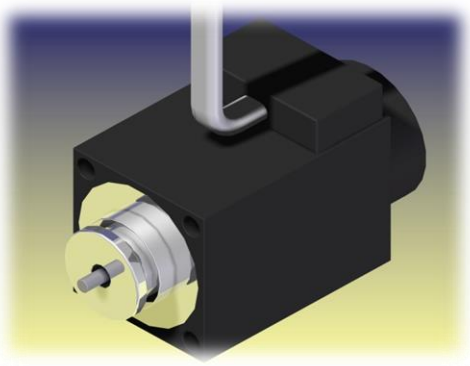




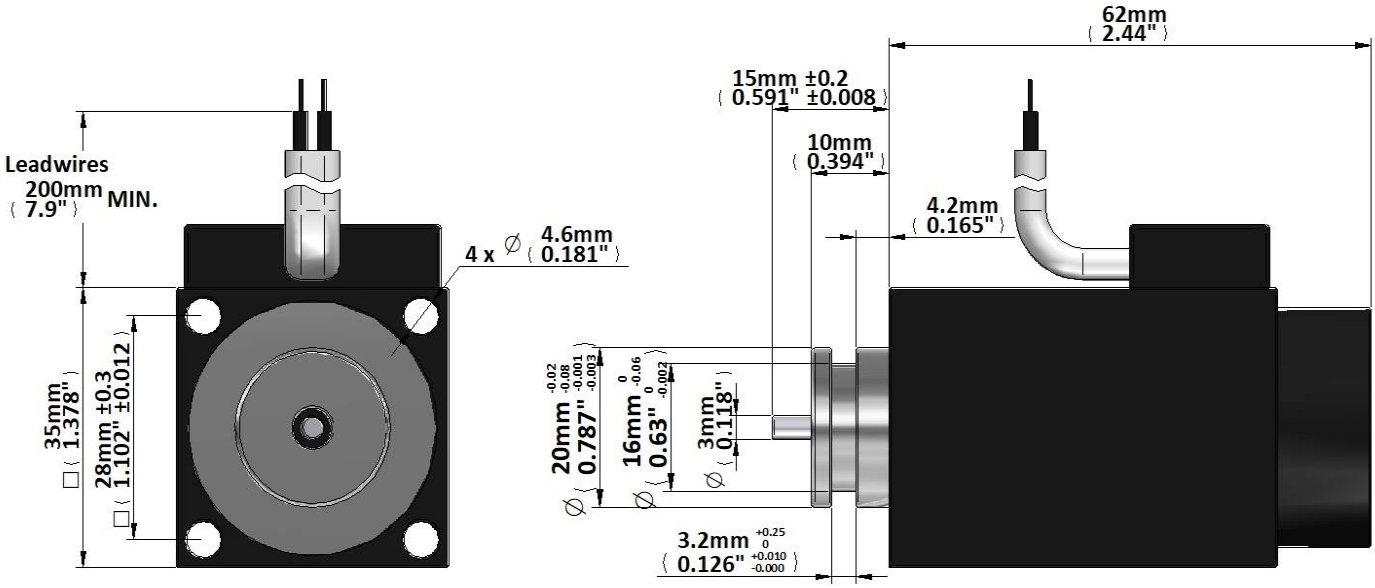
Representative Data Actual P/N, Dimensions and Data may vary from details shown

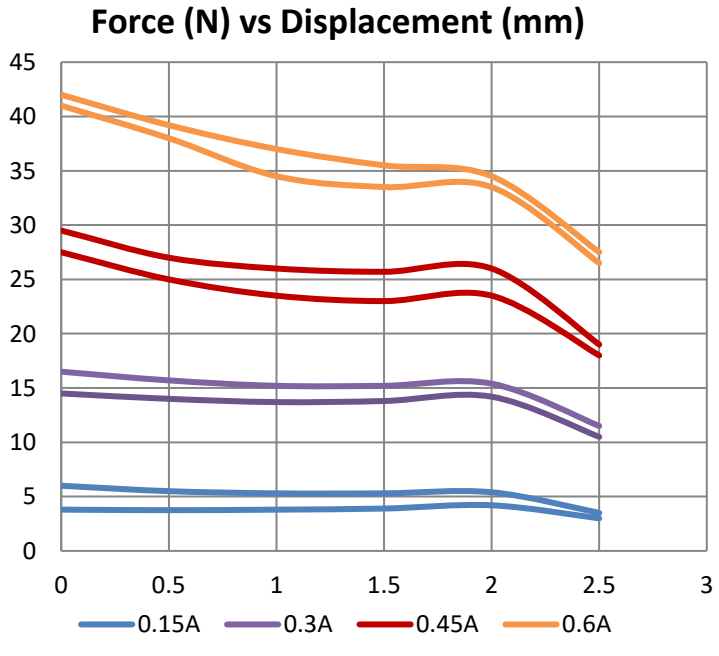
GEEPLUS PS35SX-0203

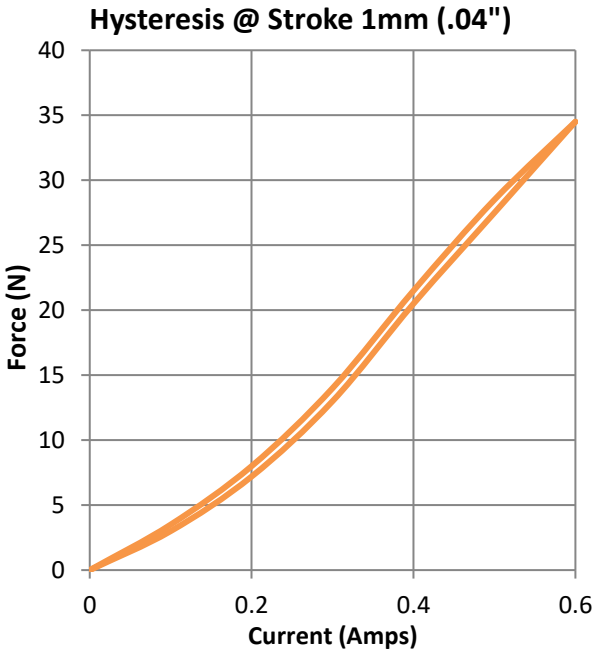
Specifications	
Parameter	**Value**
Rated Voltage	24 Volts
Current	0.6 Amps Max
Resistance	22 Ω
Nominal Power	7.9 Watts
Insulation Class	Class F (155°C)
Rated Pressure	0.35 MPa / 50PSI
Burst Pressure	1.03MPa / 150PSI
Dielectric Strength	AC 1000 V, 1 minute
Insulation Resistance	>100MΩ @ DC 500V



This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



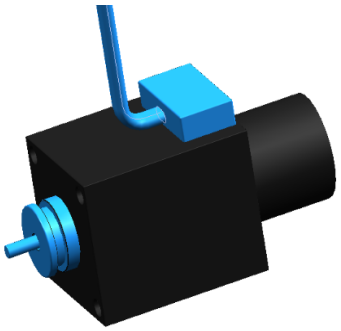




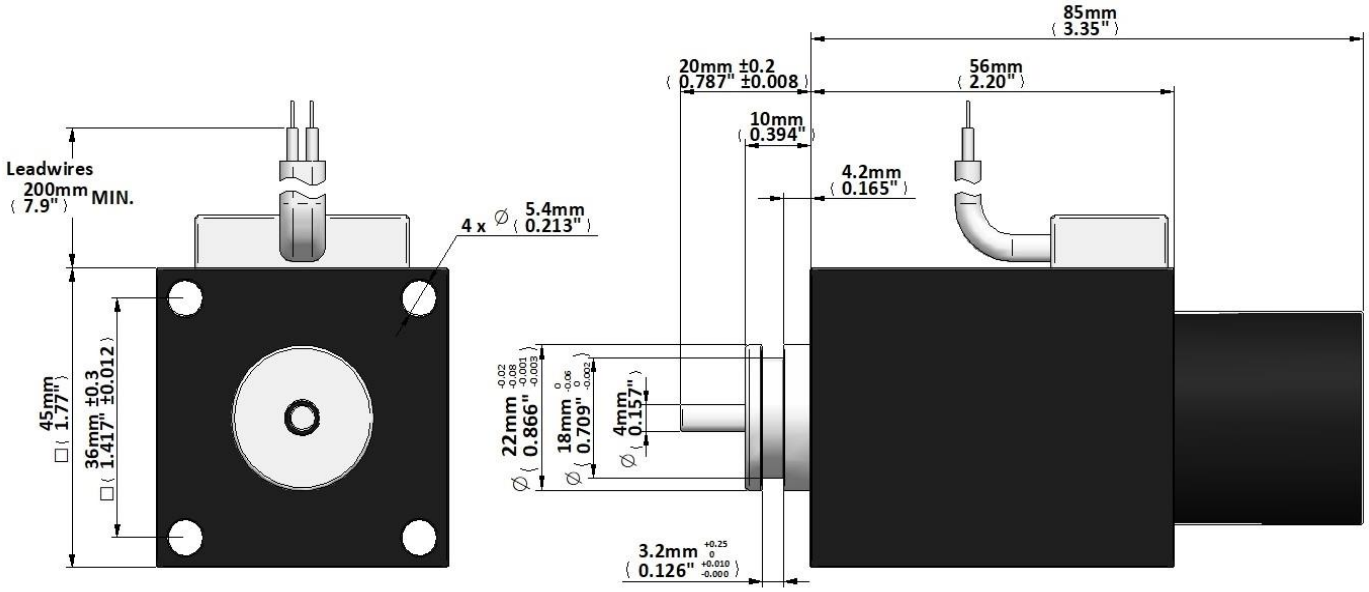
Representative Data Actual P/N, Dimensions and Data may vary from details shown

GEEPLUS PS45S-0305

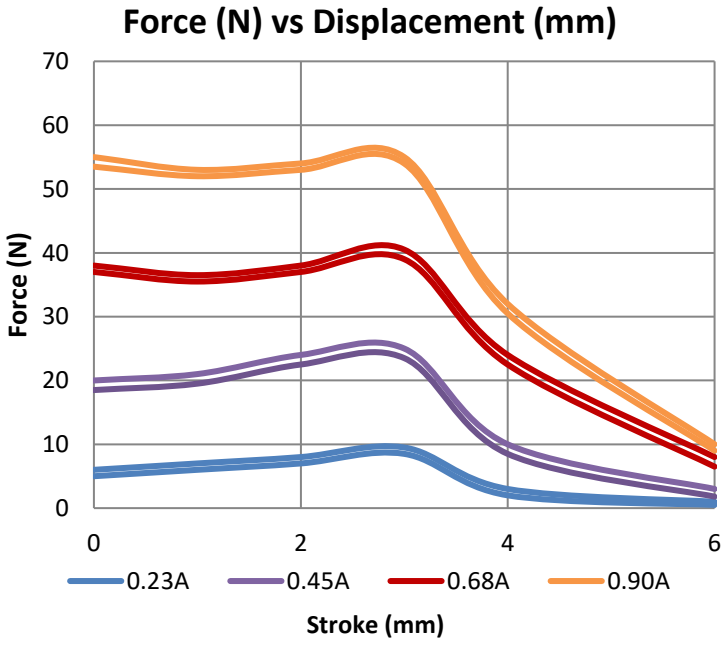
Specifications	
Parameter	**Value**
Rated Voltage	24 Volts
Current	0.9 Amps Max
Resistance	14.7 Ω (20 ° C)
Nominal Power	11.8 Watts (20 ° C)
Insulation Class	Class F (155°C)
Rated Pressure	6.8 Mpa
Burst Pressure	20.6 Mpa
Dielectric Strength	AC 1000 V, 50/60 Hz, 1 minute
Insulation Resistance	100MΩ @ DC 500V

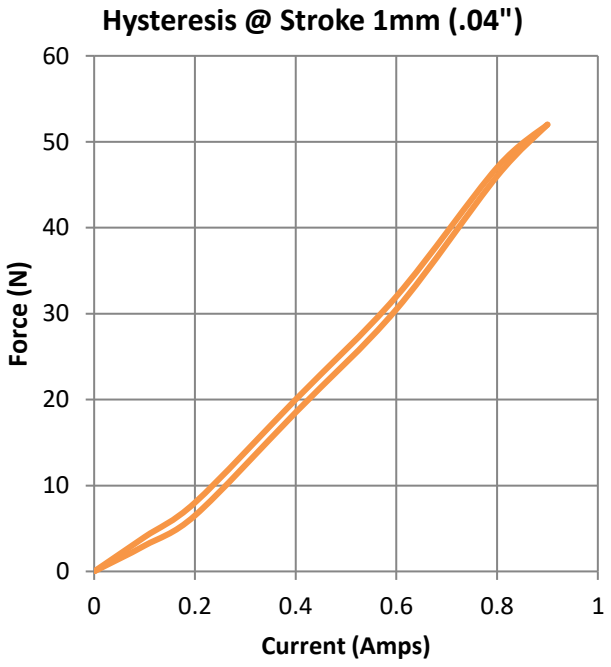


This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



Device drawn in energized condition

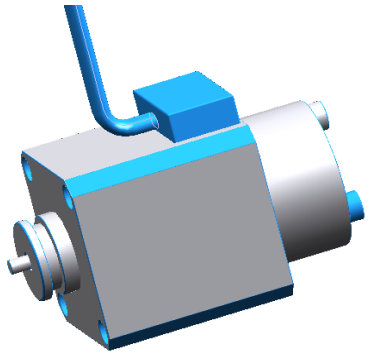




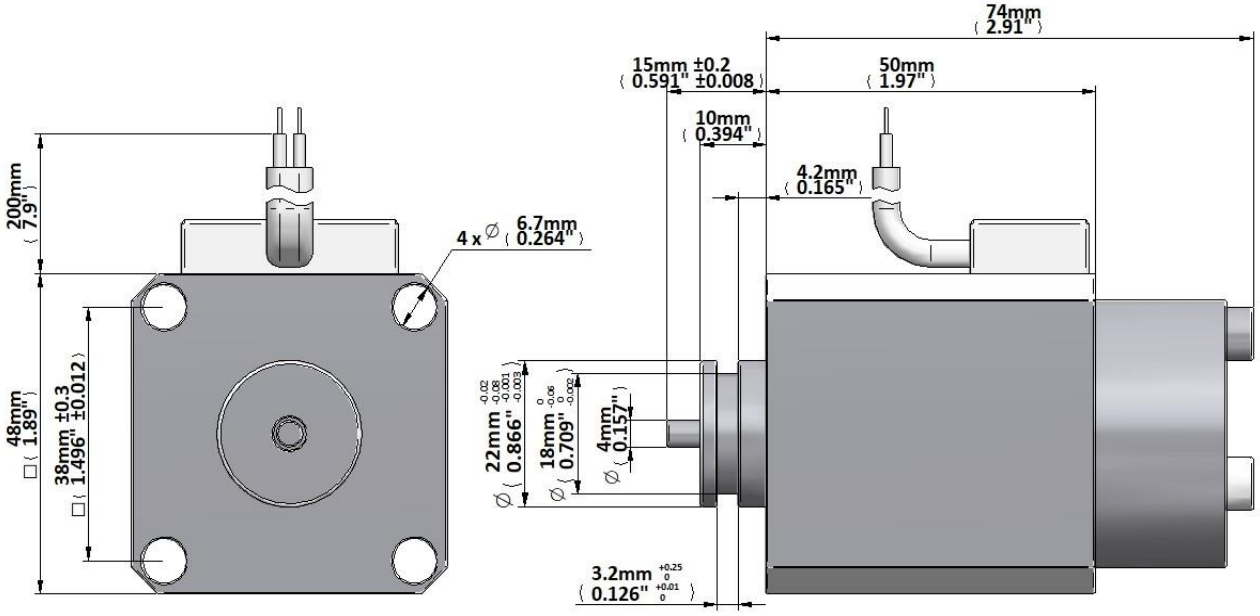
Representative Data Actual P/N, Dimensions and Data may vary from details shown

GEEPLUS PS48S-0207

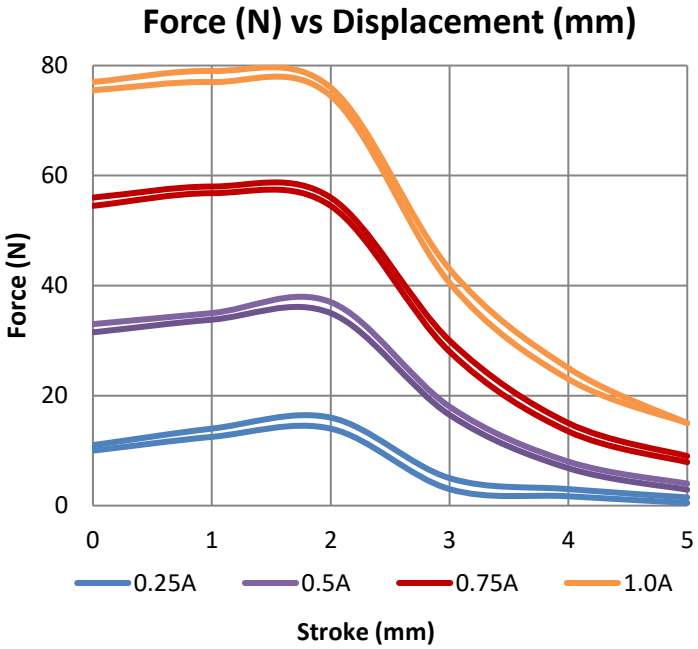
Specifications	
Parameter	**Value**
Rated Voltage	24 Volts
Current	1.0 Amps Max
Resistance	12.8 Ω (20 ° C)
Nominal Power	12.8 Watts (20 ° C)
Insulation Class	Class F (155°C)
Rated Pressure	1.03 Mpa
Burst Pressure	3.09 Mpa
Dielectric Strength	AC 1000 V, 50/60 Hz, 1 minute
Insulation Resistance	100MΩ @ DC 500V

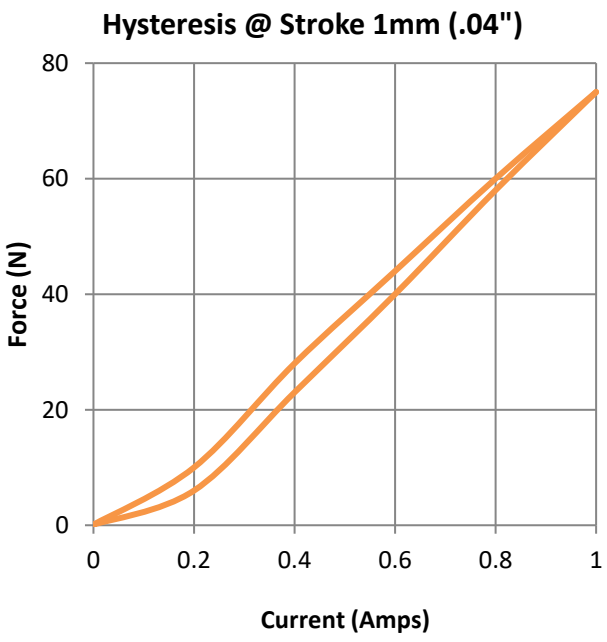


This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



Device drawn in energized condition

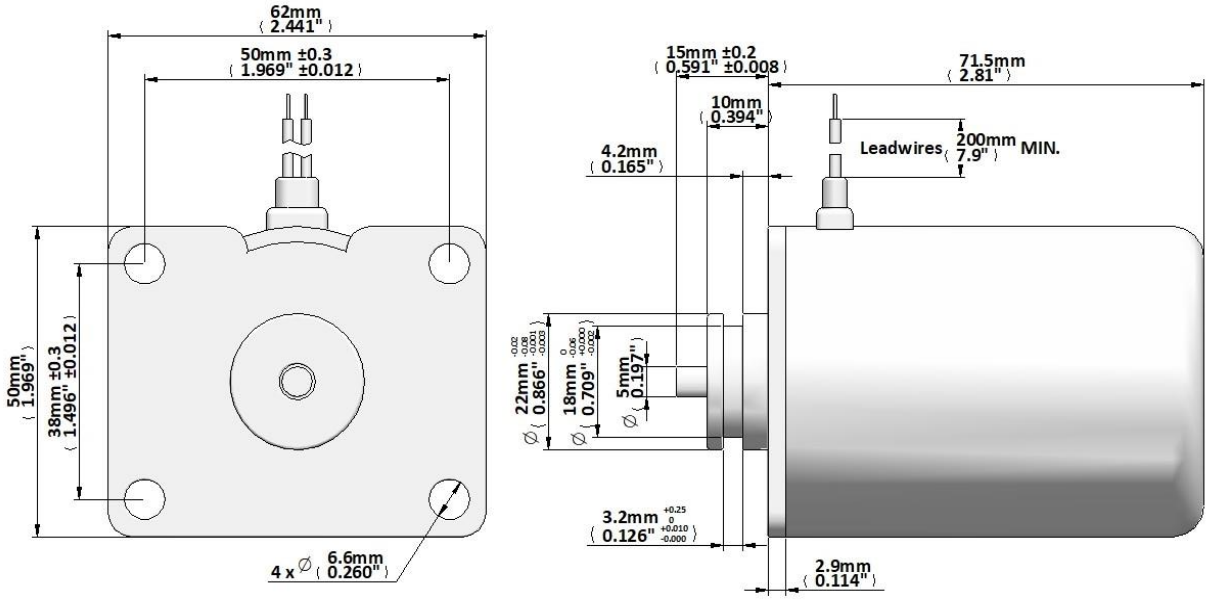




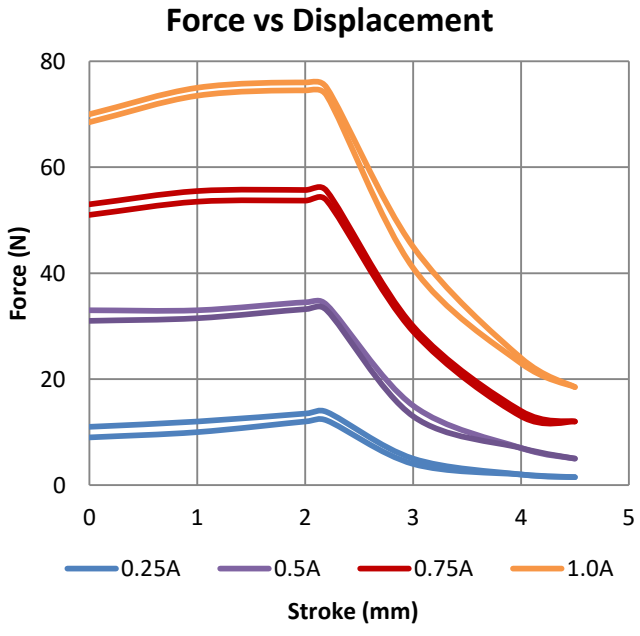
Representative Data Actual P/N, Dimensions and Data may vary from details shown

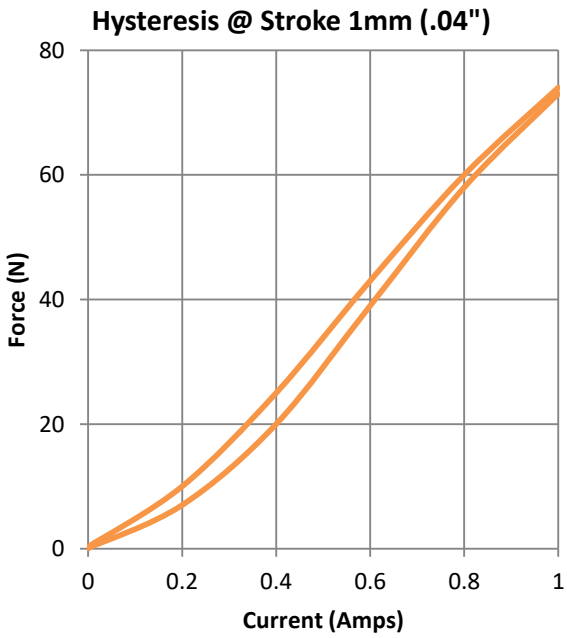
Specifications	
Parameter	**Value**
Rated Voltage	24 Volts
Current	1.0 Amps Max
Resistance	12.8 Ω (20 ° C)
Nominal Power	12.8 Watts (20 ° C)
Insulation Class	Class F (155°C)
Rated Pressure	1.03 Mpa
Burst Pressure	3.09 Mpa
Dielectric Strength	AC 1000 V, 50/60 Hz, 1 minute
Insulation Resistance	100MΩ @ DC 500V

This device is designed for hydraulic application and does not have corrosion protection of internal surfaces as standard



Device drawn in energized condition





Representative Data Actual P/N, Dimensions and Data may vary from details shown

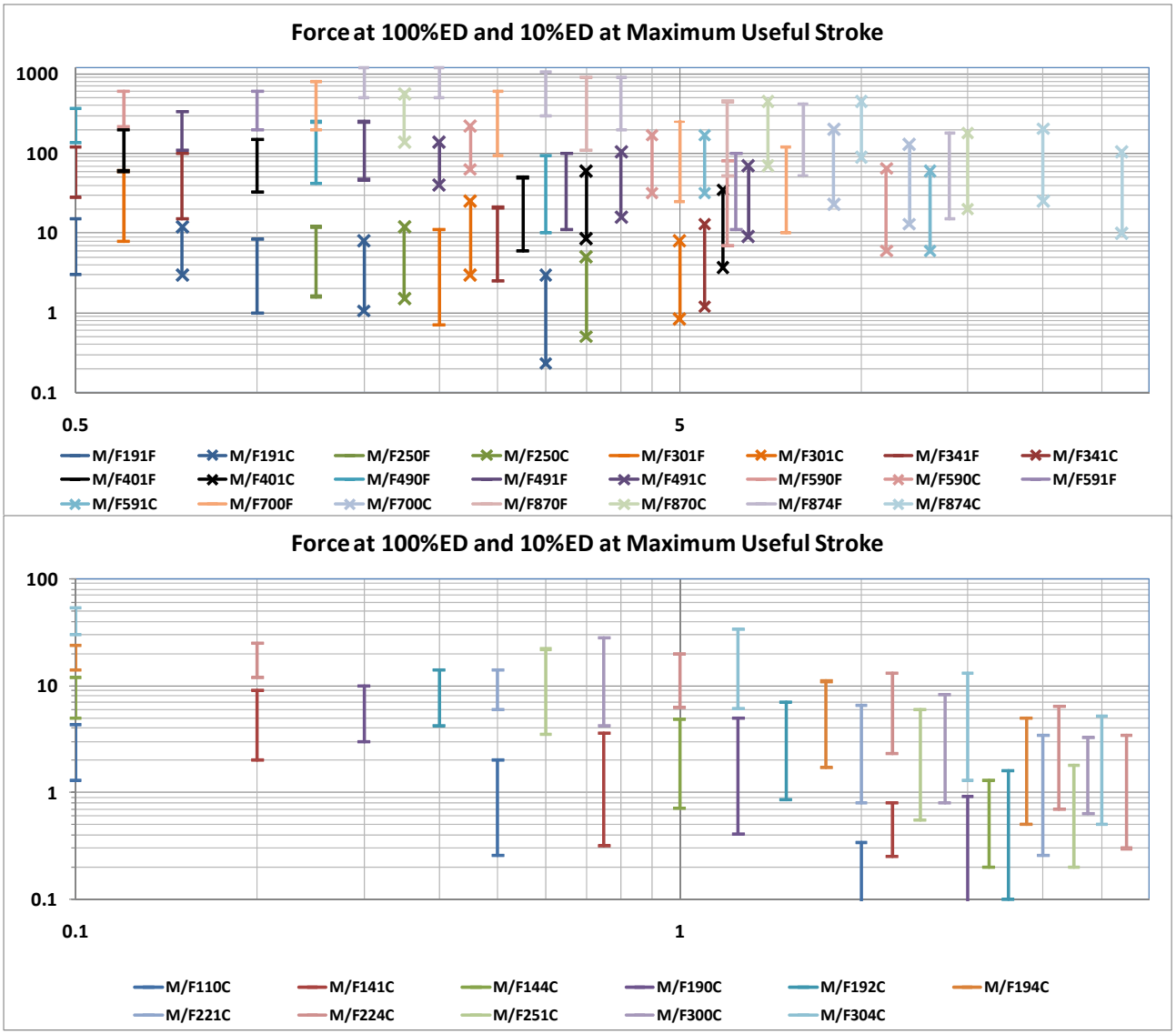
PUSH-PULL SOLENOIDS

Selection Process for Push-Pull Solenoid

1. Metric (M prefix) and SAE (F prefix) screw thread options are available.
2. The solenoid size is determined based on required force, displacement, and duty cycle from force-stroke characteristic graphs in the solenoid datasheets. Note that this may also be influenced by available power and speed requirements, for a given force requirement a larger solenoid will develop the required force with lower power input, however the higher moving mass may make this slower in operation than a smaller device
3. The pole piece form is also selected from the characteristic graphs, some sizes are available with either flat or conical polepiece design as standard options (note that intermediate or other force characteristic may be possible with polepiece geometry customisation)
4. The coil requirements are determined from tables of coil gauge / duty cycle for the chosen size of device. Coil rating is specified as AWG size of the coil wire
5. The life expectancy of the solenoid is specified by the suffix, P is standard life (2M-5M cycles), PE is extended (5M-10M cycles). For the small push-pull solenoids a different bearing construction is used with special heat-treatment of the bore for nominal >5M cycles. Life expectance if very much application specific, it will be reduced by long stroke, excessive side loading, particulate contamination and corrosive or otherwise aggressive environments. But may be increased by short stroke, low side loading and clean operating conditions. With the right environment and application setting it is possible to achieve Life expectancy of +50Million cycles. As life expectance is application specific it needs to be verified under real operating conditions in the customer application to ensure this is sufficient for purpose.

Size Determination

Device size is determined for the required force, displacement, and duty cycle from the tables below, more detailed force data is shown graphically in the datasheet for each solenoid. These charts show force at maximum useful stroke (the stroke at which force falls to 10% of the holding force at 0mm position) for 100% or 10% duty excitation.



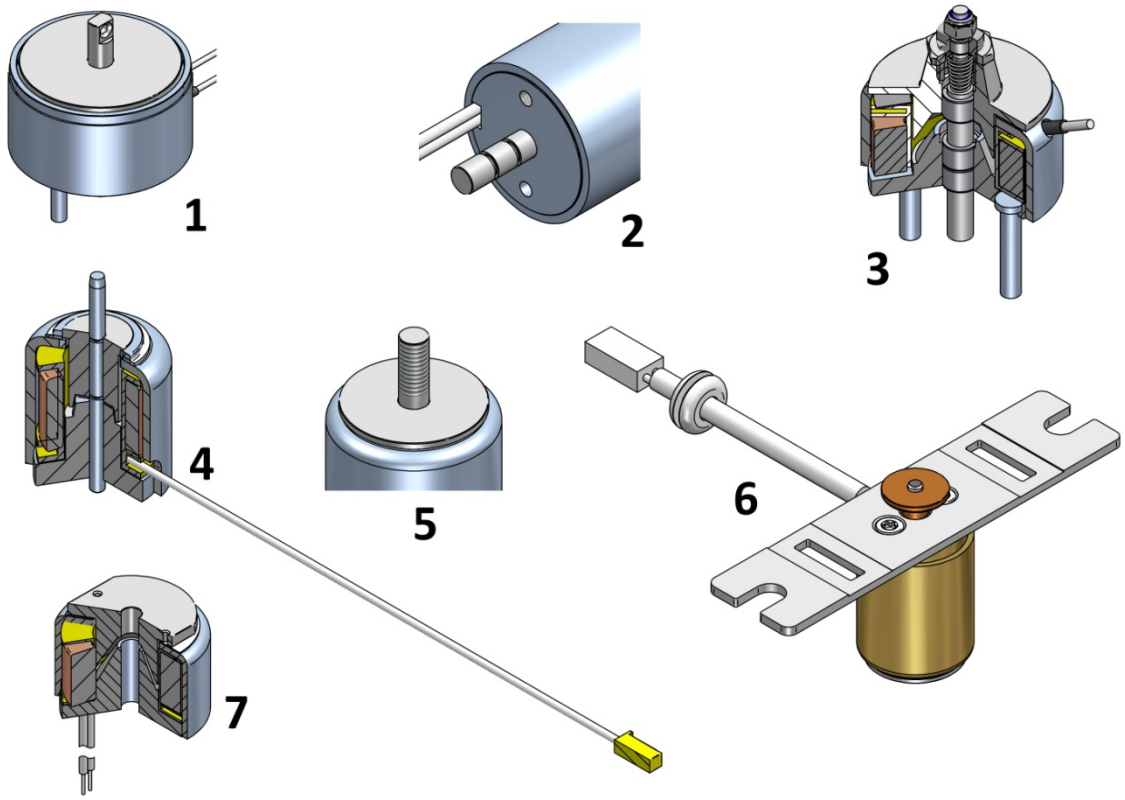
Specifying Coil AWG

Duty Cycle			100%	50%	25%	10%
Maximum 'ON' time			∞	100	36	7
Watts at 20º C			7	14	28	70
ampere-turns at 20º C			425	602	849	1350
AWG no	Resistance	no. turns	Nominal Voltage			
26	1.96	231	3.5	5	7.1	11
27	3.16	296	4.5	6.3	8.9	14
28	5.1	378	5.6	8	11	18
29	6.94	423	7.1	10	14	22
30	11	530	8.9	13	18	28
31	16.9	649	11	16	22	36
32	28.3	858	14	20	28	45

- The coil AWG is determined from tables of coil data for the given part, in the column corresponding to chosen duty cycle, the voltage closest to user supply is picked, and coil AWG corresponding to this is indicated in the LH column (example shows selection for a part operated from 12v supply at 25% duty cycle)
    - In the example illustrated, the selection of a device having higher nominal voltage than the supply is conservative, for maximum torque and speed the 28AWG coil might be more appropriate (see also point below)
    - Allowance should be made for voltage drops in switching devices, and resistive drops in wiring harness when determining the nominal voltage which will be applied to the solenoid.

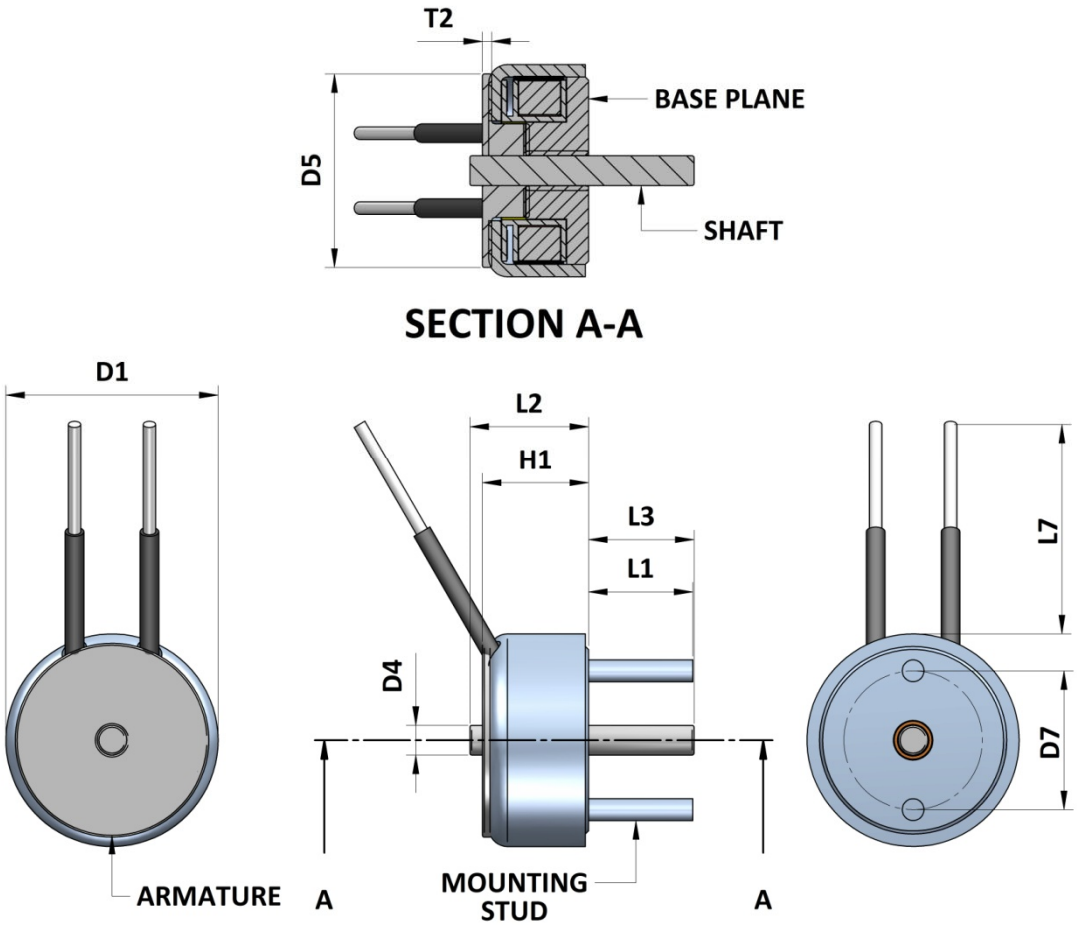
Customisation of the Push-Pull Solenoid

Most of the attachment components of the push-pull solenoid are produced by machining and are amenable to modification even in small (100's or less) quantity. Some typical examples are illustrated below.



1. Flats and cross-hole machined in shaft at armature side
2. Grooves machined in shaft at base side
3. Shaft decoupled from plunger by spring, maintenance-free bearings
4. Modified plunger with shallow angle for increased force at extended position, shaft hardened with sphere end on base side tapered on armature side, and lead wire assembly with connector
5. Screw threads machined on shaft on armature side
6. Mounting plate, bronze bush pressed on shaft, custom lead assembly
7. Modified armature with flat sides and threaded holes, no shaft

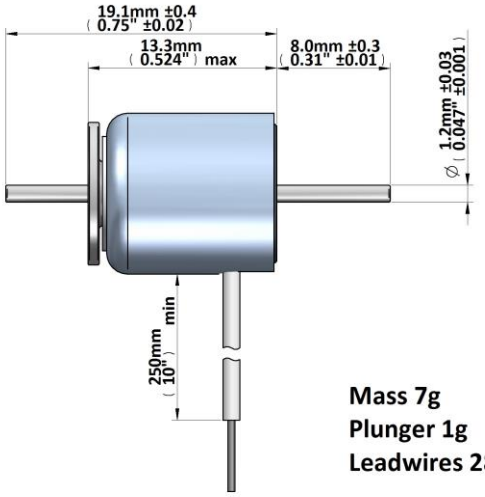
Mechanical modifications are best described with a sketch or drawing, when defining dimensions along the axis these are normally defined relative to the base plane of the solenoid, and described with reference to major components as described below.

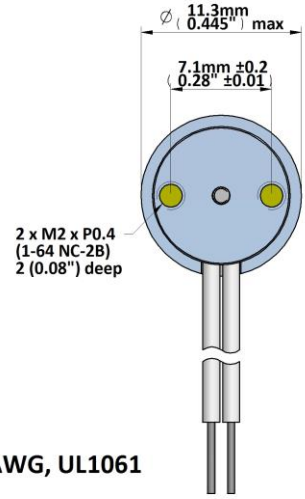


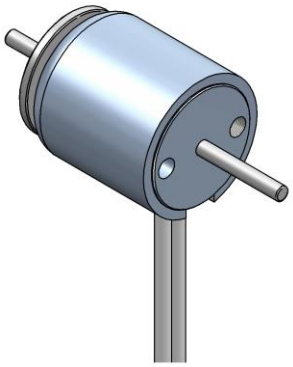
GEEPLUS Push Pull Solenoid size 110

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

Available mechanical options:
M: metric thread
F: SAE thread

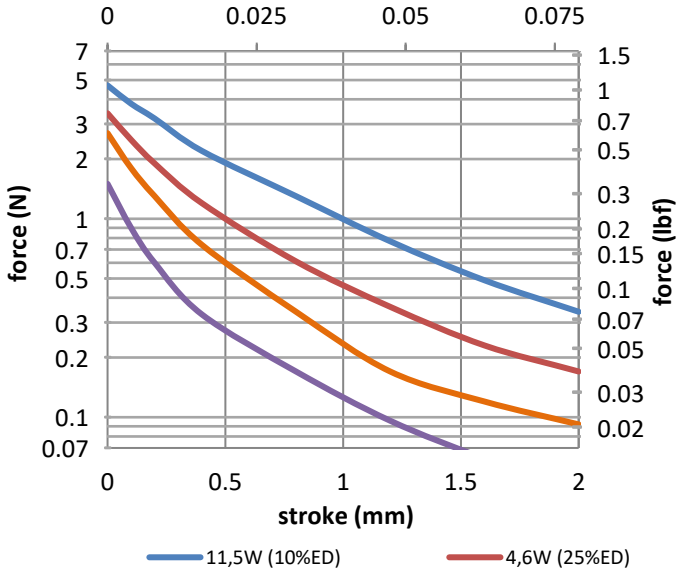




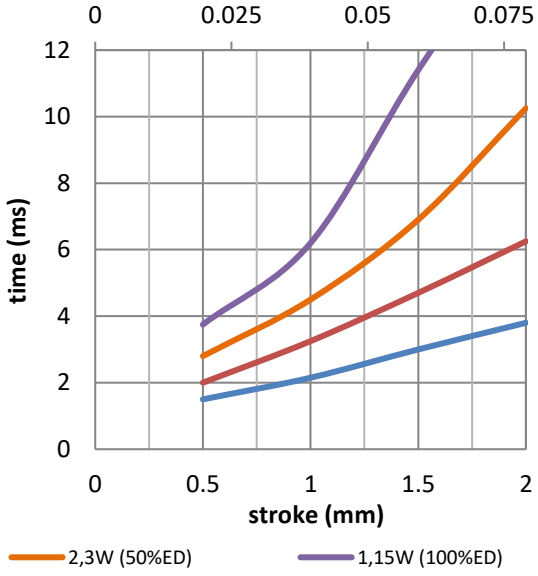


Mass 7g
Plunger 1g
Leadwires 28AWG, UL1061

force / stroke 110C



response time



11,5W (10%ED) 4,6W (25%ED) 2,3W (50%ED) 1,15W (100%ED)

Data at 20°C , without heatsink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			1.15	2.3	4.6	11.5
ampere-turns at 20°			105	148	210	332
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M110C-3V F110C-3V	10.5	390	3.0	4.2	6.0	9.5
M110C-6V F110C-6V	31.5	700	6.0	8.5	12	19
M110C-12V F110C-12V	143.0	1450	12	17	24	38

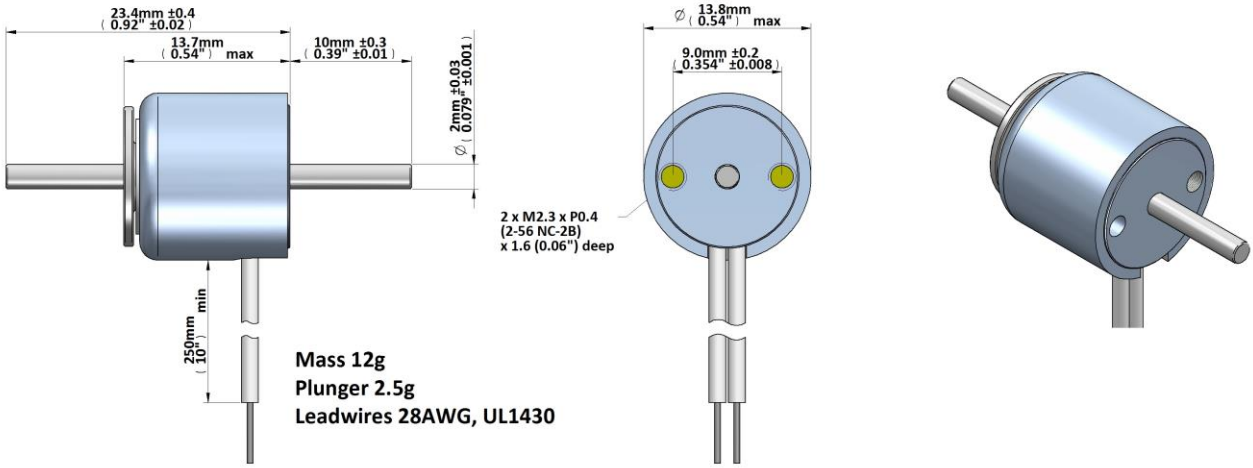
Insulation Resistance >100MΩ, 500VDC Megger
Class A (105°C) insulation class

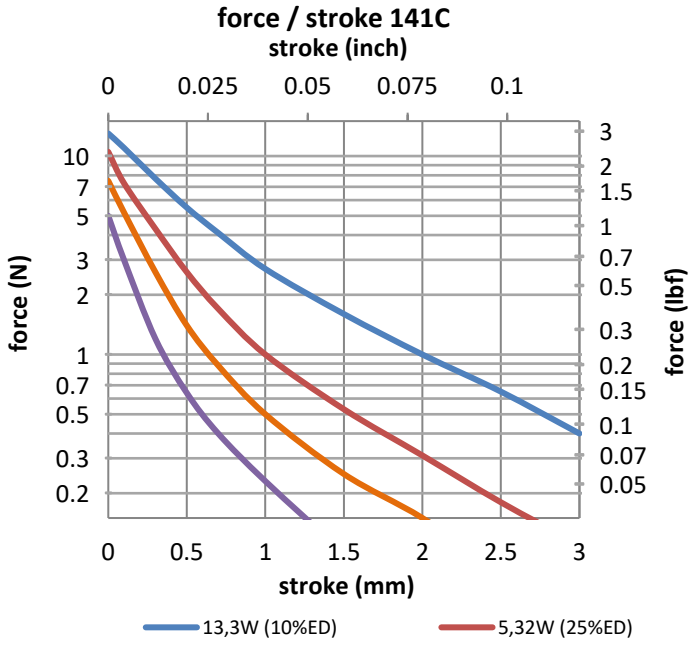
Dielectric Strength 1000VAC, 50/60Hz, 1 minute

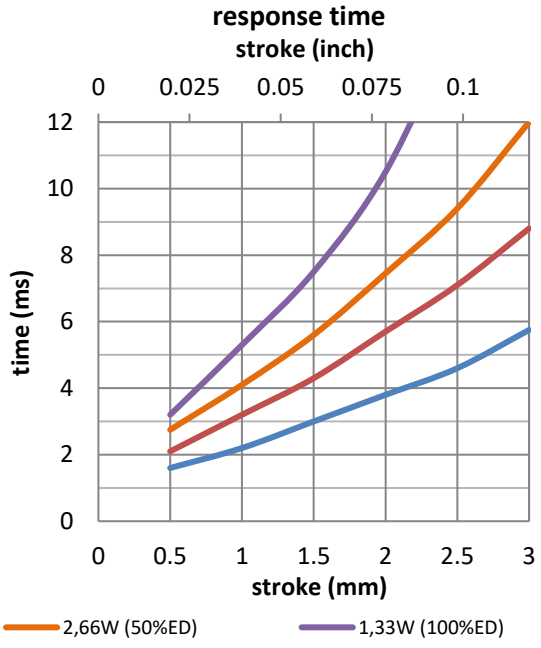
GEEPLUS Push Pull Solenoid size 141

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

Available mechanical options:
M: metric thread
F: SAE thread







Data at 20°C , without heatsink

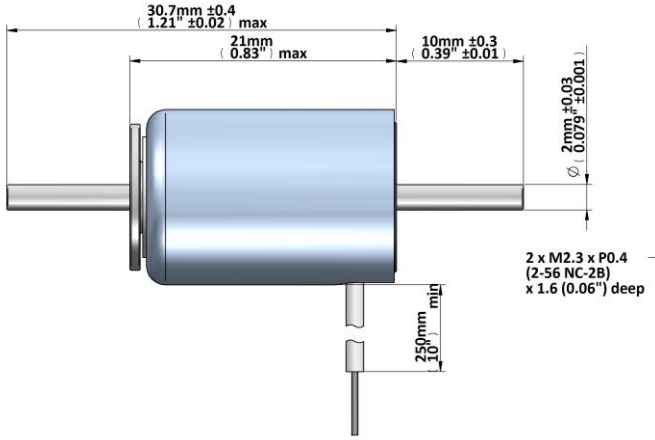
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			1.33	2.66	5.32	13.3
ampere-turns at 20°			133	189	267	422
type no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
M141C-3V F141C-3V	6.5	330	3.0	4.2	6.0	9.5
M141C-6V F141C-6V	30	700	6.0	8.5	12	19
M141C-12V F141C-12V	97	1200	12	17	24	38
M141C-24V F141C-24V	468	2600	24	34	48	76

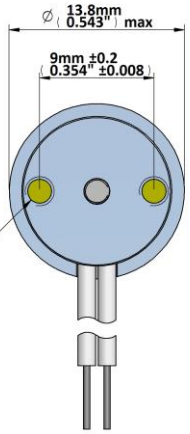
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

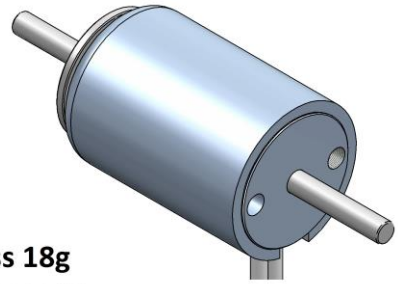
GEEPLUS Push Pull Solenoid size 144

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

Available mechanical options:
M: metric thread
F: SAE thread

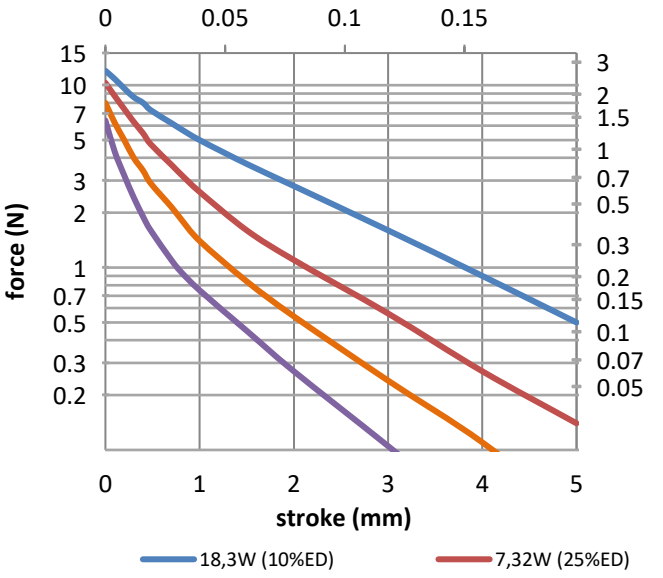




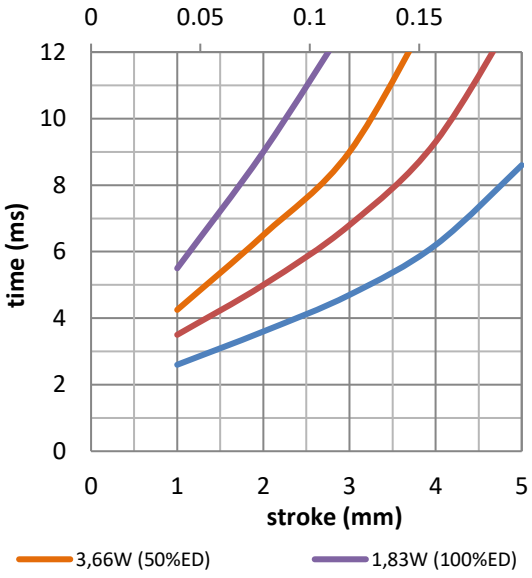


Mass 18g
Plunger 3g
Leadwires 28AWG, UL1430

force / stroke 144C



response time



18,3W (10%ED) 7,32W (25%ED) 3,66W (50%ED) 1,83W (100%ED)

Data at 20°C , without heatsink

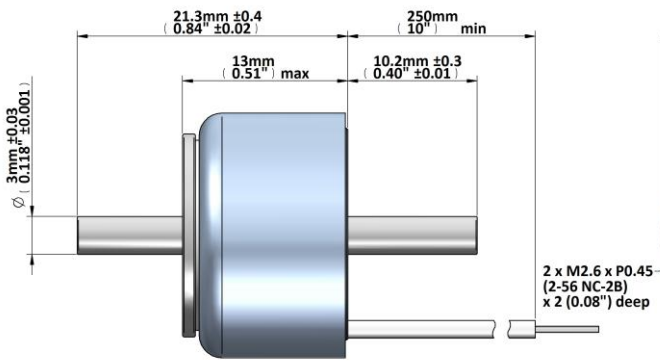
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			1.83	3.66	7.32	18.3
ampere-turns at 20°			236	334	472	746
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M144C-3V F144C-3V	5.0	415	3.0	4.2	6.0	9.5
M144C-6V F144C-6V	22.7	910	6.0	8.5	12	19
M144C-12V F144C-12V	91.5	1750	12	17	24	38
M144C-24V F144C-24V	329	3150	24	34	48	76

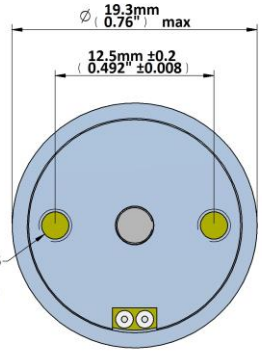
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

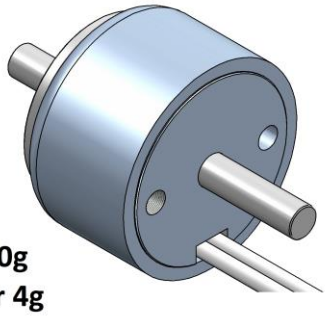
GEEPLUS Push Pull Solenoid size 190

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

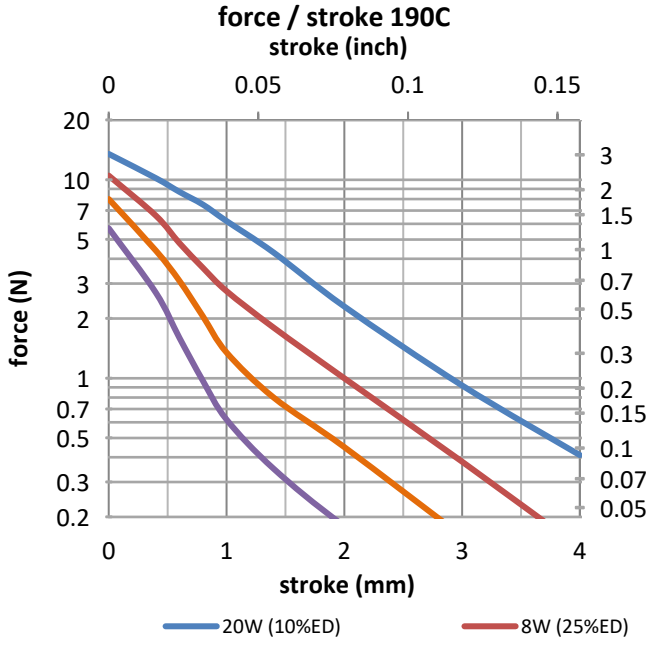
Available mechanical options:
M: metric thread
F: SAE thread

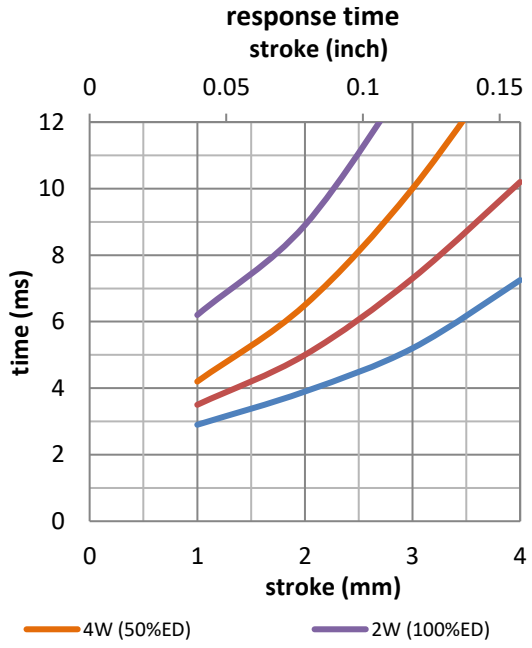






Mass 20g
Plunger 4g
Leadwires 28AWG, UL1430





Data at 20°C , without heatsink

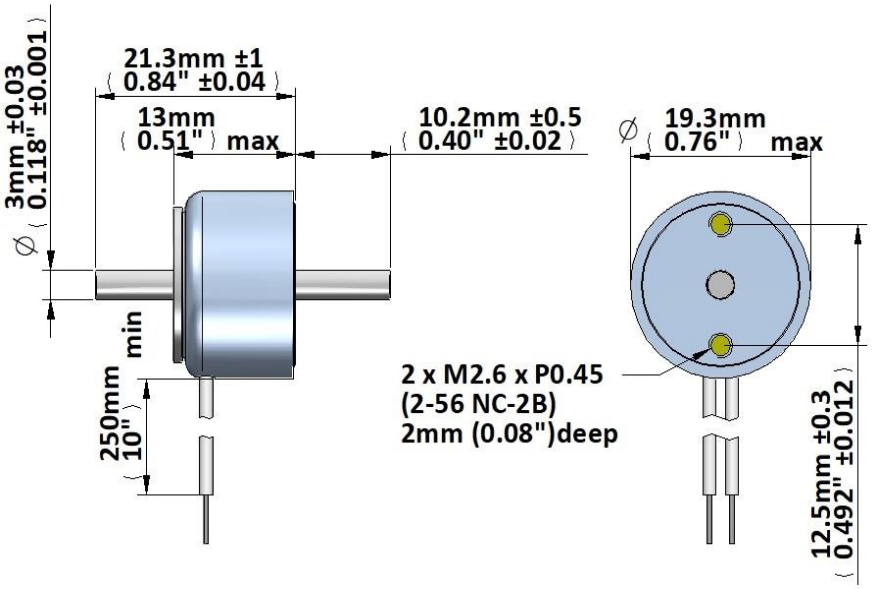
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			2	4	8	20
ampere-turns at 20°			170	240	340	537
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M190C-3V F190C-3V	4.9	295	3.0	4.2	6.0	9.5
M190C-6V F190C-6V	21.5	620	6.0	8.5	12	19
M190C-12V F190C-12V	89	1230	12	17	24	38
M190C-24V F190C-24V	307	2120	24	34	48	76

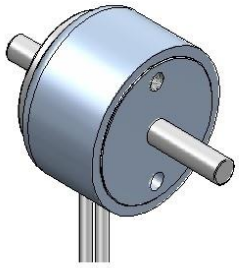
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 191

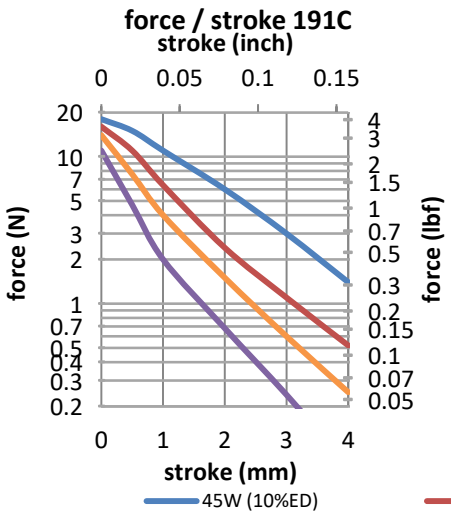
Device drawn in energised condition
plunger options: conical (191C) / flat (191F)
Life Expectancy (cycles): >2M (-P) >10M(-PE)

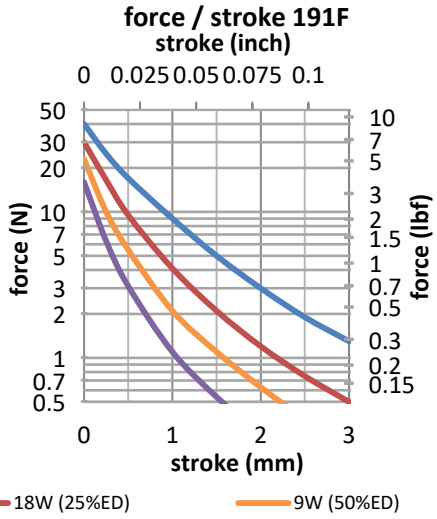
Available mechanical options:
M: metric thread
F: SAE thread

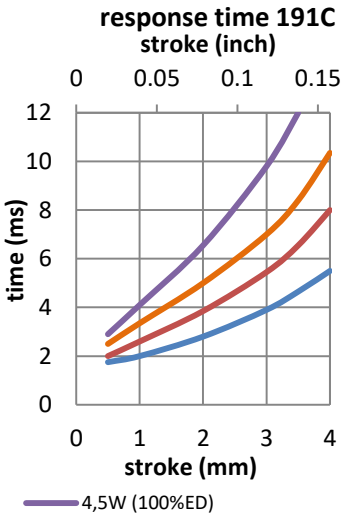




Mass 22g
Plunger (C) , (F) 4g
Leadwires 28AWG, UL1430







45W (10%ED) 18W (25%ED) 9W (50%ED) 4,5W (100%ED)

Data at 20°C , device connected to heatsink 50x50x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	100	36	7
watts at 20°C	4.5	9	18	45
ampere-turns at 20°	285	403	570	901

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
30	4.0	288	4.1	5.7	8.0	12.1
31	5.6	324	5.0	7.1	9.9	15.8
32	9.1	544	6.3	8.9	12.4	19.7
33	15.0	684	8.0	11.3	15.7	25
34	24.1	840	10.2	14.4	20	32
35	37.1	1056	12.8	18.1	25	40
36	58.5	1109	16.1	23	32	50
37	75.7	1370	19.8	28	39	62
38	118	1761	25	35	49	78
39	199	2283	33	46	64	103
40	328	4200	42	59	82	131

Insulation Resistance >100MΩ, 500VDC Megger

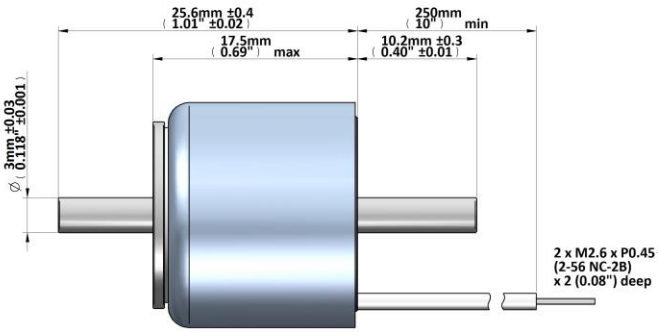
Dielectric Strength 1000VAC, 50/60Hz, 1 minute

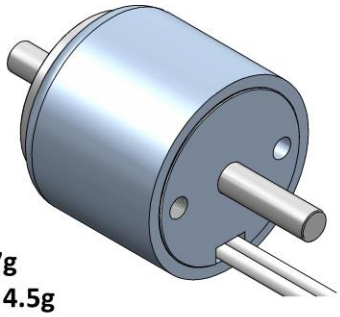
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 192

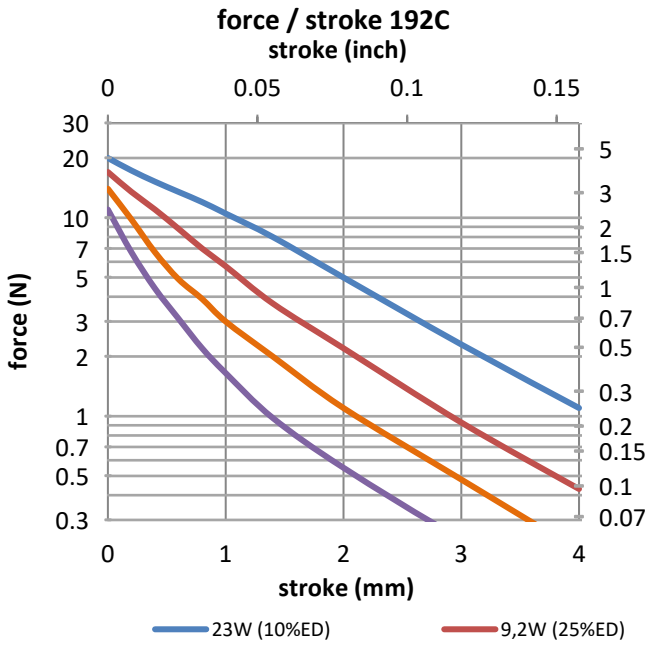
Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

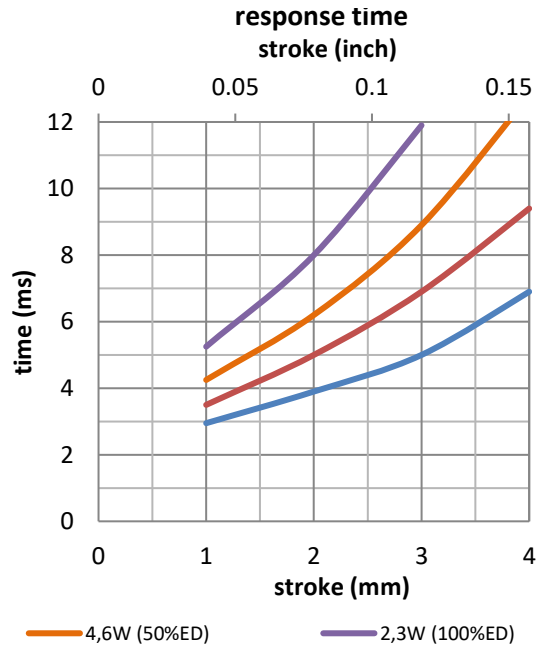
Available mechanical options:
M: metric thread
F: SAE thread





Mass 27g
Plunger 4.5g
Leadwires 28AWG, UL1430





23W (10%ED) 9,2W (25%ED) 4,6W (50%ED) 2,3W (100%ED)

Data at 20°C , without heatsink

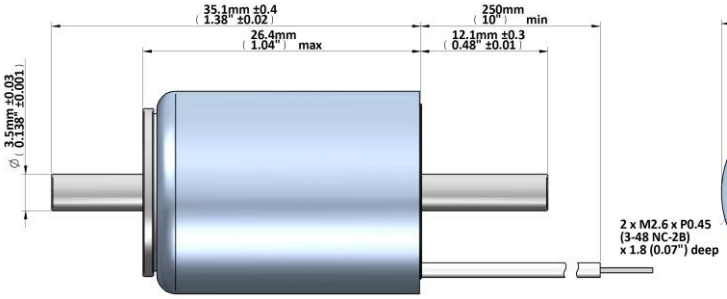
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			2.3	4.6	9.2	23
ampere-turns at 20°			265	374	530	838
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M192C-3V F192C-3V	4.3	380	3.0	4.2	6.0	9.5
M192C-6V F192C-6V	16	735	6.0	8.5	12	19
M192C-12V F192C-12V	68	1500	12	17	24	38
M192C-24V F192C-24V	242	2770	24	34	48	76

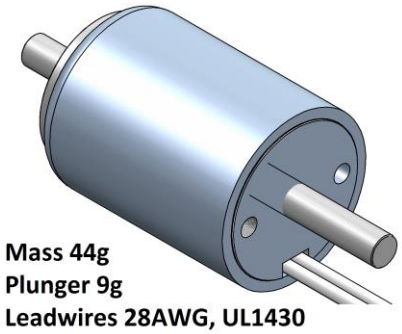
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 194

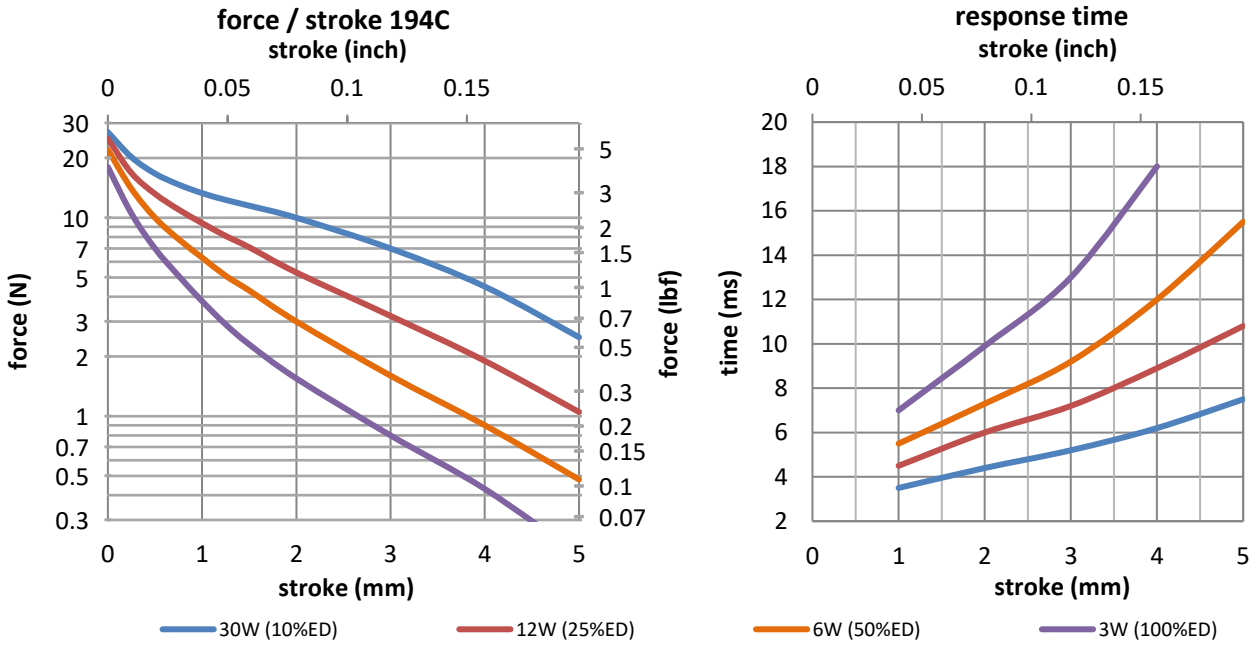
Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

Available mechanical options:
M: metric thread
F: SAE thread





Mass 44g
Plunger 9g
Leadwires 28AWG, UL1430



Data at 20°C , without heatsink

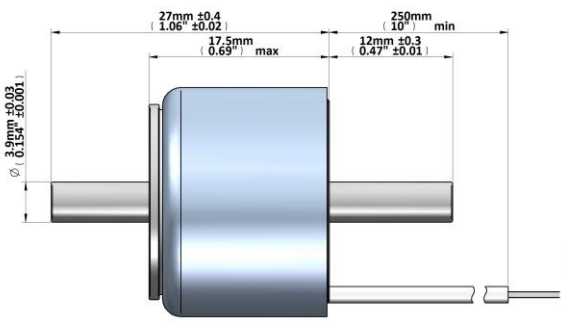
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3	6	12	30
ampere-turns at 20°			382	542	765	1211
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M194C-3V F194C-3V	2.7	360	3.0	4.2	6.0	9.5
M194C-6V F194-6V	11.8	770	6.0	8.5	12	19
M194C-12V F194C-12V	49.5	1620	12	17	24	38
M194C-24V F194C-24V	185	2950	24	34	48	76

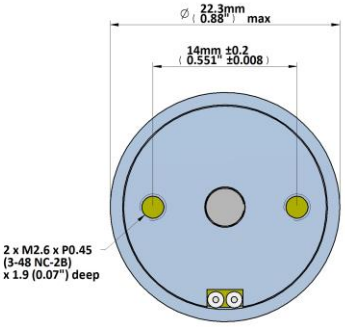
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

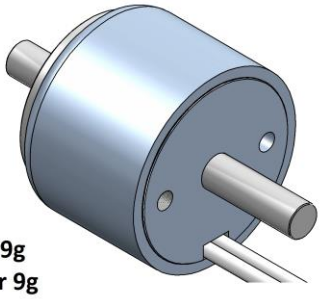
GEEPLUS Push Pull Solenoid size 221

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

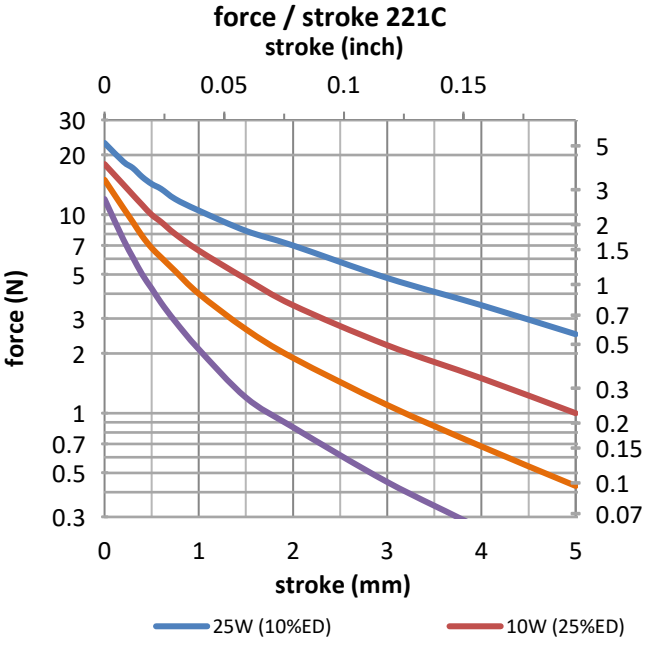
Available mechanical options:
M: metric thread
F: SAE thread

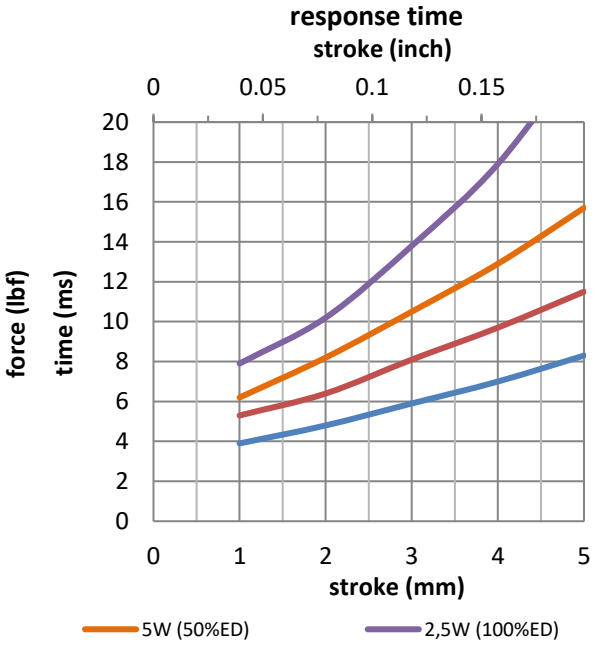






Mass 39g
Plunger 9g
Leadwires 26AWG, UL1430





Data at 20°C , without heatsink

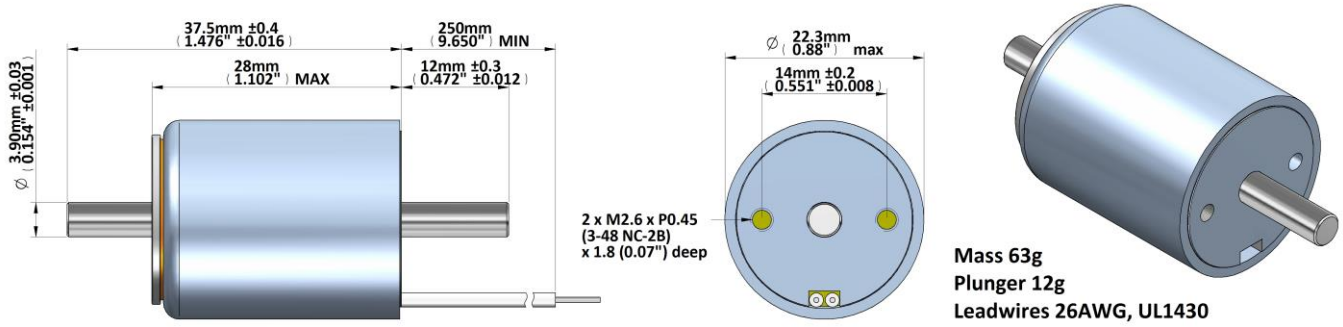
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			2.5	5	10	25
ampere-turns at 20°			253	358	507	803
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M221C-3V F221C-3V	3.8	325	3.0	4.2	6.0	9.5
M221C-6V F221C-6V	13.8	620	6.0	8.5	12	19
M221C-12V F221C-12V	59	1260	12	17	24	38
M221C-24V F221C-24V	226	2200	24	34	48	76

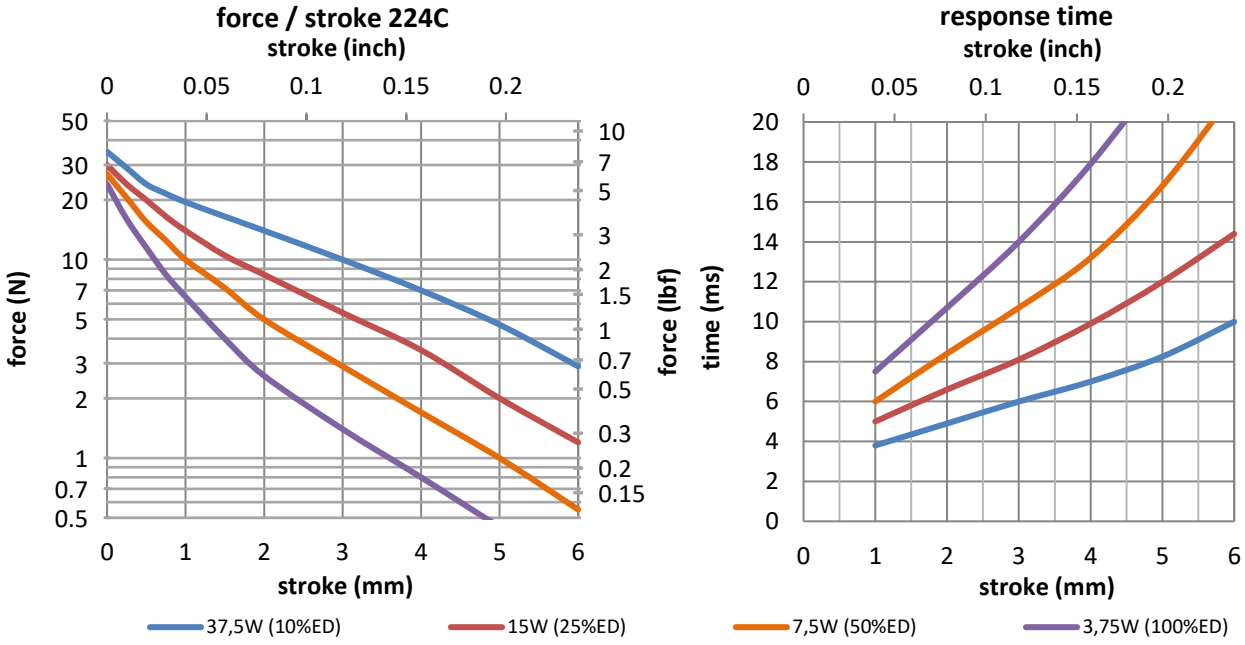
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 224

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

Available mechanical options:
M: metric thread
F: SAE thread





Data at 20°C , without heatsink

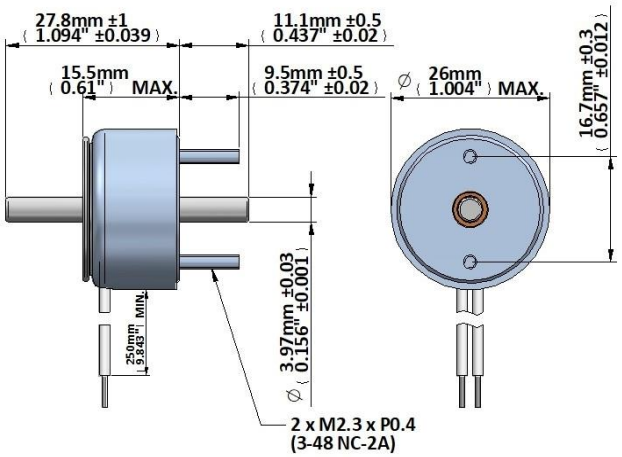
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3.75	7.5	15	37.5
ampere-turns at 20°			440	623	880	1393
type no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
M224C-3V F224C-3V	2.3	350	3.0	4.2	6.0	9.5
M224C-6V F224C-6V	10	750	6.0	8.5	12	19
M224C-12V F224C-12V	38	1460	12	17	24	38
M224C-24V F224C-24V	167	3060	24	34	48	76

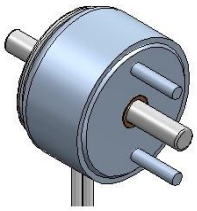
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 250

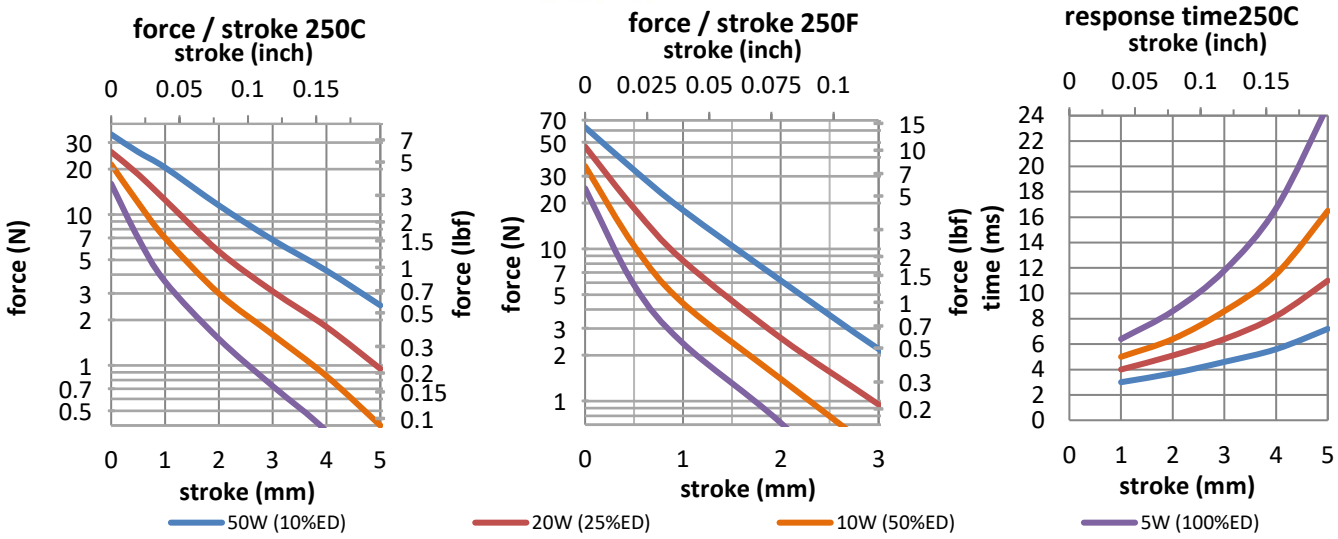
Device drawn in energised condition
plunger options: conical (250C) / flat (250F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread





Mass 47g
Plunger (C) 11g
Plunger (F) 9g
Leadwires 24AWG, UL1430



Data at 20°C , device connected to heatsink 80x80x3mm aluminum

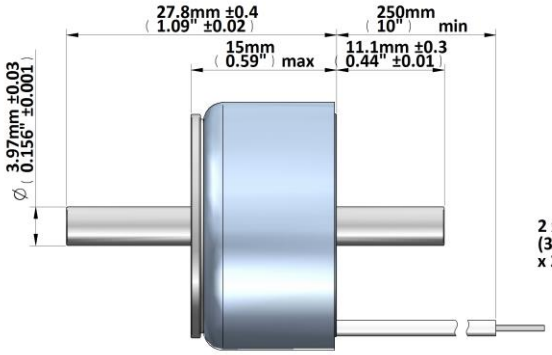
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			5	10	20	50
ampere-turns at 20°			340	480	680	1075
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
25	0.85	138	2.1	3.0	4.2	6.6
26	1.42	184	2.6	3.7	5.2	8.3
27	1.90	197	3.3	4.6	6.6	10.4
28	3.21	272	4.0	5.7	8.0	12.7
29	5.11	340	5.1	7.2	10.2	16.2
30	8.03	439	6.2	8.8	12.4	19.7
31	12.95	560	7.9	11.1	15.7	25
32	20.25	690	10.0	14.1	20	32
33	29.97	839	12.1	17.1	24	38
34	49.60	1097	15.4	22	31	49
35	82.64	1396	20	28	40	64
36	110	1551	24	34	48	76
37	157	1776	30	42	60	95
38	237	2180	37	52	74	117
39	426	3110	47	66	93	147
40	698	3802	62	88	125	197

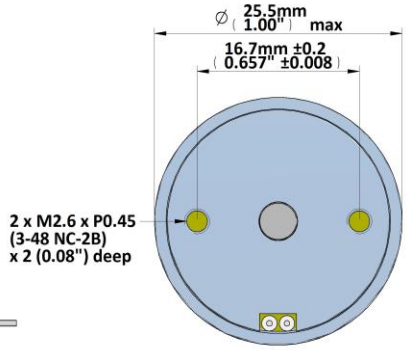
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

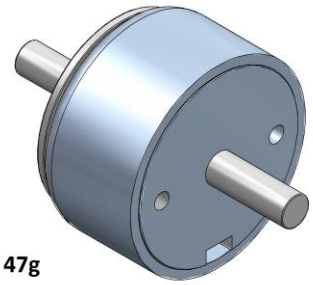
GEEPLUS Push Pull Solenoid size 251

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

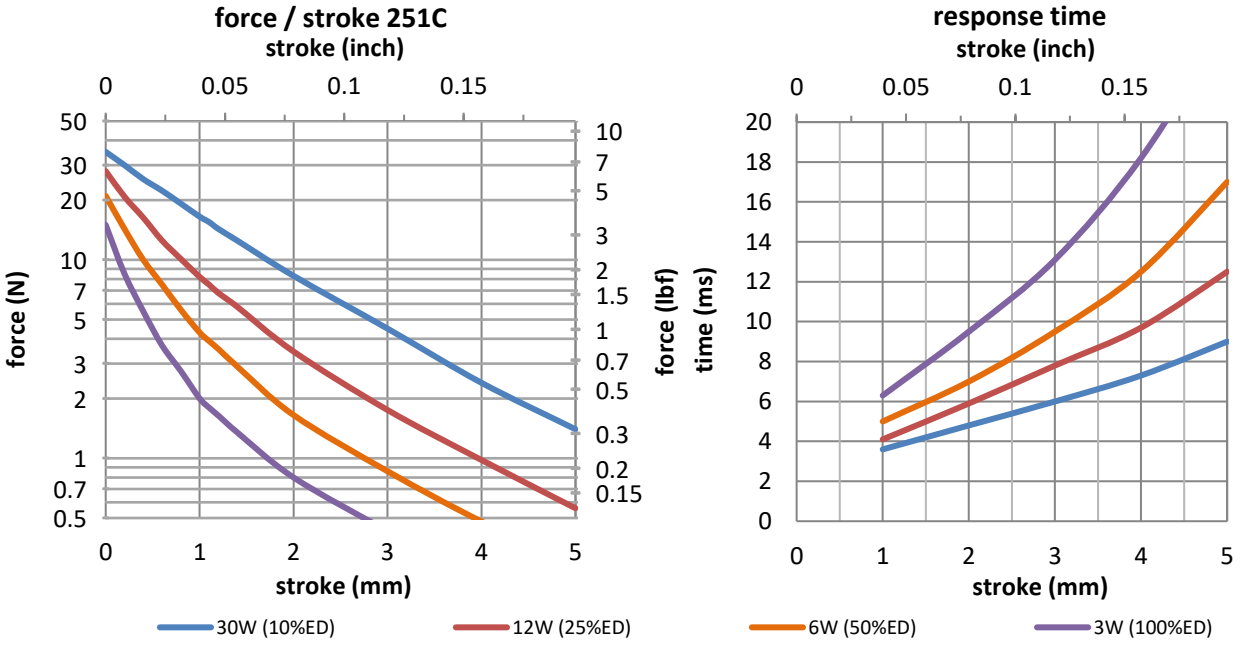
Available mechanical options:
M: metric thread
F: SAE thread







Mass 47g
Plunger 11g
Leadwires 24AWG, UL1430



Data at 20°C , without heatsink

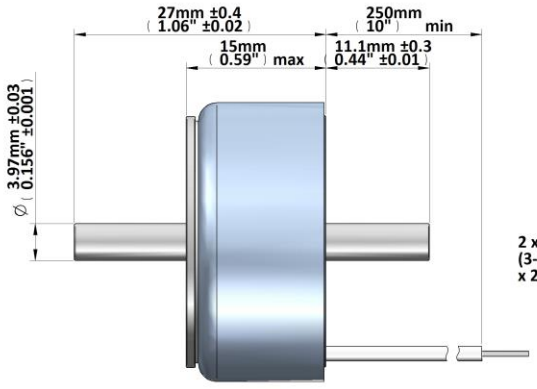
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3	6	12	30
ampere-turns at 20°			240	339	480	758
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M251C-3V F251C-3V	3.3	285	3.0	4.2	6.0	9.5
M251C-6V F251C-6V	13	570	6.0	8.5	12	19
M251C-12V F251C-12V	51	1090	12	17	24	38
M251C-24V F251C-24V	228	2250	24	34	48	76

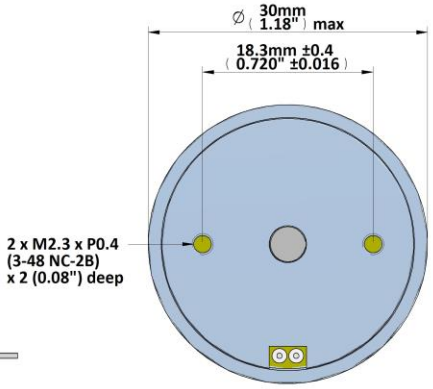
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

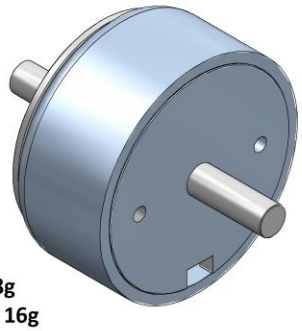
GEEPLUS Push Pull Solenoid size 300

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

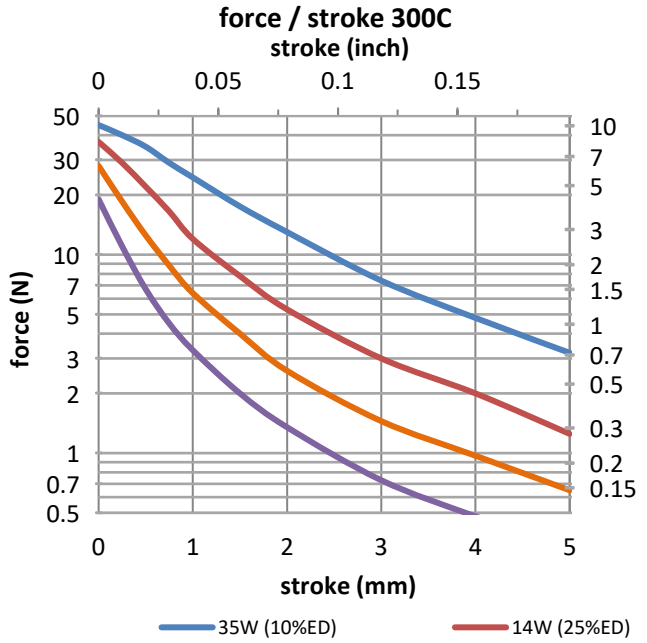
Available mechanical options:
M: metric thread
F: SAE thread

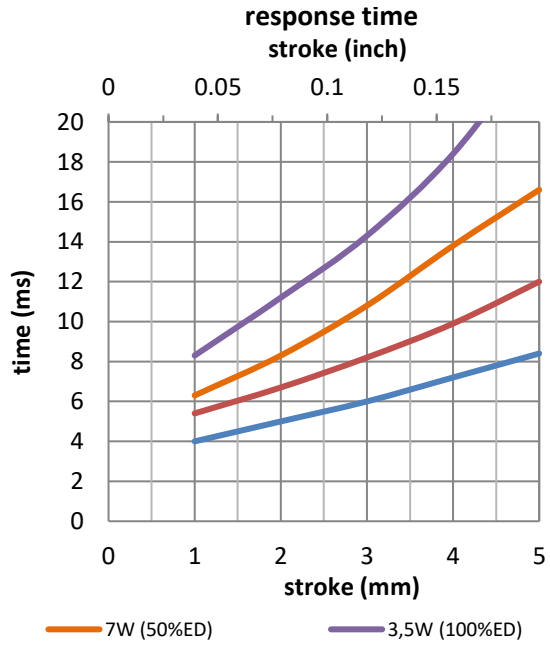






Mass 58g
Plunger 16g
Leadwires 28AWG, UL1430





Data at 20°C , without heatsink

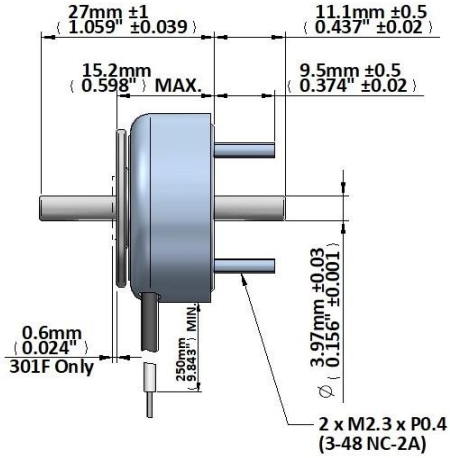
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3.5	7	14	35
ampere-turns at 20°			272	385	545	864
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M300C-3V F300C-3V	2.6	235	3.0	4.2	6.0	9.5
M300C-6V F300C-6V	10.4	485	6.0	8.5	12	19
M300C-12V F300C-12V	41.8	990	12	17	24	38
M300C-24V F300C-24V	166	1780	24	34	48	76

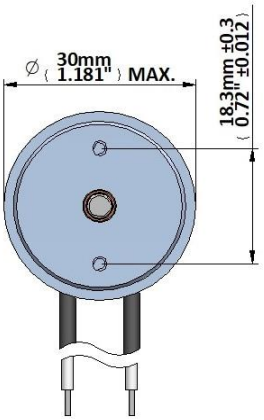
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

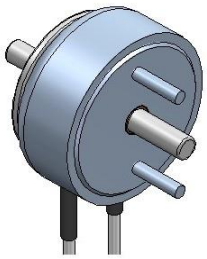
GEEPLUS Push Pull Solenoid size 301

Device drawn in energised condition
plunger options: conical (301C) / flat (301F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

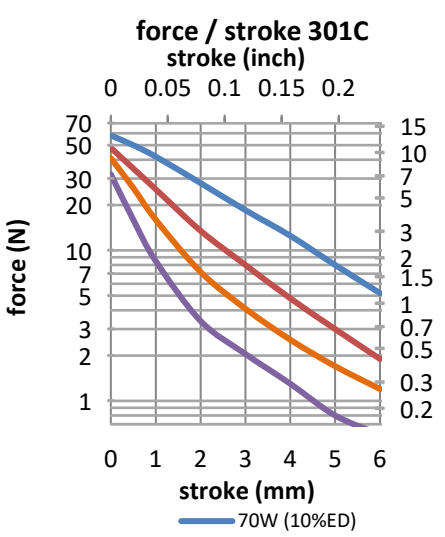
Available mechanical options:
M: metric thread
F: SAE thread

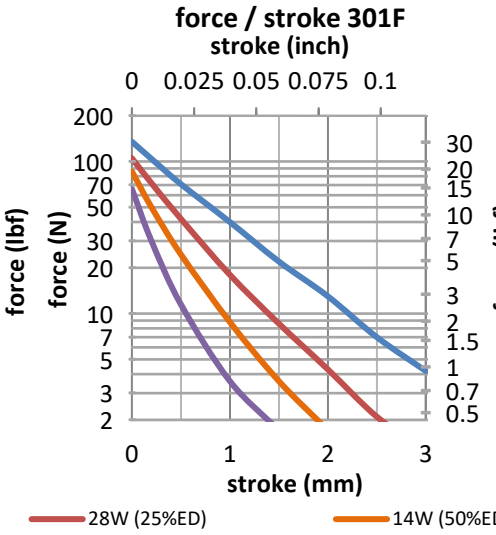


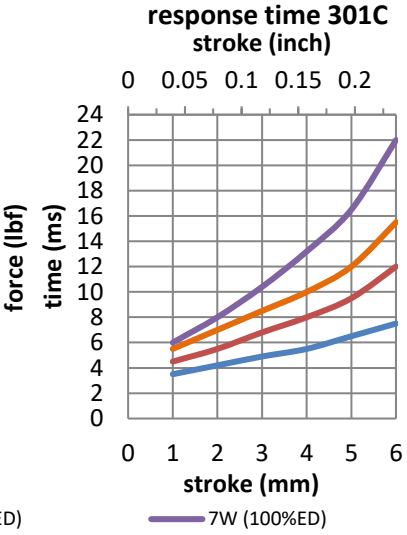




Mass 56g
Plunger (C) 16g
Plunger (F) 14g
Leadwires 24AWG, UL1430







70W (10%ED) 28W (25%ED) 14W (50%ED) 7W (100%ED)

Data at 20°C , device connected to heatsink 90x90x3mm aluminum

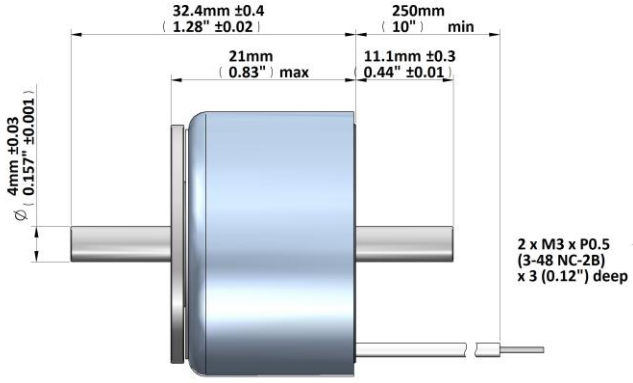
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			7	14	28	70
ampere-turns at 20°			425	602	849	1350
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
26	1.96	231	3.5	5.0	7.1	11
27	3.16	296	4.5	6.3	8.9	14
28	5.10	378	5.6	8.0	11	18
29	6.94	423	7.1	10	14	22
30	11.0	530	8.9	13	18	28
31	16.9	649	11	16	22	36
32	28.3	858	14	20	28	45
33	42.8	1036	18	25	35	56
34	69.6	1312	22	32	45	71
35	112	1674	28	39	56	89
36	148	1765	35	50	71	112
37	221	2090	45	63	89	142
38	352	2650	56	80	112	178
39	568	3380	71	100	141	224
40	882	4200	89	126	178	283

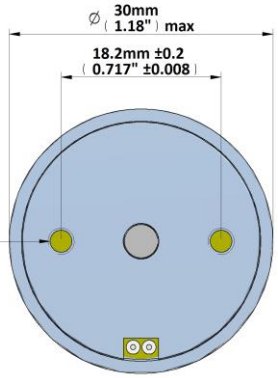
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

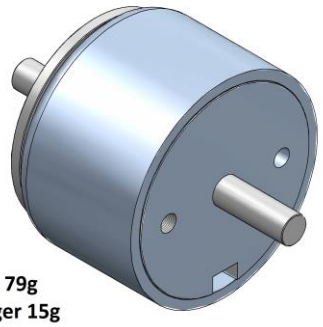
GEEPLUS Push Pull Solenoid size 304

Device drawn in energised condition
conical plunger
Life Expectancy (cycles): >5M

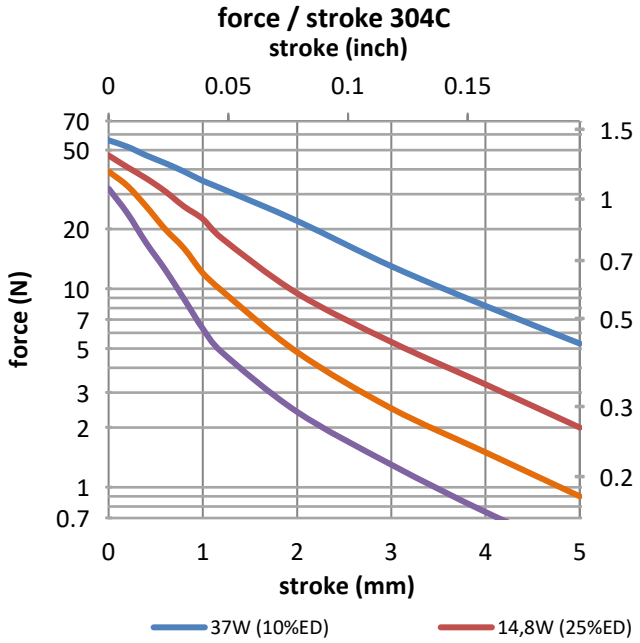
Available mechanical options:
M: metric thread
F: SAE thread

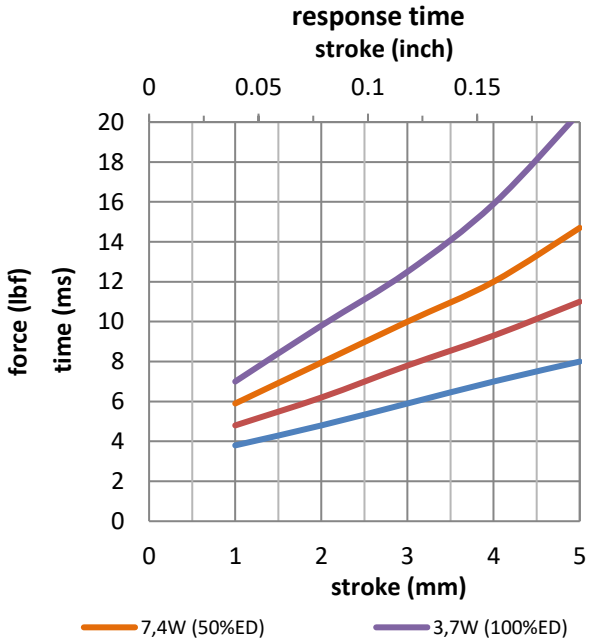






Mass 79g
Plunger 15g
Leadwires 24AWG, UL1430





Data at 20°C , without heatsink

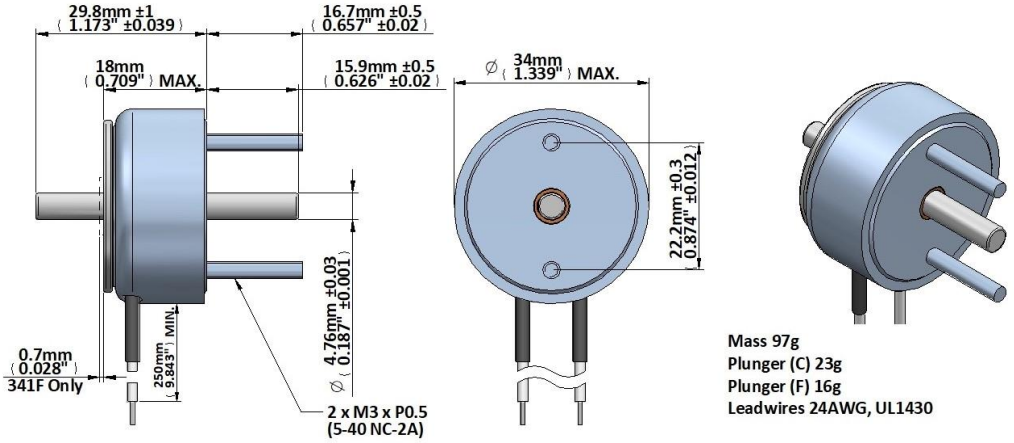
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3.7	7.4	14.8	37
ampere-turns at 20°			320	452	640	1012
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M304C-3V F304C-3V	3.15	320	3.0	4.2	6.0	9.5
M304C-6V F304C-6V	10.7	575	6.0	8.5	12	19
M304C-12V F304C-12V	43	1150	12	17	24	38
M304C-24V F304C-24V	150	2140	24	34	48	76

Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

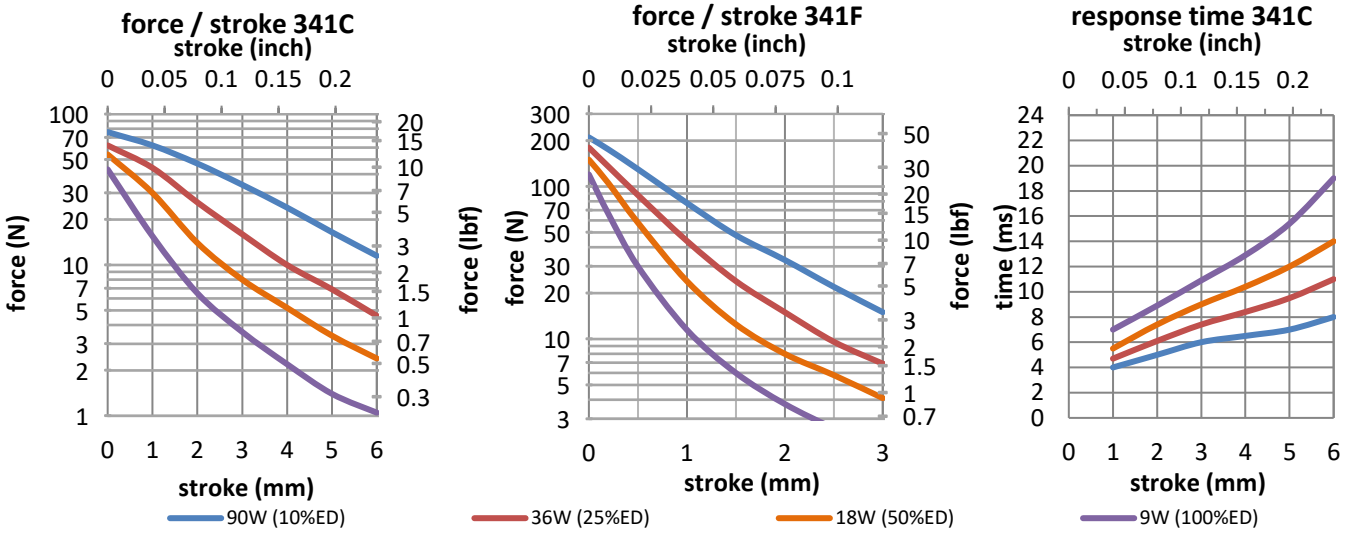
GEEPLUS Push Pull Solenoid size 341

Device drawn in energised condition
plunger options: conical (341C) / flat (341F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread



Mass 97g
Plunger (C) 23g
Plunger (F) 16g
Leadwires 24AWG, UL1430



Data at 20°C , device connected to heatsink 120x120x3mm aluminum

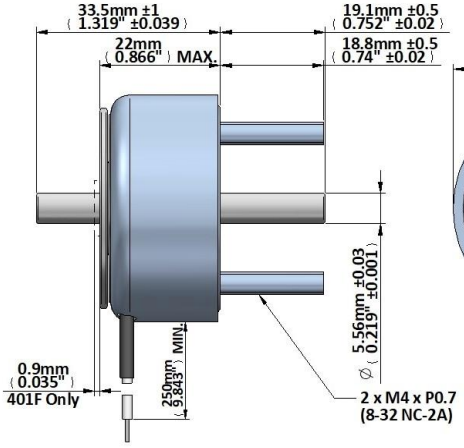
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	8
watts at 20°C			9	18	36	90
ampere-turns at 20°			535	756	1070	1690
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
25	1.97	252	4.2	5.9	8.4	13
26	3.26	328	5.3	7.5	11	17
27	5.04	405	6.7	9.4	13	21
28	8.02	510	8.4	12	17	26
29	12.2	627	10	15	21	33
30	19.2	780	13	19	26	42
31	31.8	1008	17	24	33	53
32	47.0	1215	21	30	42	66
33	75.3	1530	26	37	53	84
34	120.5	1900	33	47	67	105
35	198	2486	42	59	84	133
36	280	2700	53	75	106	167
37	426	3350	67	94	133	210
38	648	4050	84	118	168	264
39	1020	5050	105	149	211	333
40	1667	6590	133	187	265	419

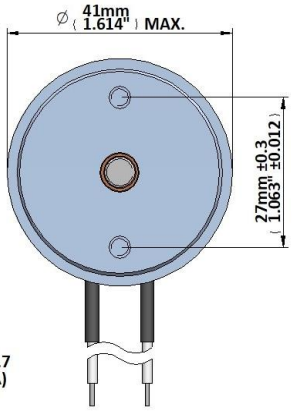
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

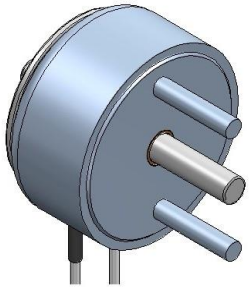
GEEPLUS Push Pull Solenoid size 401

Device drawn in energised condition
plunger options: conical (401C) / flat (401F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

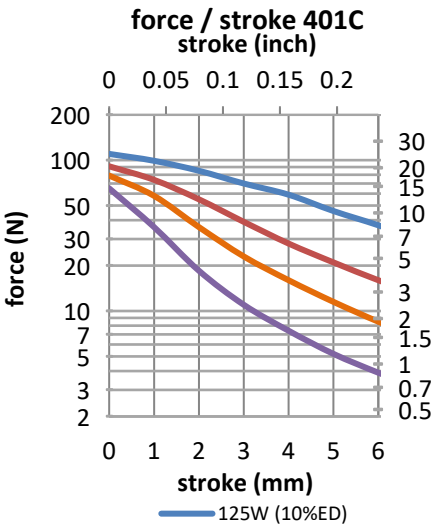
Available mechanical options:
M: metric thread
F: SAE thread

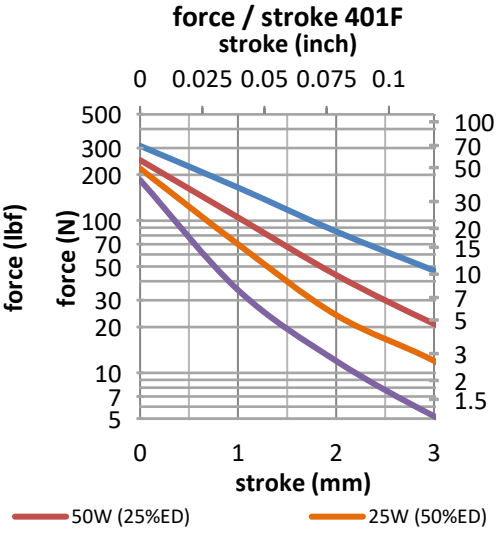


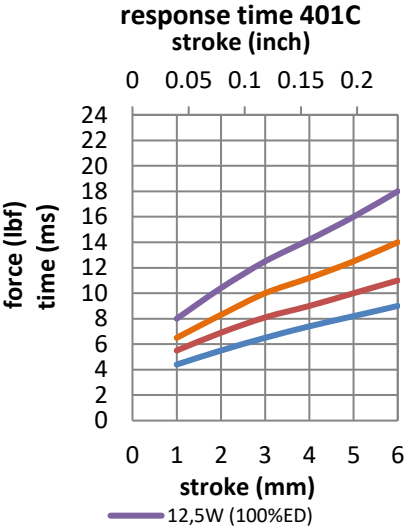




Mass 200g
Plunger (C) 40g
Plunger (F) 34g
Leadwires 22AWG, UL1430







125W (10%ED) 50W (25%ED) 25W (50%ED) 12,5W (100%ED)

Data at 20°C , device connected to heatsink 160x160x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	100	36	9
watts at 20°C	12.5	25	50	125
ampere-turns at 20°	714	1000	1425	2250

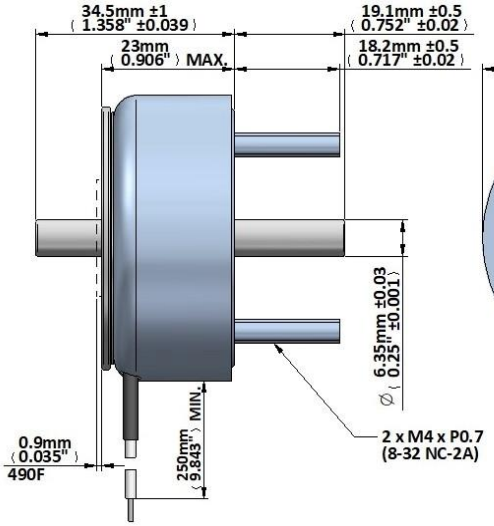
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
25	3.50	384	6.6	9.5	13	21
26	5.67	486	8.4	12	17	27
27	8.76	600	11	16	22	35
28	13.8	748	13	18	26	42
29	22.6	975	17	23	33	52
30	34.8	1190	21	30	42	67
31	56.7	1520	27	38	54	85
32	88.3	1908	35	49	70	110
33	138	2360	43	60	86	138
34	216	2904	53	75	106	168
35	351	3725	67	95	132	213
36	480	4000	85	119	169	268
37	720	4950	105	147	210	332
38	1150	6200	132	185	264	-
39	1920	8350	166	232	332	-
40	3000	10000	210	300	-	-

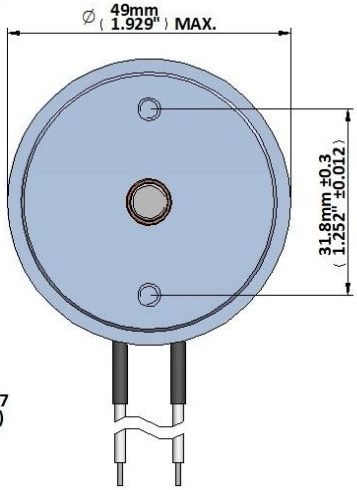
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

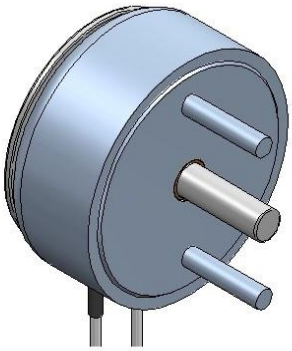
GEEPLUS Push Pull Solenoid size 490

Device drawn in energised condition
plunger options: flat (490F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread

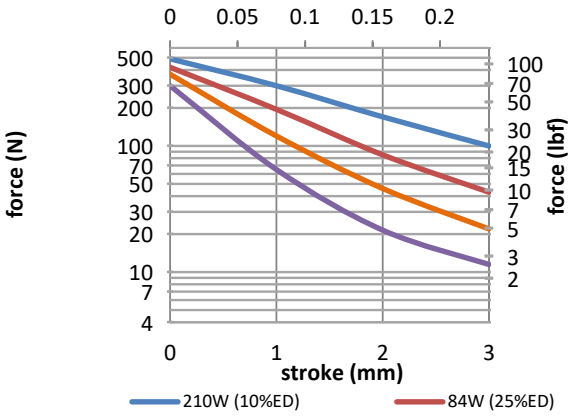




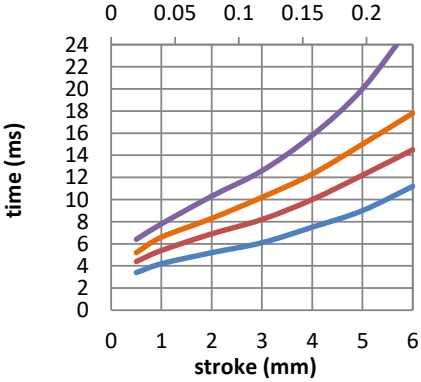


Mass 250g
Plunger 56g
Leadwires 22AWG, UL1430

force / stroke 490F



response time 490F



210W (10%ED) 84W (25%ED) 42W (50%ED) 21W (100%ED)

Data at 20°C , device connected to heatsink 190x190x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	10
watts at 20°C			21	42	84	210
ampere-turns at 20°			842	1190	1685	2660
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
24	3.20	360	7.6	11	15	24
25	4.91	440	9.5	13	19	30
26	7.72	550	12	17	24	38
27	11.1	636	15	21	30	48
28	18.8	840	19	27	38	60
29	30.5	1088	24	34	48	76
30	44.9	1275	30	43	60	95
31	70.9	1596	38	54	76	120
32	109	1974	48	67	95	150
33	175	2496	60	85	120	190
34	270	3042	76	107	151	239
35	414	3600	95	134	190	301
36	610	4200	122	173	245	386
37	940	5200	151	213	301	-
38	1560	6820	190	268	379	-

Insulation Resistance >100MΩ, 500VDC Megger

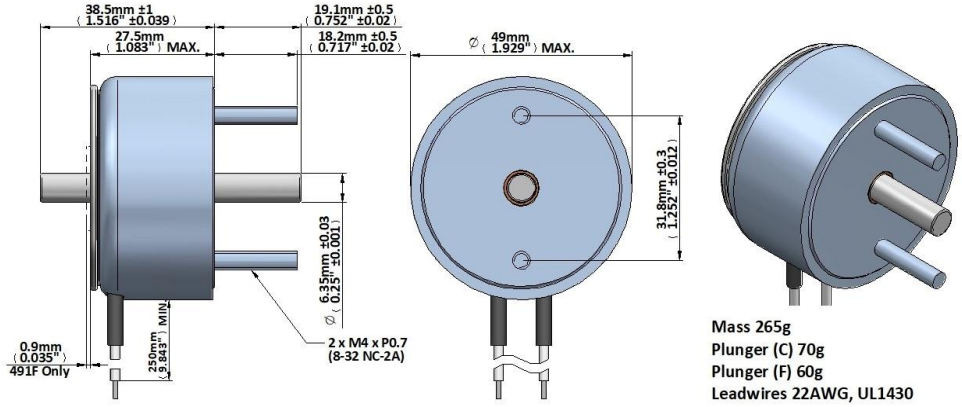
Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

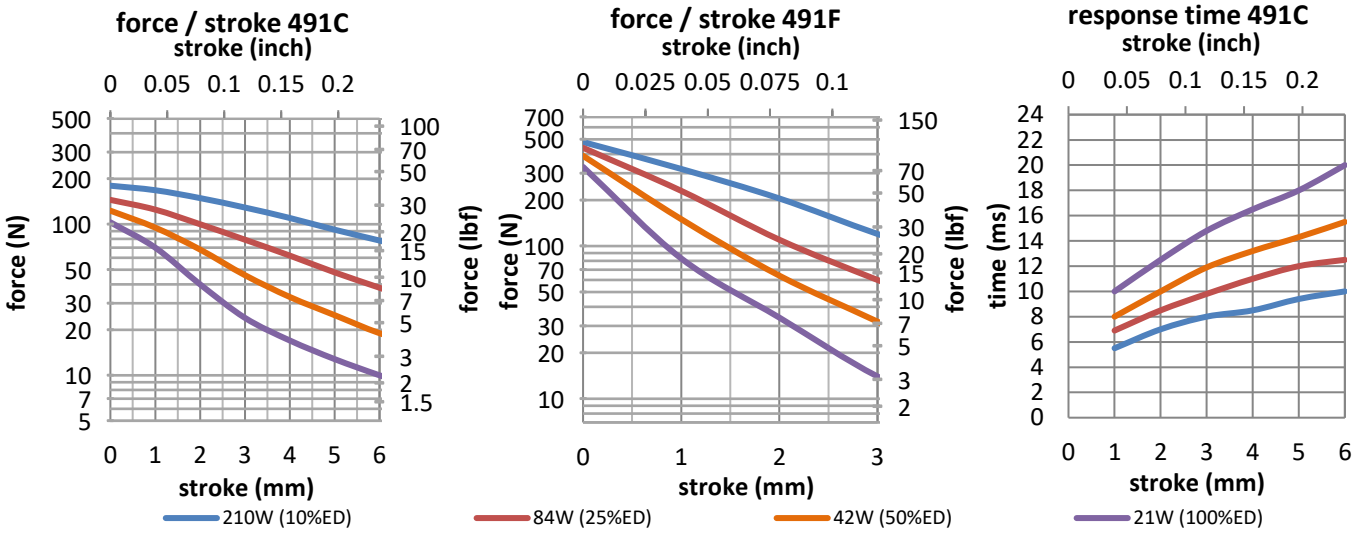
GEEPLUS Push Pull Solenoid size 491

Device drawn in energised condition
plunger options: conical (491C) / flat (491F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread



Mass 265g
Plunger (C) 70g
Plunger (F) 60g
Leadwires 22AWG, UL1430



Data at 20°C , device connected to heatsink 190x190x3mm aluminum

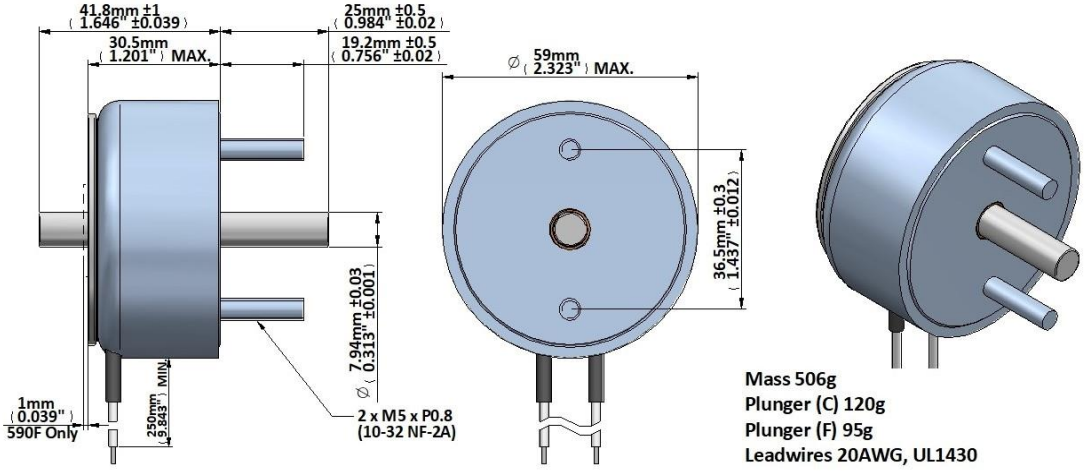
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	10
watts at 20°C			21	42	84	210
ampere-turns at 20°			1015	1440	2030	3210
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
21	1.00	228	4.5	6.4	8.9	14.1
22	1.68	301	5.7	8.1	11.4	17.9
23	2.70	384	7.2	10.1	14.3	23
24	4.30	486	9.0	12.7	18	28
25	6.66	590	11.5	16.2	23	36
26	10.3	737	14.0	20	28	44
27	15.7	900	17.7	25	35	56
28	26.6	1190	23	32	45	72
29	38.0	1380	28	40	56	89
30	62.1	1768	36	51	71	113
31	96.1	2166	45	64	90	143
32	157	2816	57	80	113	179
33	241	3432	71	101	143	226
34	364	4108	90	128	180	285
35	566	4920	117	166	234	370
36	910	6340	146	207	392	462
37	1224	6800	183	260	366	-

Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

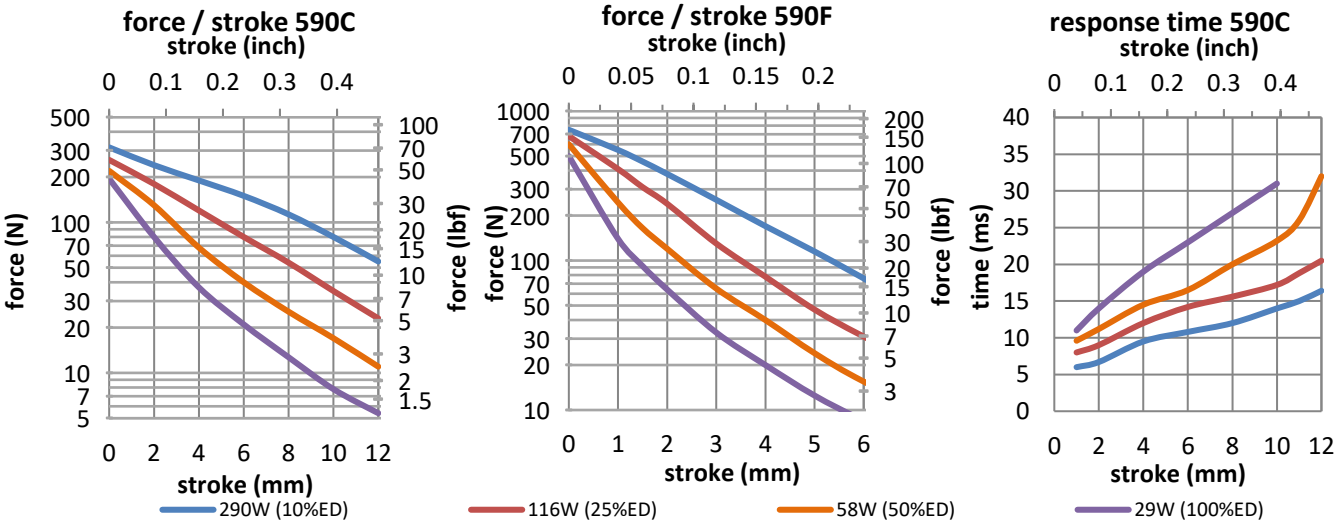
GEEPLUS Push Pull Solenoid size 590

Device drawn in energised condition
plunger options: conical (590C) / flat (590F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread



Mass 506g
Plunger (C) 120g
Plunger (F) 95g
Leadwires 20AWG, UL1430



Data at 20°C , device connected to heatsink 310x310x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	87	36	13
watts at 20°C	29	58	116	290
ampere-turns at 20°	1240	1760	2490	3920

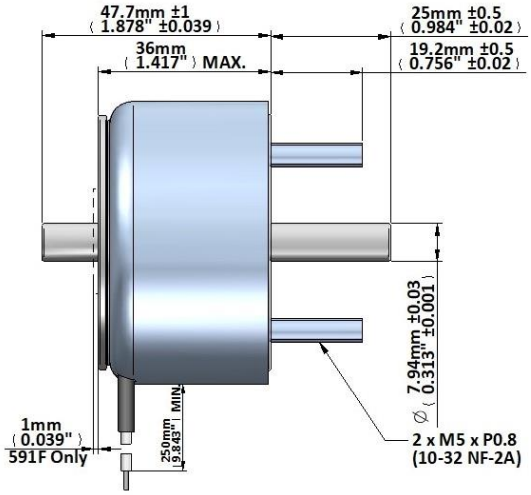
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
22	2.23	336	8.3	12	16	26
23	3.60	432	10	15	21	33
24	5.24	500	13	18	26	41
25	9.51	708	16	23	33	52
26	14.4	858	21	29	41	66
27	23.7	1110	26	37	52	83
28	38.2	1411	33	47	66	104
29	54.7	1638	41	59	83	131
30	93.7	2184	52	74	104	165
31	143	2645	66	93	131	207
32	223	3328	83	117	165	261
33	338	4004	104	147	208	329
34	550	5088	131	185	262	-
35	790	5860	165	233	330	-
36	1233	7260	208	294	-	-

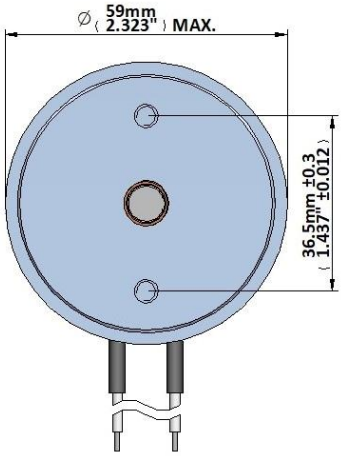
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

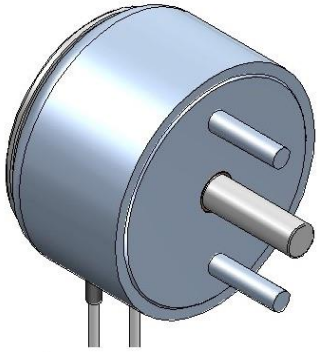
GEEPLUS Push Pull Solenoid size 591

Device drawn in energised condition
plunger options: conical (591C) / flat (591F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread

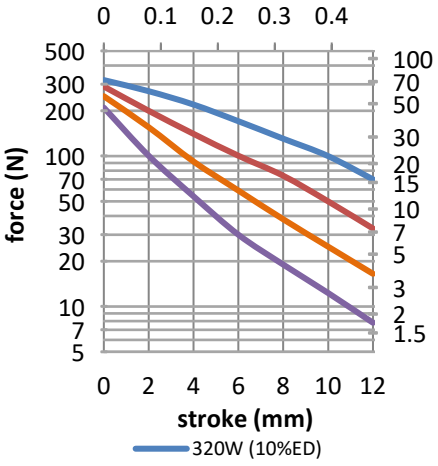




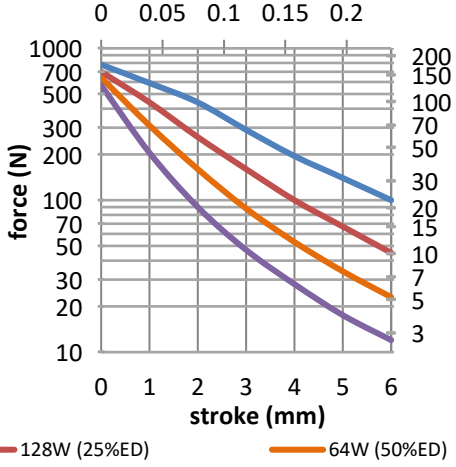


Mass 620g
Plunger (C) 145g
Plunger (F) 140g
Leadwires 20AWG, UL1430

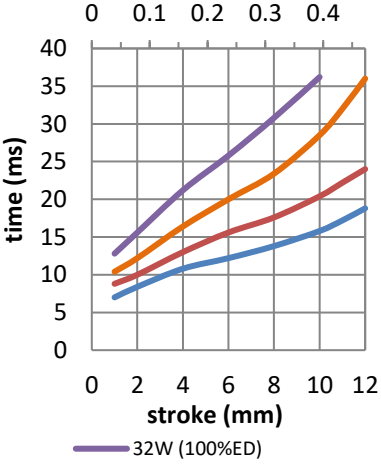
force / stroke 591C
stroke (inch)



force / stroke 591F
stroke (inch)



response time 591C
stroke (inch)



320W (10%ED) 128W (25%ED) 64W (50%ED) 32W (100%ED)

Data at 20°C , device connected to heatsink 310x310x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	87	36	13
watts at 20°C	32	64	128	320
ampere-turns at 20°	1480	2080	2940	4620

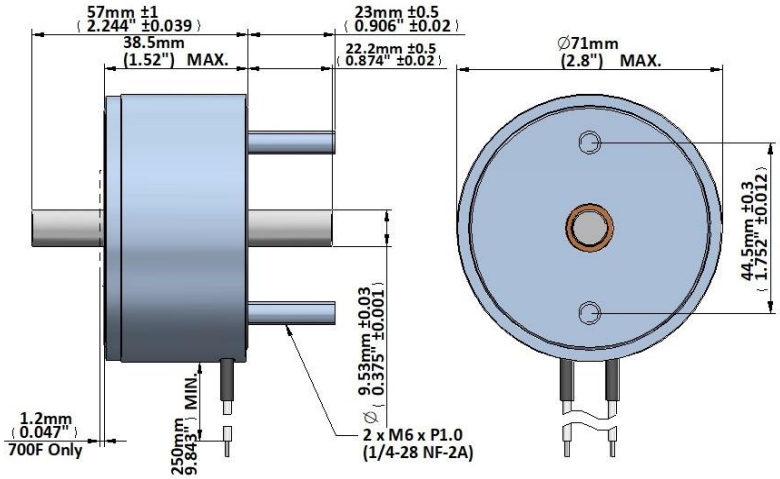
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
20	1.23	295	6.2	8.7	12.3	19.3
21	1.75	340	7.6	10.7	15.1	24
22	2.79	446	9.3	13.0	18.4	29
23	4.54	567	11.9	16.7	24	37
24	6.93	690	14.9	21	30	46
25	12.5	910	20	29	40	63
26	18.4	1120	24	34	48	76
27	33.4	1500	33	46	65	103
28	46.3	1750	39	55	78	122
29	74.5	2232	49	69	98	154
30	125.5	2940	63	89	126	197
31	199	3611	82	115	162	255
32	302	4350	103	144	204	321
33	417	5010	123	173	245	385

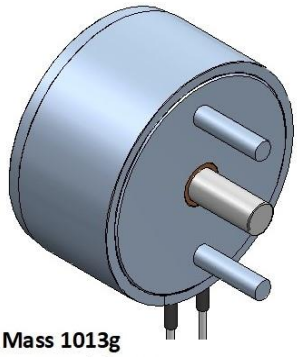
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 700

Device drawn in energised condition
plunger options: conical (700C) / flat (700F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

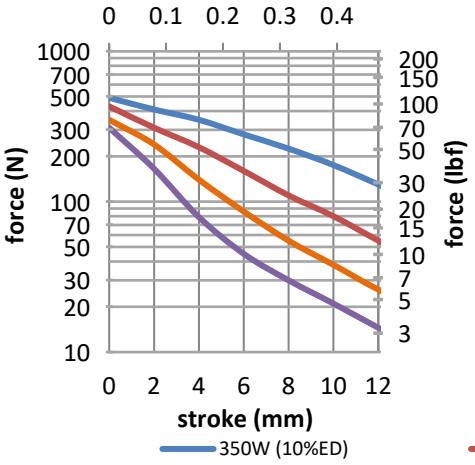
Available mechanical options:
M: metric thread
F: SAE thread



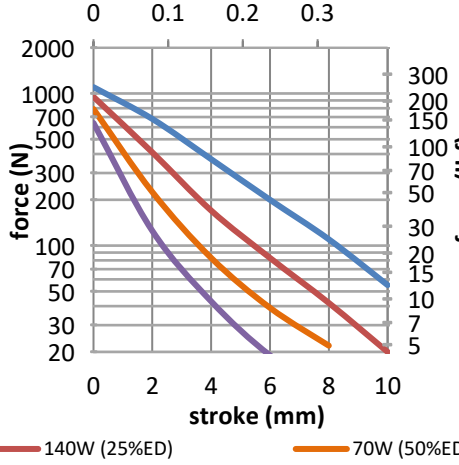


Mass 1013g
Plunger (C) 268g
Plunger (F) 285g
Leadwires 20AWG, UL1430

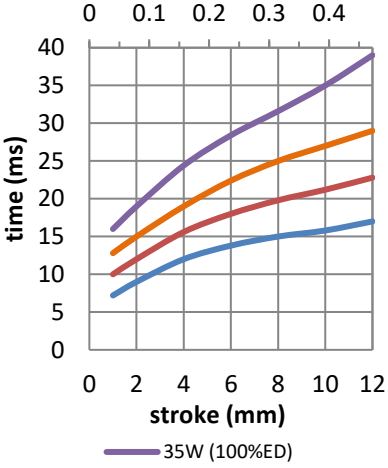
force / stroke 700C
stroke (inch)



force / stroke 700F
stroke (inch)



response time 700C
stroke (inch)



350W (10%ED) 140W (25%ED) 70W (50%ED) 35W (100%ED)

Data at 20°C , device connected to heatsink 390x390x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	80	38	16
watts at 20°C	35	70	140	350
ampere-turns at 20°	1570	2230	3150	5000

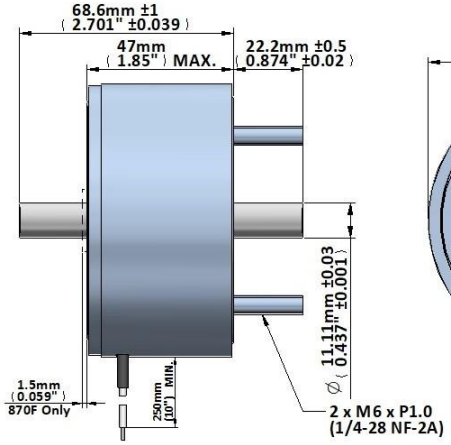
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
20	1.88	368	8	11	16	26
21	3.01	468	10	14	20	32
22	4.82	580	13	18	26	41
23	8.1	780	16	23	33	52
24	12.3	949	20	29	41	65
25	19.0	1148	26	37	52	83
26	30.8	1472	33	46	66	105
27	48.8	1854	41	59	83	132
28	81.1	2436	52	75	105	166
29	121	2944	64	92	130	206
30	190	3650	82	118	166	264
31	275	4175	104	147	209	331
32	440	5792	119	170	240	-
33	735	7000	165	235	331	-
34	995	7600	204	288	-	-

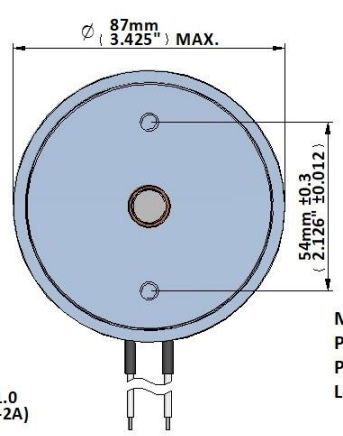
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

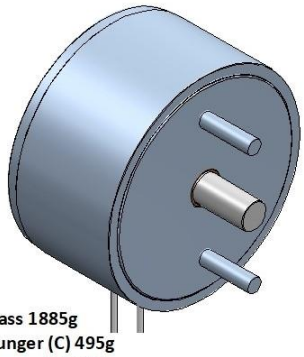
GEEPLUS Push Pull Solenoid size 870

Device drawn in energised condition
plunger options: conical (870C) / flat (870F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

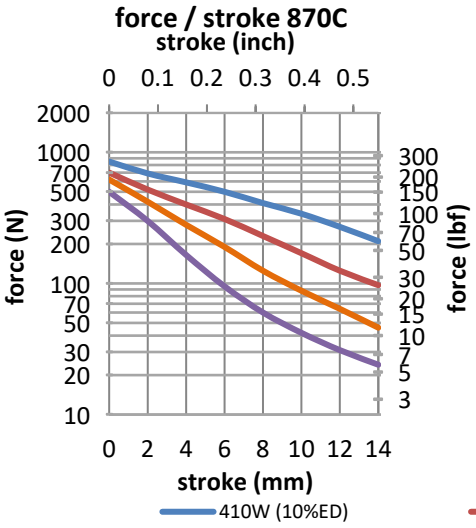
Available mechanical options:
M: metric thread
F: SAE thread

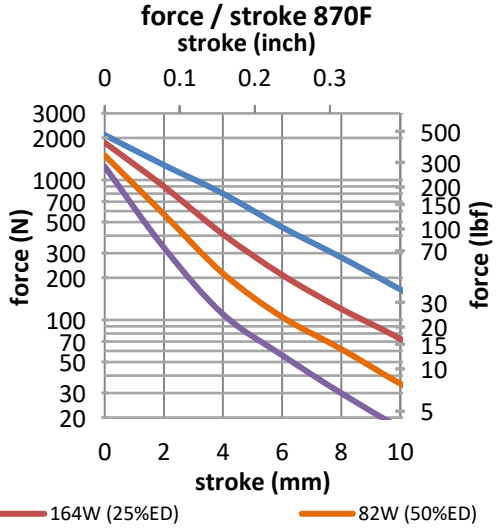


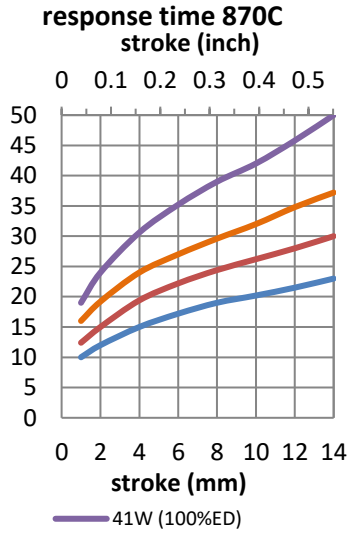




Mass 1885g
Plunger (C) 495g
Plunger (F) 480g
Leadwires 18AWG, UL1430







Data at 20°C , device connected to heatsink 520x520x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	72	43	20
watts at 20°C	41	82	164	410
ampere-turns at 20°	1910	2750	3810	5950

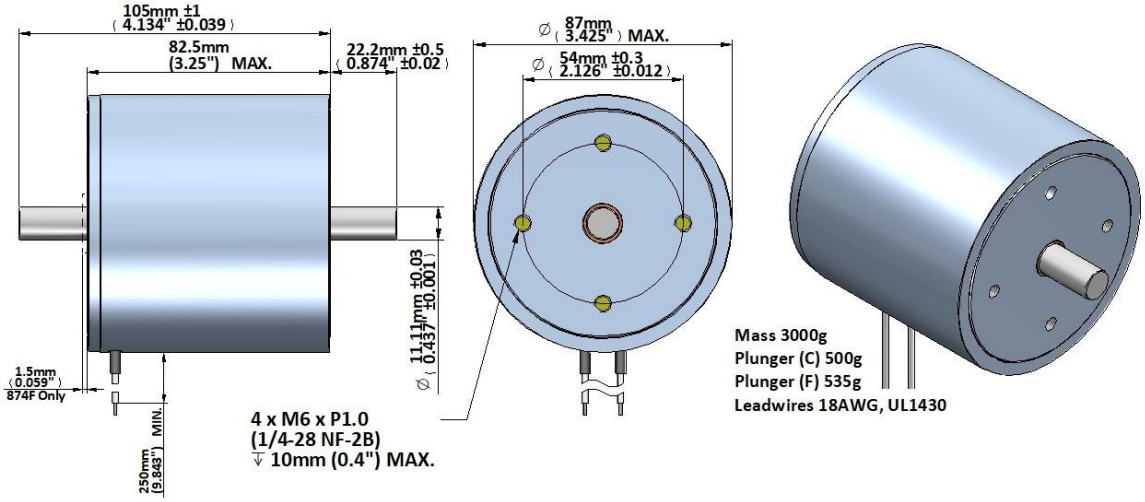
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
18	1.47	368	7.6	11	15	24
19	2.30	459	9.6	14	19	30
20	3.64	580	12	17	24	37
21	5.57	704	15	22	30	47
22	9.50	936	19	28	39	60
23	14.3	1134	24	35	48	75
24	23.3	1456	30	44	61	95
25	37.1	1836	39	56	77	120
26	58.6	2300	49	70	97	152
27	89.8	2816	61	88	121	189
28	139	3456	76	111	153	239
29	227	4480	98	138	193	300
30	376	5792	124	177	248	387
31	515	6600	148	212	297	-
32	785	7850	188	275	385	-
33	1130	9050	237	339	-	-

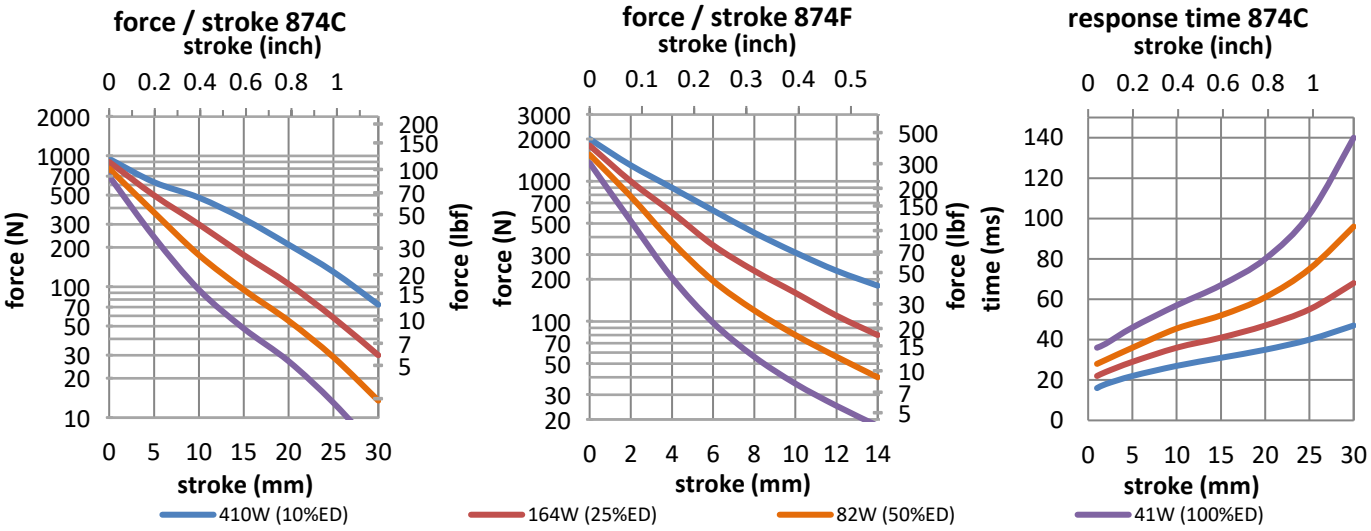
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Push Pull Solenoid size 874

Device drawn in energised condition
plunger options: conical (874C) / flat (874F)
Life Expectancy (cycles): >2M (-P), >10M (-PE)

Available mechanical options:
M: metric thread
F: SAE thread





Data at 20°C , device connected to heatsink 520x520x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	72	43	20
watts at 20°C	41	82	164	410
ampere-turns at 20°	2590	3663	5180	8190

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
18	2.54	630	10	15	21	33
19	4.15	828	13	18	26	41
20	6.38	1047	16	22	32	50
21	11.14	1408	20	29	41	65
22	16.8	1723	25	36	51	80
23	25.8	2046	33	46	65	103
24	42.5	2711	41	57	81	128
25	66.3	3279	52	74	105	166
26	105	4151	66	93	131	207
27	165	5190	82	116	165	260
28	261	6500	104	147	208	329
29	422	8340	131	185	262	-
30	664	10230	168	238	336	-
31	968	12410	202	286	-	-
32	1520	15200	259	366	-	-

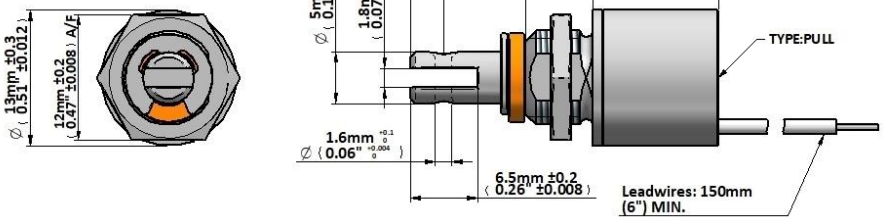
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

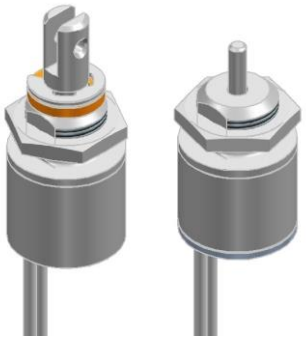
TUBULAR SOLENOIDS

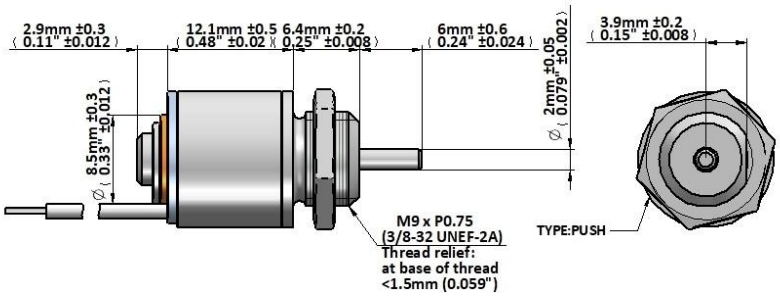
GEEPLUS Tubular Solenoid size 133

Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread

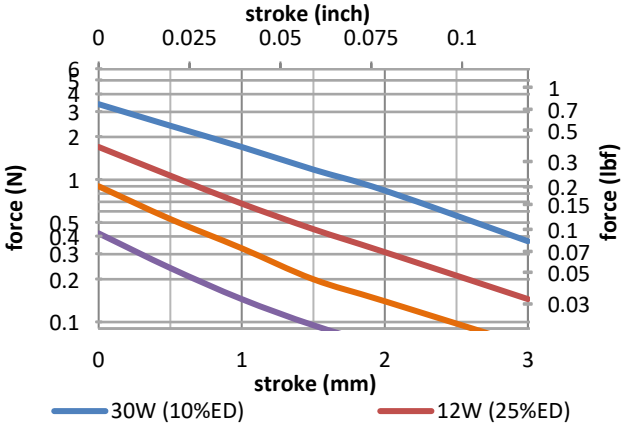
Mass 15g
Push Plunger 2g
Pull Plunger 4g
Leadwires UL1430, 28AWG



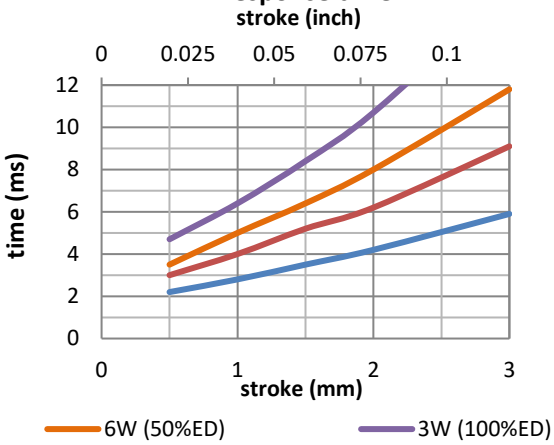




force / stroke 133



response time



Data at 20°C , device connected to heatsink 50x50x3mm aluminum

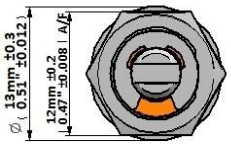
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	38	4	1
watts at 20°C			3	6	12	30
ampere-turns at 20°			232	330	465	735
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
29	1.0	141	1.7	2.4	3.4	5.0
30	1.6	175	2.0	3.0	4.3	7.0
31	2.5	217	2.7	3.8	5.4	9.0
32	3.9	268	3.4	4.8	7.0	11
33	6.1	332	4.3	6.0	9.0	14
34	9.5	410	5.4	7.7	11	17
35	14.8	506	6.8	10	14	22
36	23.0	625	8.5	12	17	27
37	35.8	770	10.8	15	22	34
38	55.7	949	13.6	19	27	43
39	86.5	1169	17.0	24	34	54
40	134	1440	21.6	31	43	68
41	209	1774	27.0	39	55	87
42	324	2184	34.5	49	69	109
43	503	2688	43.5	62	87	137

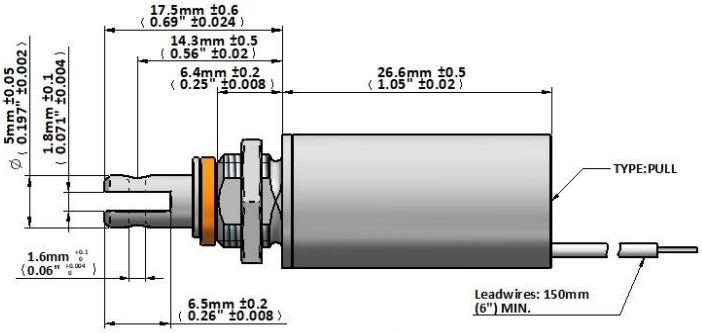
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

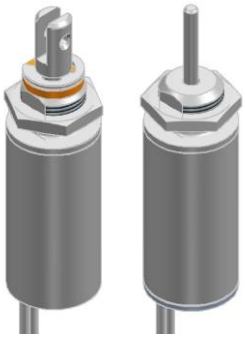
GEEPLUS Tubular Solenoid size 130

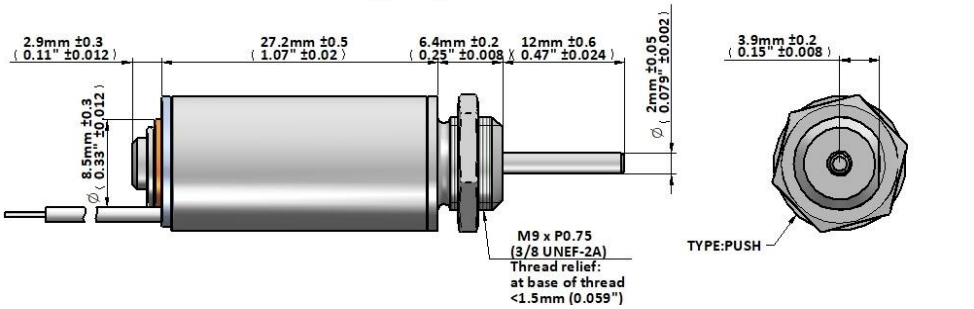
Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread

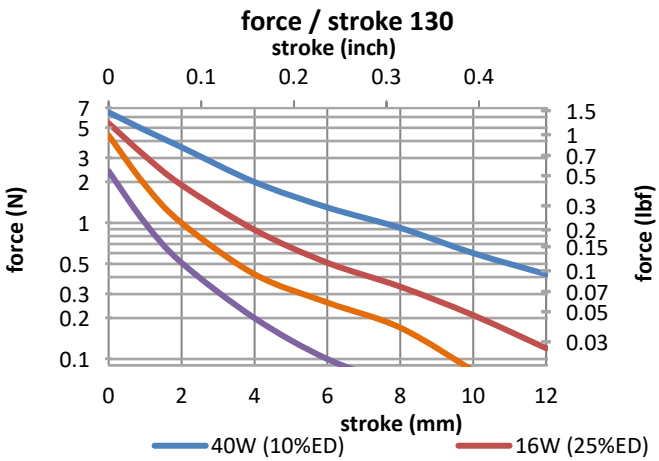
Mass 24g
Push Plunger 4g
Pull Plunger 5g
Leadwires UL1430, 28AWG

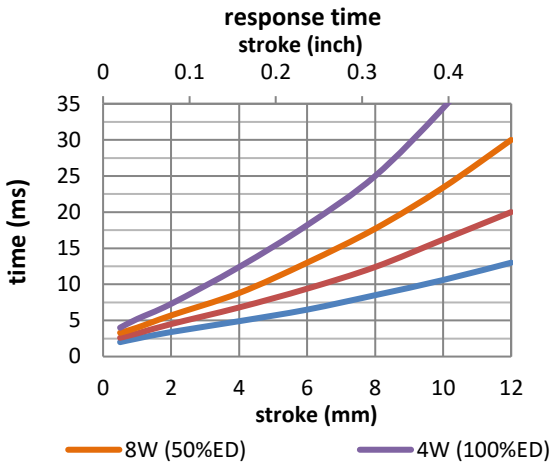












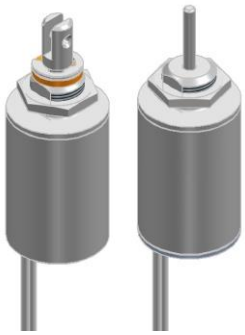
Data at 20°C , device connected to heatsink 50x50x3mm aluminum

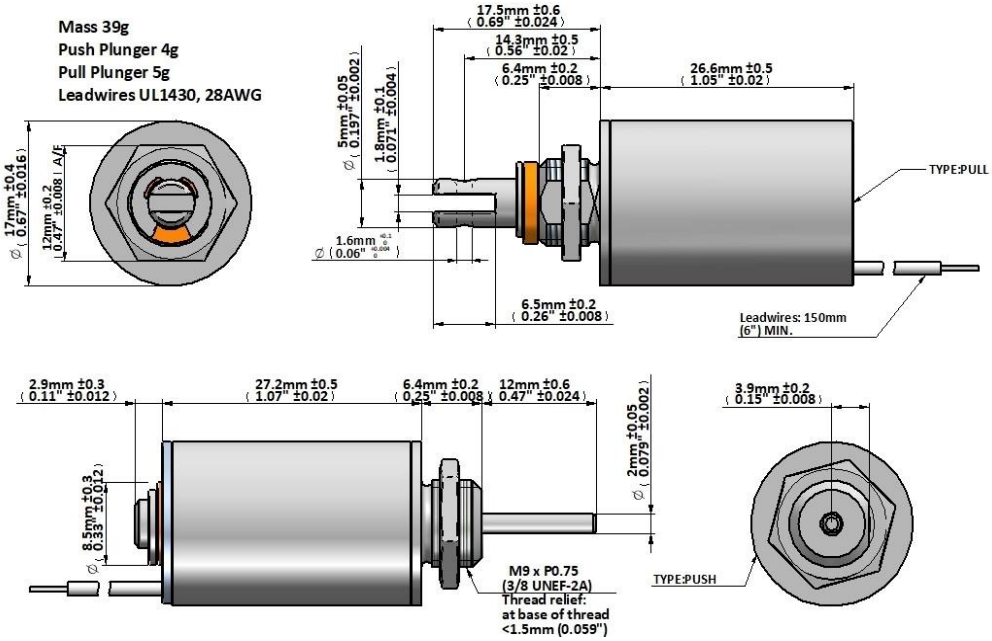
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	50	5	2
watts at 20°C			4	8	16	40
ampere-turns at 20°			453	640	905	1440
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
29	2.68	372	3.3	4.5	6.5	10.4
30	3.94	426	4.2	5.9	8.4	13.3
31	7.36	632	5.3	7.4	10.5	16.8
32	10.1	704	6.5	9.2	13.0	21
33	18.1	990	8.3	11.7	16.5	26
34	25.6	1100	10.6	14.9	21	34
35	44.2	1500	13.6	19.2	27	43
36	71.3	1932	16.9	24	34	54
37	99.0	2170	21	29	41	66
38	159.5	2768	26	37	52	83
39	300	3980	34	48	68	109
40	469	4884	44	61	87	138
41	709	6024	53	75	107	170
42	1152	7784	67	95	134	213
43	1780	9330	87	112	173	275

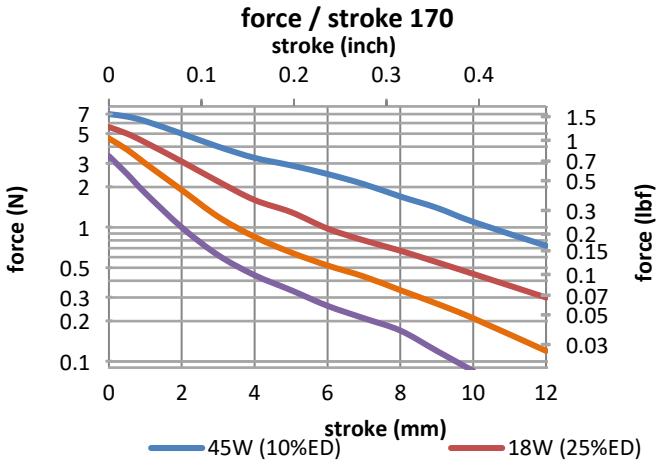
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

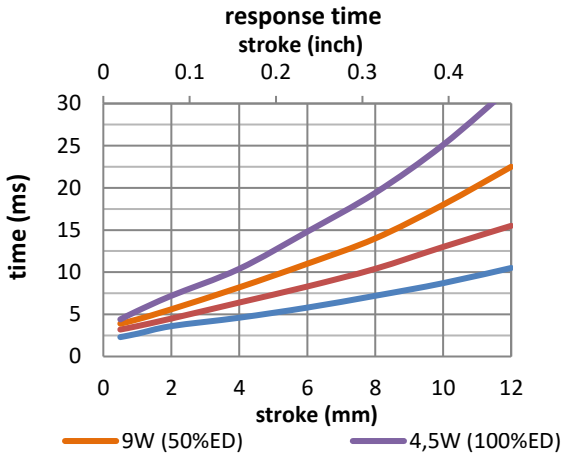
GEEPLUS Tubular Solenoid size 170

Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread









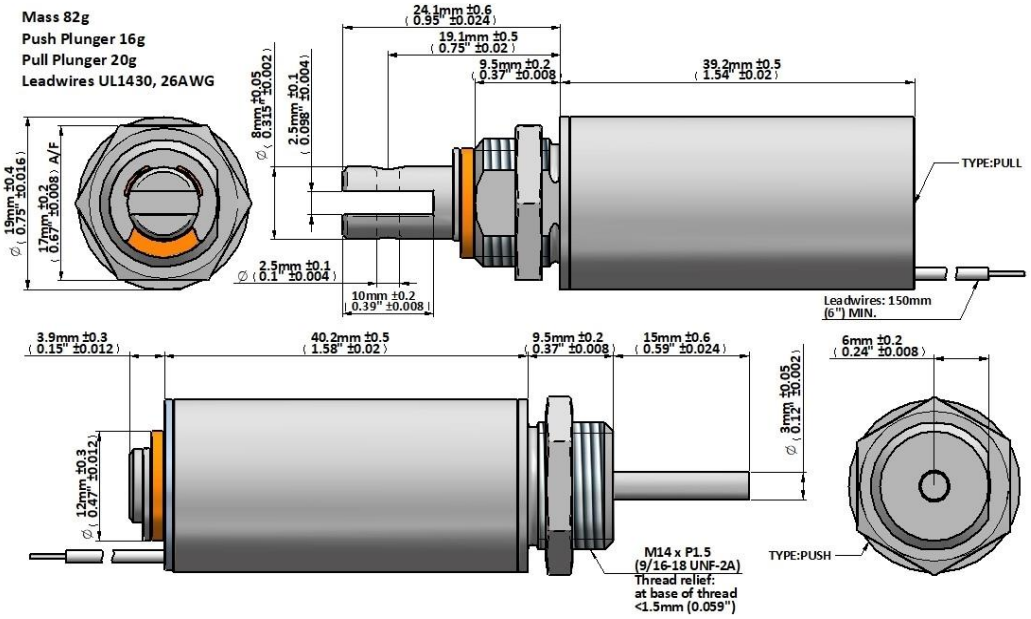
Data at 20°C , device connected to heatsink 50x50x3mm aluminum

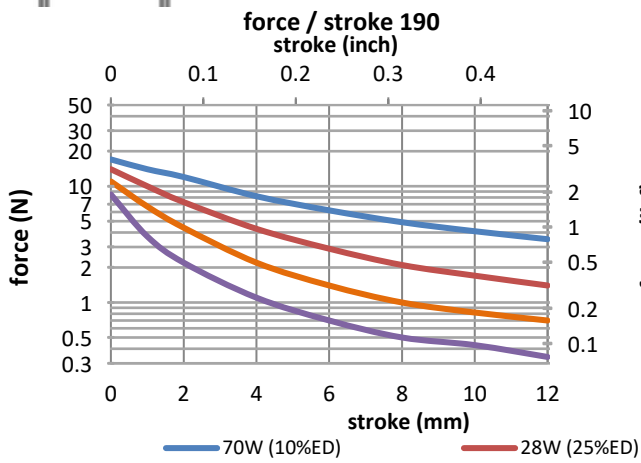
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	50	5	2
watts at 20°C			4.5	9	18	45
ampere-turns at 20°			631	892	1262	1995
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
27	2.83	520	3.4	4.9	6.9	10.9
28	4.90	695	4.4	6.3	8.9	14.1
29	6.59	760	5.5	7.7	10.9	17.3
30	11.0	985	7.0	10.0	14.1	22
31	18.0	1246	9.1	12.9	18.2	29
32	28.2	1580	11.3	15.9	23	36
33	46.3	2080	14.0	19.9	28	44
34	69	2460	17.6	25	35	56
35	119	3260	23	33	46	73
36	177	3700	30	43	60	95
37	280	5000	35	50	71	112
38	408	6000	43	61	86	136
39	715	8080	56	79	112	177
40	1108	9700	72	102	144	228
41	1763	12000	93	131	185	293

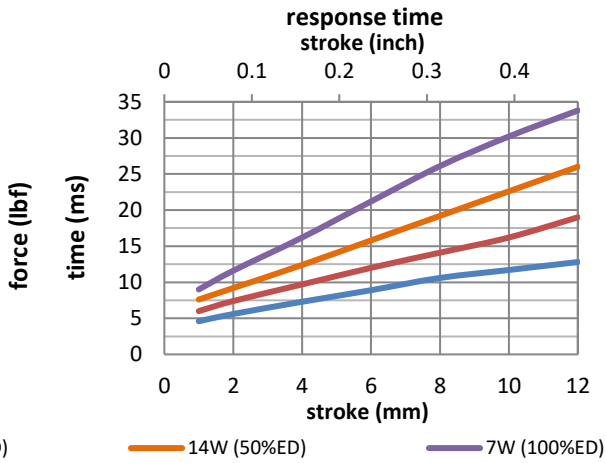
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

GEEPLUS Tubular Solenoid size 190

Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread







Data at 20°C , device connected to heatsink 80x80x3mm aluminum

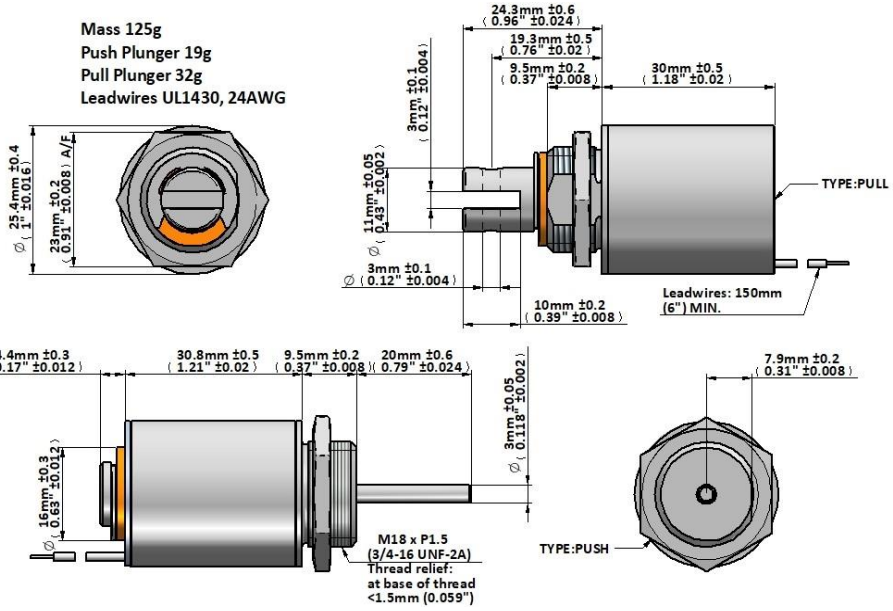
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	230	25	6
watts at 20°C			7	14	28	70
ampere-turns at 20°			760	1075	1520	2403
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
25	1.65	372	3.4	4.9	6.9	10.9
26	3.10	551	4.4	6.2	8.7	13.8
27	4.33	615	5.4	7.7	10.9	17.2
28	7.78	870	6.9	9.8	13.8	22
29	10.7	960	8.6	12.2	17.2	27
30	18.6	1308	11.0	15.6	22	35
31	30.9	1722	13.9	19.6	28	44
32	41.6	1890	17	24	34	54
33	69.0	2448	22	31	44	69
34	110	3060	28	39	56	88
35	176	3860	35	50	70	111
36	266	4686	44	62	88	139
37	435	6214	54	77	109	172
38	658	7420	69	97	137	217
39	1135	9792	90	127	180	284
40	1815	12210	115	162	229	362

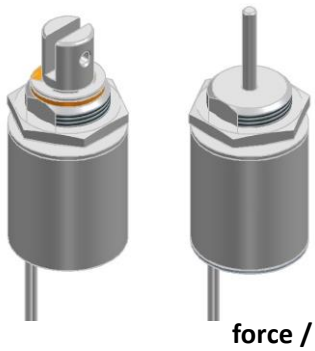
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

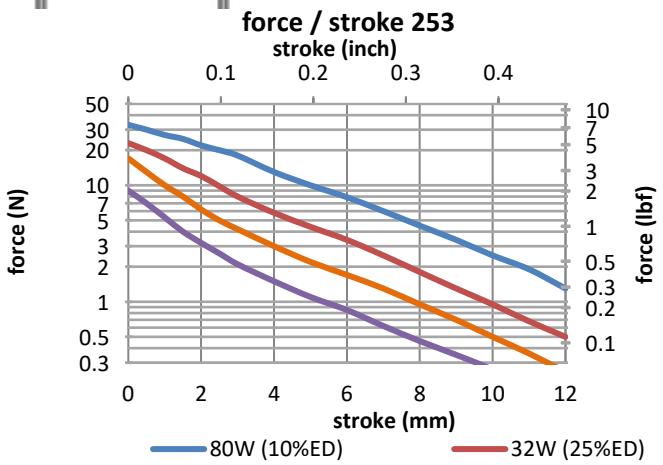
GEEPLUS Tubular Solenoid size 253

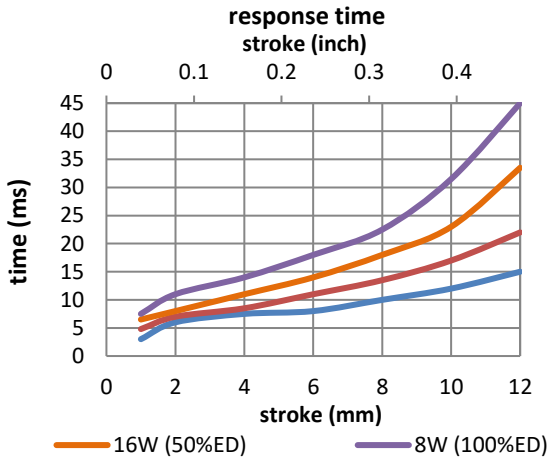
Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread

Mass 125g
Push Plunger 19g
Pull Plunger 32g
Leadwires UL1430, 24AWG









Data at 20°C , device connected to heatsink 100x100x3mm aluminum

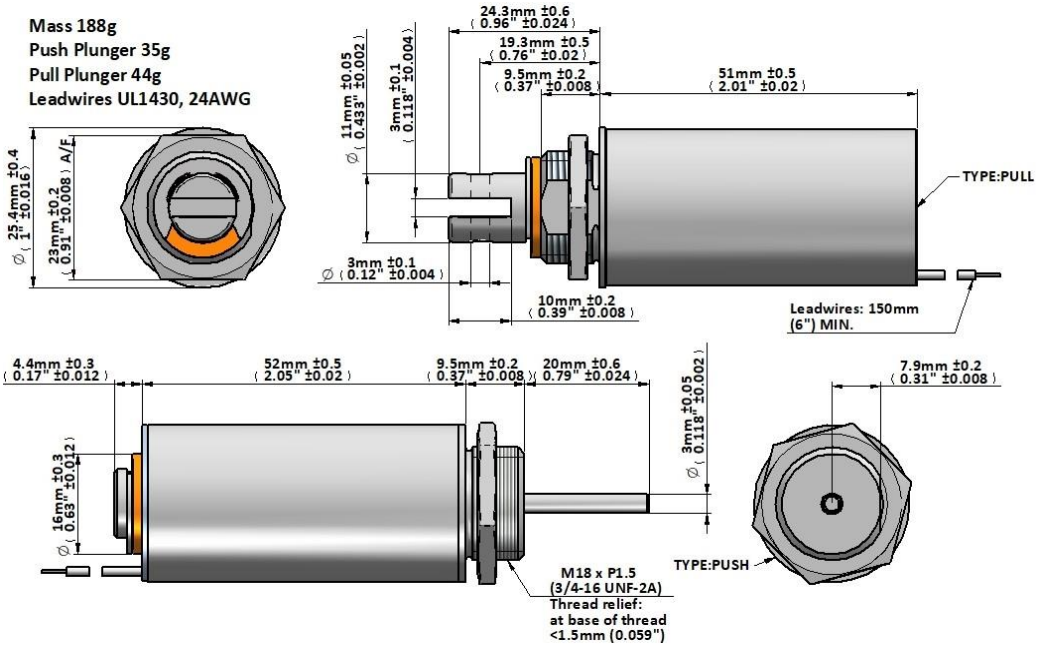
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	360	32	8
watts at 20°C			8	16	32	80
ampere-turns at 20°			666	942	1332	2106
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
25	1.91	328	3.9	5.5	7.8	12.3
26	3.49	460	5.1	8.7	12.3	19.4
27	4.79	520	6.1	8.7	12.3	19.4
28	8.27	696	7.9	11.2	15.8	25
29	14.7	910	10.8	15.2	22	34
30	18.6	1020	12.1	17.2	24	38
31	31.3	1360	15.3	22	31	48
32	50.3	1620	21	29	41	65
33	76.8	2060	25	35	50	79
34	121	2570	31	44	63	99
35	207	3350	41	58	82	130
36	308	4100	50	71	100	158
37	490	5100	64	91	128	202
38	720	6000	80	113	160	253
39	1320	8550	103	145	206	325
40	2040	10500	129	183	259	409

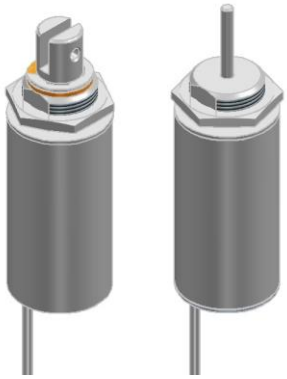
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

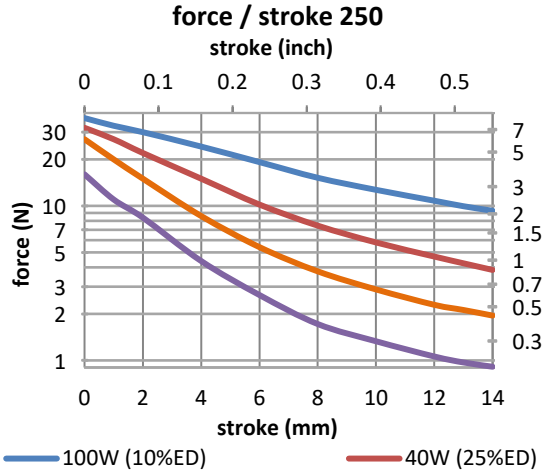
GEEPLUS Tubular Solenoid size 250

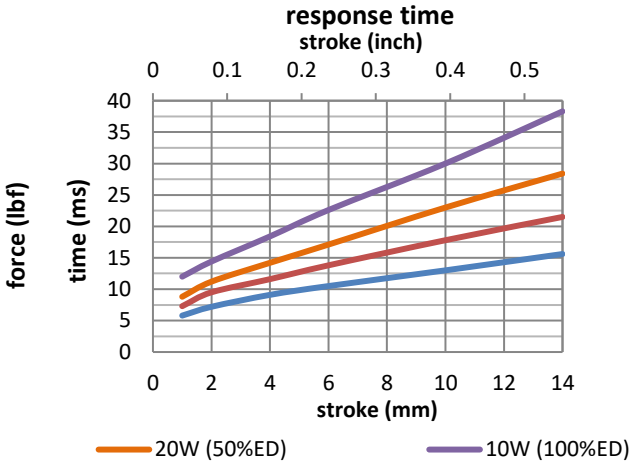
Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread

Mass 188g
Push Plunger 35g
Pull Plunger 44g
Leadwires UL1430, 24AWG









Data at 20°C , device connected to heatsink 100x100x3mm aluminum

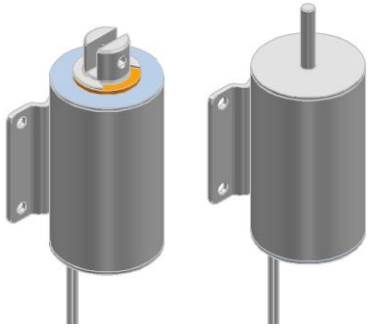
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	360	32	8
watts at 20°C			10	20	40	100
ampere-turns at 20°			1090	1541	2180	3447
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
23	1.49	402	4.1	5.8	8.2	13.0
24	2.87	600	5.2	7.4	10.4	16.4
25	3.98	672	6.6	9.3	13.1	21
26	7.06	940	8.3	11.7	16.6	26
27	9.8	1050	10.4	14.6	21	33
28	16.9	1415	13.2	18.6	26	42
29	27.0	1820	16.4	23	33	52
30	45.0	2365	21	30	42	66
31	71.6	2990	26	37	53	84
32	107	3660	32	46	65	102
33	172	4550	42	59	83	132
34	265	5550	53	75	106	167
35	443	7310	67	95	134	212
37	1032	11000	104	147	207	328
38	1535	12930	131	185	262	415

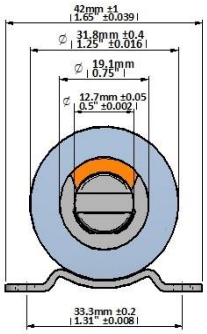
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

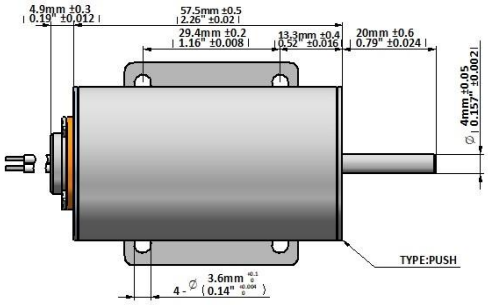
Tubular Solenoid size 320

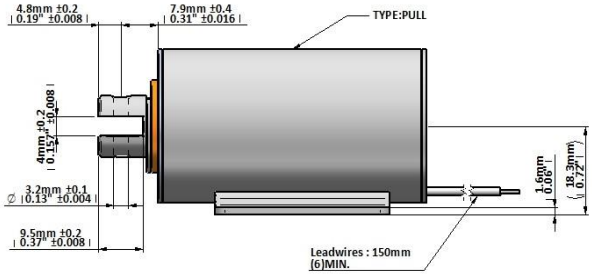
Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, -HL)
Available mechanical options:
M: metric thread
F: SAE thread

Mass 299g
Push Plunger 53g
Pull Plunger 54g
Leadwires UL1430, 22AWG

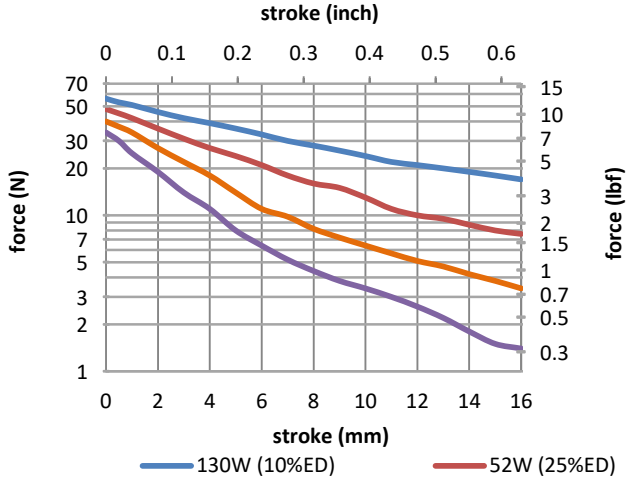




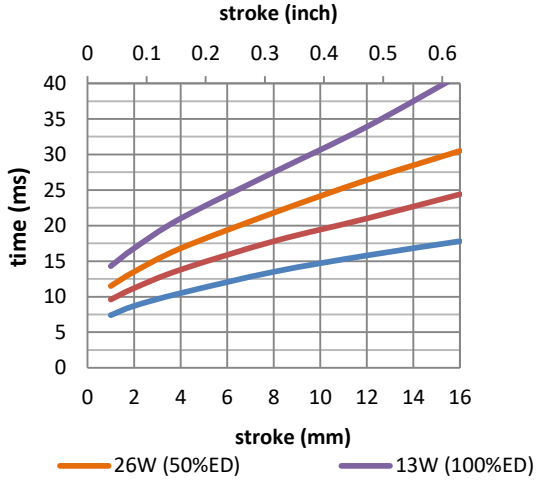




force / stroke 320



response time



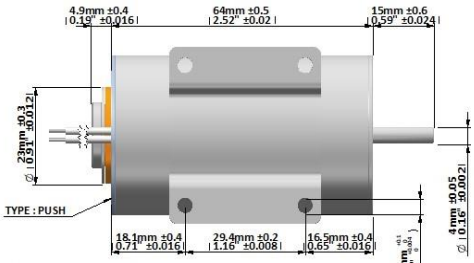
Data at 20°C , device connected to heatsink 130x130x3mm aluminum

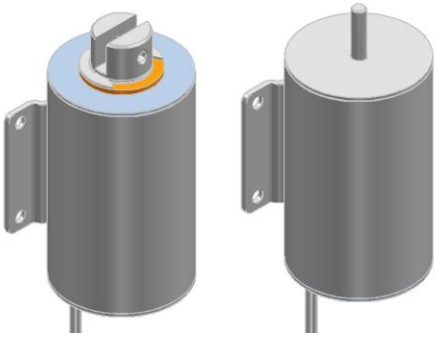
duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	390	60	18
watts at 20°C			13	26	52	130
ampere-turns at 20°			1500	2121	3000	4743
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
21	1.40	496	4.3	6.1	8.6	13.5
22	2.52	700	5.4	7.7	10.9	17.2
23	3.52	780	6.8	9.6	13.6	22
24	6.04	1056	8.6	12.2	17.2	27
25	8.5	1176	10.9	15.4	22	34
26	14.1	1540	13.8	19.5	28	44
27	22.5	1970	17.3	24	35	55
28	36.1	2484	22	31	44	69
29	55.1	3060	27	38	54	86
30	88.1	3805	35	49	70	110
31	147	5044	44	62	88	139
32	214	5992	54	76	107	170
33	354	7744	69	98	138	218
34	566	9730	88	124	175	277
35	900	12200	111	157	222	351
36	1310	14150	139	197	278	440
37	2060	18100	172	243	344	544

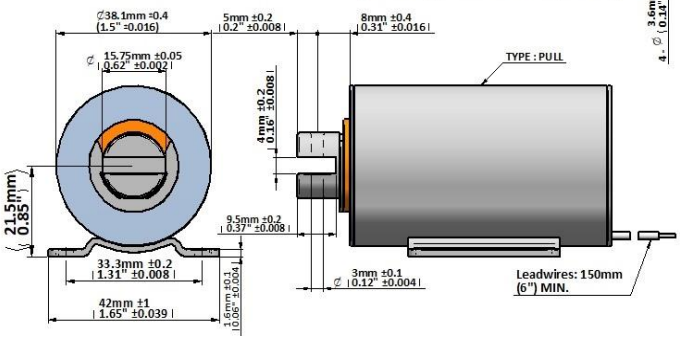
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

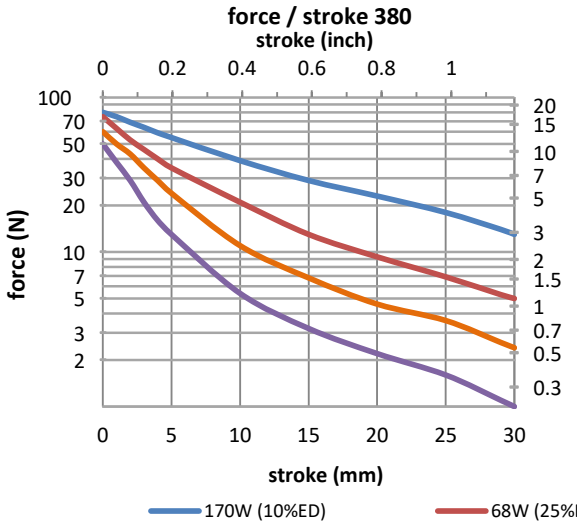
Device drawn in energised condition
Available plunger options:
pull (-Lx) / push (-Hx)
Life Expectancy (cycles):
>2M (-L, ;-H),
>5M (-LE, ;-HE),
>10M (-LL, ;HL)
Available mechanical options:
M: metric thread
F: SAE thread

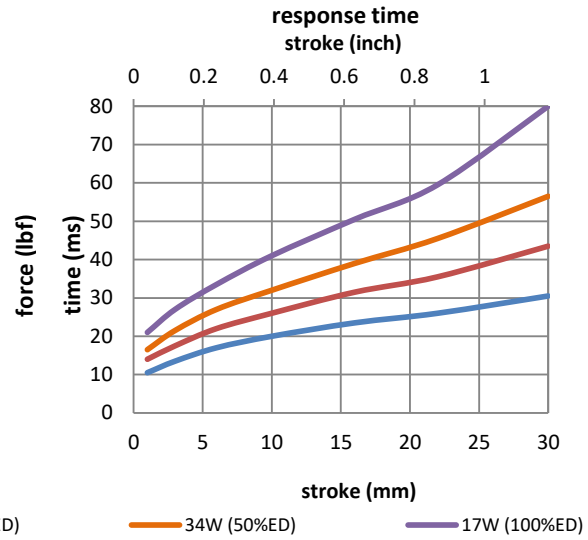
Mass 497g
Plunger 95g
Leadwires
UL1430, 20 AWG









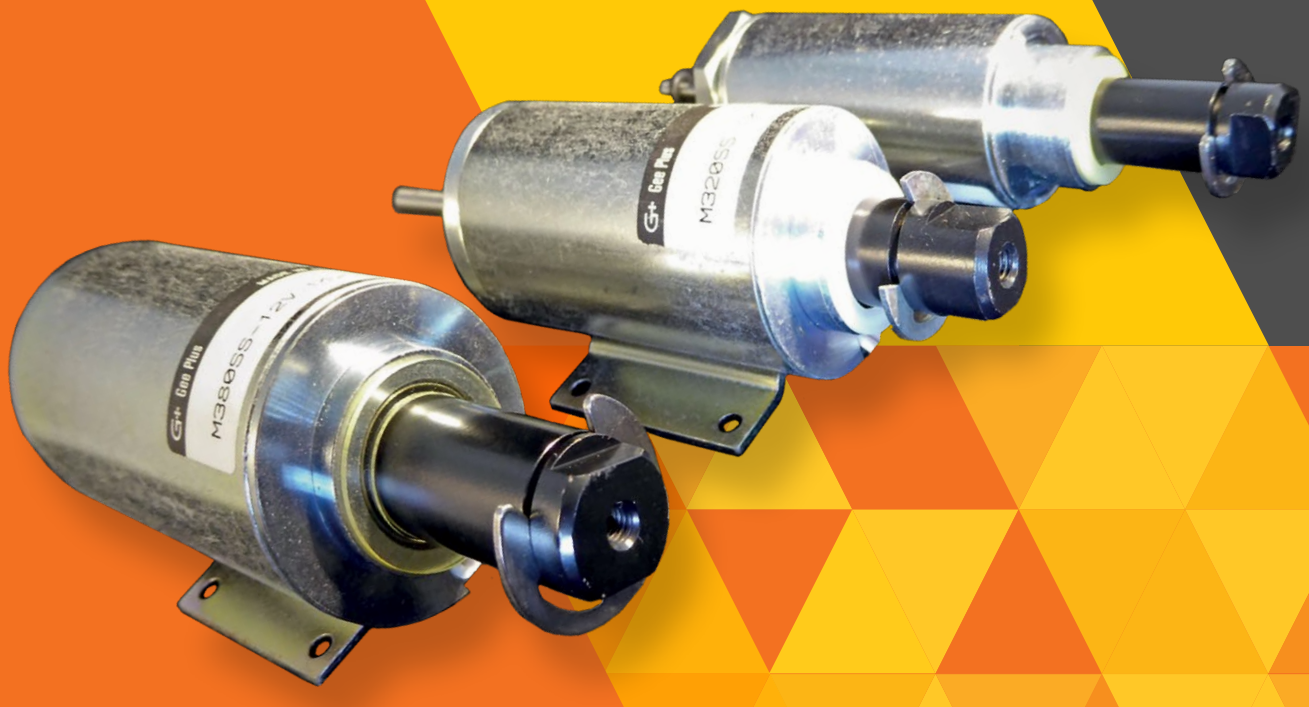


Data at 20°C , device connected to heatsink 150x150x3mm aluminum

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	420	100	25
watts at 20°C			17	34	68	170
ampere-turns at 20°			1800	2546	3600	5692
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
19	0.93	432	3.9	5.5	7.8	12.4
20	1.34	488	4.9	6.9	9.8	15.5
21	2.34	680	6.2	8.7	12.3	19.5
22	3.35	770	7.8	11.1	15.7	25
23	5.6	1030	9.8	13.9	19.7	31
24	9.30	1344	12.4	17.6	25	39
25	14.9	1712	15.7	22	31	50
26	24.0	2180	19.9	28	40	63
27	36.9	2680	25	35	50	79
28	58.4	3322	32	45	63	100
29	87.5	4008	39	56	79	124
30	148	5292	50	71	101	159
31	224	6360	63	90	127	200
32	344	7956	78	110	155	246
33	554	10070	100	141	199	315
34	871	12400	127	179	253	401
35	1360	15300	160	227	320	507
36	2140	19200	201	284	402	636

Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

SUPER STROKE SOLENOIDS



Super Stroke Solenoid

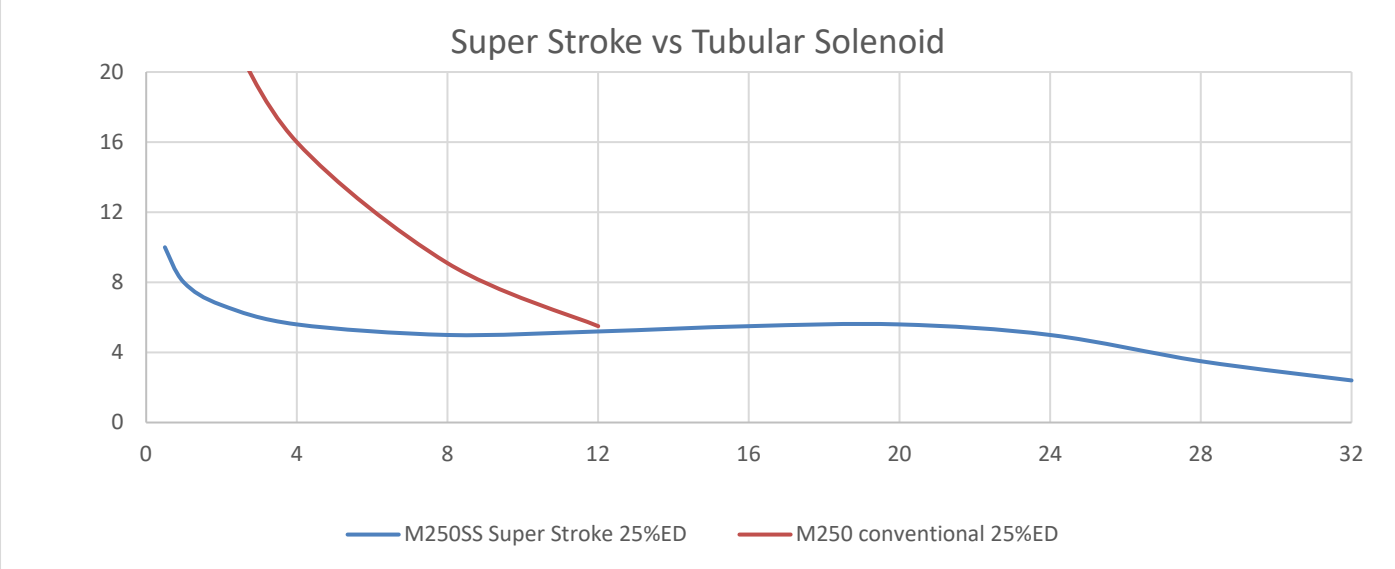
Description

The super stroke solenoid is a special implementation of the tubular solenoid design, modifications have been made to the geometry of the pole-piece and magnetic return path to produce a device which develops useful force over an exceptionally long stroke, with high efficiency, and with a flat force characteristic having many of the characteristics of a proportional solenoid allowing approximate position control over a large linear stroke.

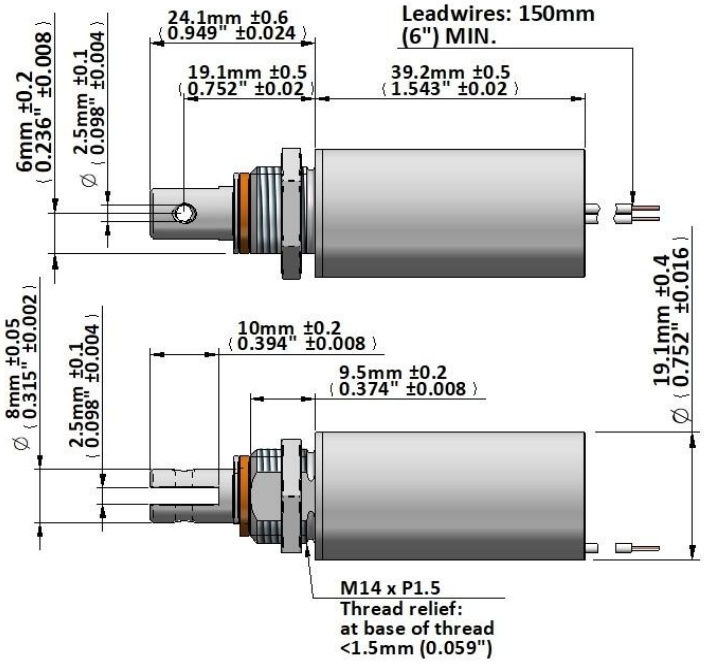
The use of many of the components of the tubular solenoid range makes the super stroke solenoid a cost-effective solution compared to other long-stroke actuators or proportional solenoid designs.

The long stroke with flat force characteristic makes the super stroke solenoid a good replacement for small air cylinders in applications where a few linear actuators are needed, but where air supply is otherwise not required, machinery can be made independent of air supply with elimination of compressors, airline, and air preparation equipment and associated maintenance.

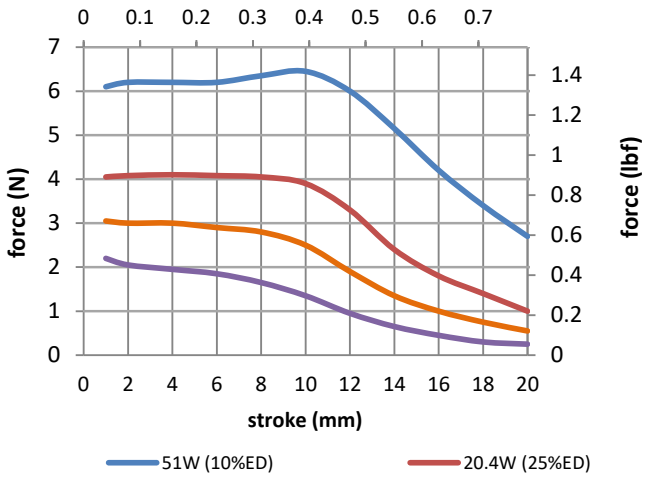
The super stroke solenoid allows approximate proportional control over a long linear stroke, the force is proportional to applied current, and is uniform over the operating stroke. This characteristic can be used to control tension of wire, fibres, or web material, or can be applied against a spring to realise an actuation system where position can be controlled proportional to the applied current.



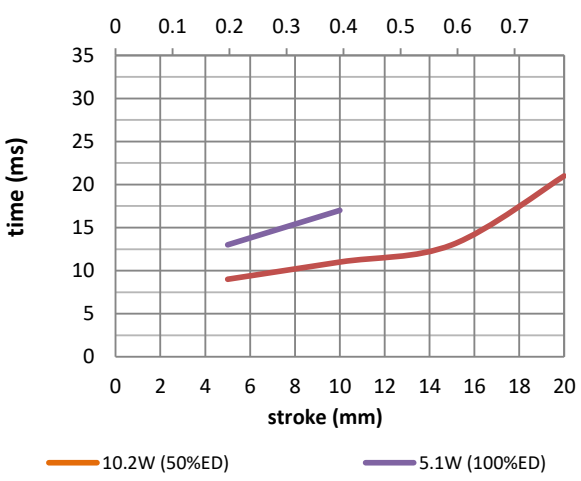
Device drawn in energised condition
Life Expectancy >2M cycles
Leadwires UL1430, 22AWG
Plunger Mass 20 grammes
Mass 81 grammes



force / stroke M190SS



response time



51W (10%ED) 20.4W (25%ED) 10.2W (50%ED) 5.1W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	180	20	5
watts at 20°C	5.1	10.2	20.4	51
ampere-turns at 20°	646	914	1292	2043

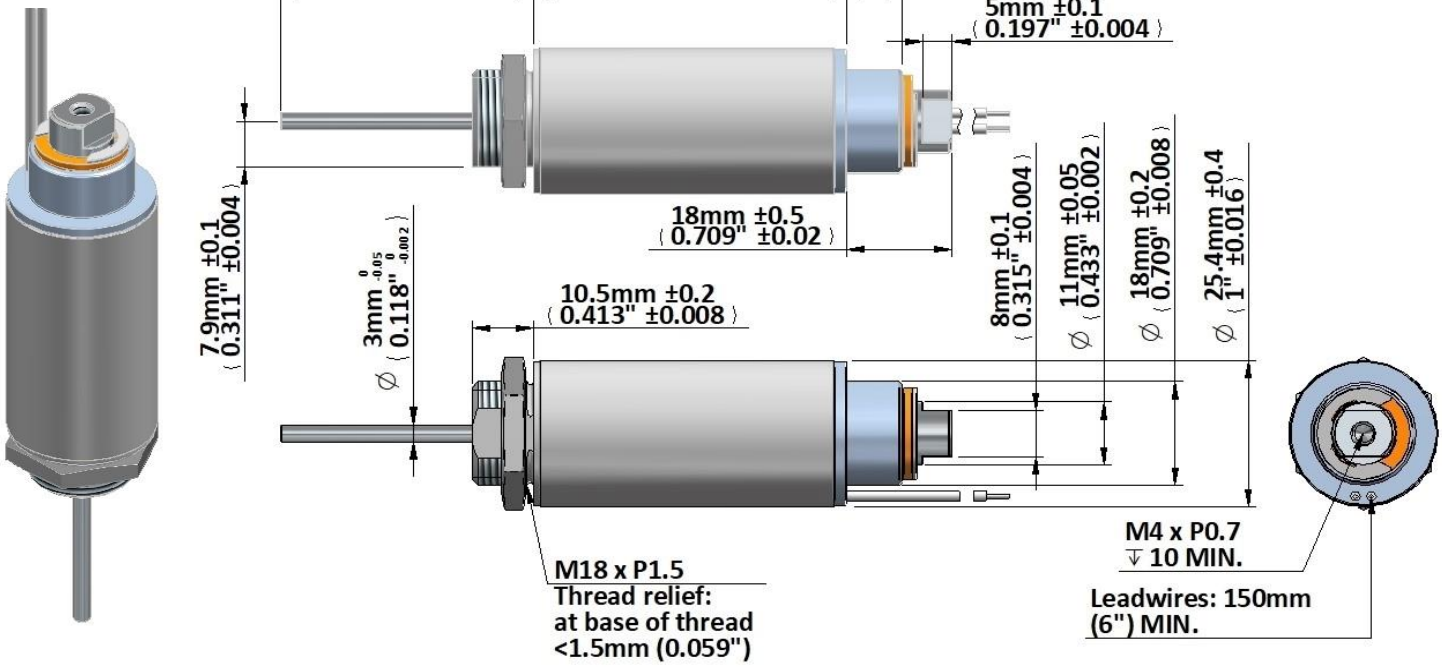
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M190SS-12v	30.9	1722	12.0	17.0	24.0	38.0
M190SS-24v	110	3060	24.0	34.0	48.0	76.0
M190SS-48v	435	6214	48.0	68.0	96.0	152.0
M190SS-96v	1815	12210	96.0	136.0	192	304

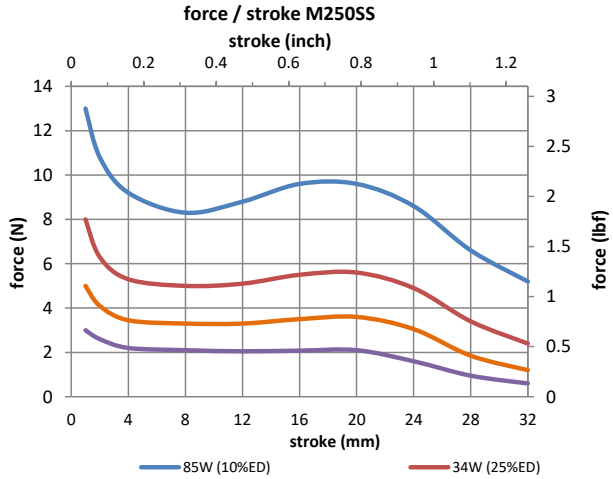
Insulation Resistance >100MΩ, 500VDC Megger

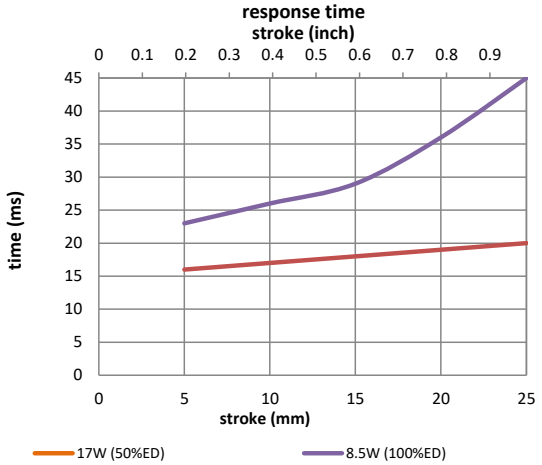
Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

Device drawn in energised condition
Life Expectancy >2M cycles
Leadwires UL1430, 22AWG
Plunger Mass 46 grammes
Mass 200 grammes







Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	290	26	6
watts at 20°C	8.5	17	34	85
ampere-turns at 20°	983	1390	1966	3109

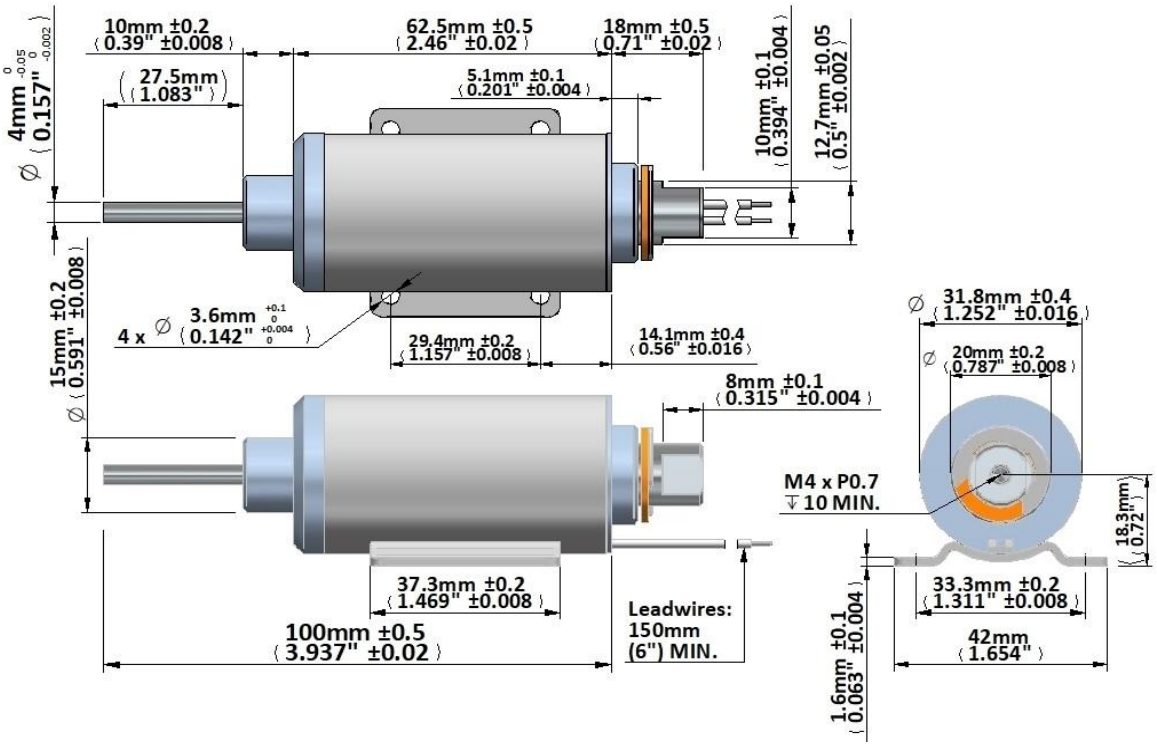
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M250SS-12v	17	1392	12.0	17.0	24.0	38.0
M250SS-24v	66	2686	24.0	34.0	48.0	76.0
M250SS-48v	260	5380	48.0	68.0	96.0	152.0
M250SS-96v	1170	11400	96.0	136.0	192	304

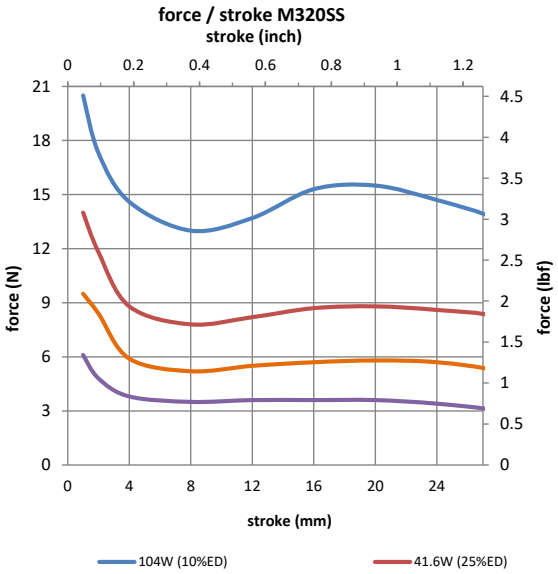
Insulation Resistance >100MΩ, 500VDC Megger

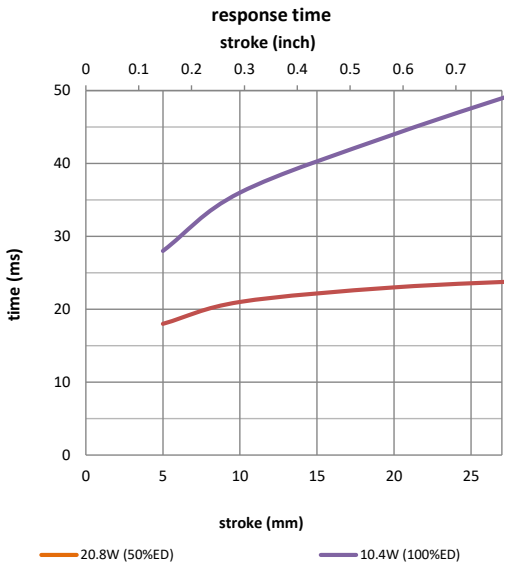
Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

Device drawn in energised condition
Life Expectancy >2M cycles
Leadwires UL1430, 22AWG
Plunger Mass 69 grammes
Mass 355 grammes







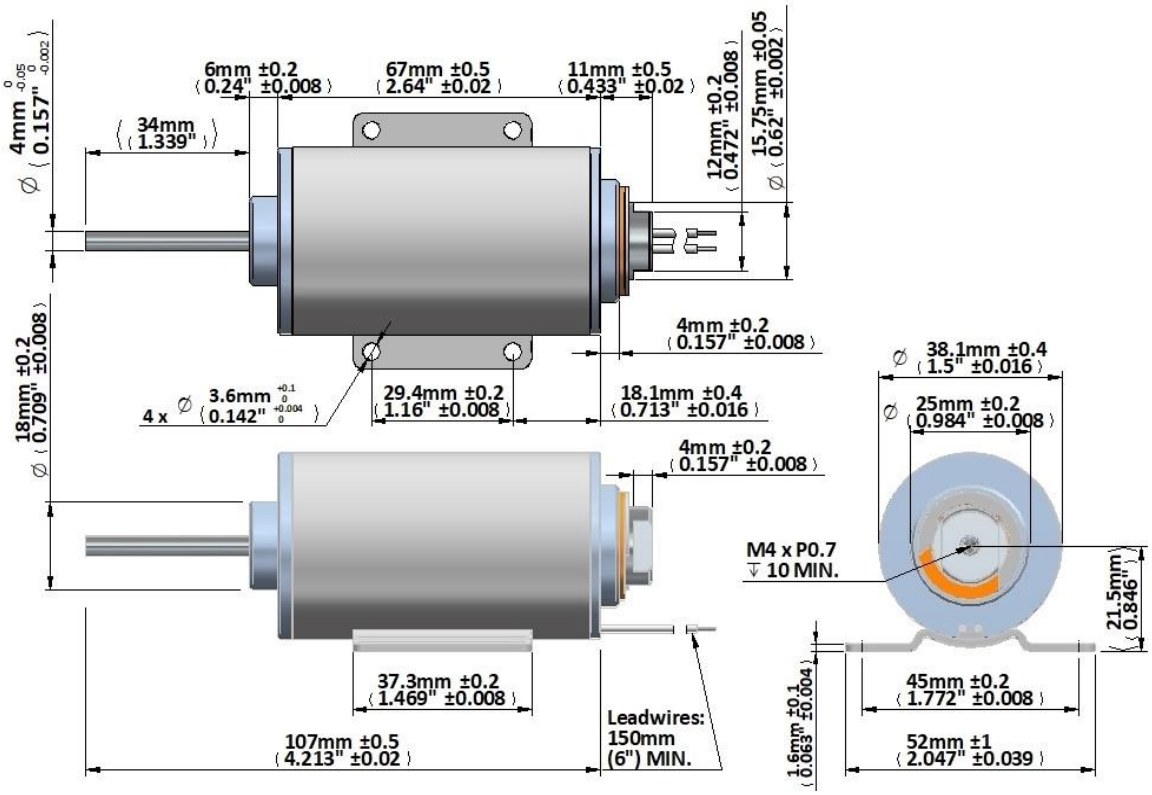
Data at 20°C , device performance measured without heat sink

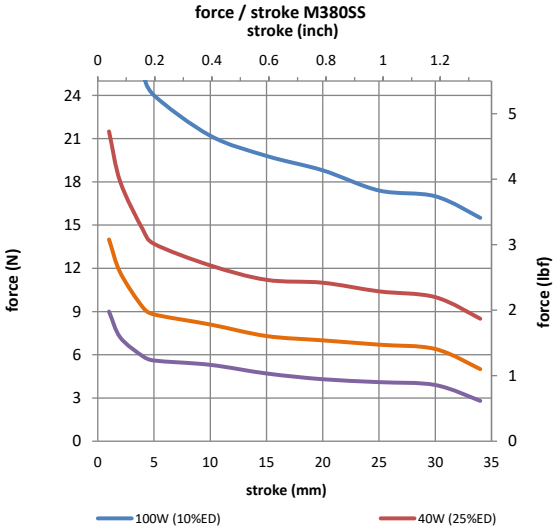
duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	310	48	14
watts at 20°C	10.4	20.8	41.6	104
ampere-turns at 20°	1335	1888	2670	4222

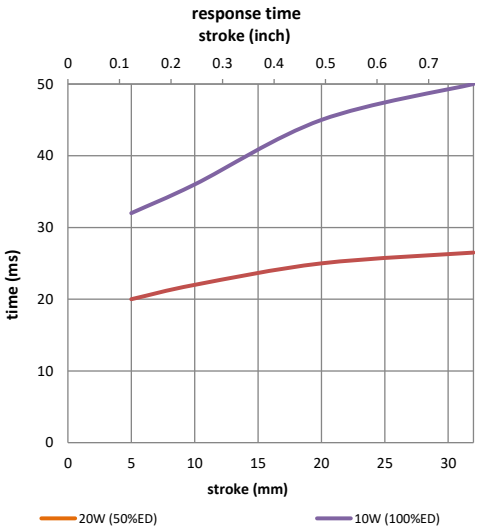
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M320SS-12v	14	1541	12.0	17.0	24.0	38.0
M320SS-24v	55	3060	24.0	34.0	48.0	76.0
M320SS-48v	214	5992	48.0	68.0	96.0	152.0
M320SS-96v	900	12200	96.0	136.0	192	304

Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

Device drawn in energised condition
Life Expectancy >2M cycles
Leadwires UL1430, 22AWG
Plunger Mass 91 grammes
Mass 535 grammes







Data at 20°C , device performance measured without heat sink

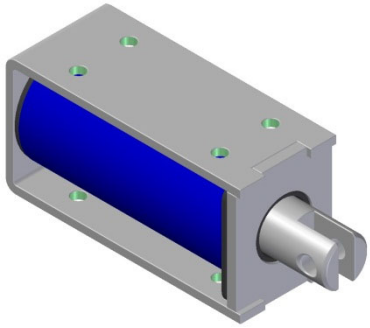
duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	330	80	20
watts at 20°C	10	20	40	100
ampere-turns at 20°	1360	1923	2720	4300

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
M380SS-12v	15	1712	12.0	17.0	24.0	38.0
M380SS-24v	58	3322	24.0	34.0	48.0	76.0
M380SS-48v	224	6360	48.0	68.0	96.0	152.0
M380SS-96v	871	12400	96.0	136.0	192	304

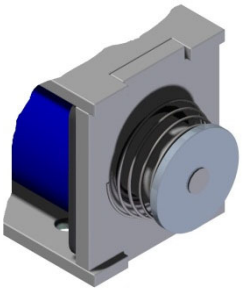
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 1000VAC, 50/60Hz, 1 minute
Class E (120°C) insulation class

OPEN FRAME SOLENOIDS

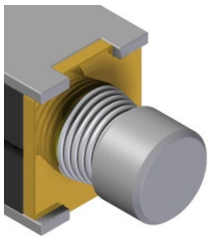
Open Frame Solenoid Modification

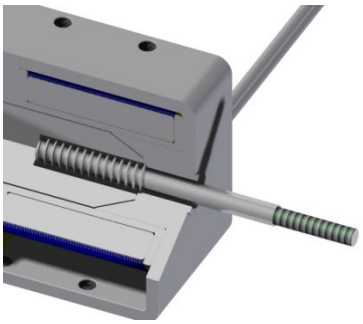


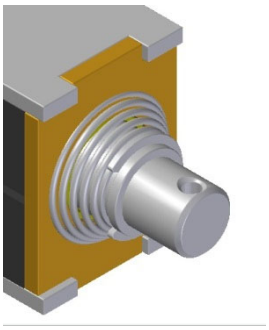
The standard configuration for most open-frame solenoids is pull configuration with a clevis connection to plunger (a slot with cross-hole running through this at 90 deg). Smaller solenoids may have just a cross-hole in the plunger. The solenoid is mounted with threaded holes in one or more of the flat sides. The plunger of the open frame solenoid is normally allowed to close fully against the pole piece, so some degree of residual magnetism is commonly seen. Solenoids are normally drawn & dimensioned in the energised position (with plunger fully retracted into the body). It should be noted that the construction of open-frame solenoids is suited to high-volume production, and modification may add substantially to pricing in small (typically <5k for these parts) volume.



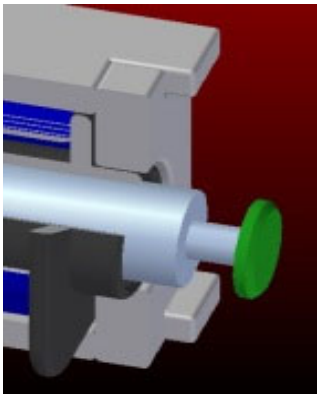
Spring - Addition of a return spring is a common modification, these can be fitted in many different ways either externally or internally. External springs can be secured with a staked disc, springs can also be secured with an e-ring, shoulder machined on plunger, or fitted in a groove machined in plunger. Conical springs can have shorter compressed length, and help prevent end of the spring getting trapped between plunger and sleeve, straight springs may require a stepped washer to control end position. Springs fitted internally will reduce the cross-section of the plunger and force developed by the solenoid. Where springs are required the spring force should be specified at the 0mm (energised), and at a specified extension position.



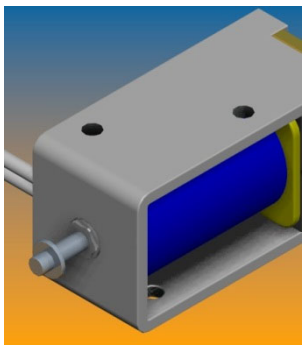


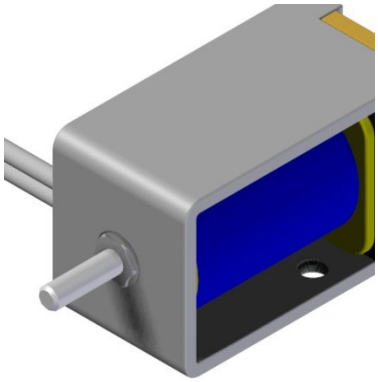


Plunger Modification - Modification of the plunger attachment is also common. This may be to incorporate threaded hole, e-ring groove, stop washer to avoid residual magnetism. The simplest and cheapest termination in high volume is probably a simple turned groove.



Pushrod – A pushrod may be added to the solenoid either as an interface to the load, or to provide a means of limiting displacement. It should be noted that fitting a pushrod requires removal of material from the plunger and endstop, and will generally lead to a reduction in the achievable force when energised. When used as a stop, the stroke may be limited by fitting an E-ring, nuts, or by other means.





Coil Modification – The coil winding of a solenoid may be modified to optimise for available supply voltage and required duty cycle (ED). It should be noted that coils wound for lower voltage operation use thicker wire and less turns, these are faster to wind and more robust, and in higher volumes may be significantly cheaper. Less common winding modifications involve addition of a diode to clamp 'back-emf' spikes, or use of different leadwires to suit a particular connector style.

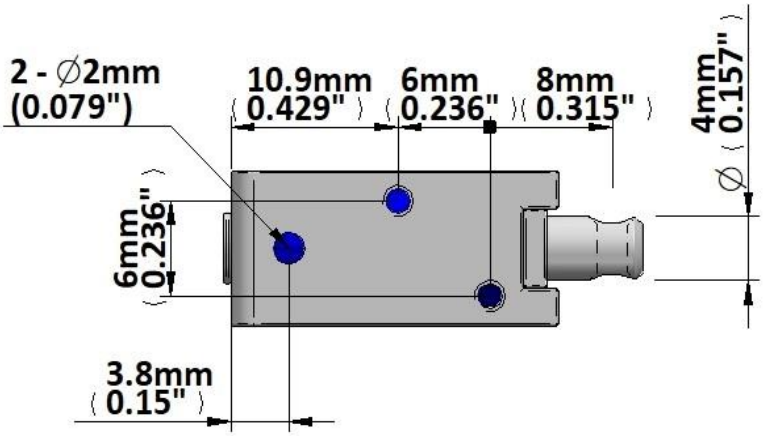
Connectors – In the manufacture of coils for open-frame solenoids, the flexible leadwires are usually terminated manually to the coil wire after winding. Where connectors are required, it may be more cost-effective to terminate the connector to leadwire automatically before this is terminated to the coil, than to fit the connector to the completed solenoid.

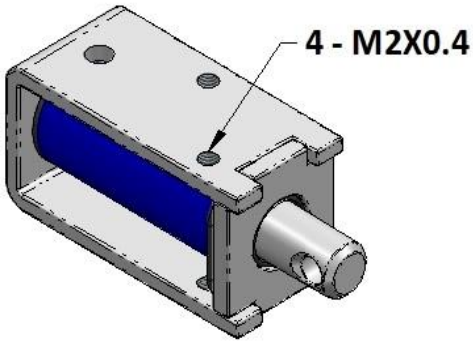
Frame / Mounting Holes – Changes to the frame / mounting hole size and position usually requires tooling. For samples / small volume it may be possible to produce by laser cutting / machining but this is a fairly expensive process. We would generally advise that quantity >10k per annum is required to consider modifications to the solenoid frame.

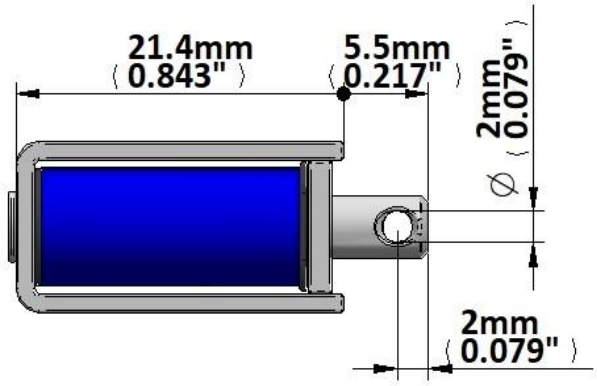
Open Frame Solenoid RD-A420

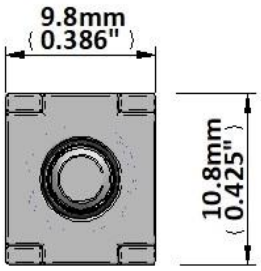
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1571, 26AWG, 310mm±10

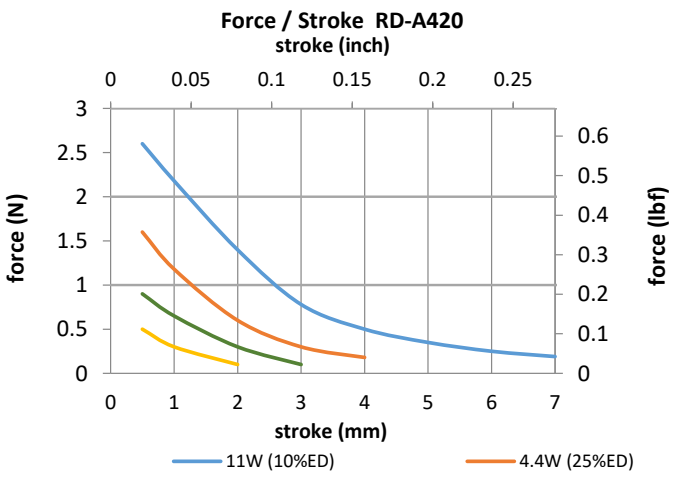
Plunger Mass 2 grammes
Total Mass 12 grammes

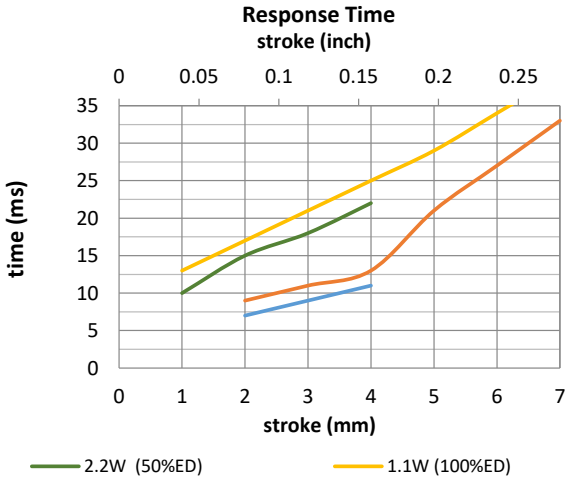












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	155	38	14
watts at 20°C			1.1	2.2	4.4	11
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A420-6v	32.7		6.0	8.5	12.0	19.0
RD-A420-12v	131		12.0	17.0	24.0	38.0
RD-A420-24v	524		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

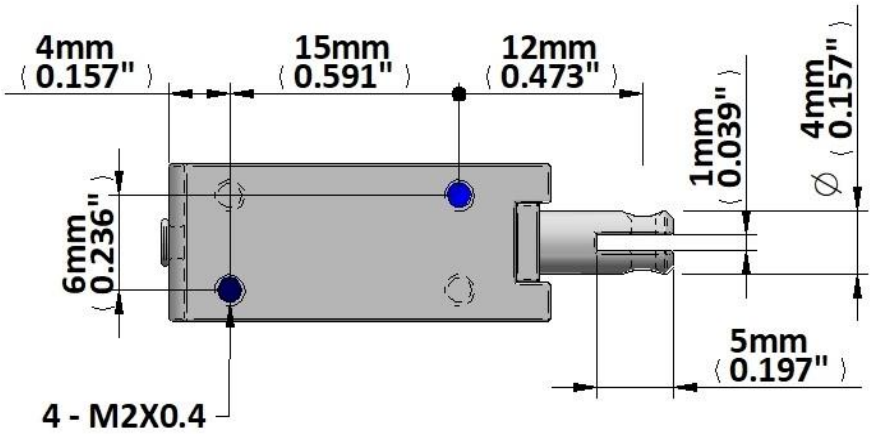
Dielectric Strength 500VAC, 50/60Hz, 1 minute

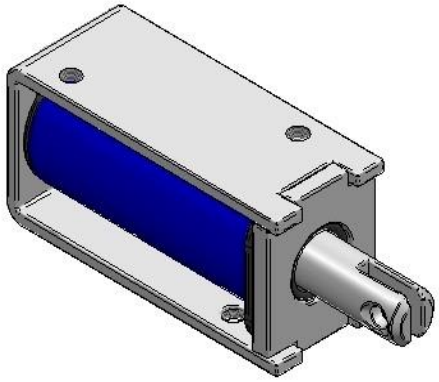
Class A (105°C) insulation class

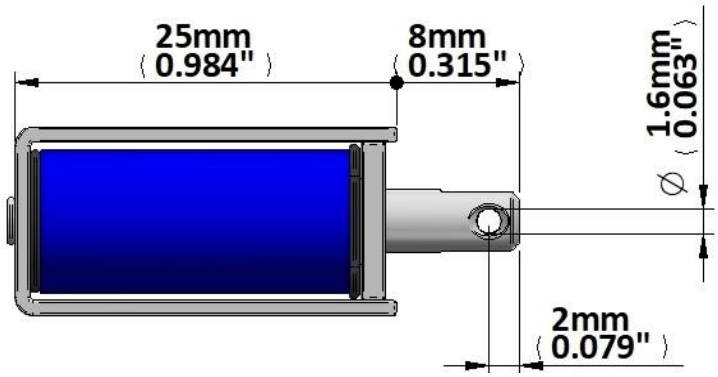
Open Frame Solenoid RD-B425

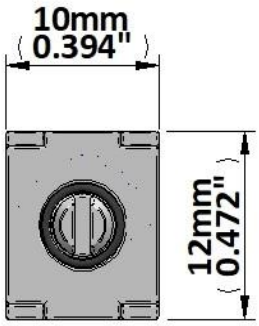
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1571, 26AWG, 300mm

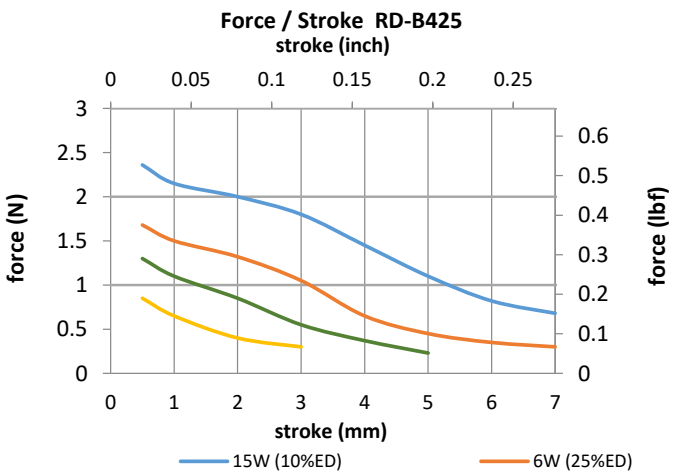
Plunger Mass 3 grammes
Total Mass 16 grammes

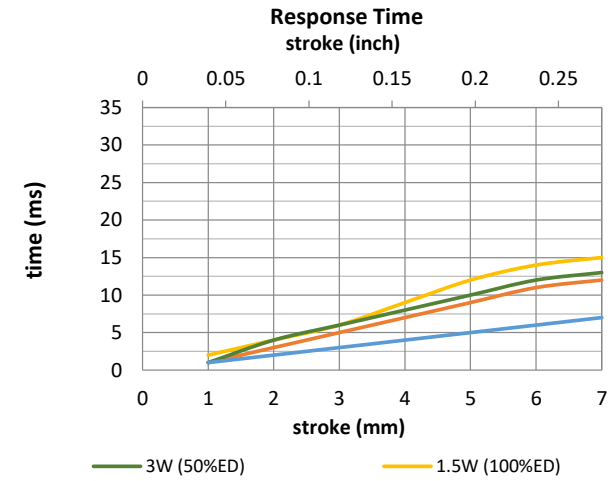












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	185	65	18
watts at 20°C			1.5	3.0	6.0	15.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-B425-6v	24		6.0	8.5	12.0	19.0
RD-B425-12v	96		12.0	17.0	24.0	38.0
RD-B425-24v	384		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

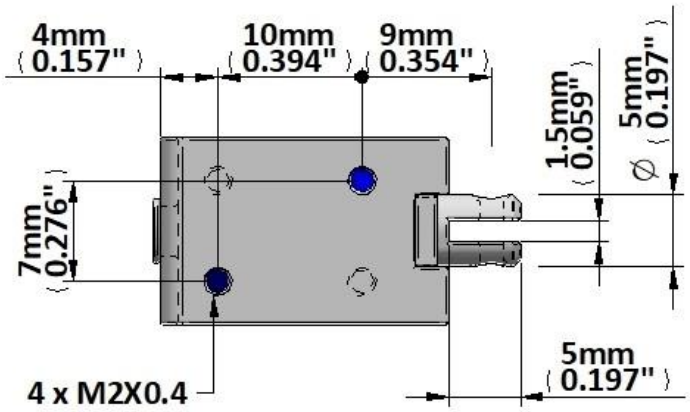
Dielectric Strength 500VAC, 50/60Hz, 1 minute

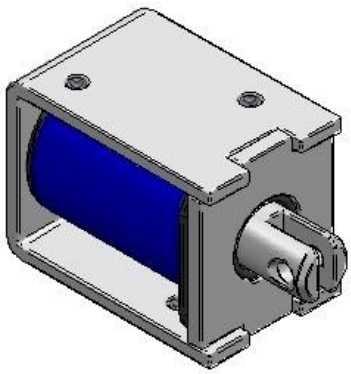
Class A (105°C) insulation class

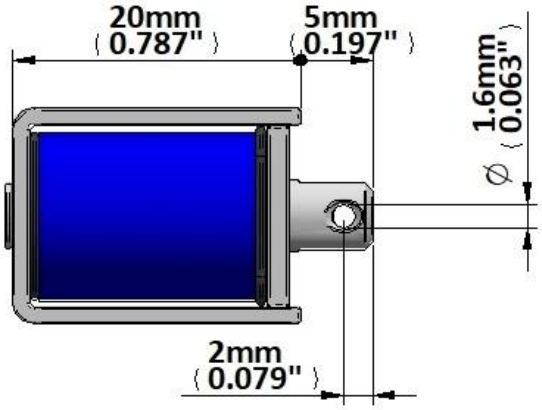
Open Frame Solenoid RD-A520

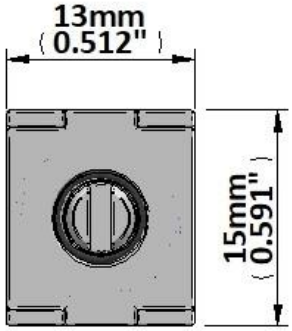
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 310mm

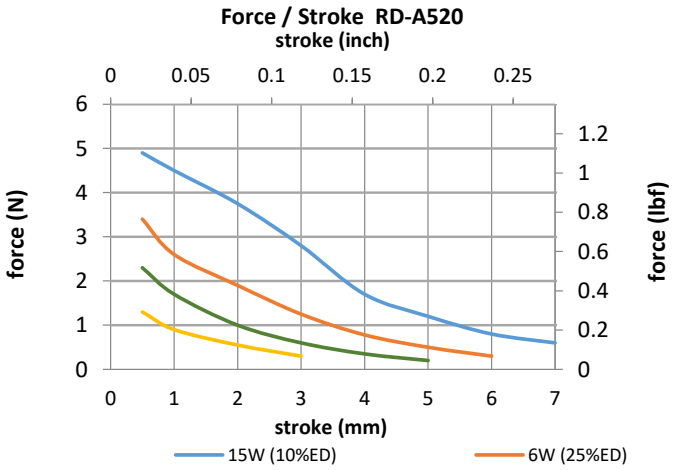
Plunger Mass 3 grammes
Total Mass 20 grammes

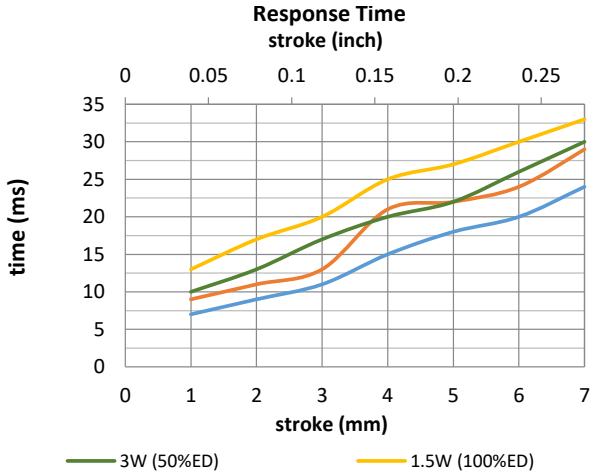












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	239	83	21
watts at 20°C			1.5	3.0	6.0	15.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A520-6v	24		6.0	8.5	12.0	19.0
RD-A620-12v	96		12.0	17.0	24.0	38.0
RD-A520-24v	384		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

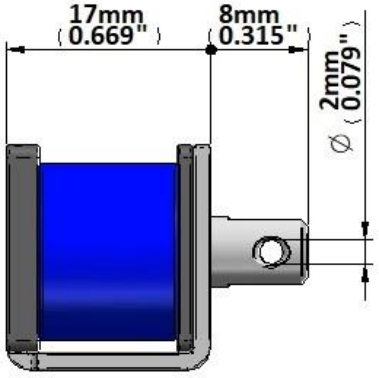
Dielectric Strength 500VAC, 50/60Hz, 1 minute

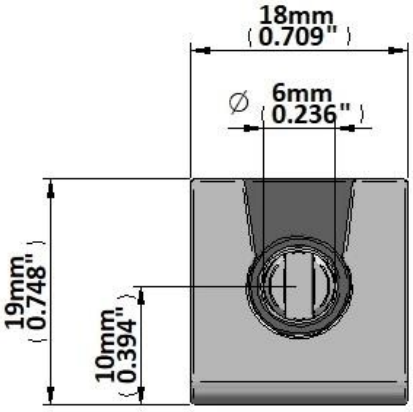
Class A (105°C) insulation class

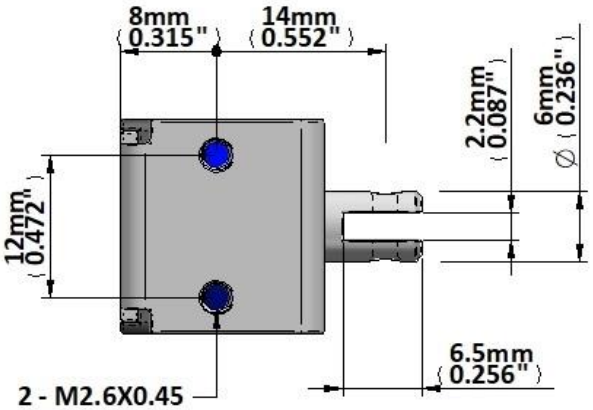
Open Frame Solenoid RD-U617

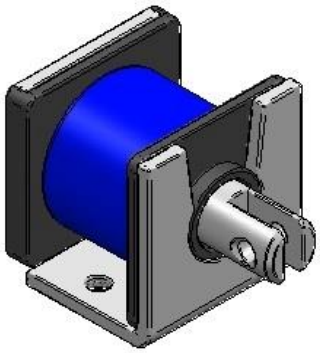
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 310mm

Plunger Mass 4 grammes
Total Mass 25 grammes

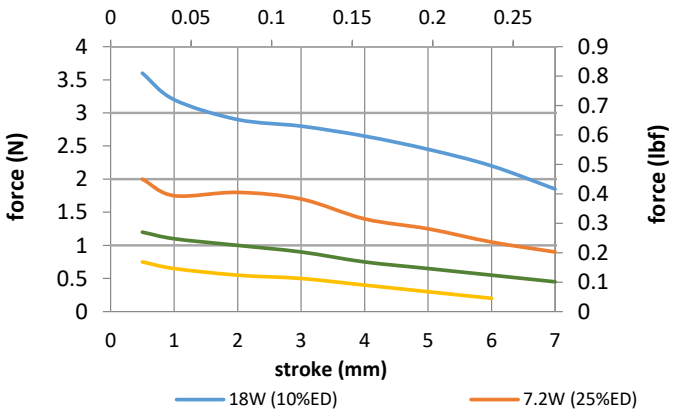




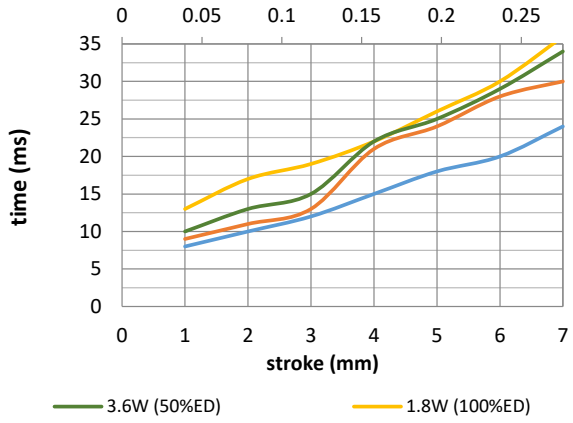




Force / Stroke RD-U617



Response Time



18W (10%ED) 7.2W (25%ED) 3.6W (50%ED) 1.8W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	256	85	24
watts at 20°C			1.8	3.6	7.2	18.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-U617-6v	20		6.0	8.5	12.0	19.0
RD-U617-12v	80		12.0	17.0	24.0	38.0
RD-U617-24v	320		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

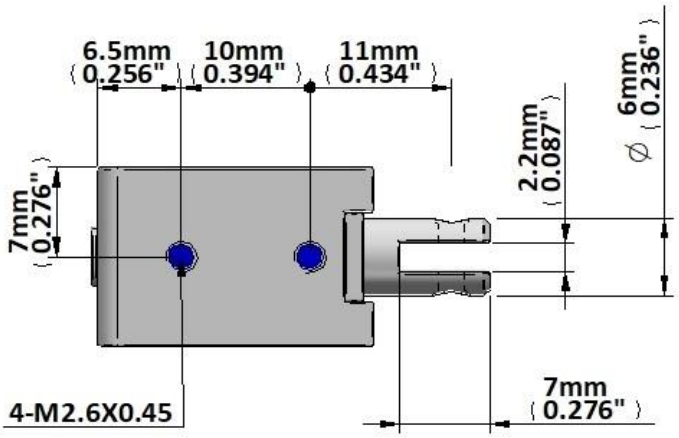
Dielectric Strength 500VAC, 50/60Hz, 1 minute

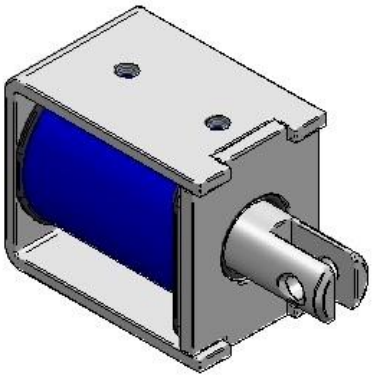
Class A (105°C) insulation class

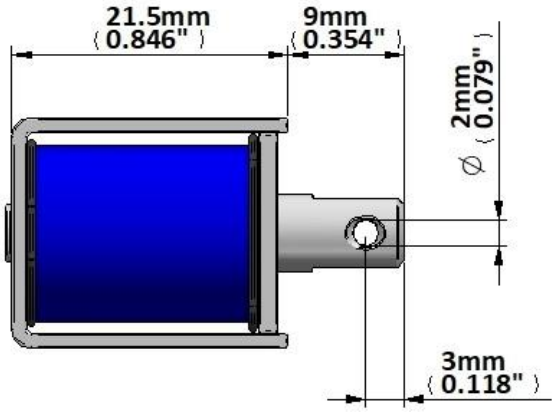
Open Frame Solenoid RD-S622

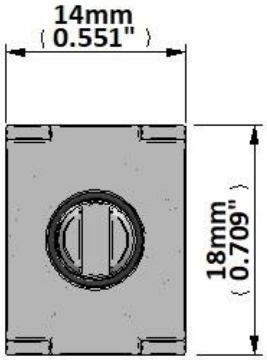
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

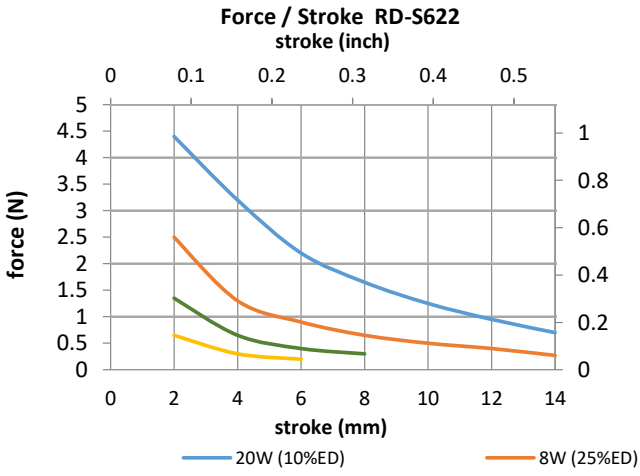
Plunger Mass 6 grammes
Total Mass 26 grammes

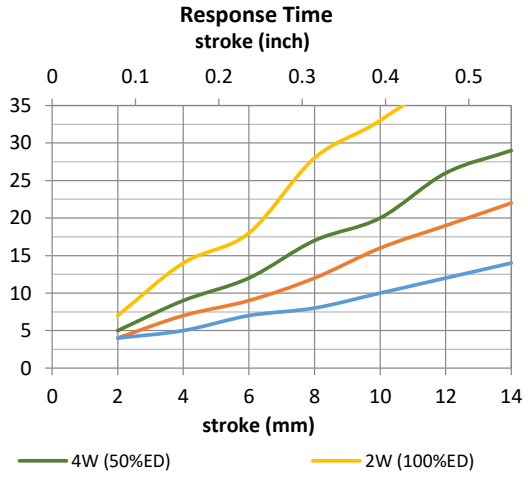












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	168	59	16
watts at 20°C			2.0	4.0	8.0	20.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-S622-6v	18		6.0	8.5	12.0	19.0
RD-S622-12v	72		12.0	17.0	24.0	38.0
RD-S622-24v	288		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

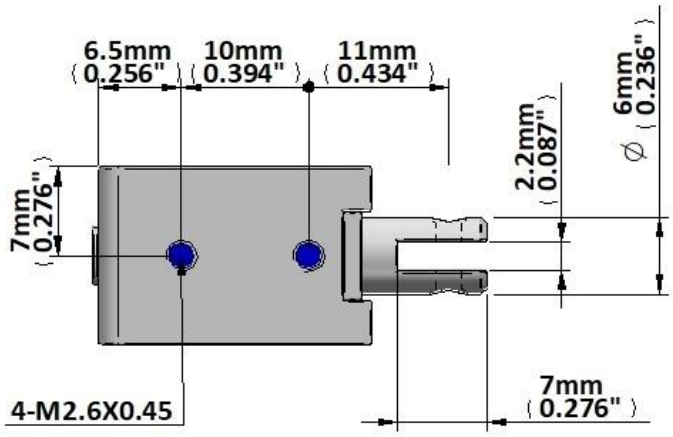
Dielectric Strength 500VAC, 50/60Hz, 1 minute

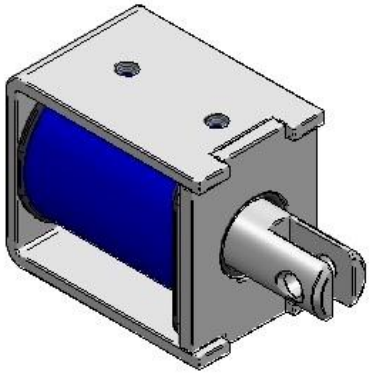
Class A (105°C) insulation class

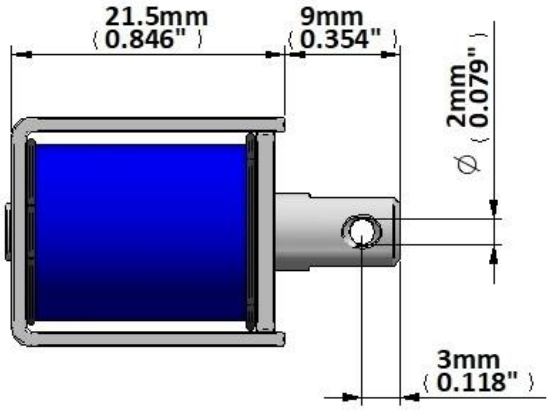
Open Frame Solenoid RD-A622

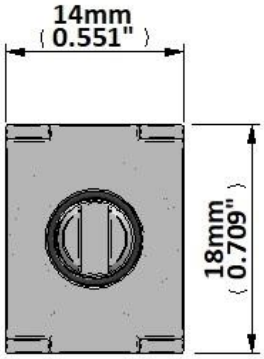
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

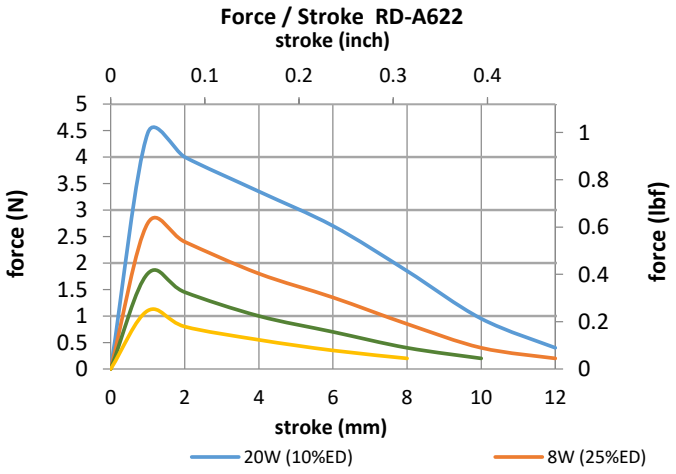
Plunger Mass 5 grammes
Total Mass 26 grammes

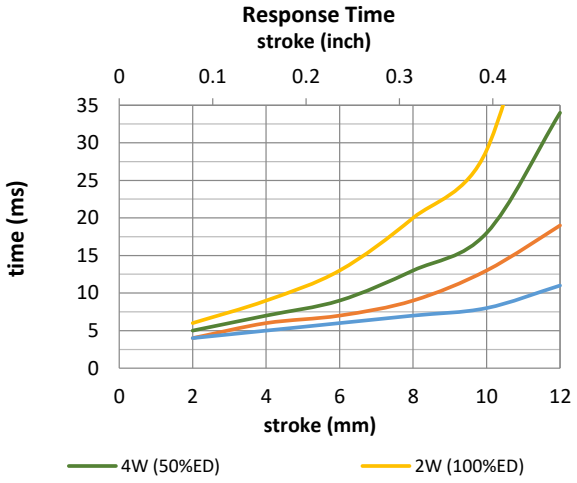












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	168	59	16
watts at 20°C			2.0	4.0	8.0	20.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A622-6v	18		6.0	8.5	12.0	19.0
RD-A622-12v	72		12.0	17.0	24.0	38.0
RD-A622-24v	288		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

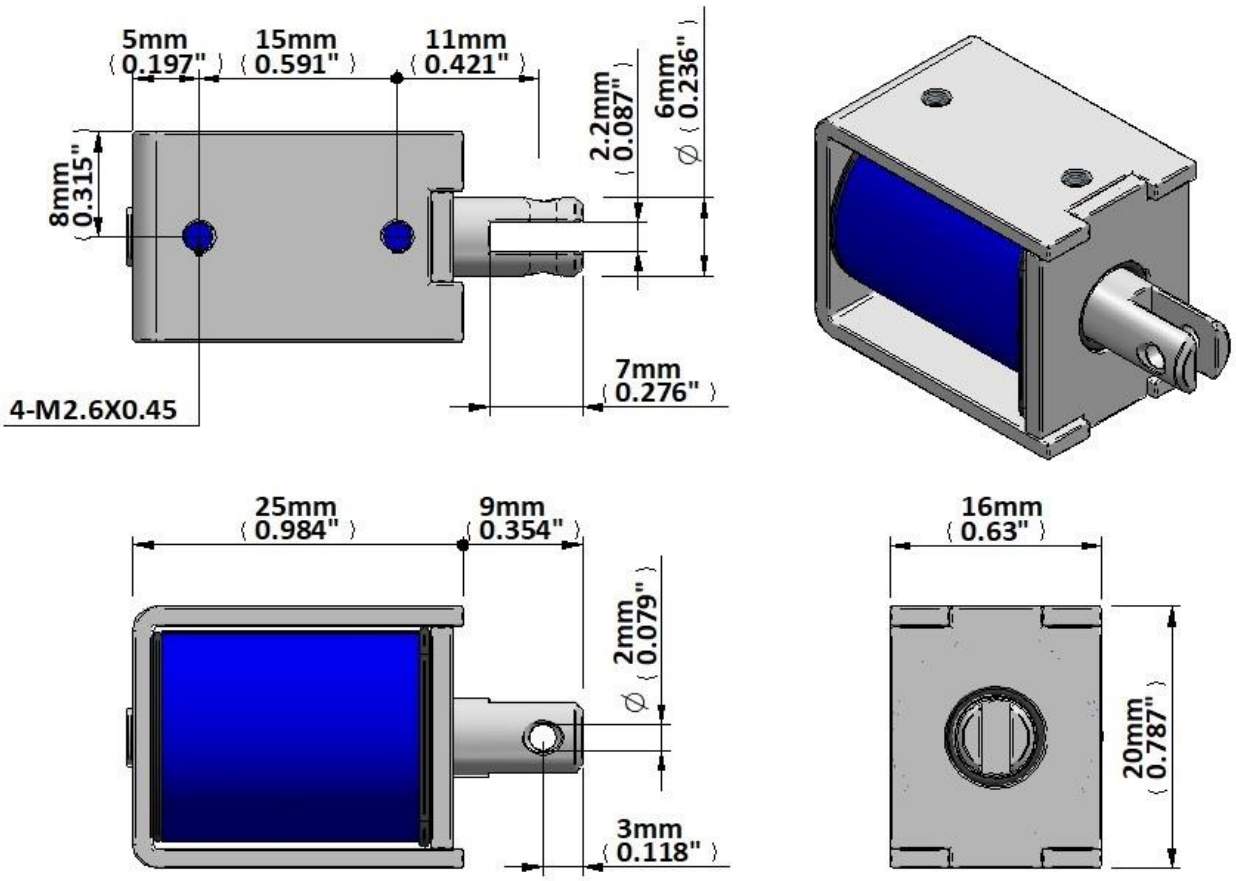
Dielectric Strength 500VAC, 50/60Hz, 1 minute

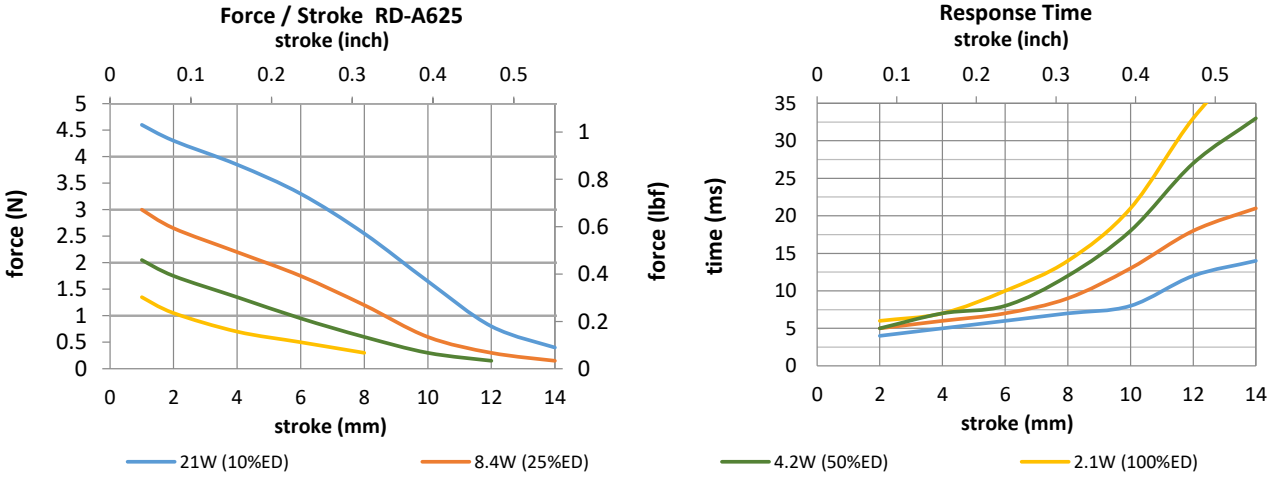
Class A (105°C) insulation class

Open Frame Solenoid RD-A625

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

Plunger Mass 5 grammes
Total Mass 39 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	310	100	27
watts at 20°C			2.1	4.2	8.4	21.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A625-6v	17.1		6.0	8.5	12.0	19.0
RD-A625-12v	68.6		12.0	17.0	24.0	38.0
RD-A625-24v	274		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

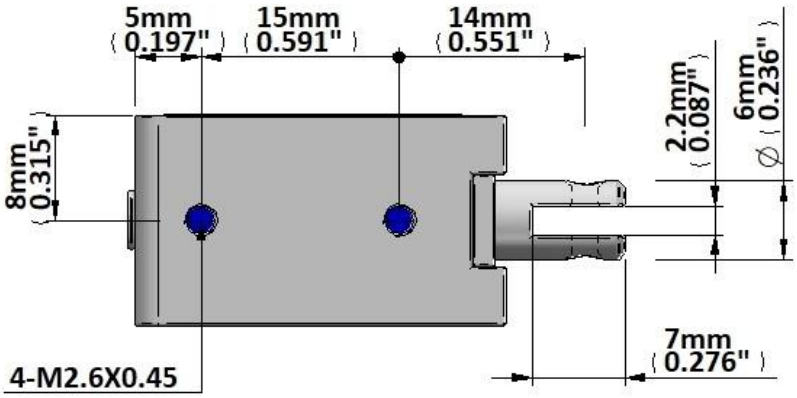
Dielectric Strength 500VAC, 50/60Hz, 1 minute

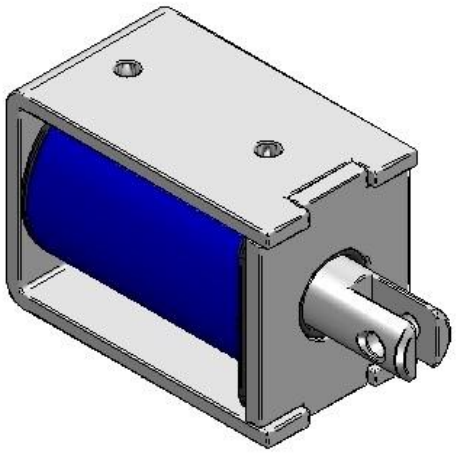
Class A (105°C) insulation class

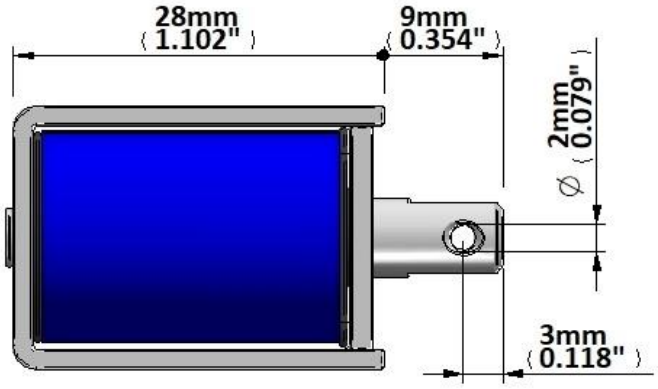
Open Frame Solenoid RD-A628

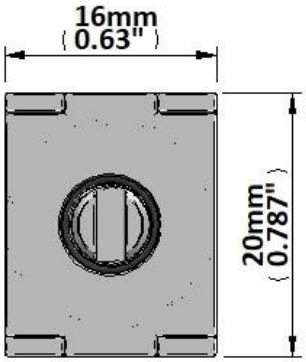
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

Plunger Mass 6 grammes
Total Mass 43 grammes

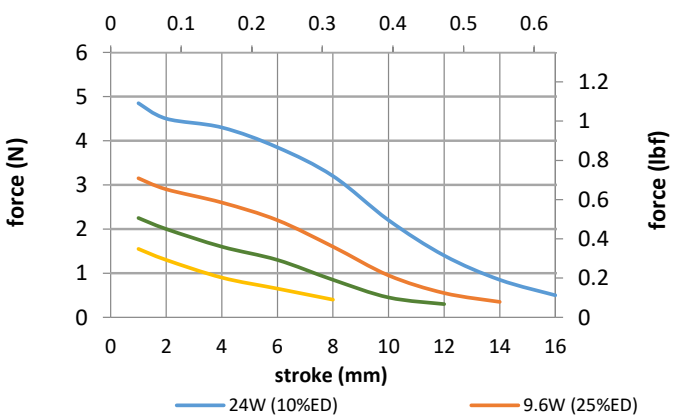




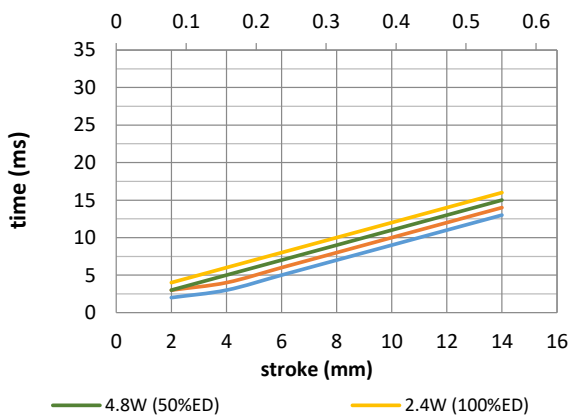




Force / Stroke RD-A628



Response Time



24W (10%ED) 9.6W (25%ED) 4.8W (50%ED) 2.4W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	319	109	23
watts at 20°C			2.4	4.8	9.6	24.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A628-6v	15		6.0	8.5	12.0	19.0
RD-A628-12v	60		12.0	17.0	24.0	38.0
RD-A628-24v	240		24.0	34.0	48.0	76.0

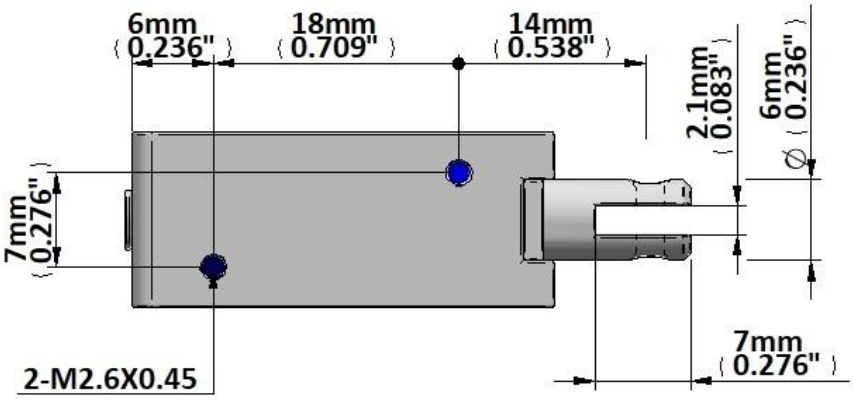
Insulation Resistance >100MΩ, 500VDC Megger

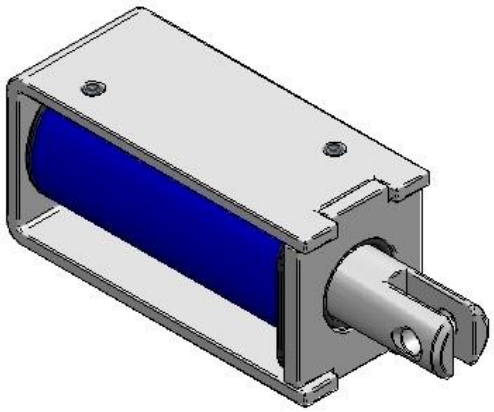
Dielectric Strength 500VAC, 50/60Hz, 1 minute

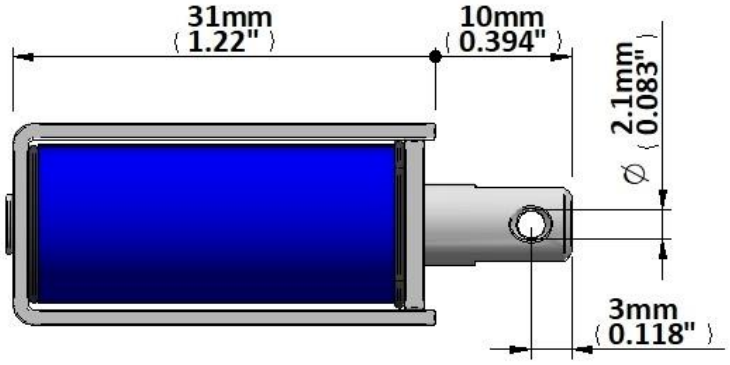
Class A (105°C) insulation class

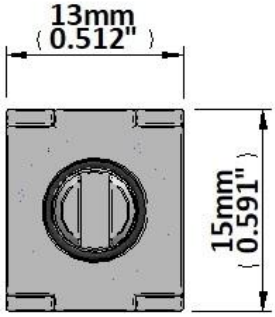
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

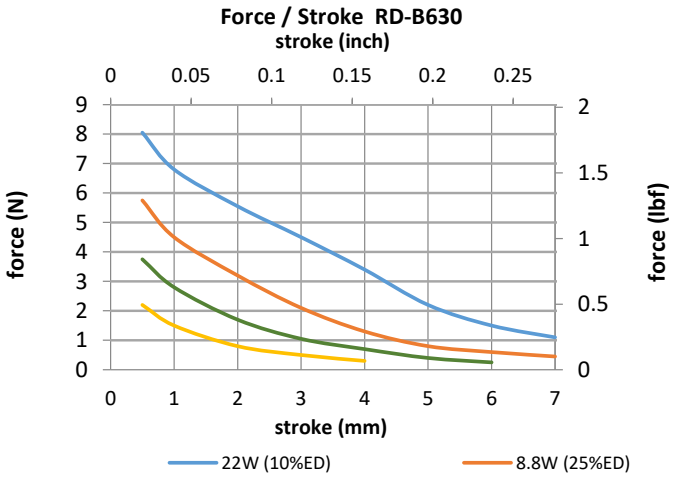
Plunger Mass 6 grammes
Total Mass 29 grammes

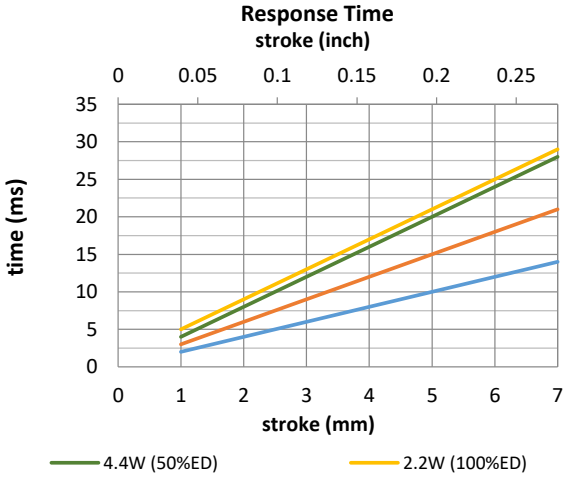












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	233	82	20
watts at 20°C			2.2	4.4	8.8	22.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-B630-6v	15		6.0	8.5	12.0	19.0
RD-B630-12v	60		12.0	17.0	24.0	38.0
RD-B630-24v	240		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

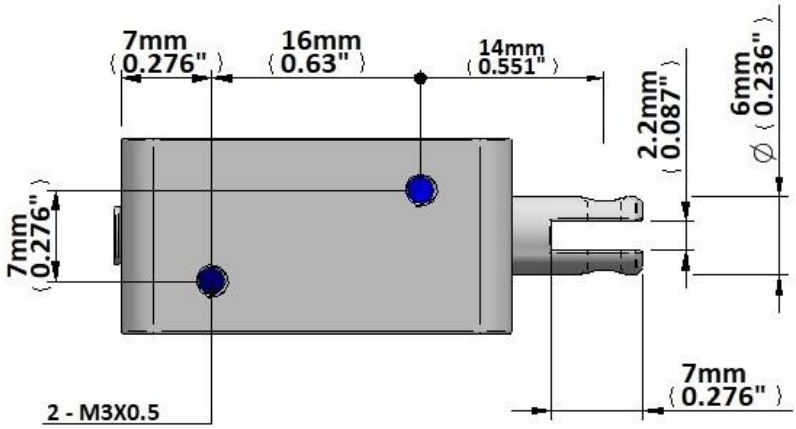
Dielectric Strength 500VAC, 50/60Hz, 1 minute

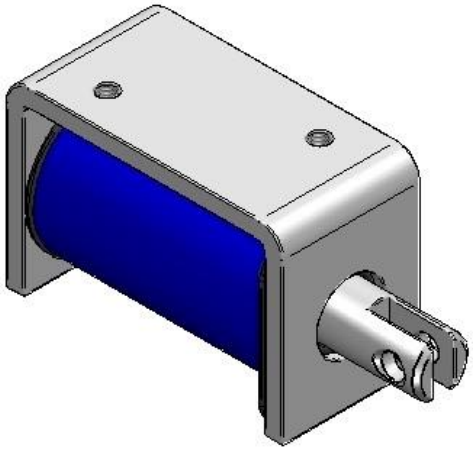
Class A (105°C) insulation class

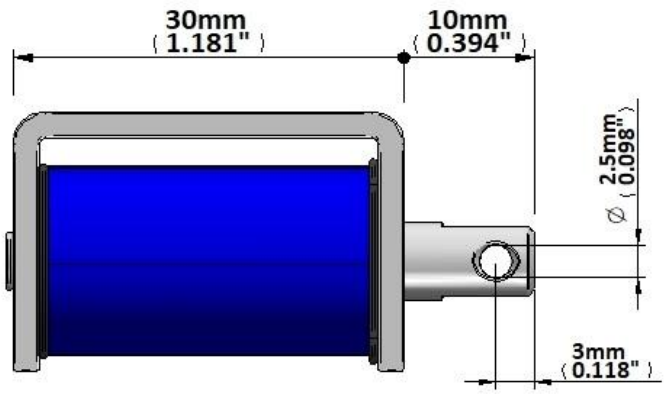
Open Frame Solenoid RD-U630

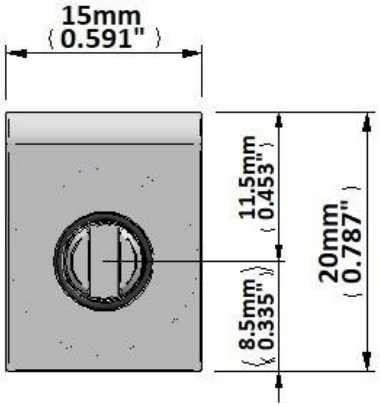
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

Plunger Mass 6 grammes
Total Mass 42 grammes

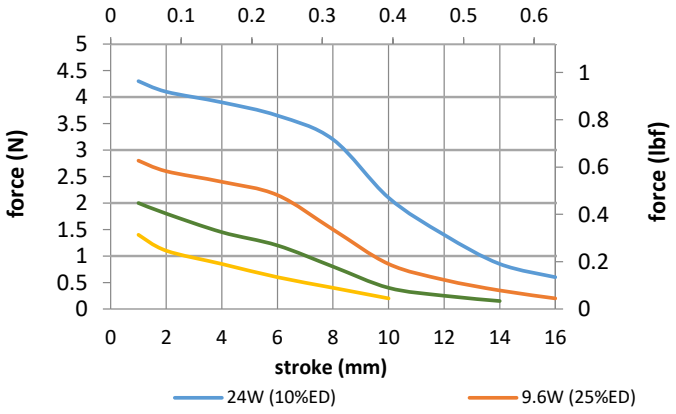




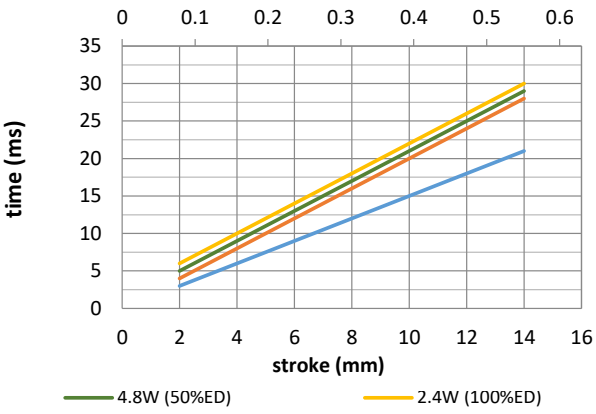




Force / Stroke RD-U630



Response Time



Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	322	103	30
watts at 20°C			2.4	4.8	9.6	24.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-U630-6v	15		6.0	8.5	12.0	19.0
RD-U630-12v	60		12.0	17.0	24.0	38.0
RD-U630-24v	240		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

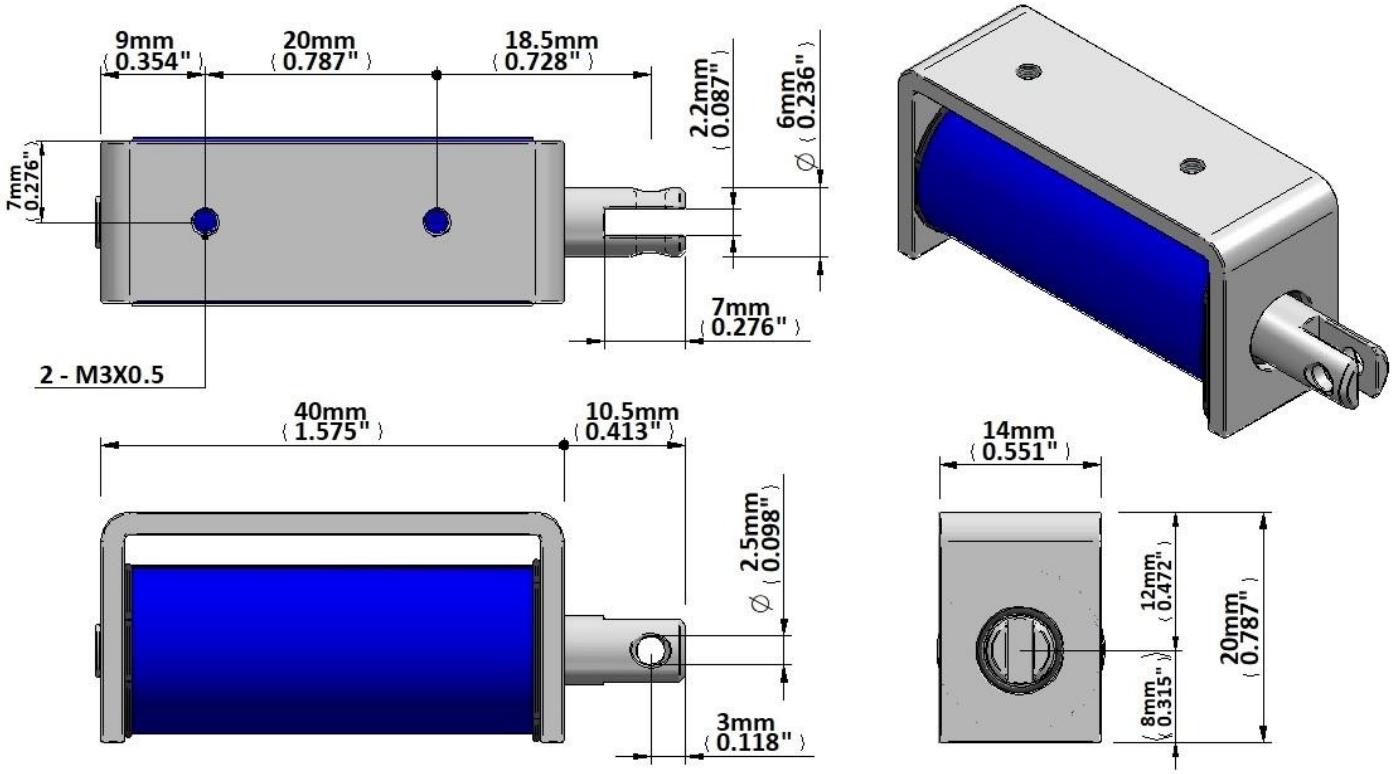
Dielectric Strength 500VAC, 50/60Hz, 1 minute

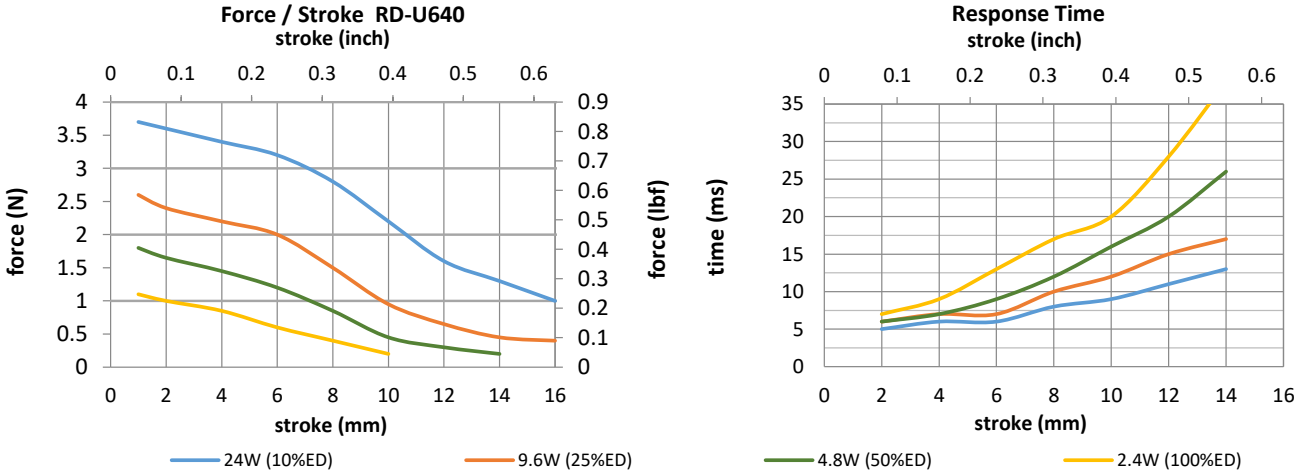
Class A (105°C) insulation class

GEEPLUS Open Frame Solenoid RD-U640

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

Plunger Mass 8 grammes
Total Mass 44 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	363	111	30
watts at 20°C			2.4	4.8	9.6	24.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-U640-6v	15		6.0	8.5	12.0	19.0
RD-U640-12v	60		12.0	17.0	24.0	38.0
RD-U640-24v	240		24.0	34.0	48.0	76.0

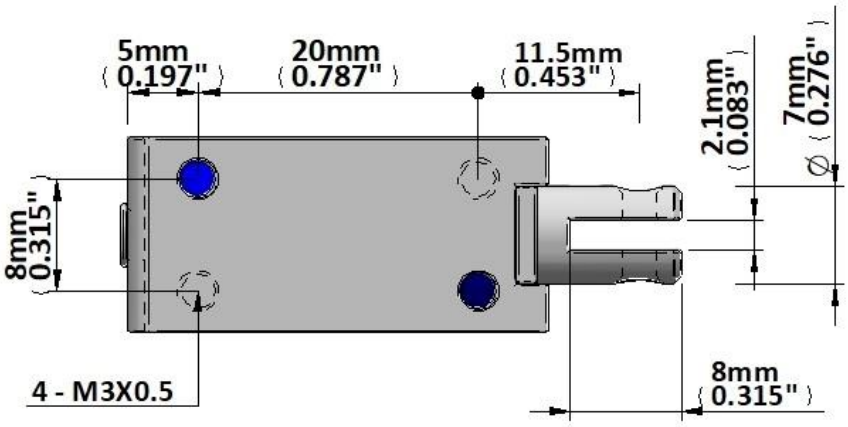
Insulation Resistance >100MΩ, 500VDC Megger **Dielectric Strength 500VAC, 50/60Hz, 1 minute**

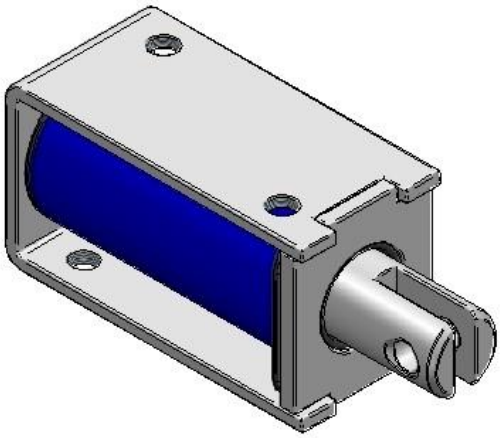
Class A (105°C) insulation class

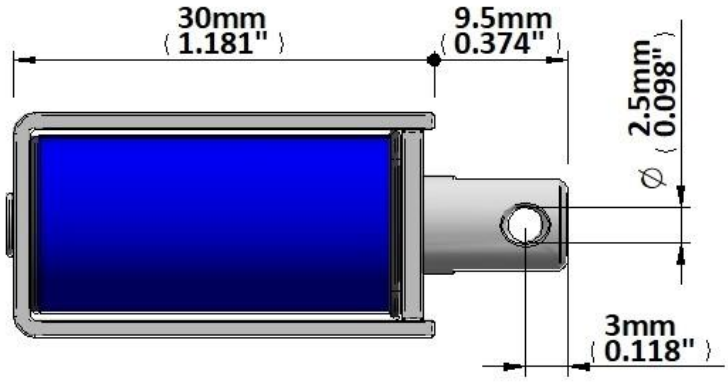
Open Frame Solenoid RD-A730

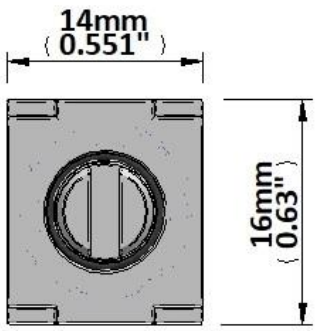
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

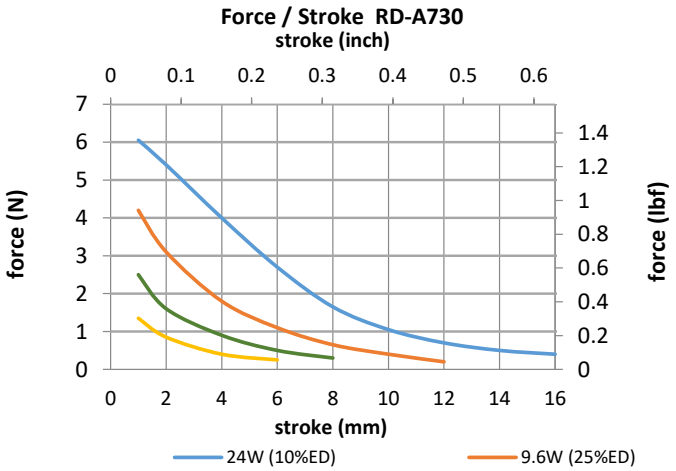
Plunger Mass 9 grammes
Total Mass 32 grammes

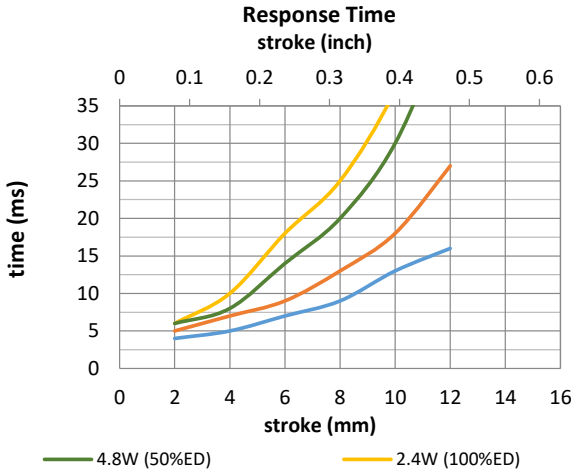












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	264	85	19
watts at 20°C			2.2	4.4	8.8	22.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A730-6v	16		6.0	8.5	12.0	19.0
RD-A730-12v	66		12.0	17.0	24.0	38.0
RD-A730-24v	262		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

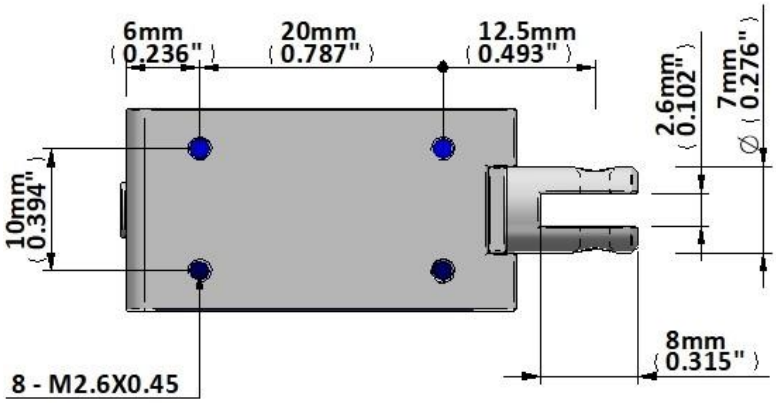
Dielectric Strength 500VAC, 50/60Hz, 1 minute

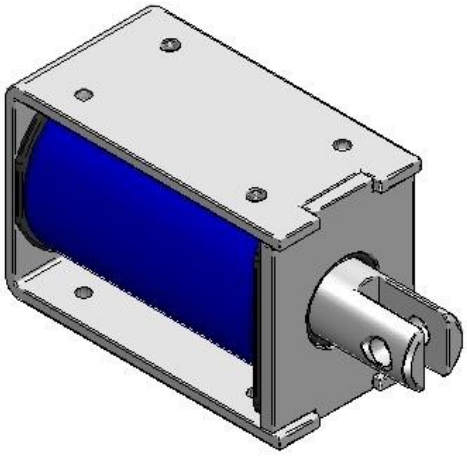
Class A (105°C) insulation class

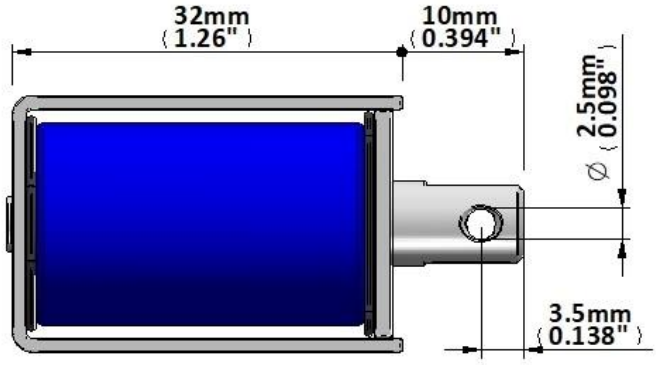
Open Frame Solenoid RD-A732

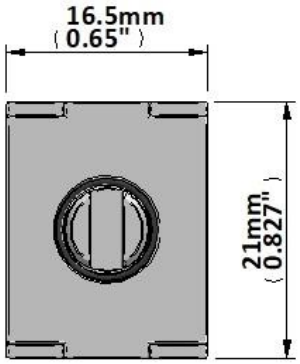
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

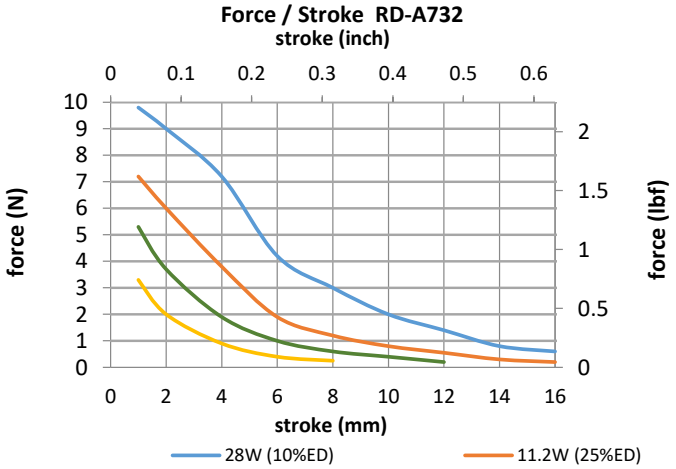
Plunger Mass 9 grammes
Total Mass 53 grammes

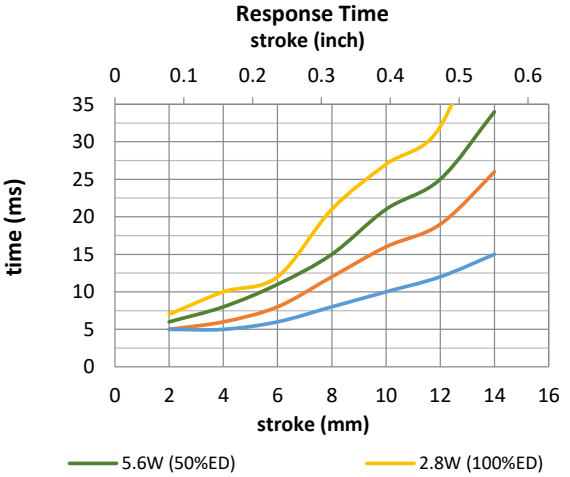












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	309	100	28
watts at 20°C			2.8	5.6	11.2	28.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A732-6v	12.9		6.0	8.5	12.0	19.0
RD-A732-12v	51.4		12.0	17.0	24.0	38.0
RD-A732-24v	206		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

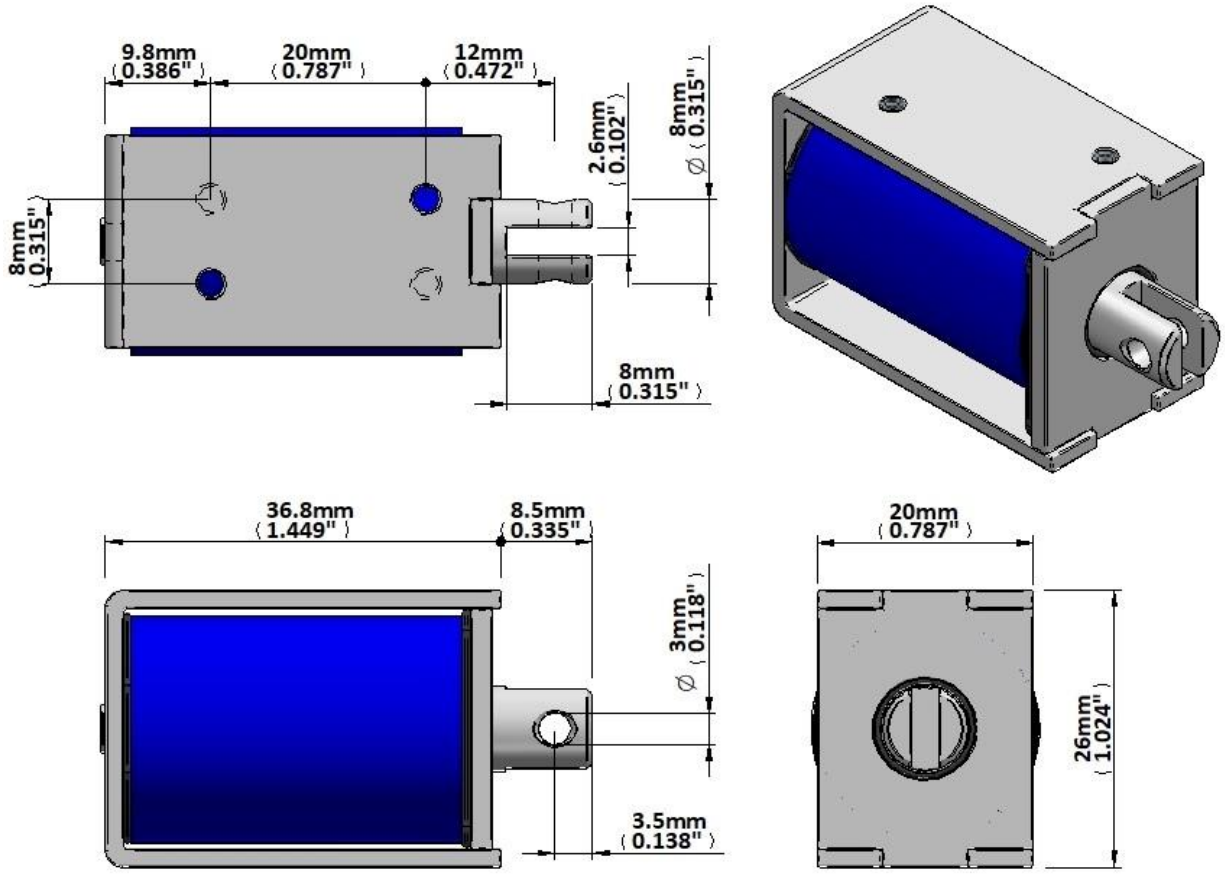
Dielectric Strength 500VAC, 50/60Hz, 1 minute

Class A (105°C) insulation class

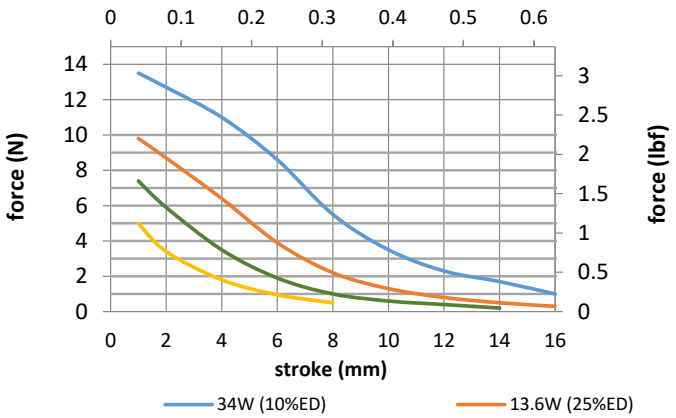
Open Frame Solenoid RD-A840

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

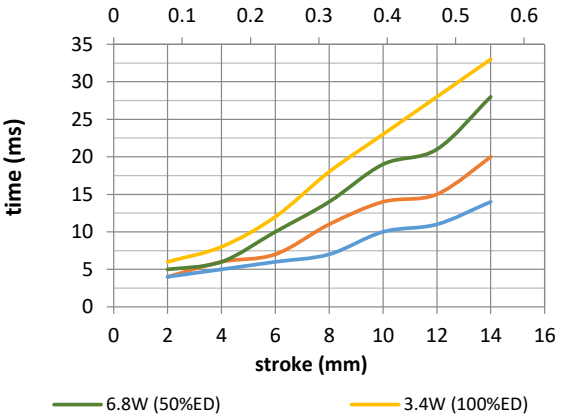
Plunger Mass 12 grammes
Total Mass 83 grammes



Force / Stroke RD-A840



Response Time



34W (10%ED) — 13.6W (25%ED) — 6.8W (50%ED) — 3.4W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	394	112	32
watts at 20°C			3.4	6.8	13.6	34.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A840-6v	10.6		6.0	8.5	12.0	19.0
RD-A840-12v	42.4		12.0	17.0	24.0	38.0
RD-A840-24v	169		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

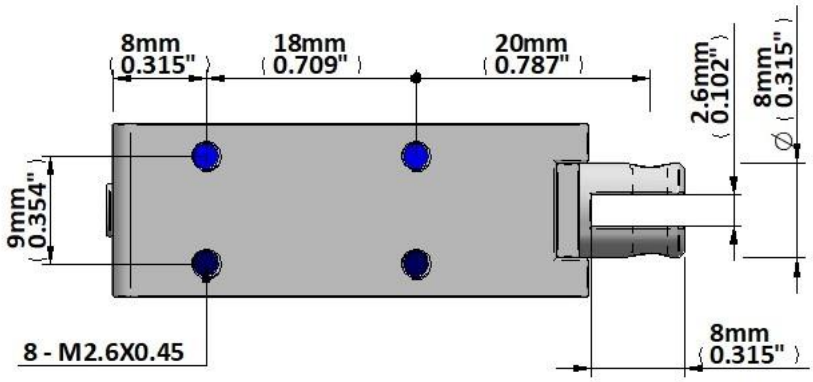
Dielectric Strength 500VAC, 50/60Hz, 1 minute

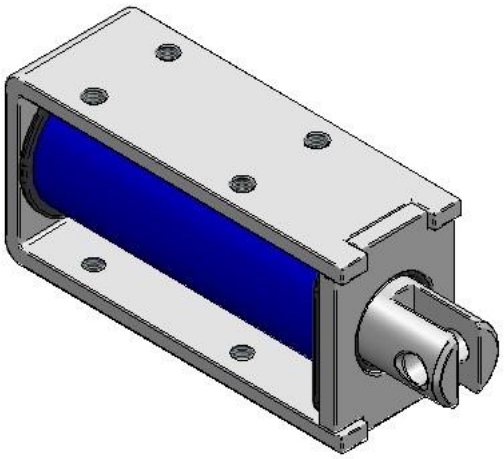
Class A (105°C) insulation class

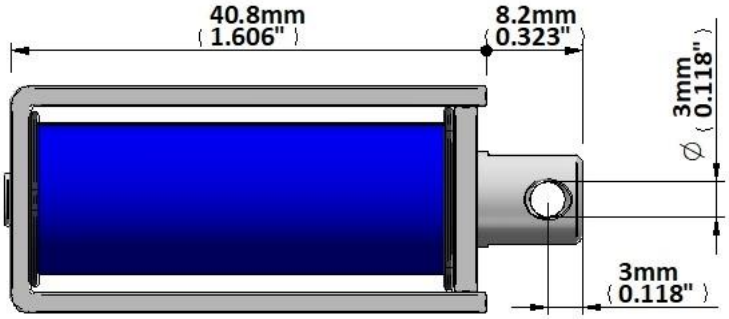
GEEPLUS Open Frame Solenoid RD-B840

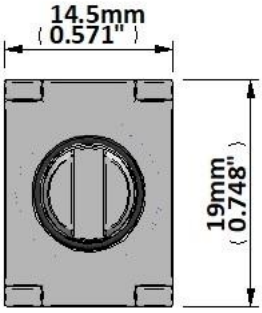
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 300mm

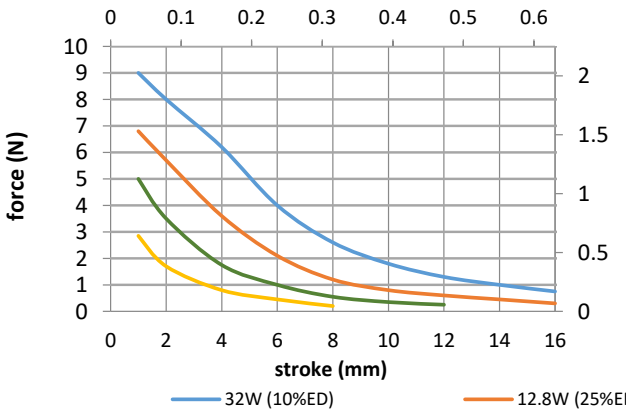
Plunger Mass 14 grammes
Total Mass 58 grammes

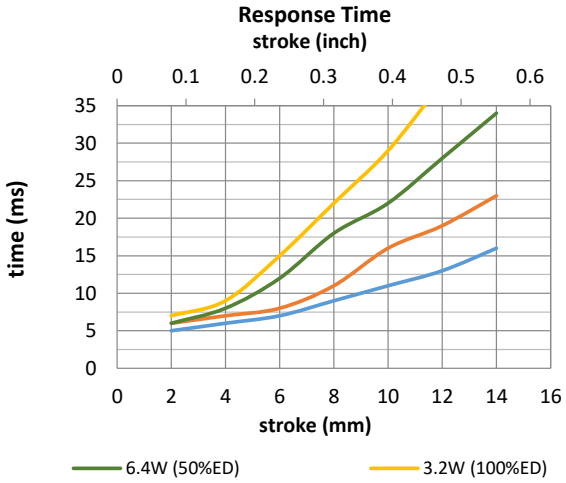












Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	277	87	18
watts at 20°C			3.2	6.4	12.8	32.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-B840-6v	11.3		6.0	8.5	12.0	19.0
RD-B840-12v	45		12.0	17.0	24.0	38.0
RD-B840-24v	180		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

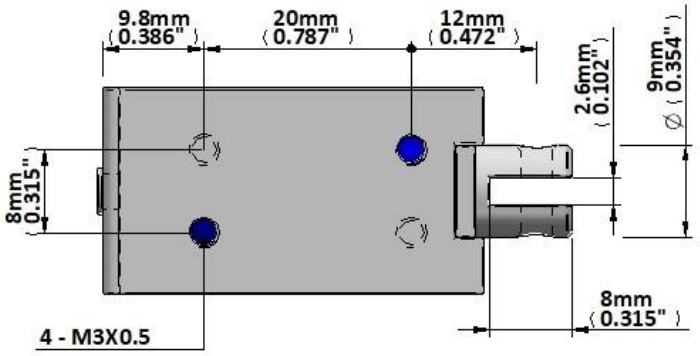
Dielectric Strength 500VAC, 50/60Hz, 1 minute

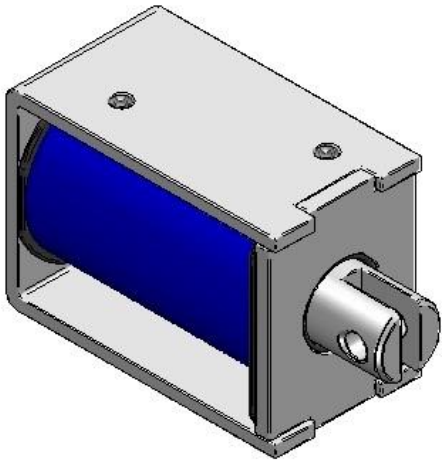
Class A (105°C) insulation class

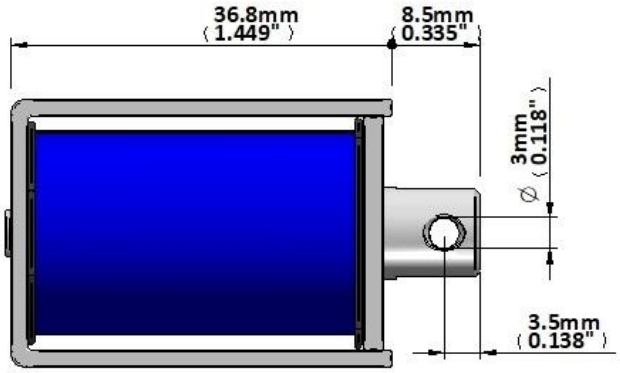
Open Frame Solenoid RD-A940

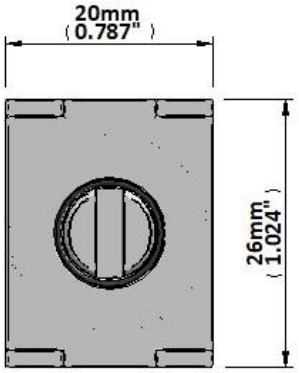
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

Plunger Mass 16 grammes
Total Mass 85 grammes

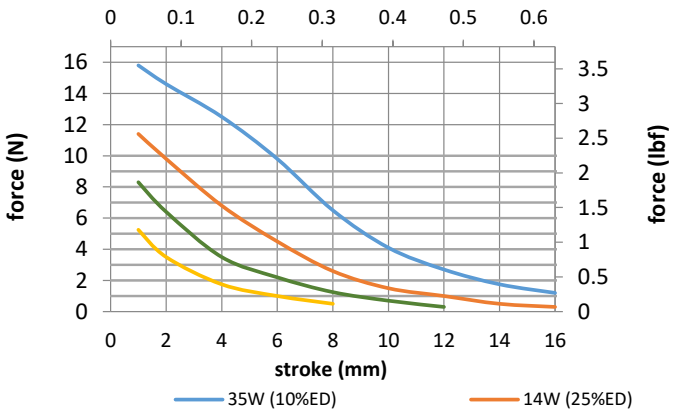




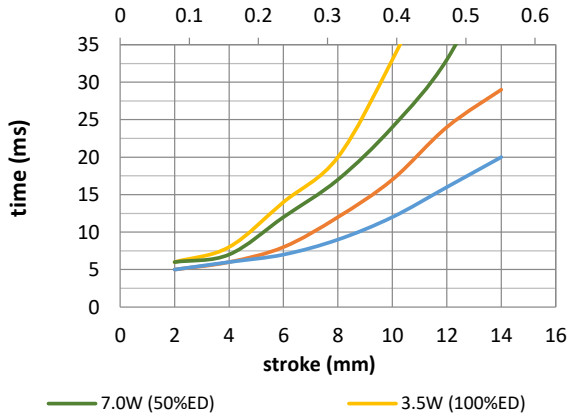




Force / Stroke RD-A940



Response Time



Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	437	134	35
watts at 20°C			3.5	7.0	14.0	35.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A940-6v	10.3		6.0	8.5	12.0	19.0
RD-A940-12v	41.1		12.0	17.0	24.0	38.0
RD-A940-24v	165		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

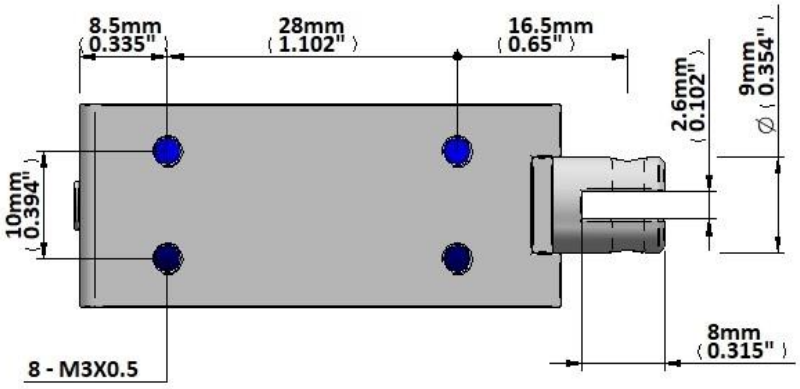
Dielectric Strength 500VAC, 50/60Hz, 1 minute

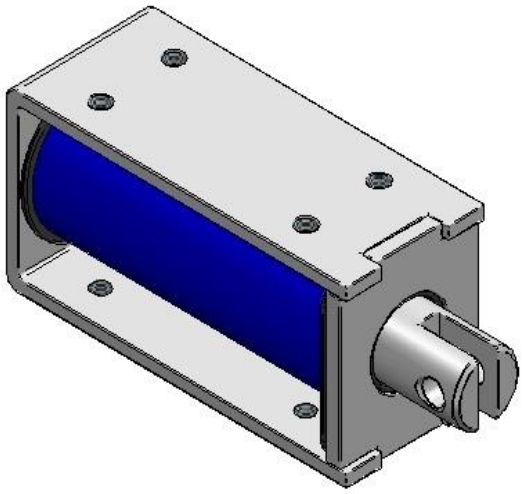
Class A (105°C) insulation class

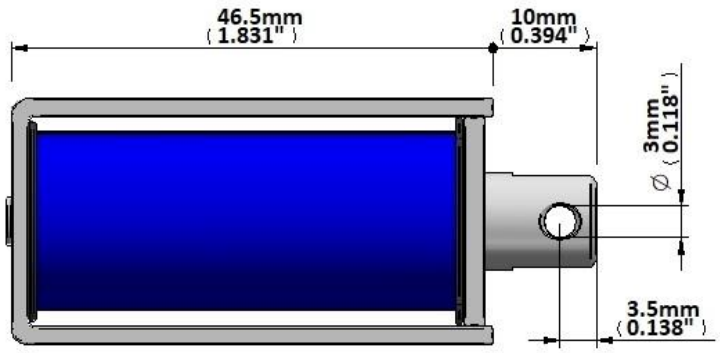
GEEPLUS Open Frame Solenoid RD-B945

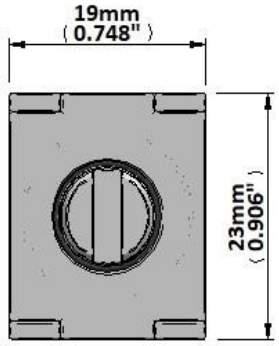
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

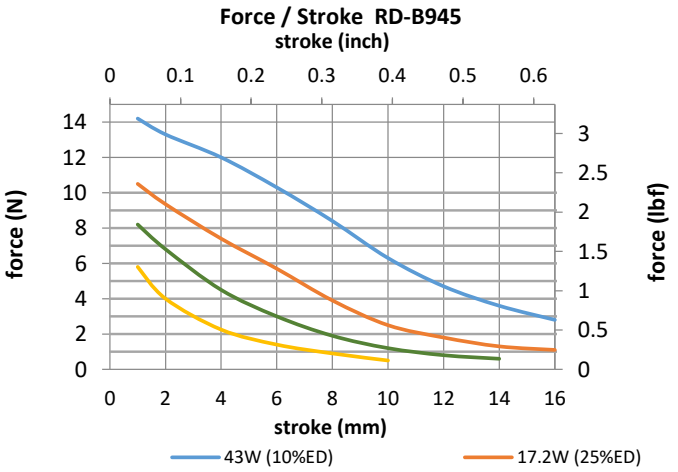
Plunger Mass 20 grammes
Total Mass 98 grammes

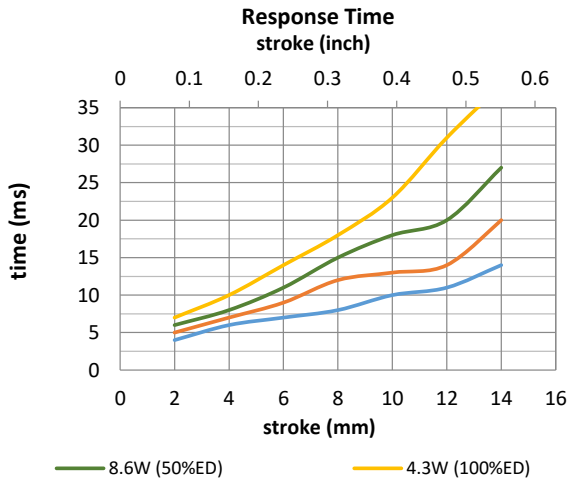












43W (10%ED) 17.2W (25%ED) 8.6W (50%ED) 4.3W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	348	112	28
watts at 20°C			4.3	8.6	17.2	43.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-B945-6v	8.4		6.0	8.5	12.0	19.0
RD-B945-12v	33.5		12.0	17.0	24.0	38.0
RD-B945-24v	134		24.0	34.0	48.0	76.0

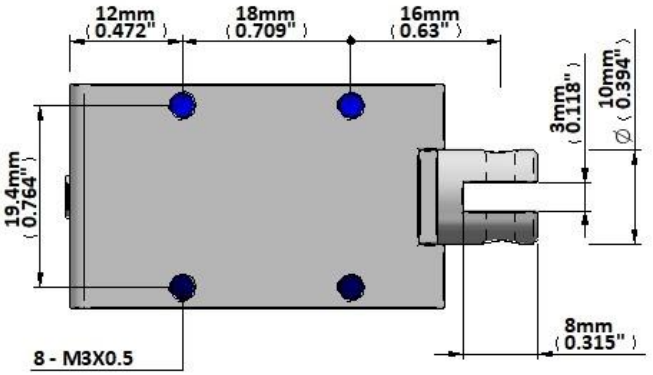
Insulation Resistance >100MΩ, 500VDC Megger **Dielectric Strength 500VAC, 50/60Hz, 1 minute**

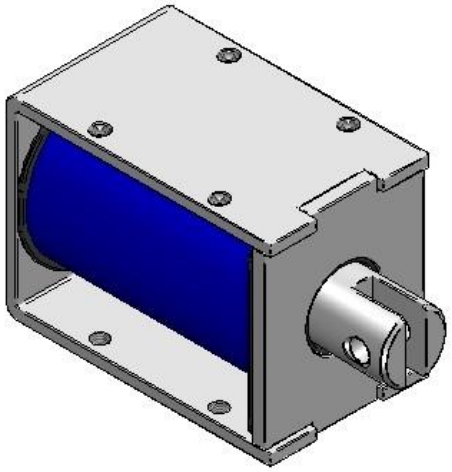
Class A (105°C) insulation class

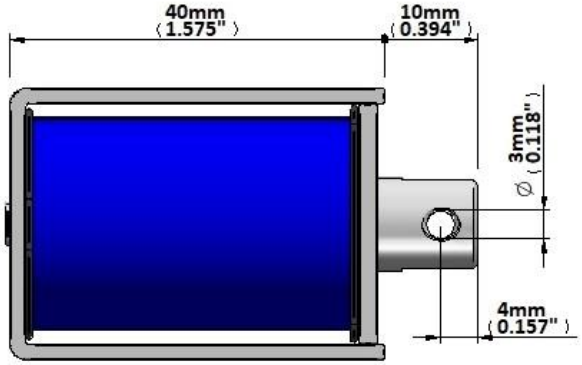
Open Frame Solenoid RD-A1040

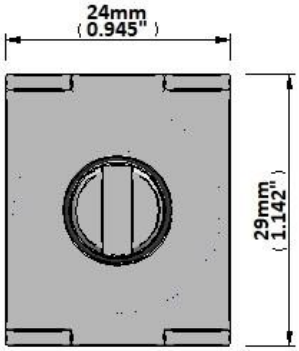
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

Plunger Mass 22 grammes
Total Mass 129 grammes

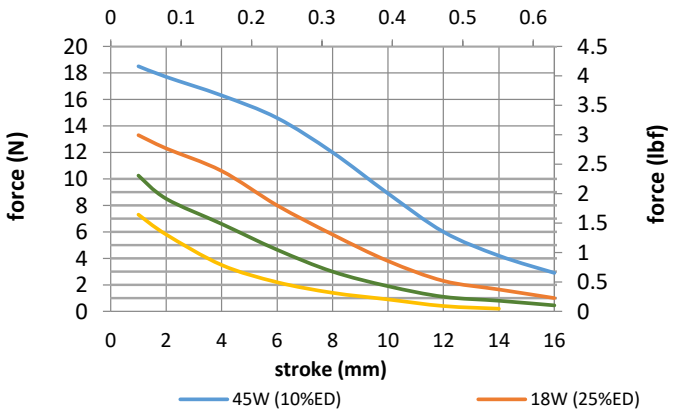




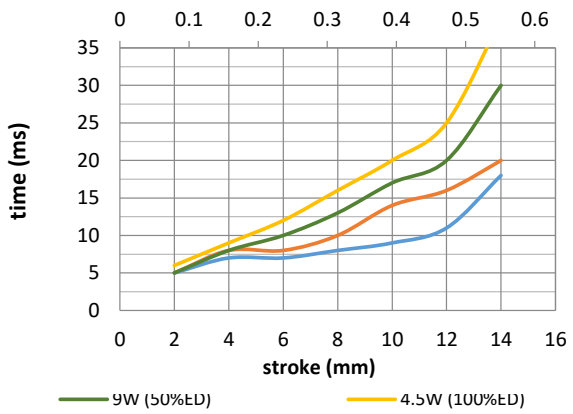




Force / Stroke RD-A1040



Response Time



Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	500	170	48
watts at 20°C			4.5	9.0	18.0	45.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A1040-6v	8.0		6.0	8.5	12.0	19.0
RD-A1040-12v	32.0		12.0	17.0	24.0	38.0
RD-A1040-24v	128		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

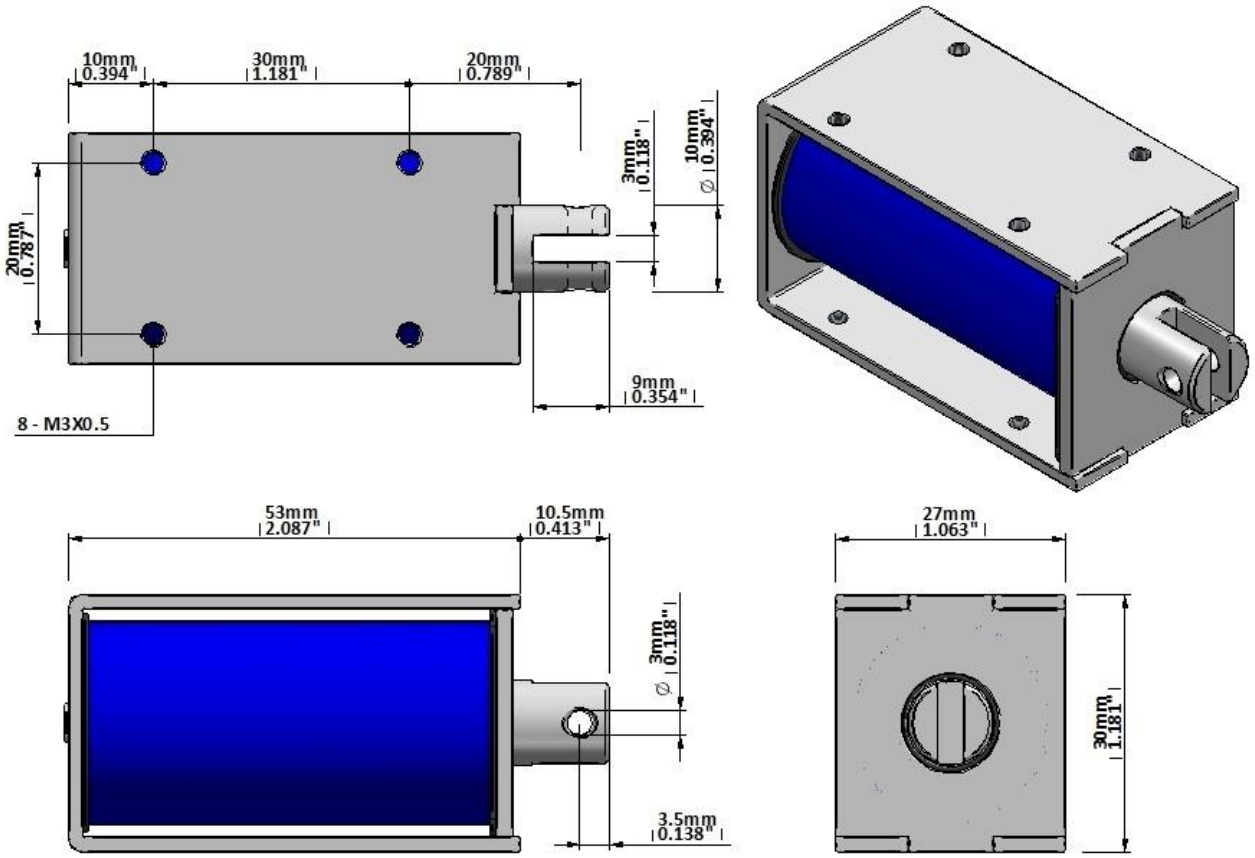
Dielectric Strength 500VAC, 50/60Hz, 1 minute

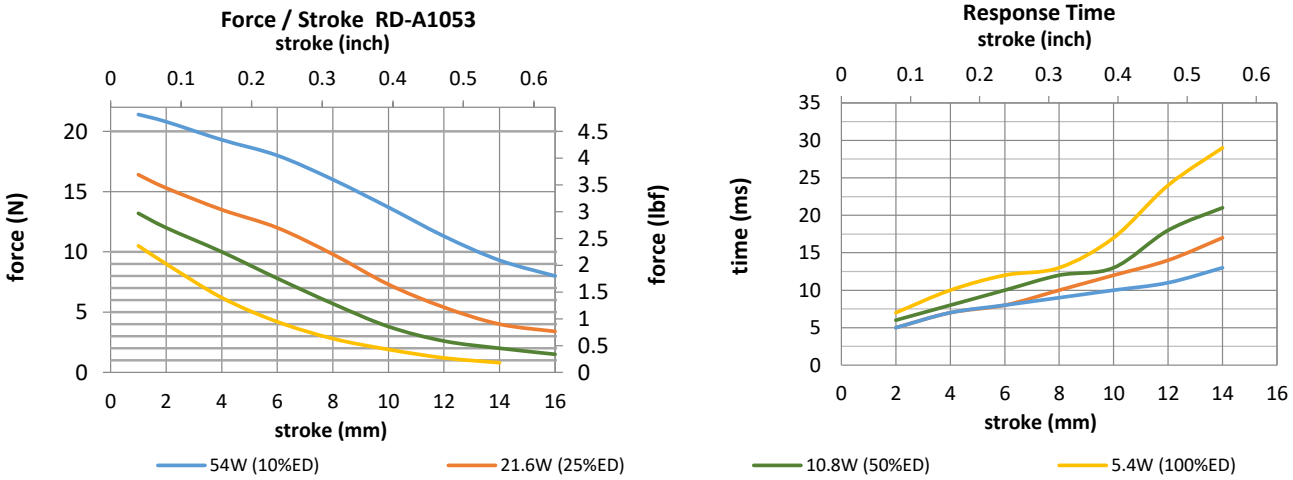
Class A (105°C) insulation class

Open Frame Solenoid RD-A1053

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

Plunger Mass 29 grammes
Total Mass 194 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	590	192	64
watts at 20°C			5.4	10.8	21.6	54.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A1053-6v	6.7		6.0	8.5	12.0	19.0
RD-A1053-12v	26.7		12.0	17.0	24.0	38.0
RD-A1053-24v	107		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

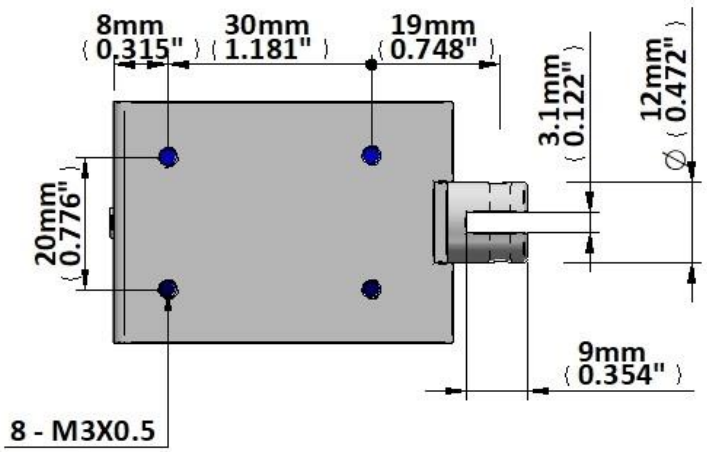
Dielectric Strength 500VAC, 50/60Hz, 1 minute

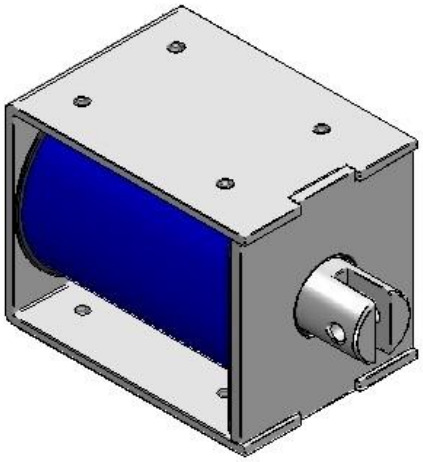
Class A (105°C) insulation class

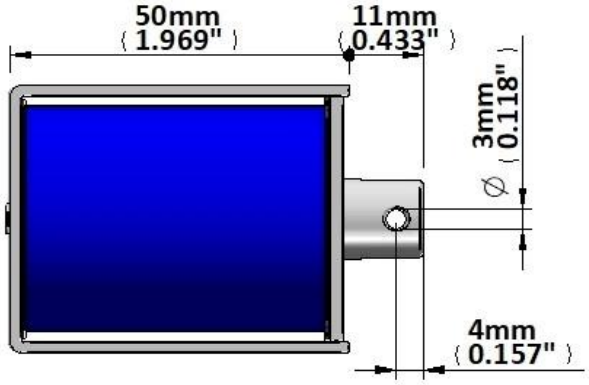
Open Frame Solenoid RD-A1250

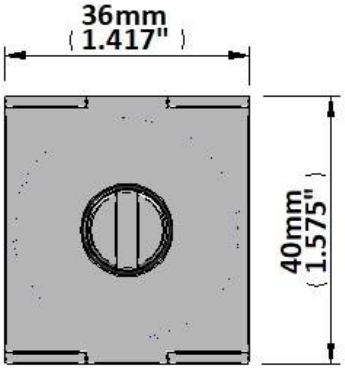
Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

Plunger Mass 38 grammes
Total Mass 319 grammes

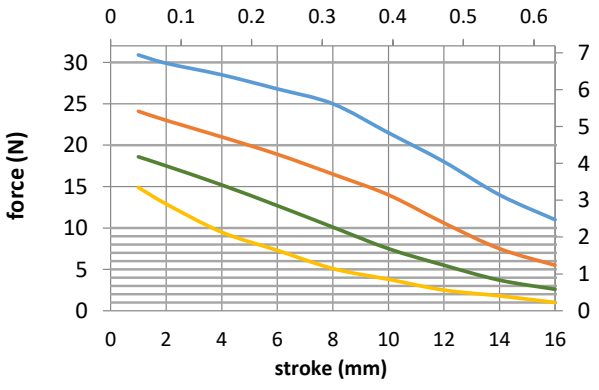




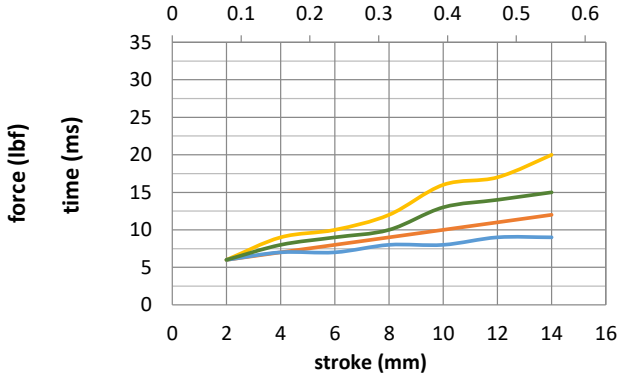




Force / Stroke RD-A1250



Response Time



75W (10%ED) 30W (25%ED) 15W (50%ED) 7.5W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	713	249	76
watts at 20°C			7.5	15.0	30.0	75.0
ampere-turns at 20°						
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
RD-A1250-6v	4.8		6.0	8.5	12.0	19.0
RD-A1250-12v	19.2		12.0	17.0	24.0	38.0
RD-A1250-24v	76.8		24.0	34.0	48.0	76.0

Insulation Resistance >100MΩ, 500VDC Megger

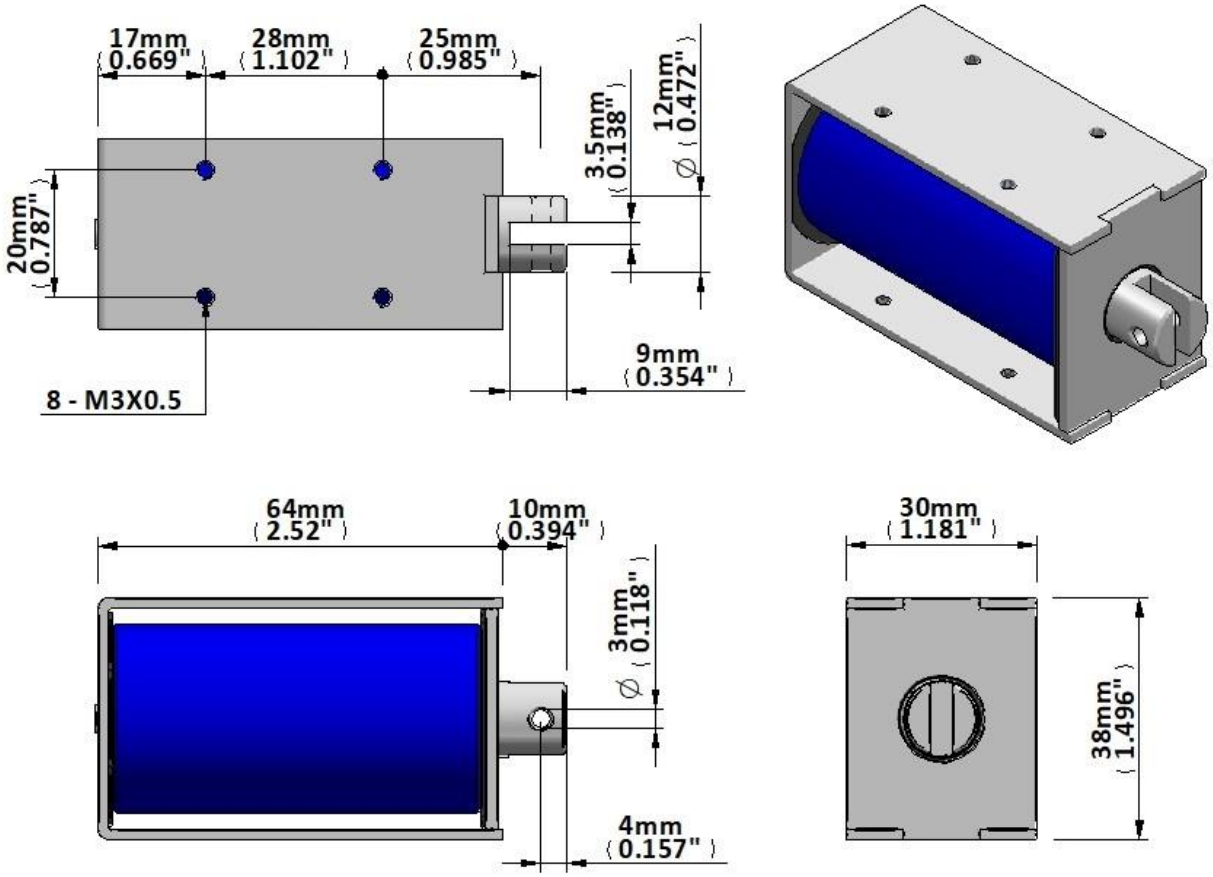
Dielectric Strength 500VAC, 50/60Hz, 1 minute

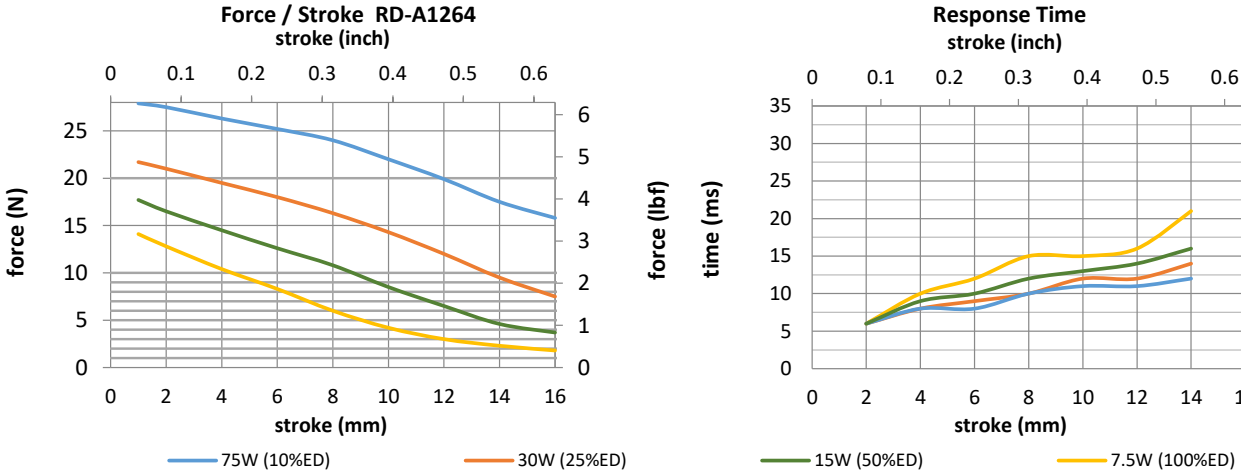
Class A (105°C) insulation class

Open Frame Solenoid RD-A1264

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 22AWG, 320mm

Plunger Mass 49 grammes
Total Mass 337 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	713	305	95
watts at 20°C			7.5	15.0	30.0	75.0
ampere-turns at 20°						
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
RD-A1264-6v	4.8		6.0	8.5	12.0	19.0
RD-A1264-12v	19.2		12.0	17.0	24.0	38.0
RD-A1264-24v	76.8		24.0	34.0	48.0	76.0

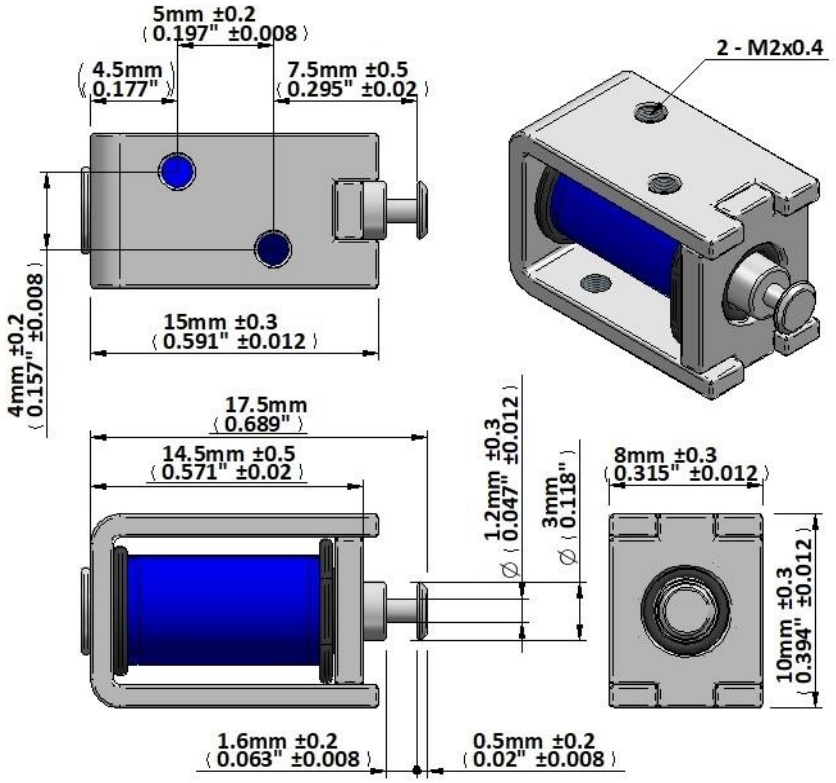
Insulation Resistance >100MΩ, 500VDC Megger

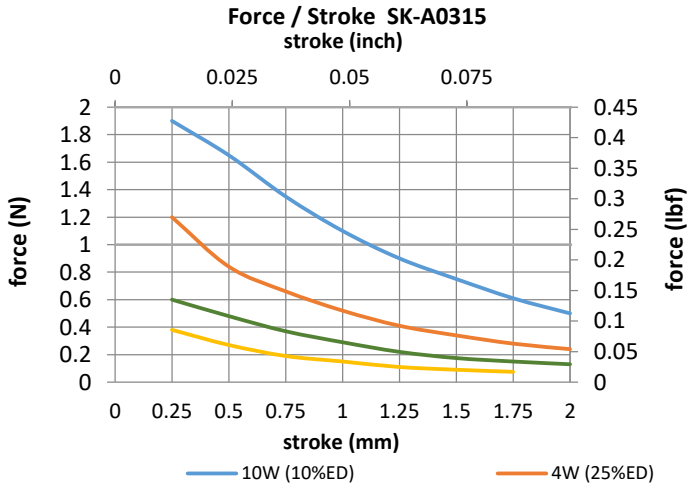
Dielectric Strength 500VAC, 50/60Hz, 1 minute

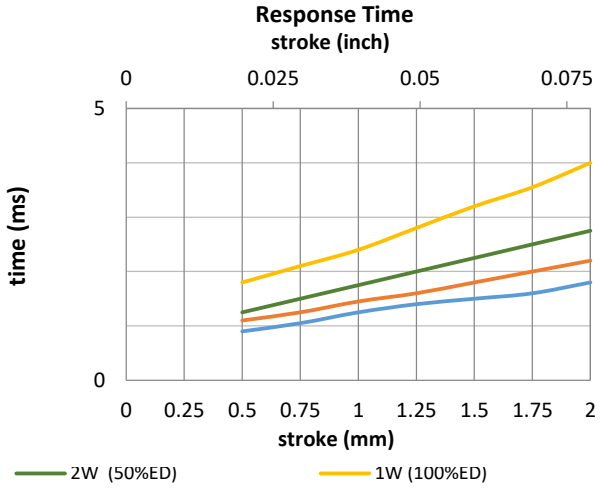
Class A (105°C) insulation class

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1571, 28AWG, 240mm

Plunger Mass 1 grammes
Total Mass 5 grammes







Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	50	18	2
watts at 20°C			1.0	2.0	4.0	10.0
ampere-turns at 20°			140	198	280	442
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A0315-6v	36	920	6.0	8.5	12.0	19.0
SK-A0315-12v	144	1750	12.0	17.0	24.0	38.0
SK-A0315-24v	576	3370	24.0	34.0	48.0	76.0
SK-A0315-48v	2304	6700	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

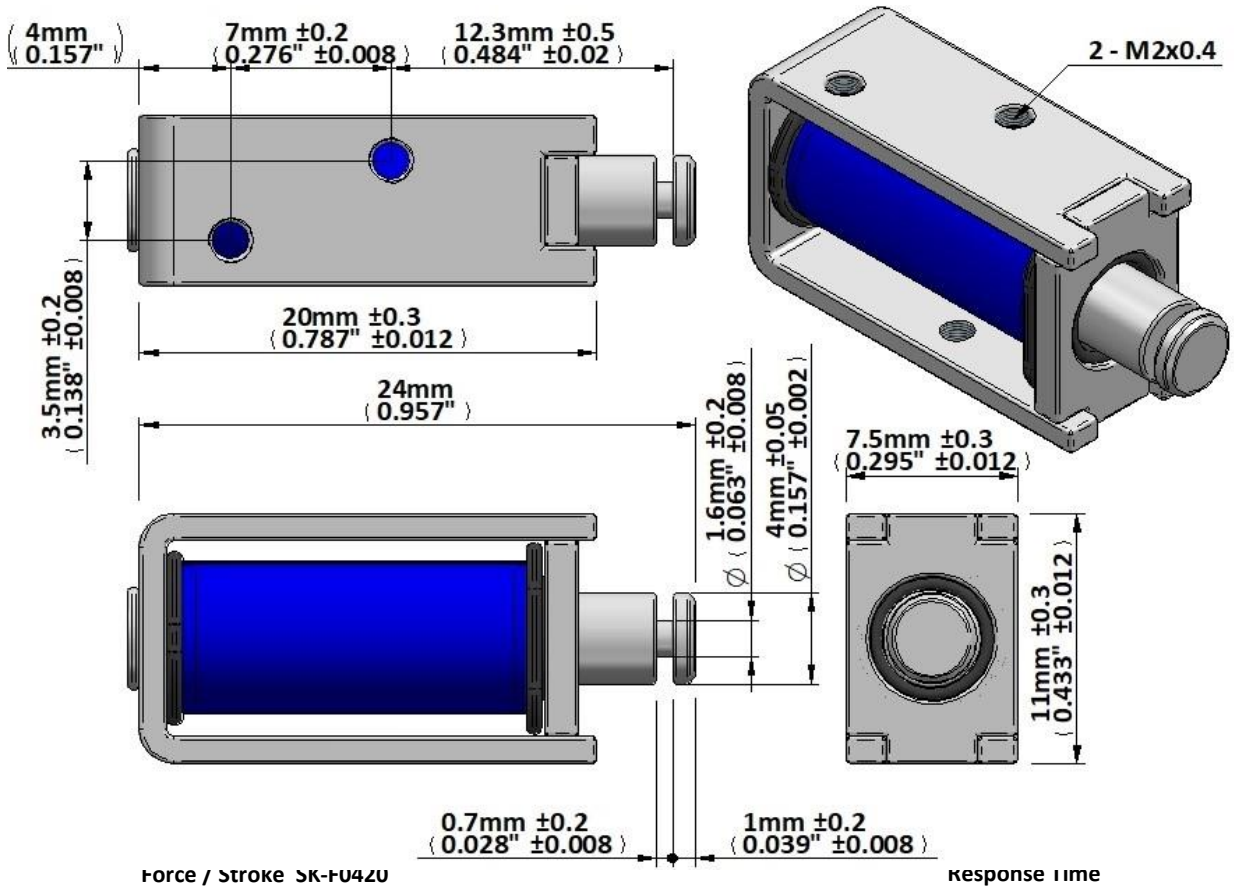
Dielectric Strength 500VAC, 50/60Hz, 1 minute

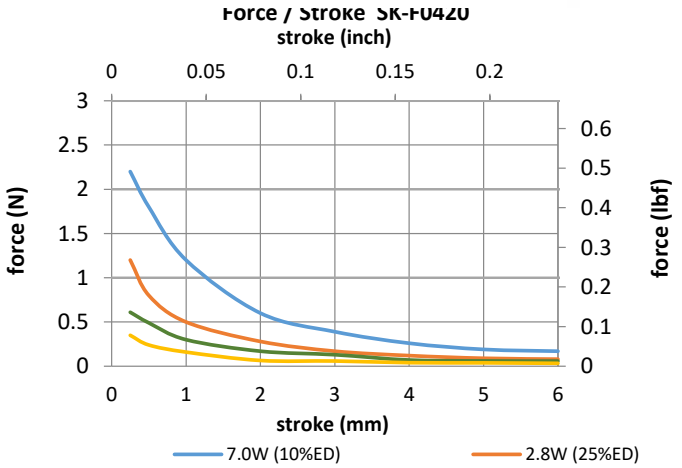
Class A (105°C) insulation class

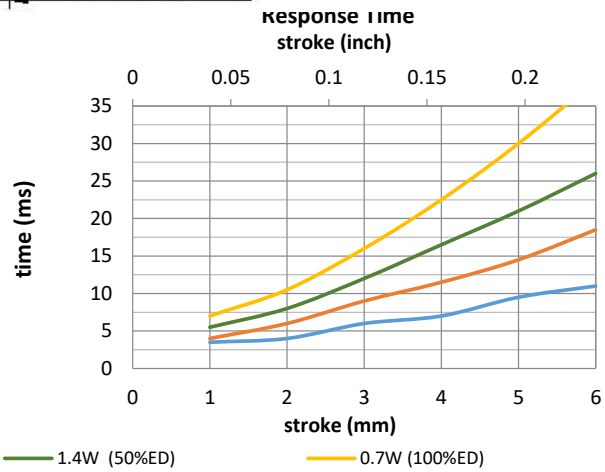
Open Frame Solenoid SK-F0420

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1571, 28AWG, 240mm

Plunger Mass 2 grammes
Total Mass 8 grammes







Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	50	18	2
watts at 20°C			0.7	1.4	2.8	7.0
ampere-turns at 20°			119	168	238	376
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-F0420-6v	51	1100	6.0	8.5	12.0	19.0
SK-F0420-12v	205	2120	12.0	17.0	24.0	38.0
SK-F0420-24v	823	4100	24.0	34.0	48.0	76.0
SK-F0420-48v	3291	8100	48.0	68.0	96.0	152

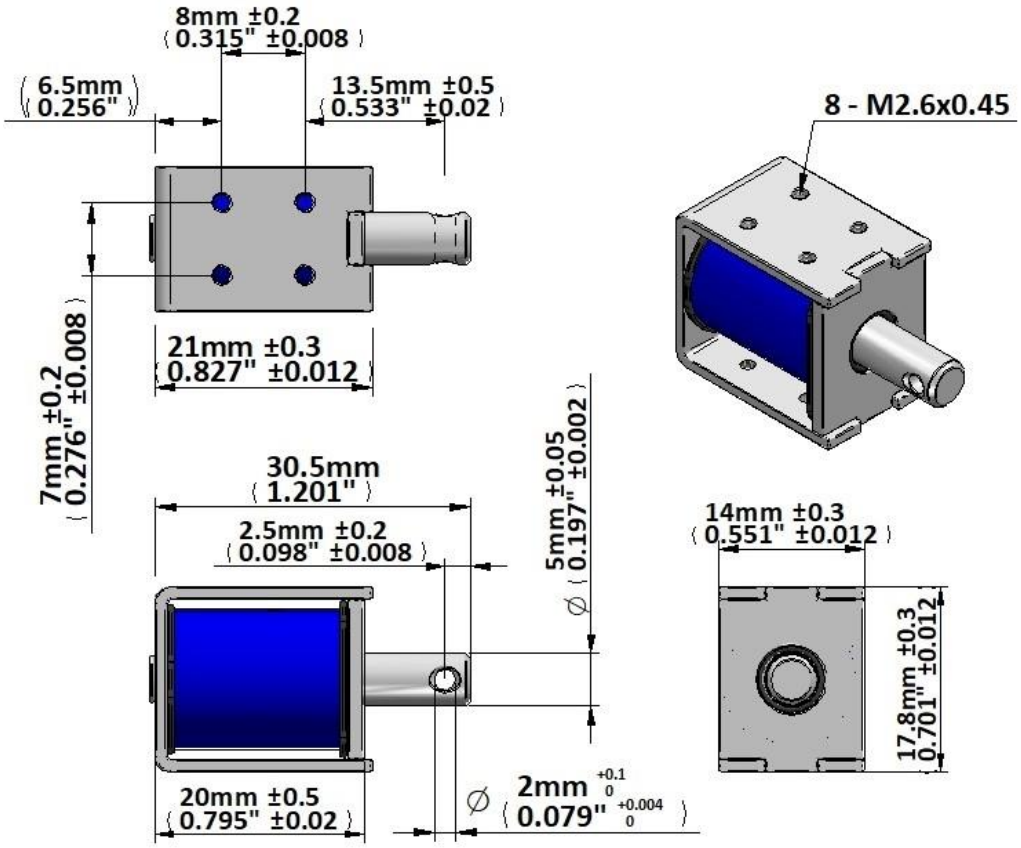
Insulation Resistance >100MΩ, 500VDC Megger

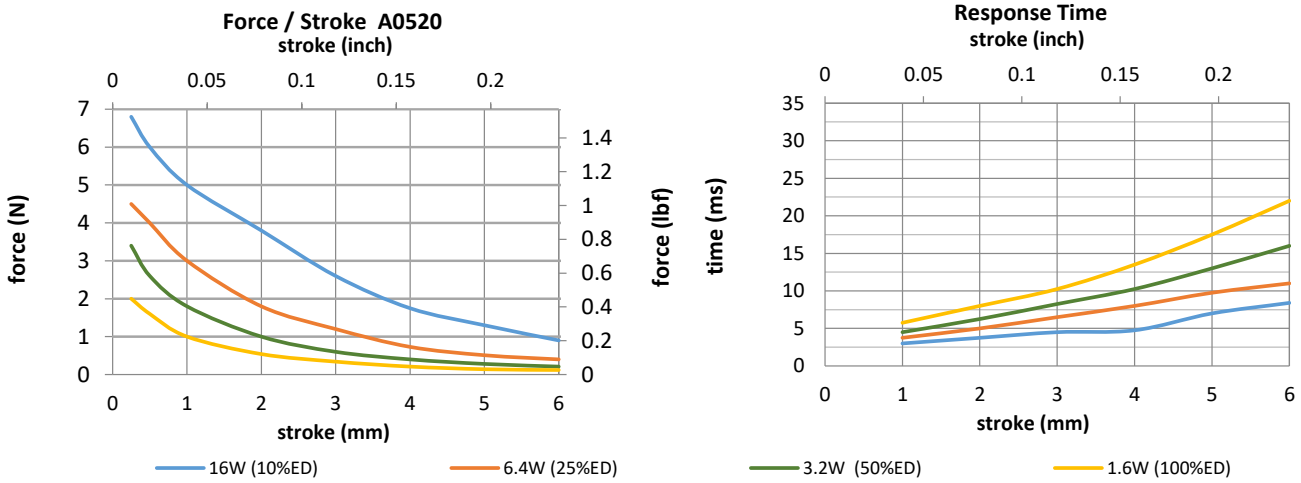
Dielectric Strength 500VAC, 50/60Hz, 1 minute

Class A (105°C) insulation class

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 28AWG, 240mm

Plunger Mass 4 grammes
Total Mass 22 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	55	19	3
watts at 20°C			1.6	3.2	6.4	16.0
ampere-turns at 20°			300	424	600	948
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A0520-6v	23	1150	6.0	8.5	12.0	19.0
SK-A0520-12v	90	2290	12.0	17.0	24.0	38.0
SK-A0520-24v	360	4500	24.0	34.0	48.0	76.0
SK-A0520-48v	1440	8600	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

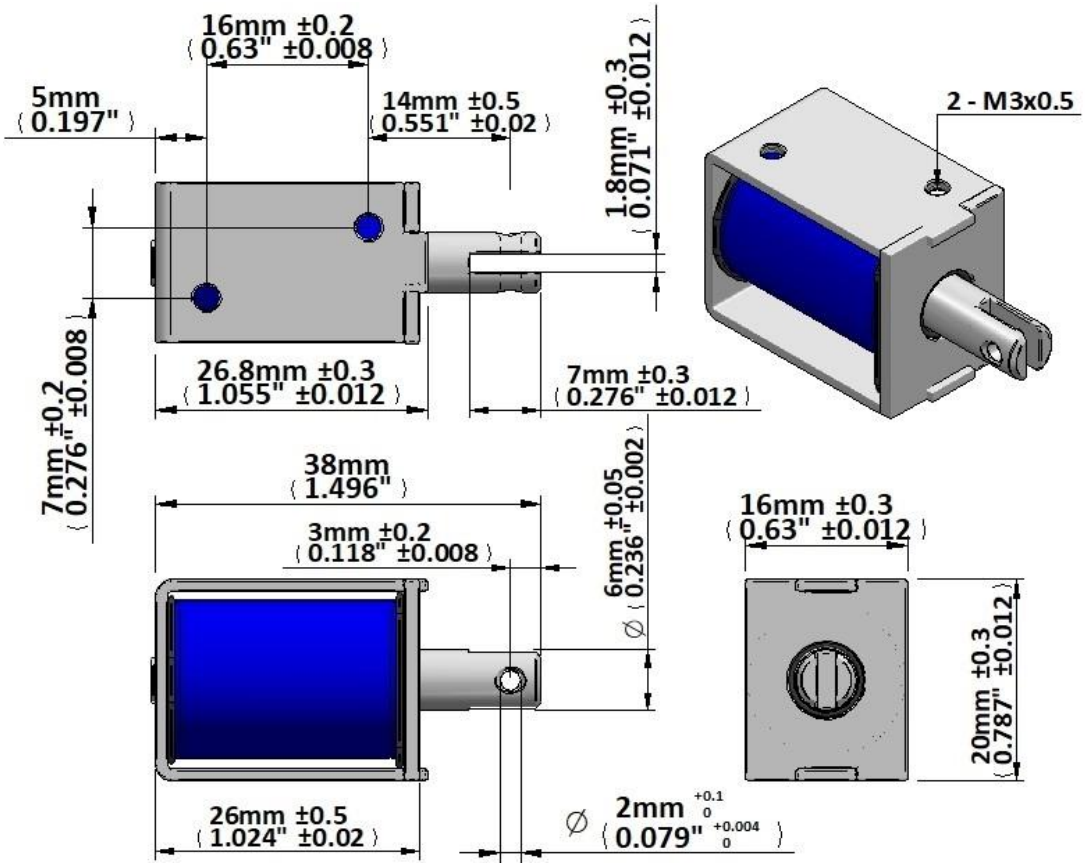
Dielectric Strength 500VAC, 50/60Hz, 1 minute

Class A (105°C) insulation class

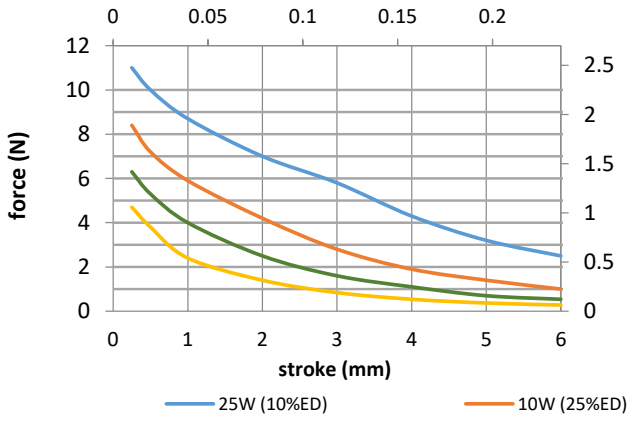
Open Frame Solenoid SK-A0626

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

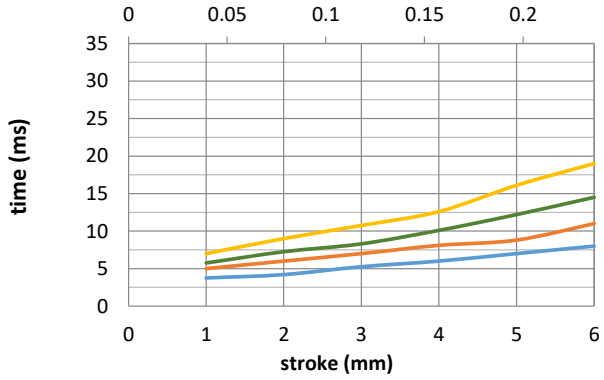
Plunger Mass 7 grammes
Total Mass 43 grammes



Force / Stroke A0626
stroke (inch)



Response Time
stroke (inch)



25W (10%ED) — 10W (25%ED) — 5W (50%ED) — 2.5W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			2.5	5.0	10.0	25.0
ampere-turns at 20°			428	605	856	1353
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
SK-A0626-6v	14	1090	6.0	8.5	12.0	19.0
SK-A0626-12v	58	2090	12.0	17.0	24.0	38.0
SK-A0626-24v	230	4110	24.0	34.0	48.0	76.0
SK-A0626-48v	922	8200	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

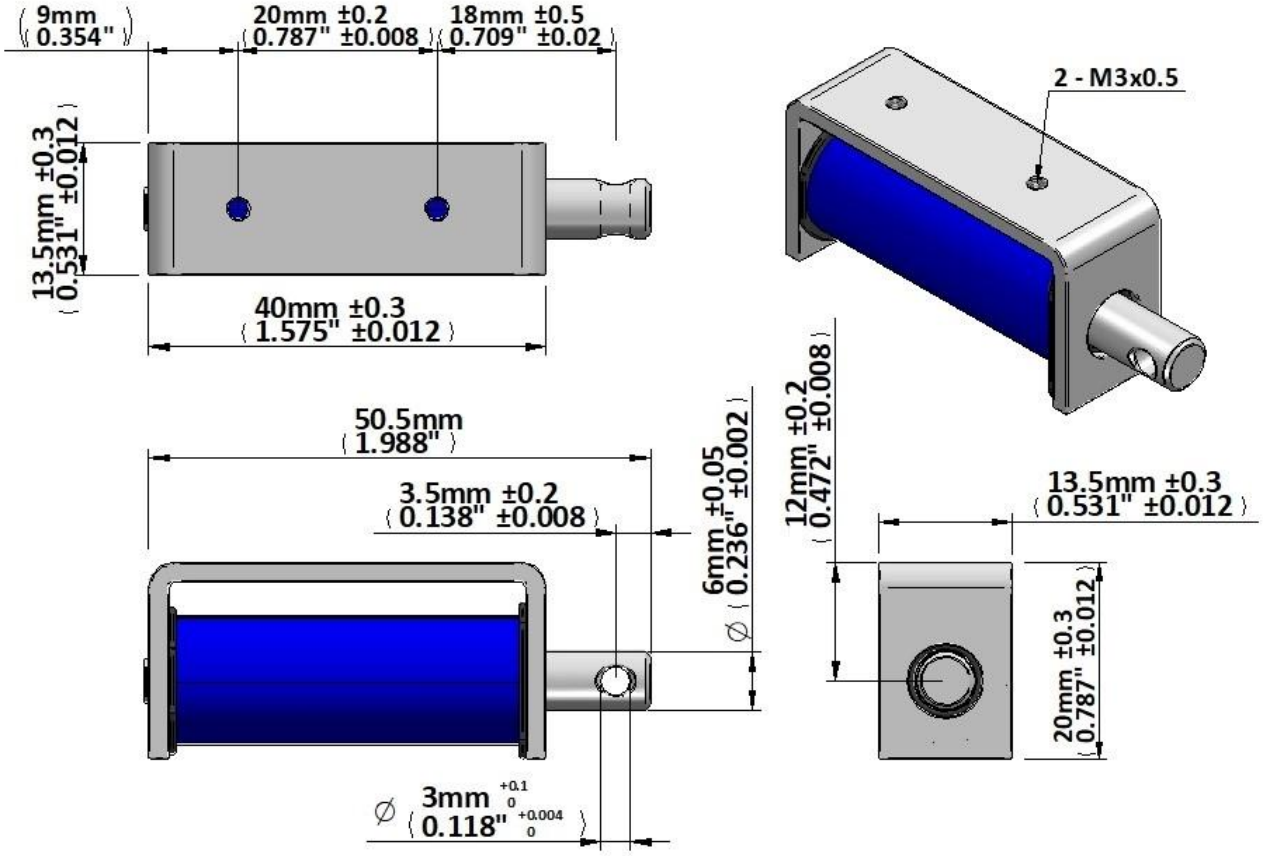
Dielectric Strength 500VAC, 50/60Hz, 1 minute

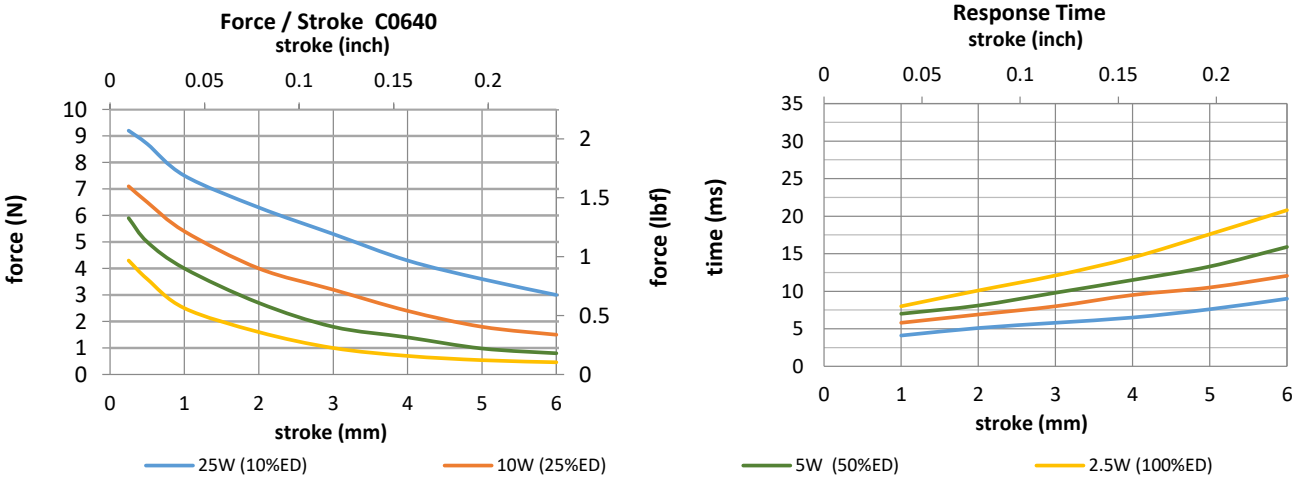
Class A (105°C) insulation class

Open Frame Solenoid SK-C0640

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

Plunger Mass 9 grammes
Total Mass 48 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	100	36	7
watts at 20°C	2.5	5.0	10.0	25.0
ampere-turns at 20°	504	712	1008	1593

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-C0640-6v	14	1185	6.0	8.5	12.0	19.0
SK-C0640-12v	58	2480	12.0	17.0	24.0	38.0
SK-C0640-24v	230	4830	24.0	34.0	48.0	76.0
SK-C0640-48v	922	9460	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

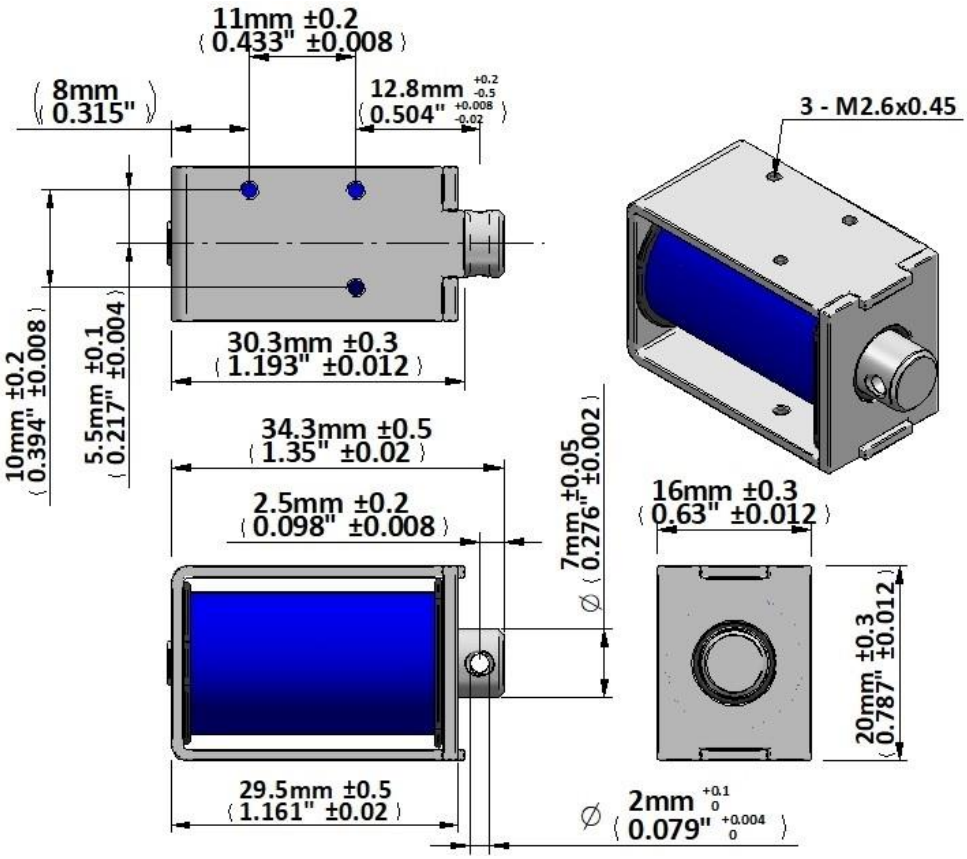
Dielectric Strength 500VAC, 50/60Hz, 1 minute

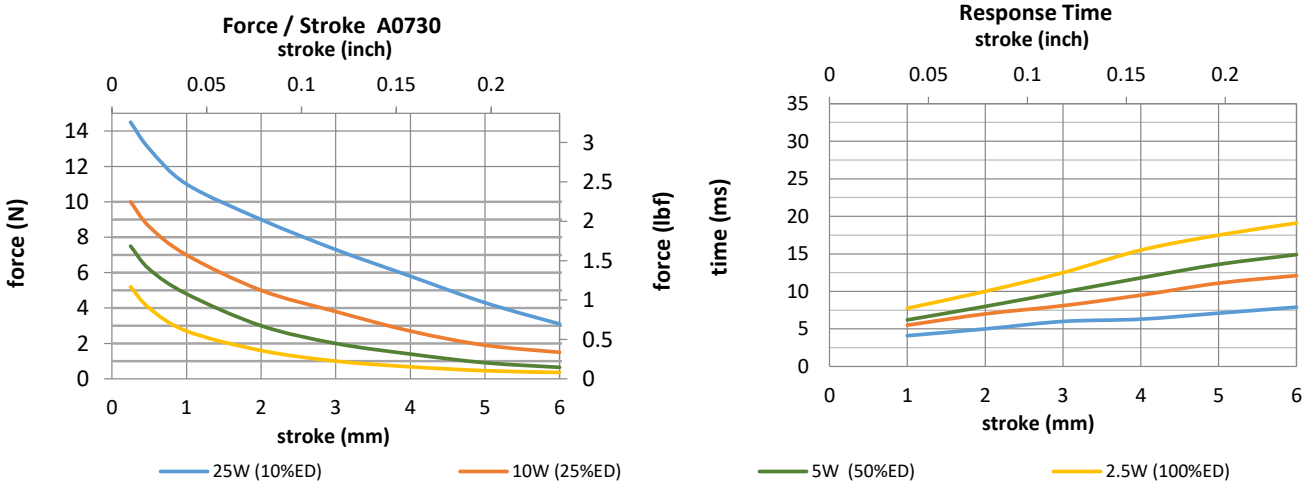
Class A (105°C) insulation class

Open Frame Solenoid SK-A0730

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

Plunger Mass 8 grammes
Total Mass 48 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	100	36	7
watts at 20°C	2.5	5.0	10.0	25.0
ampere-turns at 20°	389	550	778	1230

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A0730-6v	14	990	6.0	8.5	12.0	19.0
SK-A0730-12v	58	1925	12.0	17.0	24.0	38.0
SK-A0730-24v	230	3730	24.0	34.0	48.0	76.0
SK-A0730-48v	922	7300	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

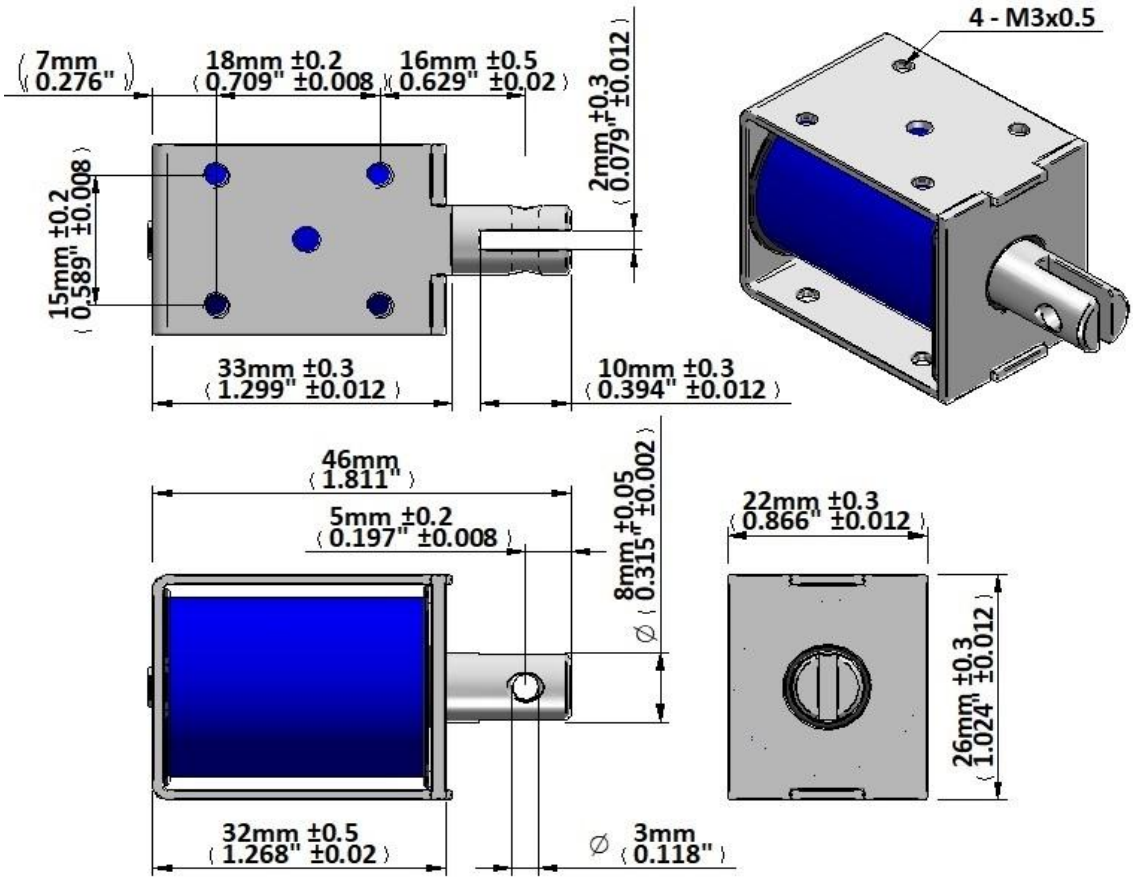
Dielectric Strength 500VAC, 50/60Hz, 1 minute

Class A (105°C) insulation class

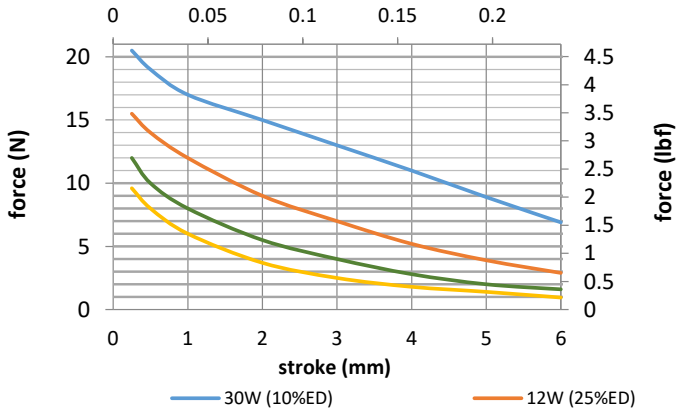
GEEPLUS Open Frame Solenoid SK-A0832

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

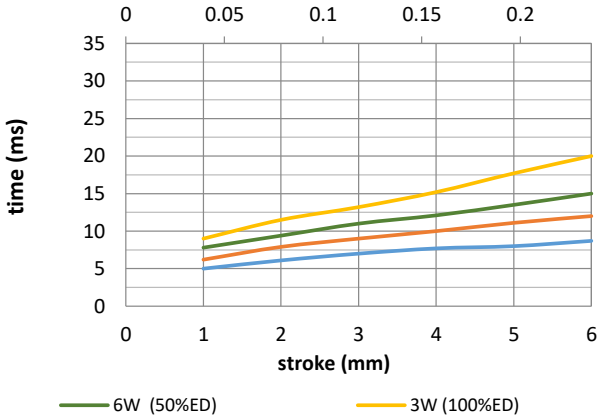
Plunger Mass 14grammes
Total Mass 82 grammes



Force / Stroke A0832



Response Time



30W (10%ED) 12W (25%ED) 6W (50%ED) 3W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3.0	6.0	12.0	30.0
ampere-turns at 20°			571	807	1142	1805
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A0832-6v	12	1150	6.0	8.5	12.0	19.0
SK-A0832-12v	46	2300	12.0	17.0	24.0	38.0
SK-A0832-24v	186	4430	24.0	34.0	48.0	76.0
SK-A0832-48v	743	8410	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

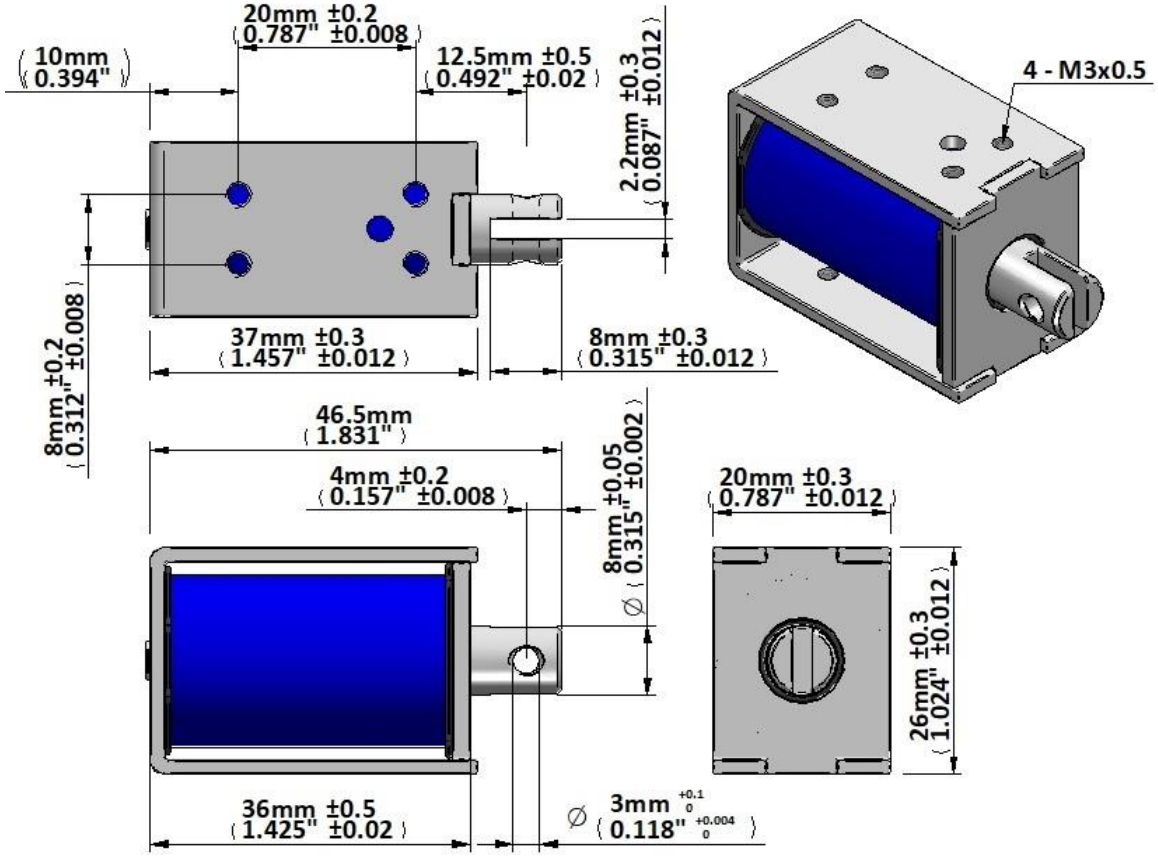
Dielectric Strength 500VAC, 50/60Hz, 1 minute

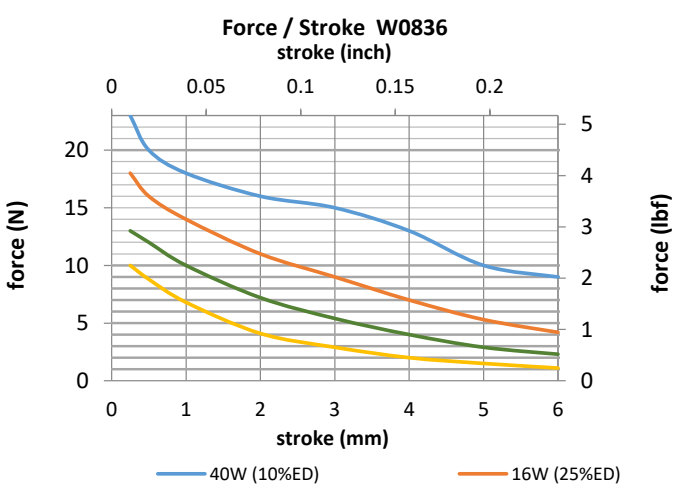
Class A (105°C) insulation class

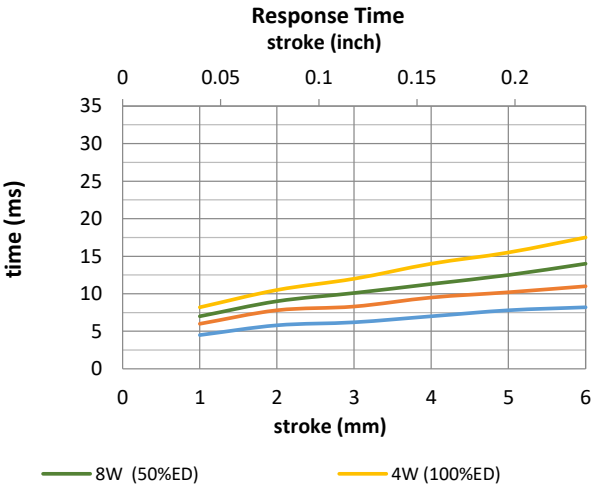
GEEPLUS Open Frame Solenoid SK-W0836

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

Plunger Mass 14grammes
Total Mass 100 grammes







40W (10%ED) 16W (25%ED) 8W (50%ED) 4W (100%ED)

Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			4.0	8.0	16.0	40.0
ampere-turns at 20°			666	941	1332	2106
AWG no.	**resistance Ω±10% (at 20°C)**	**number of turns**	**volts DC**			
SK-W0836-6v	9	1000	6.0	8.5	12.0	19.0
SK-W0836-12v	36	2000	12.0	17.0	24.0	38.0
SK-W0836-24v	144	4000	24.0	34.0	48.0	76.0
SK-W0836-48v	576	7540	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

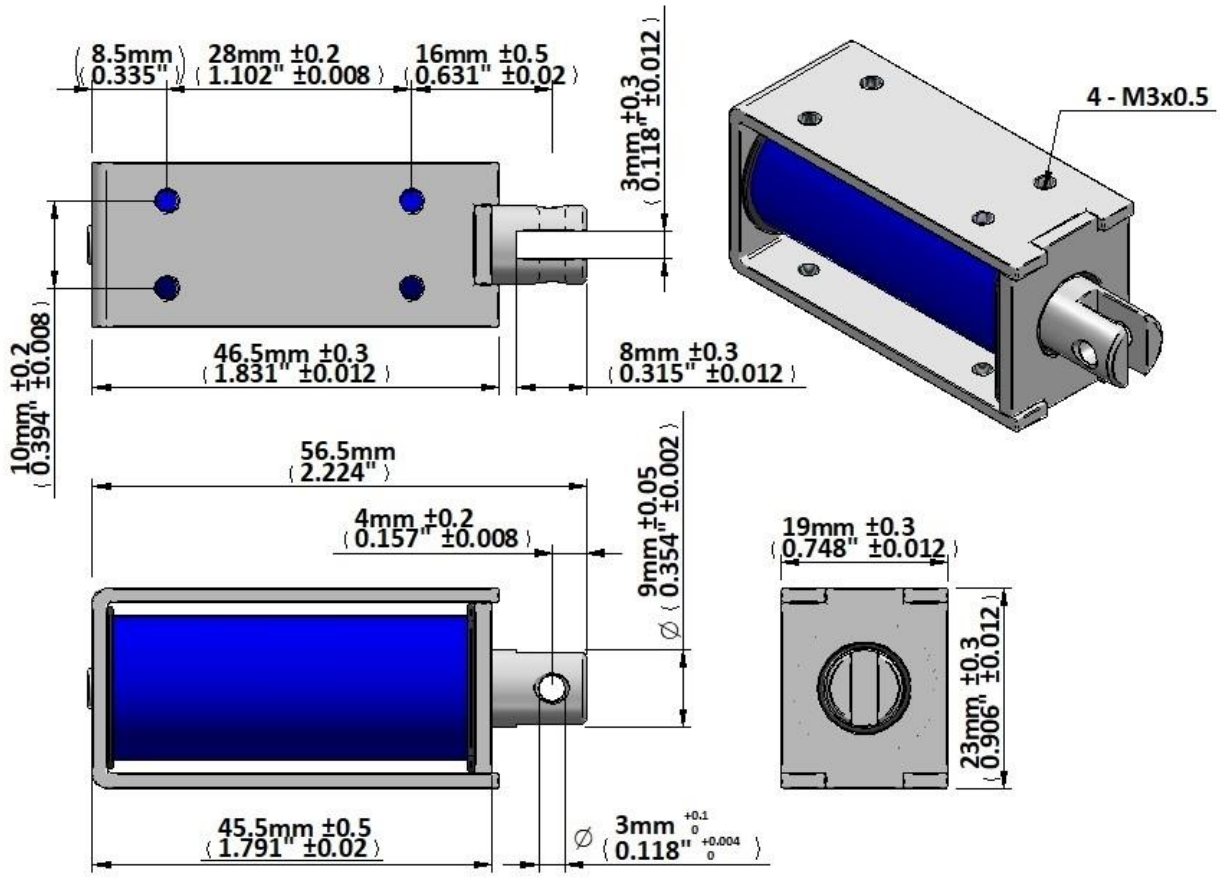
Dielectric Strength 500VAC, 50/60Hz, 1 minute

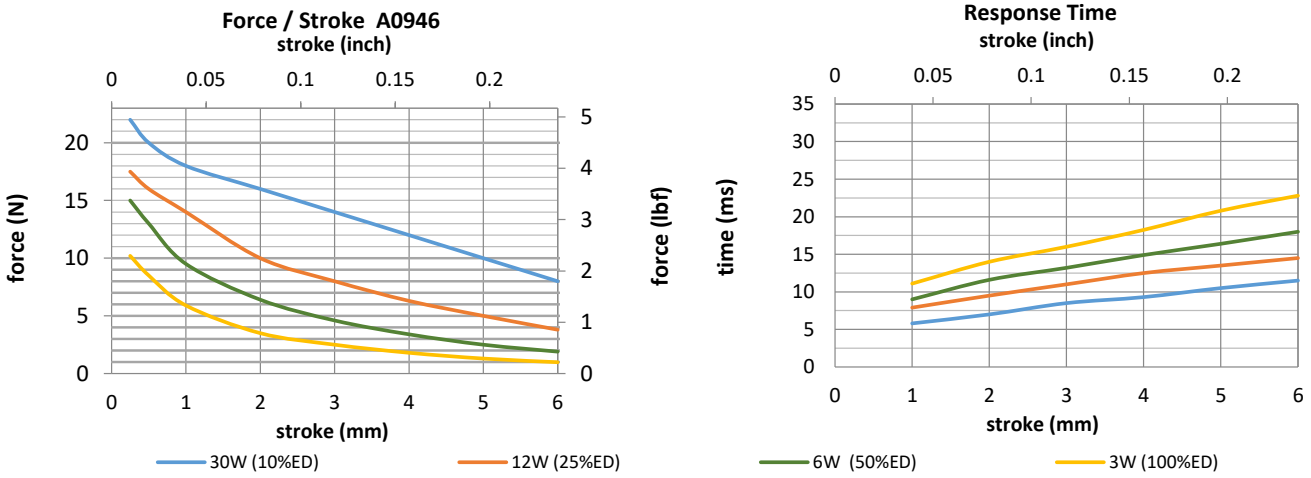
Class A (105°C) insulation class

Open Frame Solenoid SK-A0946

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

Plunger Mass 20grammes
Total Mass 96 grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	100	36	7
watts at 20°C	3.0	6.0	12.0	30.0
ampere-turns at 20°	585	827	1170	1849

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A0946-6v	12	1120	6.0	8.5	12.0	19.0
SK-A0946-12v	48	2320	12.0	17.0	24.0	38.0
SK-A0946-24v	192	4680	24.0	34.0	48.0	76.0
SK-A0946-48v	768	9000	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

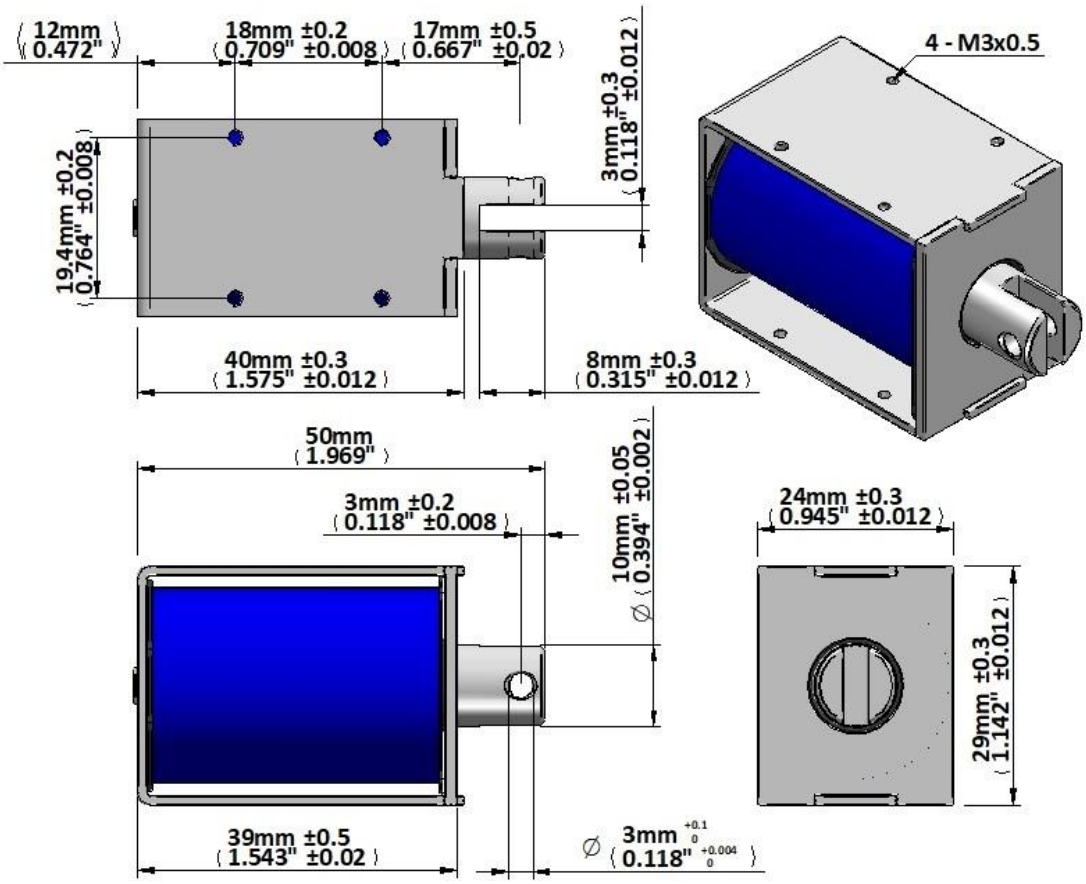
Dielectric Strength 500VAC, 50/60Hz, 1 minute

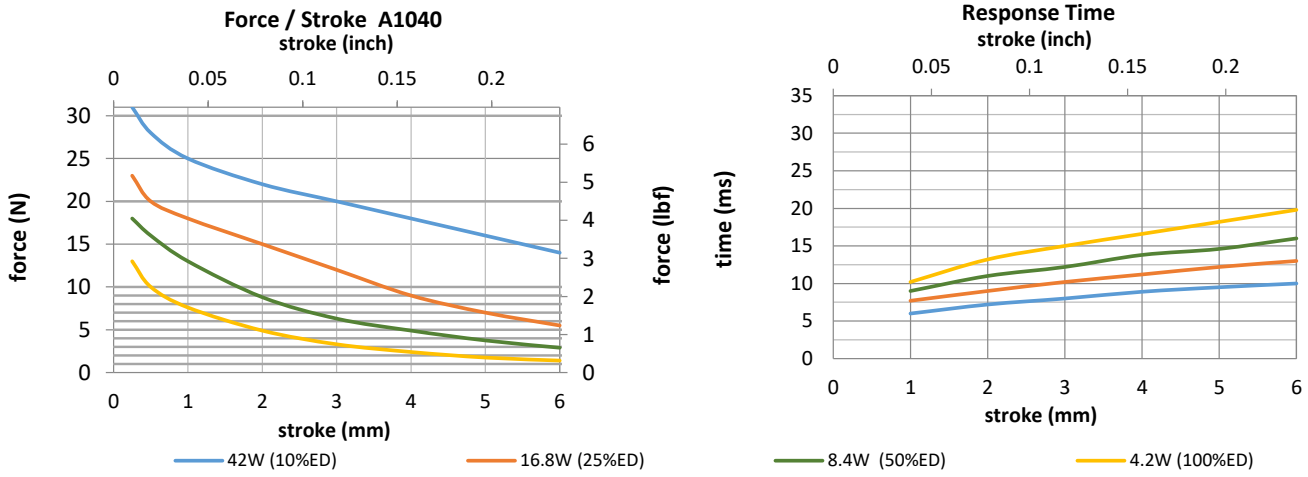
Class A (105°C) insulation class

Open Frame Solenoid SK-A1040

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 240mm

Plunger Mass 23grammes
Total Mass 126grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			4.2	8.4	16.8	42.0
ampere-turns at 20°			635	898	1270	2008
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-A01040-6v	9	1020	6.0	8.5	12.0	19.0
SK-A1040-12v	34	2000	12.0	17.0	24.0	38.0
SK-A1040-24v	137	3625	24.0	34.0	48.0	76.0
SK-A1040-48v	549	7420	48.0	68.0	96.0	152

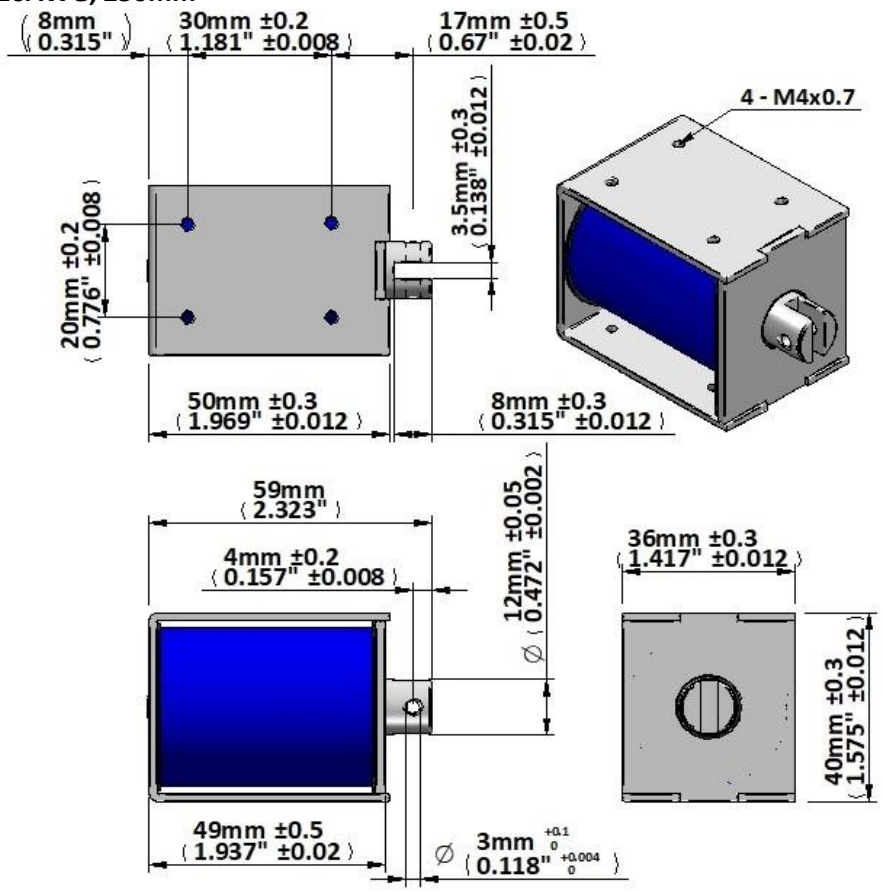
Insulation Resistance >100MΩ, 500VDC Megger

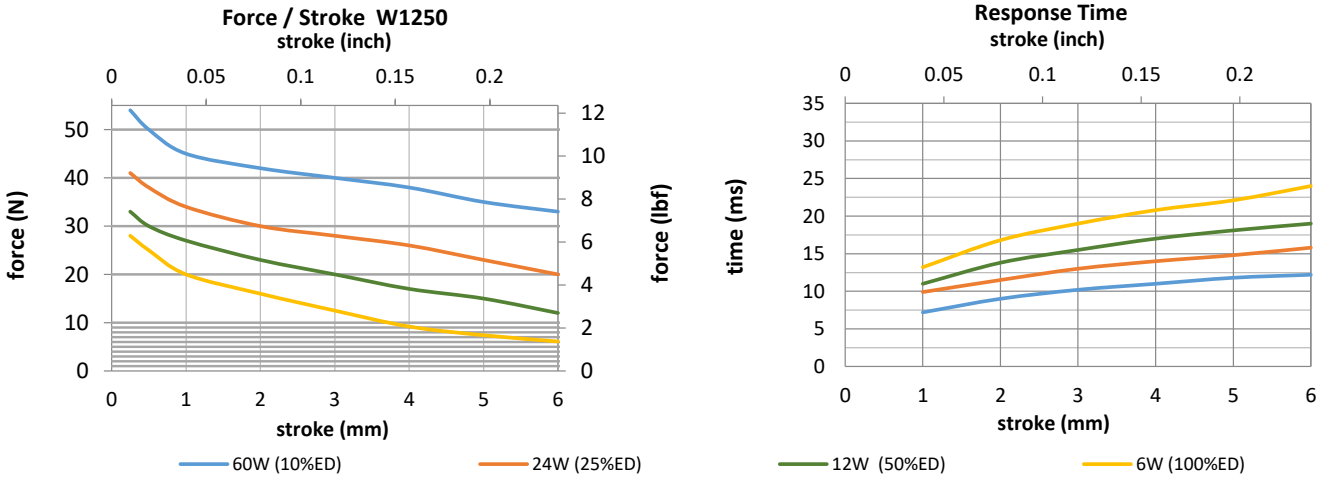
Dielectric Strength 500VAC, 50/60Hz, 1 minute

Class A (105°C) insulation class

Device drawn in energised condition
Life Expectancy >250K cycles
Leadwires UL1007, 26AWG, 250mm

Plunger Mass 40grammes
Total Mass 362grammes





Data at 20°C , device performance measured without heat sink

duty cycle = "on" time / ("on" time + "off" time) x 100%	100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds	∞	140	50	9
watts at 20°C	6.0	12.0	24.0	60.0
ampere-turns at 20°	1150	1626	2300	3636

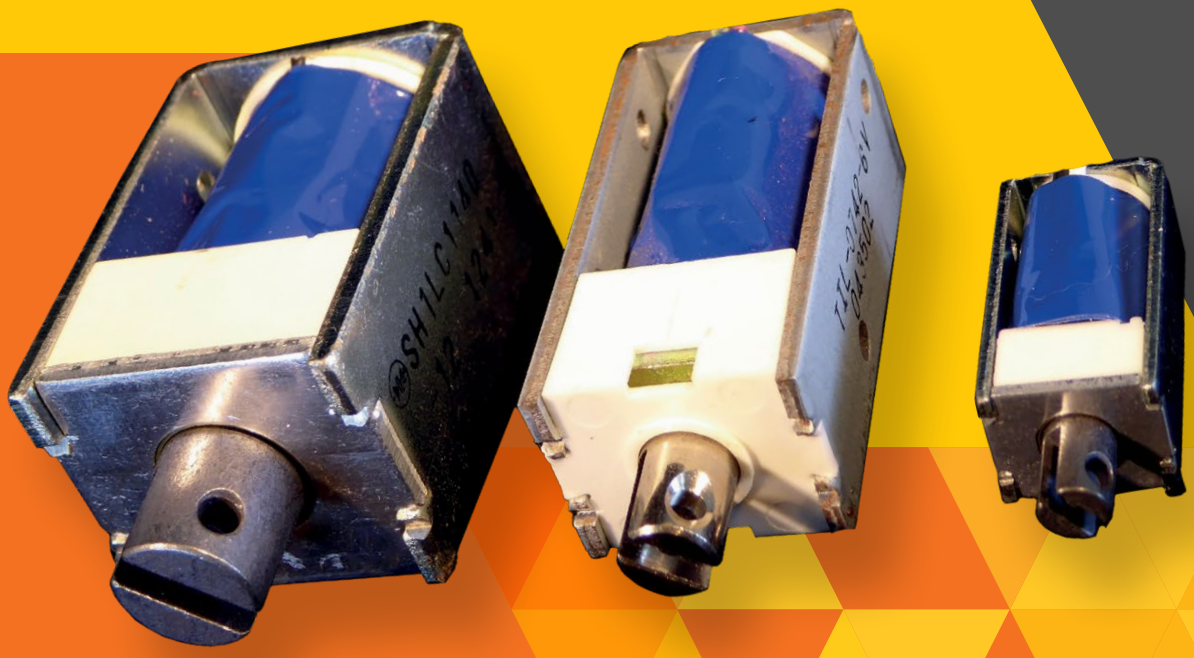
AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
SK-W1250-6v	6	1100	6.0	8.5	12.0	19.0
SK-W1250-12v	24	2370	12.0	17.0	24.0	38.0
SK-W1250-24v	96	4600	24.0	34.0	48.0	76.0
SK-W1250-48v	384	8640	48.0	68.0	96.0	152

Insulation Resistance >100MΩ, 500VDC Megger

Dielectric Strength 500VAC, 50/60Hz, 1 minute

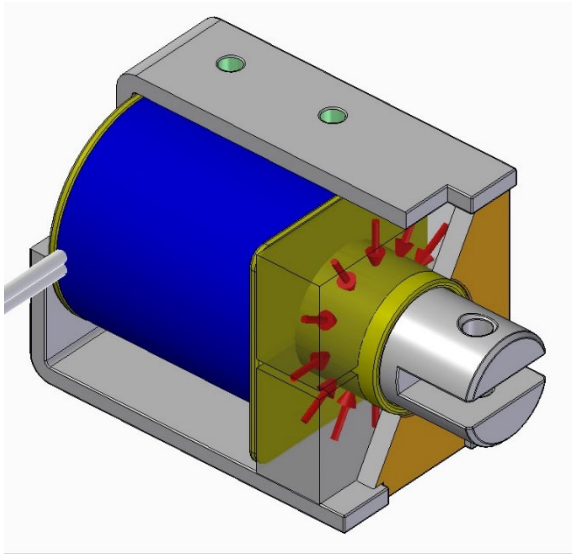
Class A (105°C) insulation class

LATCHING SOLENOIDS



Single Latching Solenoid

A latching solenoid of open frame single coil construction is illustrated with a section to show how it differs from other parts.



The end-frame is non-magnetic and has no impact on behaviour.

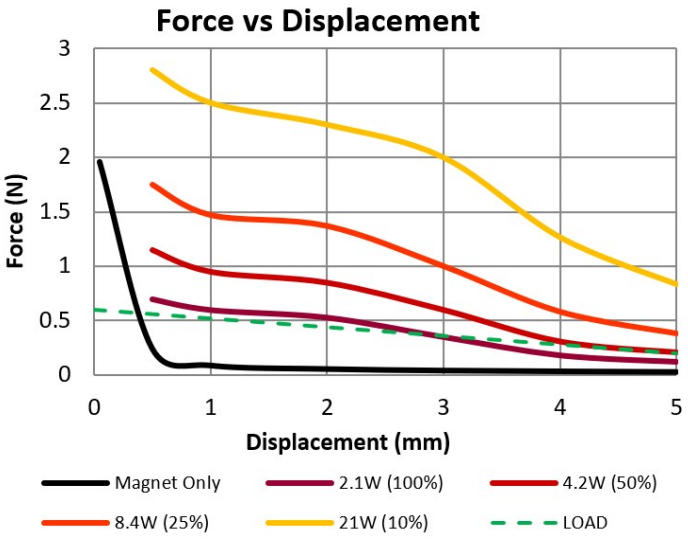
Permanent magnets are incorporated (shown transparent), in the de-energised condition these drive magnetic flux around the magnetic circuit of the solenoid to develop latching force with no power applied.

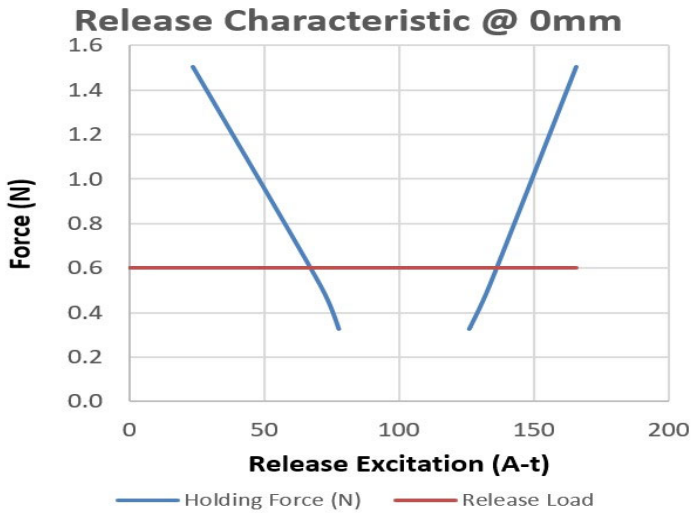
When energised in a forward direction, the coil reinforces the field driven by the magnets to develop a higher force

When energised in a reverse direction, the coil opposes the field driven by the magnets, as the current is increased the magnetic flux reduces until flux and force approaches zero. If the reverse current is increased further, flux is driven in the reverse direction, and the solenoid again develops an attraction force – this is in the same direction as when forward-energised.

Force Characteristic

Characteristic force curves for a single coil latching solenoid are shown, and a return spring curve LOAD is included.





- The top graph shows force curves in the de-energised and forward-energised conditions.

In the de-energised condition, a high holding force is developed which reduces rapidly as displacement increases. This is greater than the spring curve for displacement <0.5mm and will hold this position, for displacement >0.5mm the spring force is larger, and the solenoid will move to an extended position.

As excitation power increases, the ‘pull-in’ force increases, and the solenoid will try to move to the 0mm position.

With reverse (Release) excitation the magnetic attraction force will decrease as current increases, when this becomes less than the Release Load the solenoid will release. As excitation increases further, the flux will eventually be driven in the opposite direction, and the solenoid will again develop force to pull in towards the 0mm position.

GEEPLUS S1L-0211-4v

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

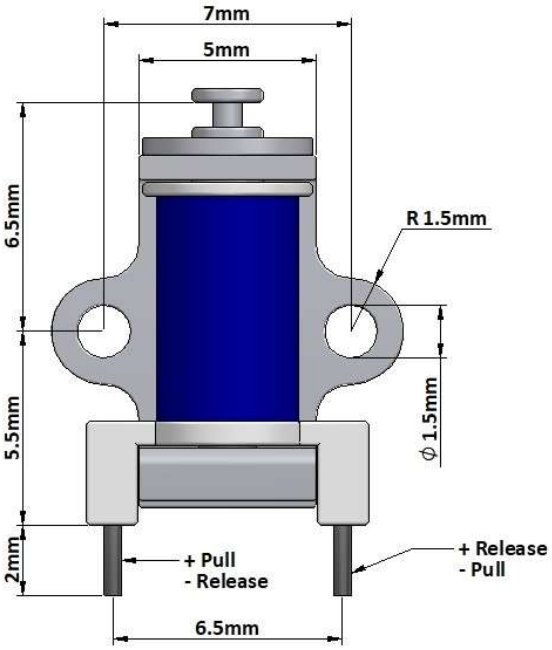
Maximum "on" time in seconds	7*
Watts at 20°C	2.67
Ampere-Turns at 20°C	285

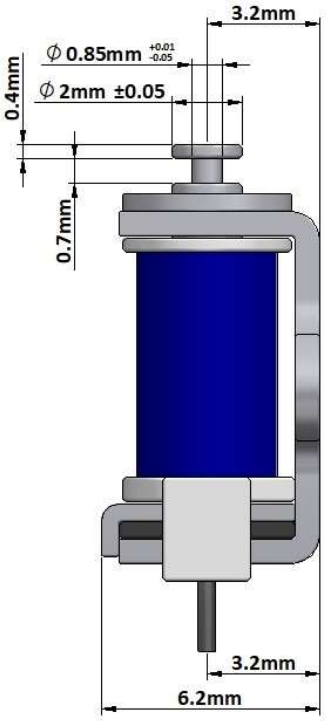
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
S1L-0211-4v	24.0 Ω	725	4	167 mA

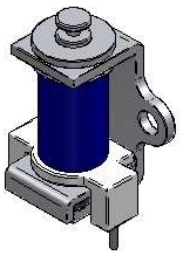
*With Solenoid mounted on a massive heatsink

General Parameters

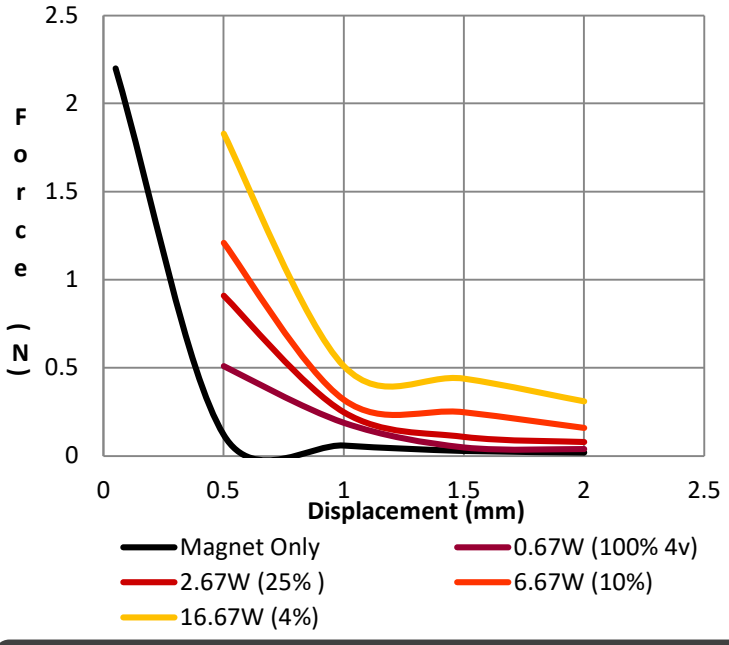
Life Expectancy (Cycles)	100,000
Mass	1.45 grammes
Plunger Mass	0.3 grammes
Board pins for termination	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



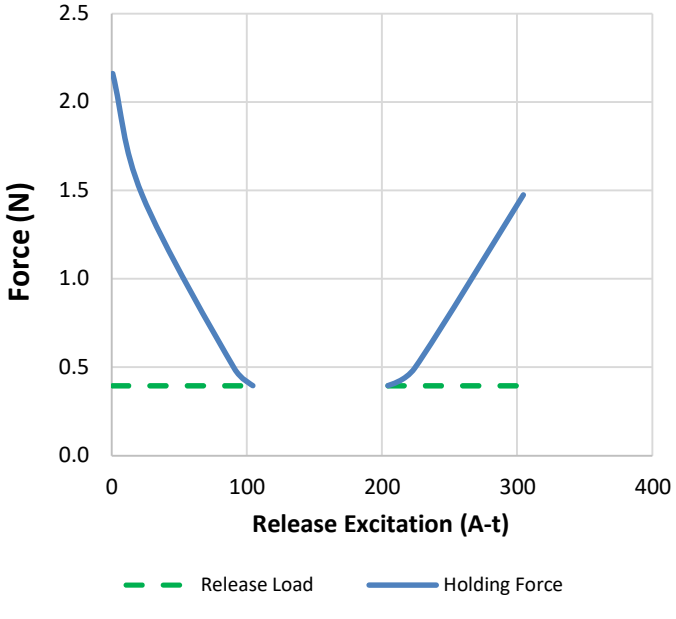




Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 5

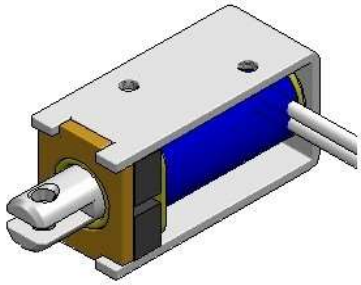
Watts at 20°C — 8.4

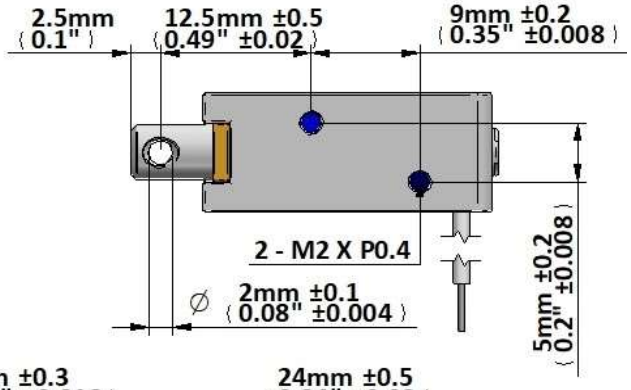
Ampere-Turns at 20°C — 452

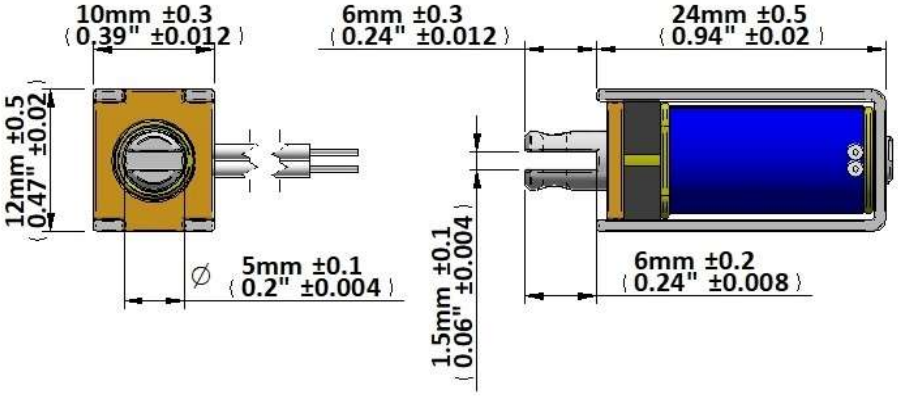
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LC-0524-06	4.3 Ω	340	6	360 mA
SH1LC-0524-12	17.1 Ω	630	12	200 mA
SH1LC-0524-24	68.6 Ω	1260	24	100 mA

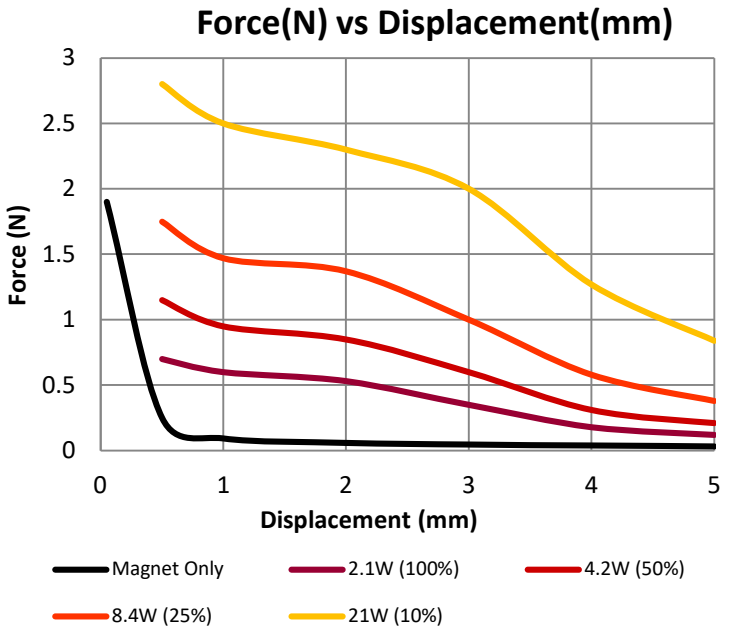
General Parameters

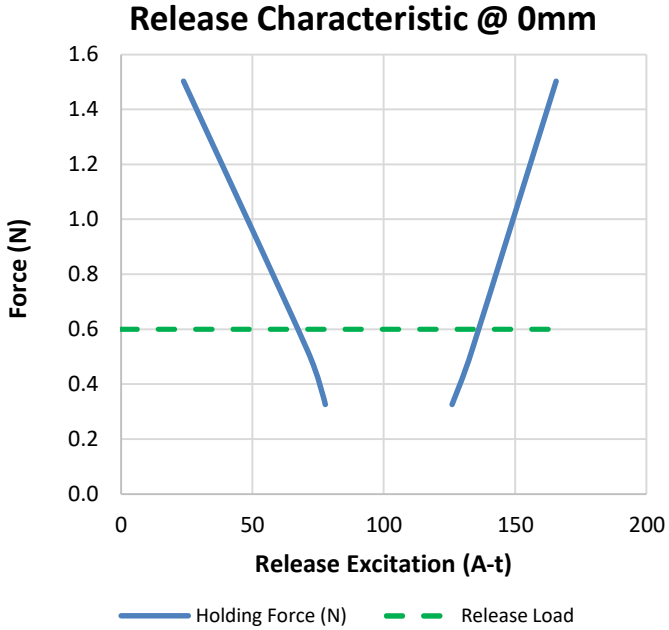
Life Expectancy (Cycles)	200,000
Mass	14.0 grammes
Plunger Mass	3.3 grammes
Leadwires 250mm (10")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	











GEEPLUS SH1LC-0730-xx

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 10

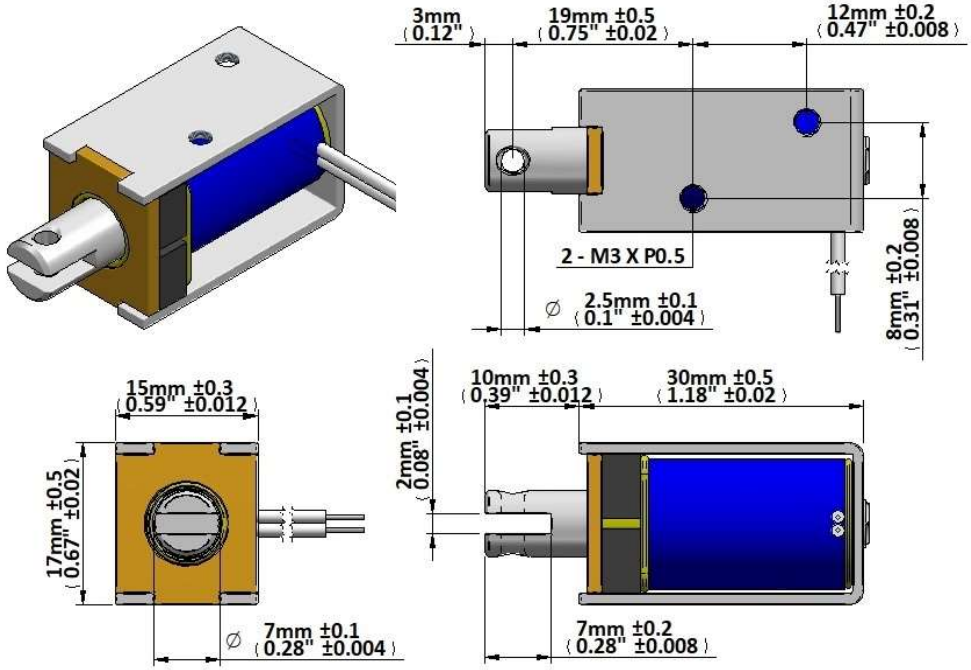
Watts at 20°C — 9.6

Ampere-Turns at 20°C — 614

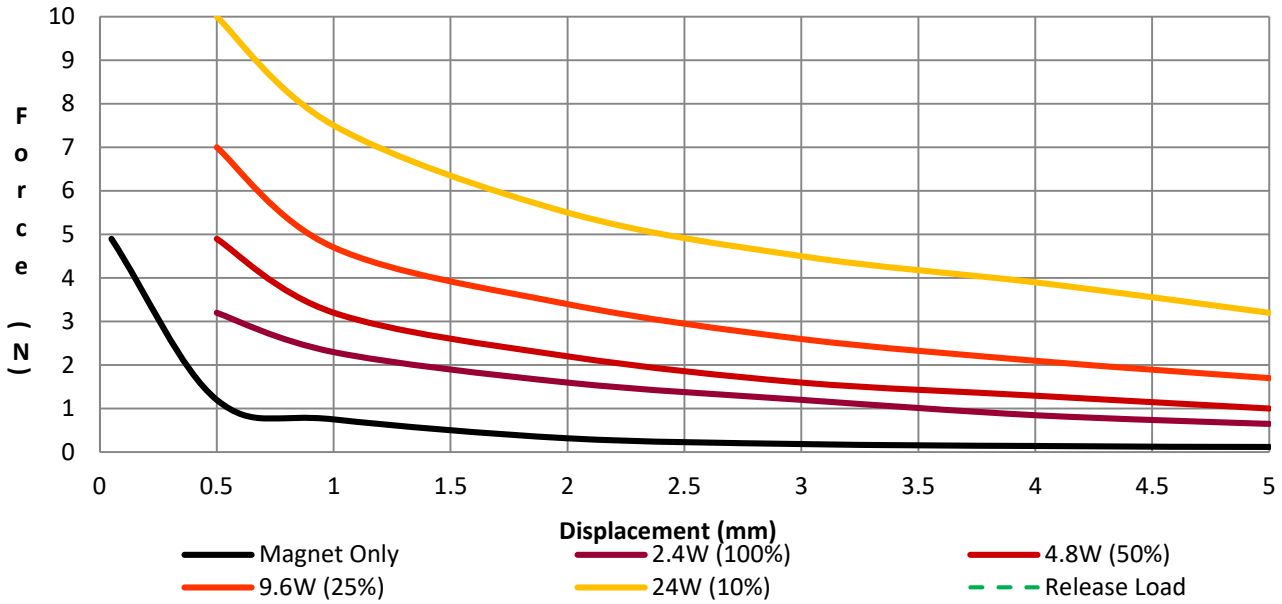
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LC-0730-06	3.8 Ω	385	6	650 mA
SH1LC-0730-12	15.0 Ω	780	12	320 mA
SH1LC-0730-24	60.0 Ω	1530	24	160 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	38.0 grammes
Plunger Mass	9.2 grammes
Leadwires 250mm (10")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 20

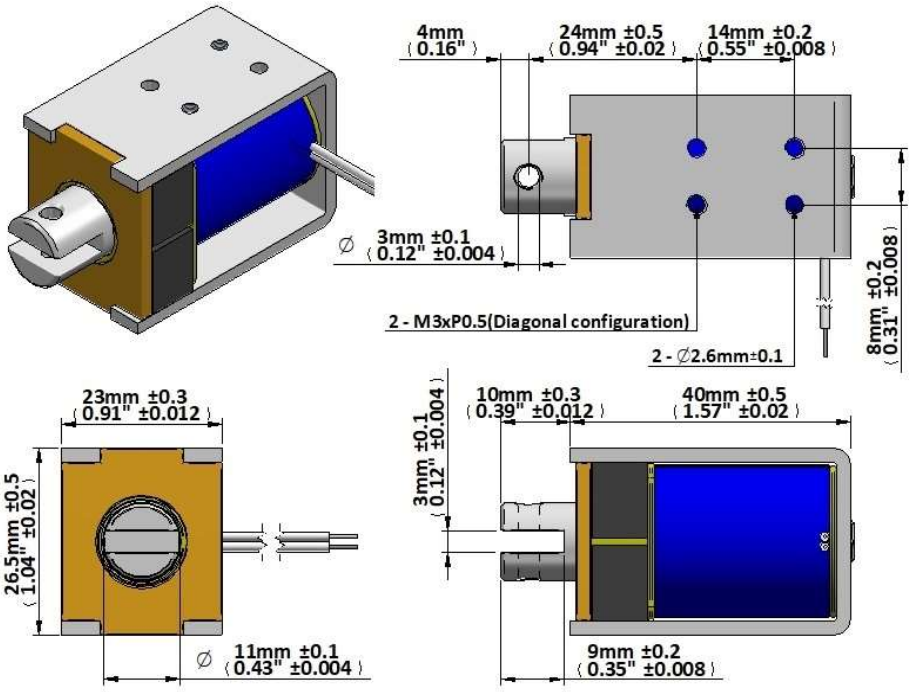
Watts at 20°C — 17.6

Ampere-Turns at 20°C — 968

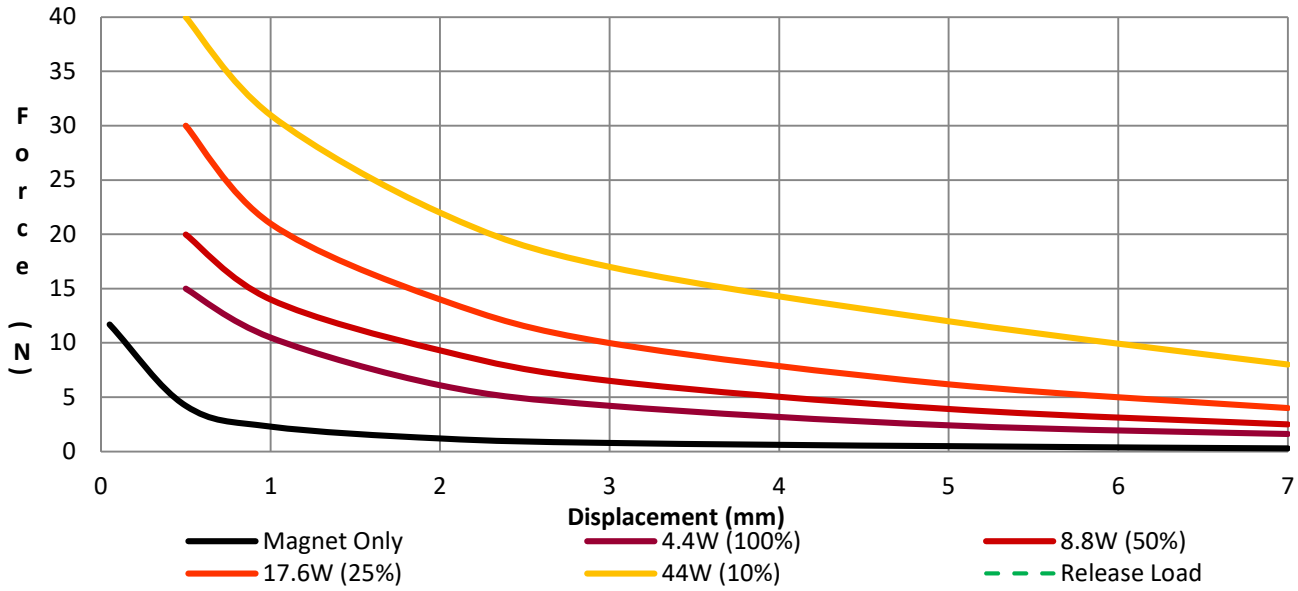
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LC-1140-06	2.1 Ω	340	6	1060 mA
SH1LC-1140-12	8.2 Ω	640	12	560 mA
SH1LC-1140-24	32.7 Ω	1360	24	260 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	120 grammes
Plunger Mass	28 grammes
Leadwires 250mm (10")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 20

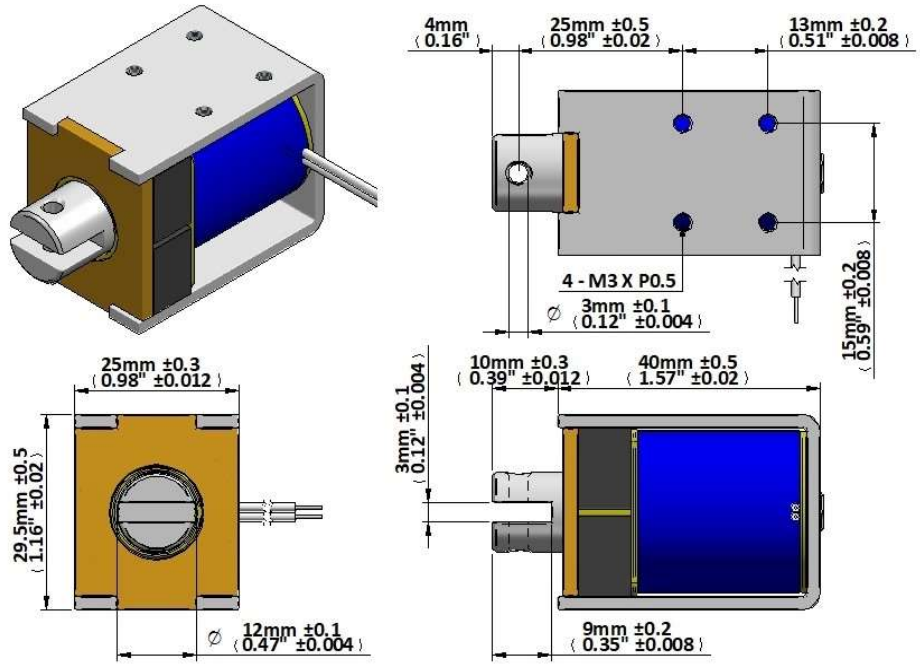
Watts at 20°C — 18.4

Ampere-Turns at 20°C — 979

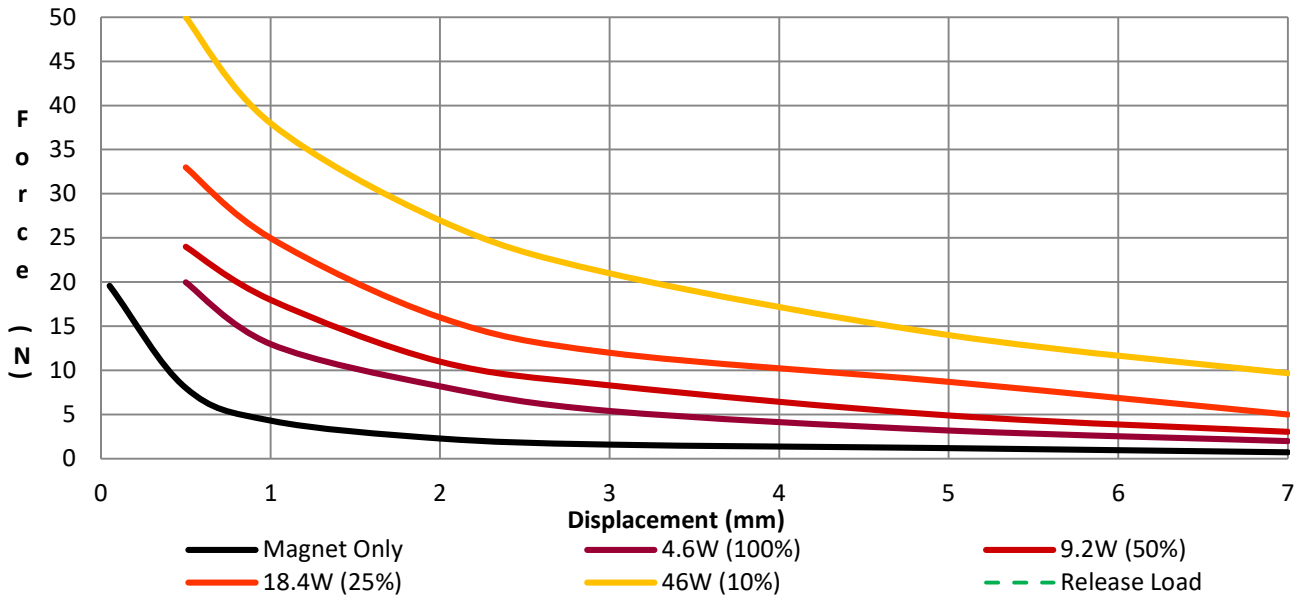
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LC-1240-06	2.0 Ω	320	6	1620 mA
SH1LC-1240-12	7.8 Ω	630	12	820 mA
SH1LC-1240-24	31.3 Ω	1315	24	400 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	145 grammes
Plunger Mass	34 grammes
Leadwires 250mm (10")min, UL1007, AWG24	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



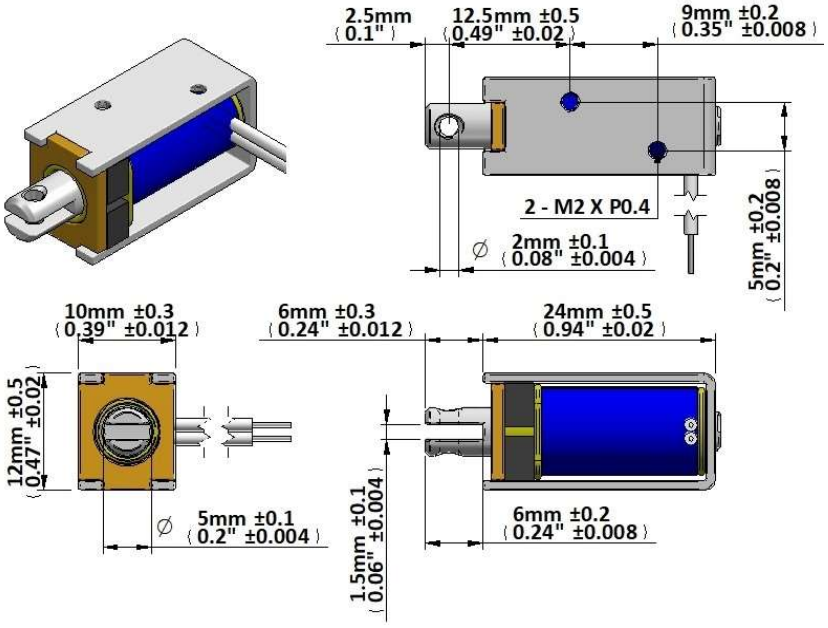
Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100%		25% ED
Maximum "on" time in seconds		5
Watts at 20°C		8.4
Ampere-Turns at 20°C		452

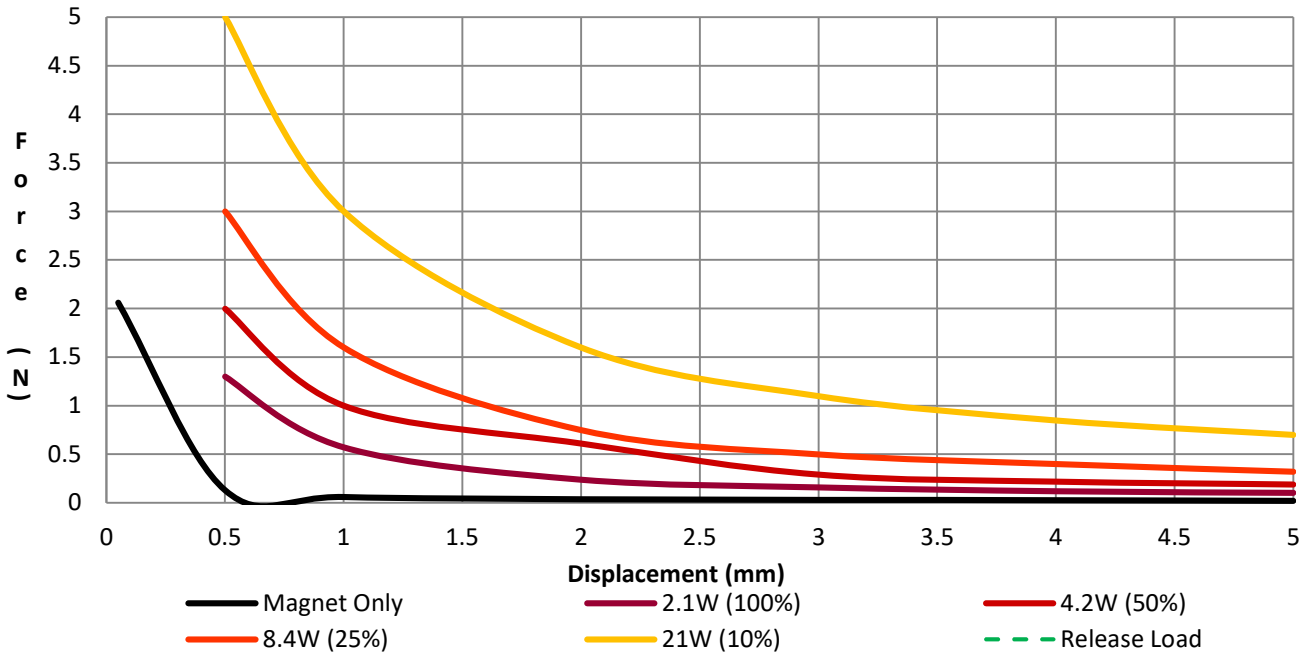
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LF-0524-06	4.3 Ω	340	6	360 mA
SH1LF-0524-12	17.1 Ω	630	12	200 mA
SH1LF-0524-24	68.6 Ω	1260	24	100 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	14.0 grammes
Plunger Mass	3.3 grammes
Leadwires 250mm (10")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



GEEPLUS SH1LF-0730-xx

Coil Data

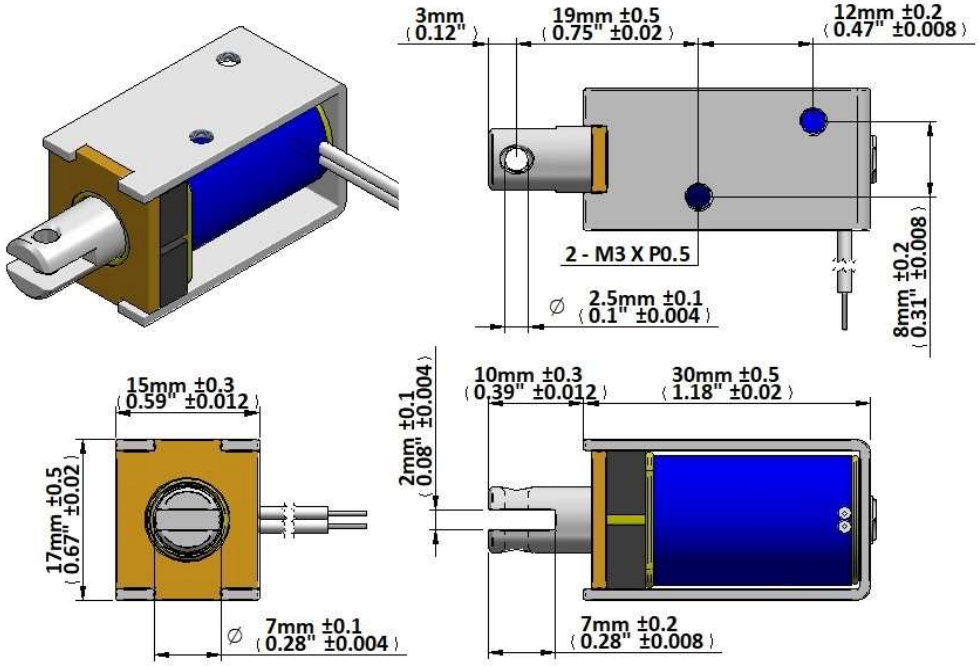
Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds	10
Watts at 20°C	9.6
Ampere-Turns at 20°C	614

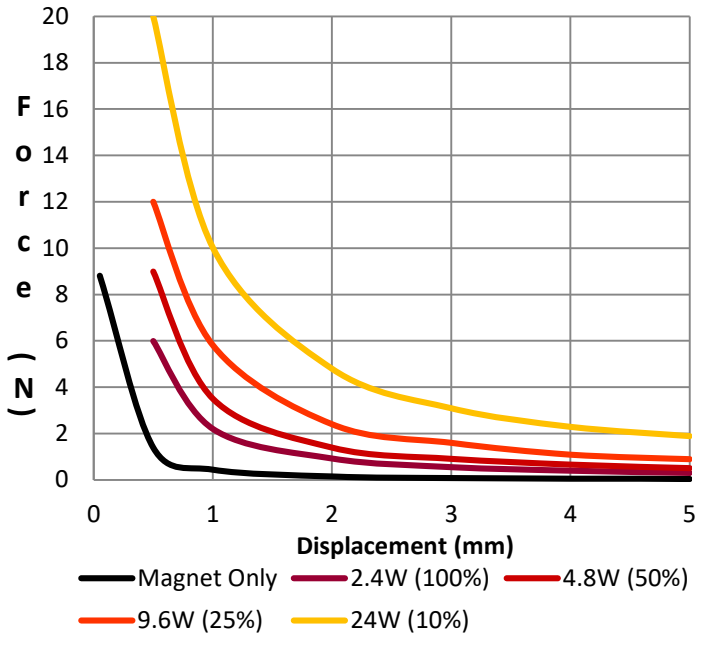
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LF-0730-06	3.8 Ω	385	6	650 mA
SH1LF-0730-12	15.0 Ω	780	12	320 mA
SH1LF-0730-24	60.0 Ω	1530	24	160 mA

General Parameters

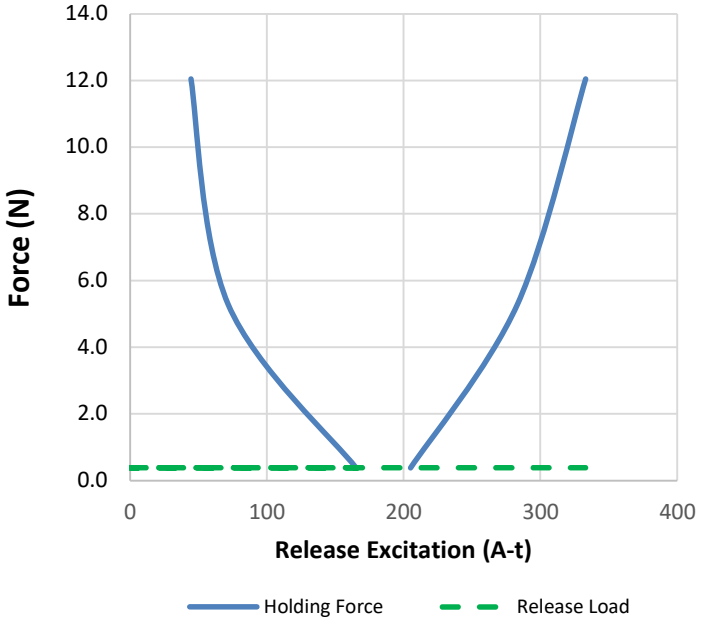
Life Expectancy (Cycles)	200,000
Mass	38.0 grammes
Plunger Mass	9.2 grammes
Leadwires 250mm (10")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS SH1LF-1140-xx

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 20

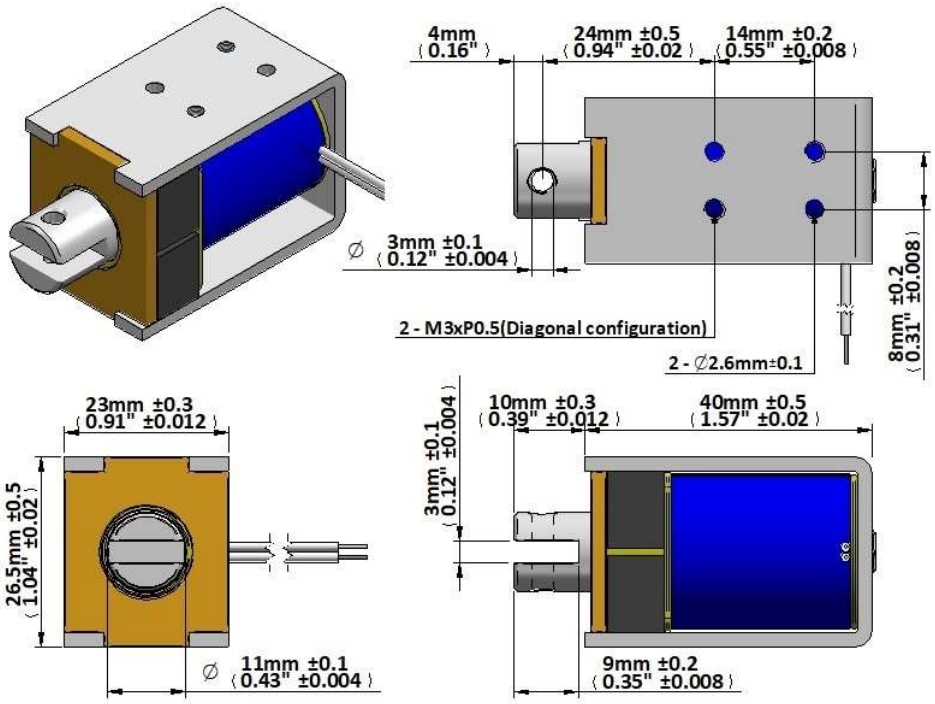
Watts at 20°C — 17.6

Ampere-Turns at 20°C — 968

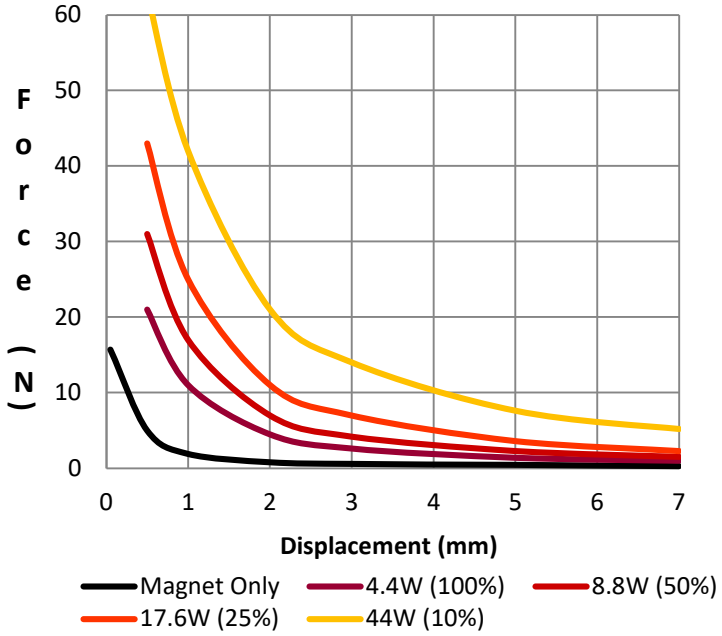
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LF-1140-06	2.1 Ω	340	6	1060 mA
SH1LF-1140-12	8.2 Ω	640	12	560 mA
SH1LF-1140-24	32.7 Ω	1360	24	260 mA

General Parameters

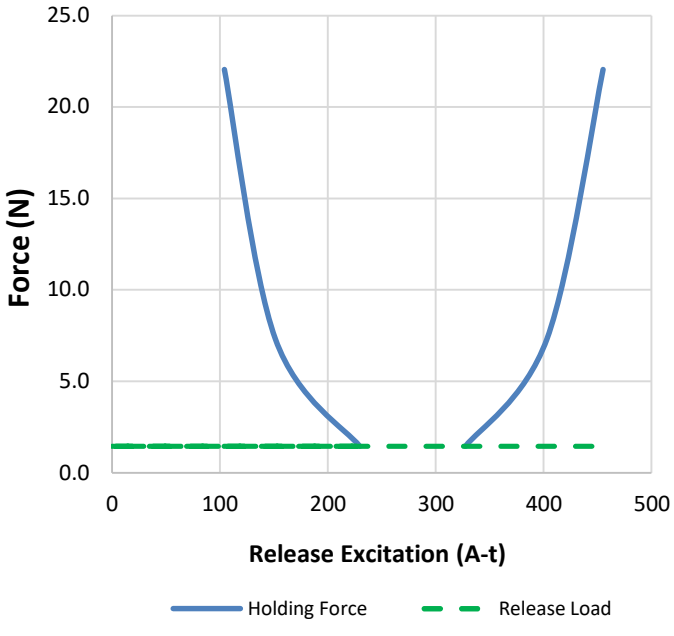
Life Expectancy (Cycles)	200,000
Mass	120 grammes
Plunger Mass	28 grammes
Leadwires 250mm (10")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS SH1LF-1240-xx

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 20

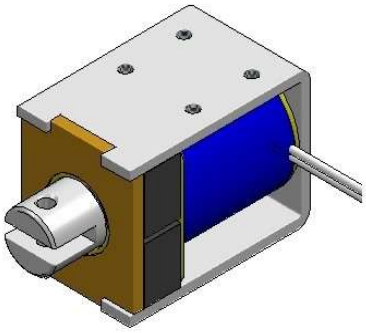
Watts at 20°C — 18.4

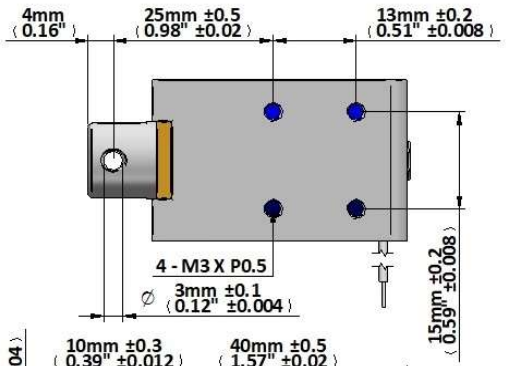
Ampere-Turns at 20°C — 979

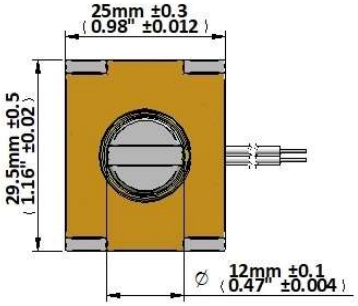
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
SH1LF-1240-06	2.0 Ω	320	6	1620 mA
SH1LF-1240-12	7.8 Ω	630	12	820 mA
SH1LF-1240-24	31.3 Ω	1315	24	400 mA

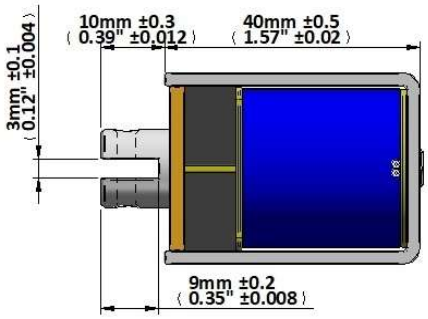
General Parameters

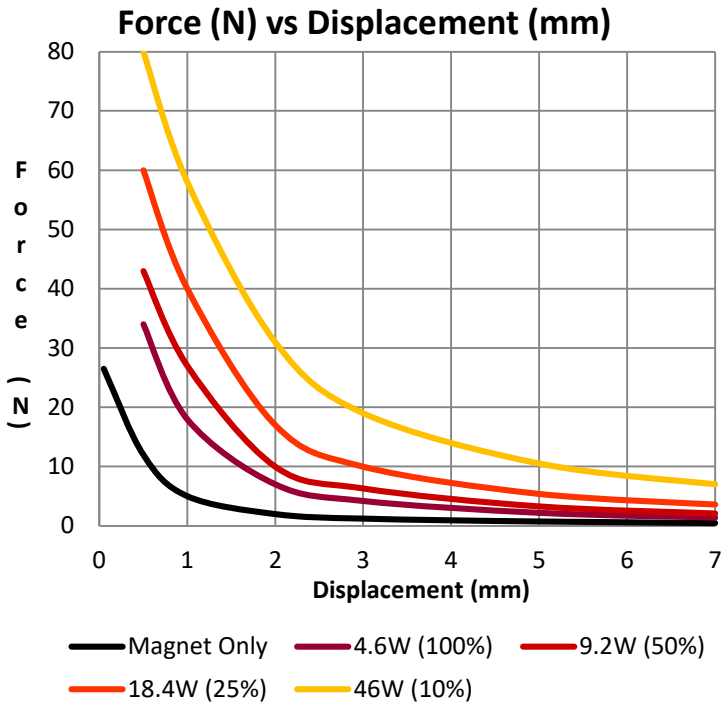
Life Expectancy (Cycles)	200,000
Mass	145 grammes
Plunger Mass	34 grammes
Leadwires 250mm (10")min, UL1007, AWG24	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	

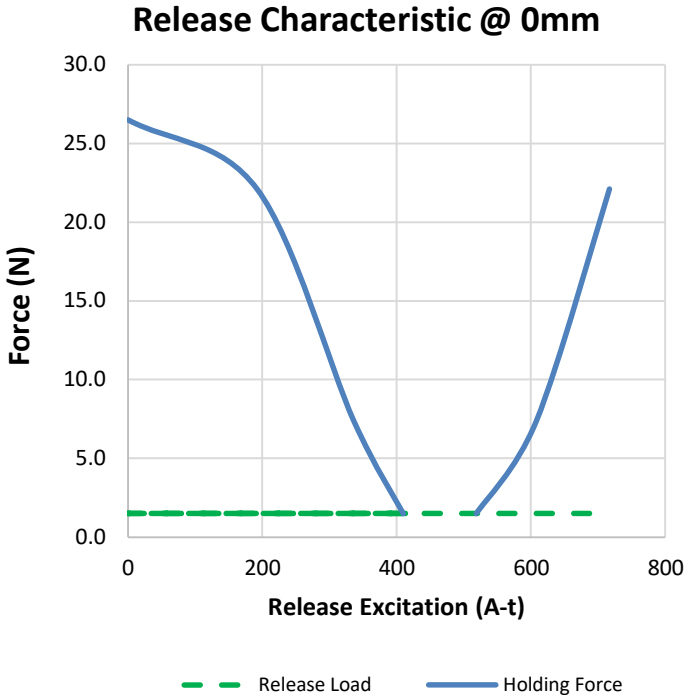












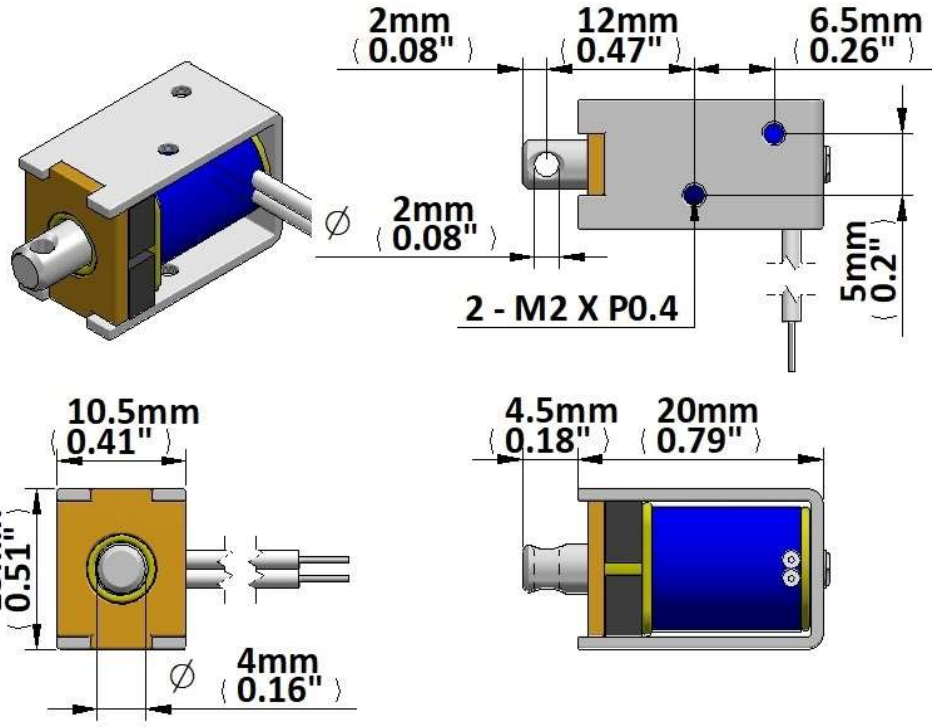
GEEPLUS T1L-0420-xxV

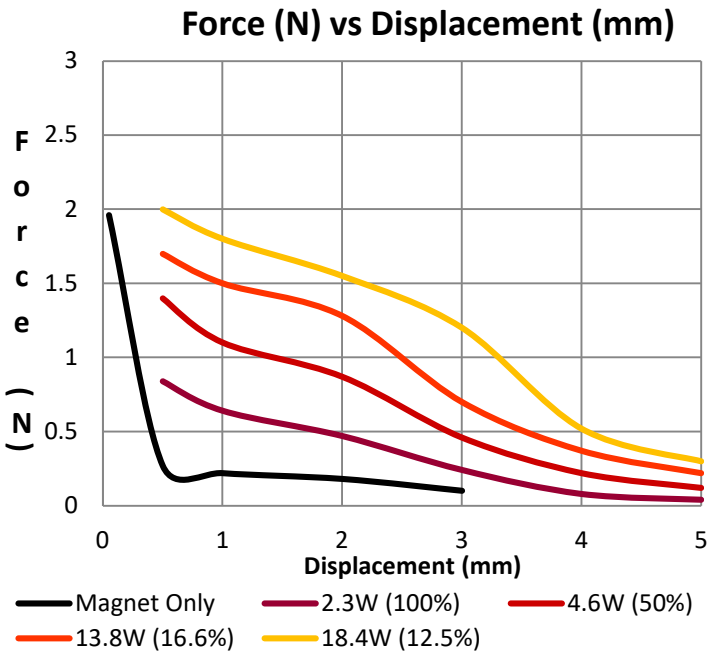
Coil Data

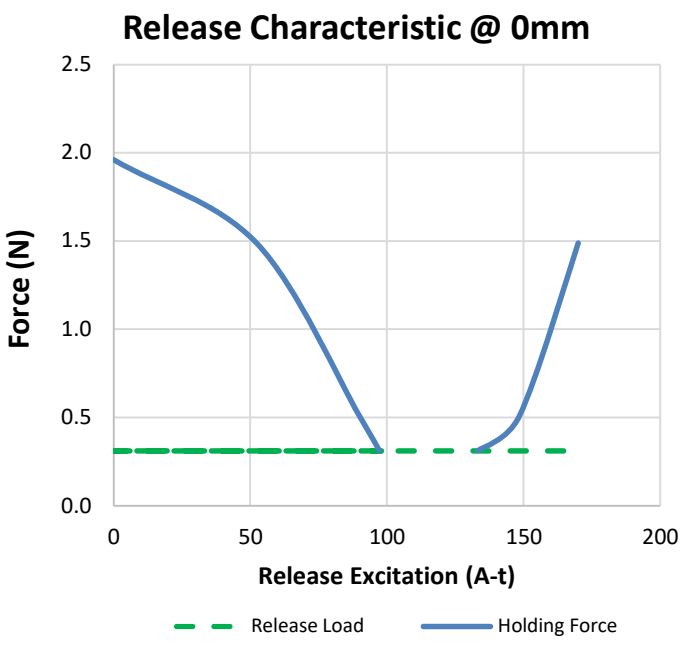
	Duty Cycle = "on" time / ("on" time + "off" time) x 100%			100% ED
	Maximum "on" time in seconds			∞
	Watts at 20°C			2.3
	Ampere-Turns at 20°C			340
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0420-6v	16.0 Ω	900	6	375 mA
T1L-0420-12v	63.0 Ω	1850	12	190 mA
T1L-0420-24v	250.0 Ω	3450	24	96 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	13.5 grammes
Plunger Mass	1.7 grammes
Leadwires 200mm (7.87")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	







GEEPLUS T1L-0421-xxV

Coil Data

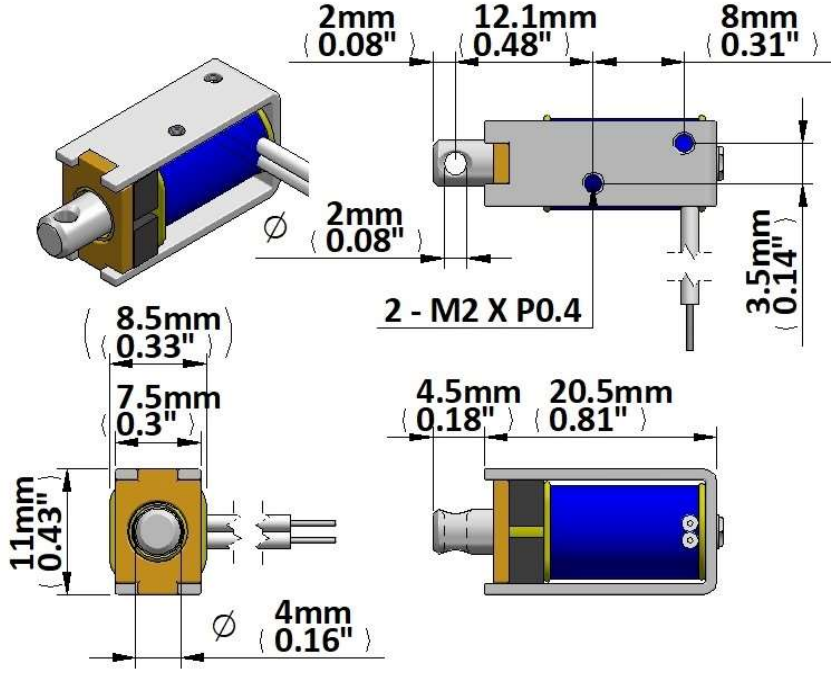
Duty Cycle = "on" time / ("on" time + "off" time) x 100%

	100% ED
Maximum "on" time in seconds	∞
Watts at 20°C	2.8
Ampere-Turns at 20°C	225

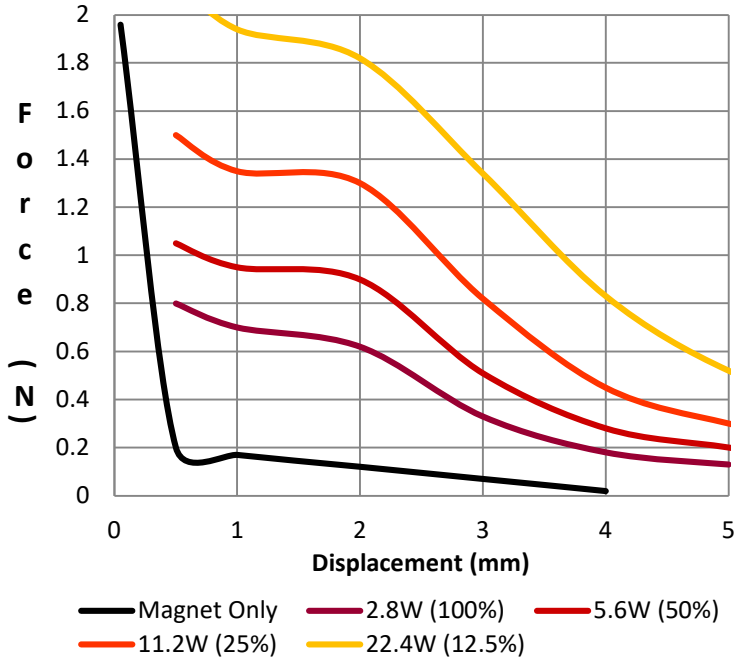
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0421-6v	12.9 Ω	480	6	465 mA
T1L-0421-12v	51.4 Ω	940	12	233 mA
T1L-0421-24v	205.7 Ω	1890	24	117 mA

General Parameters

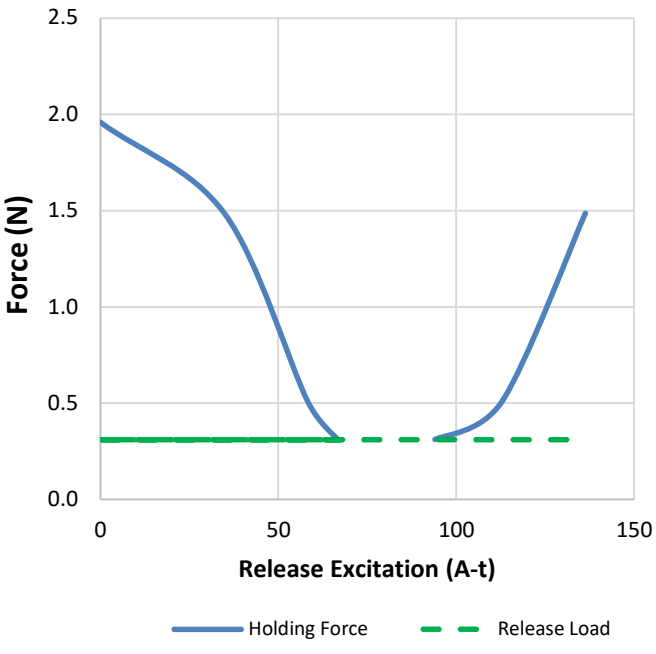
Life Expectancy (Cycles)	200,000
Mass	9.5 grammes
Plunger Mass	1.7 grammes
Leadwires 200mm (7.87")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS T1L-0422-xxV

Coil Data

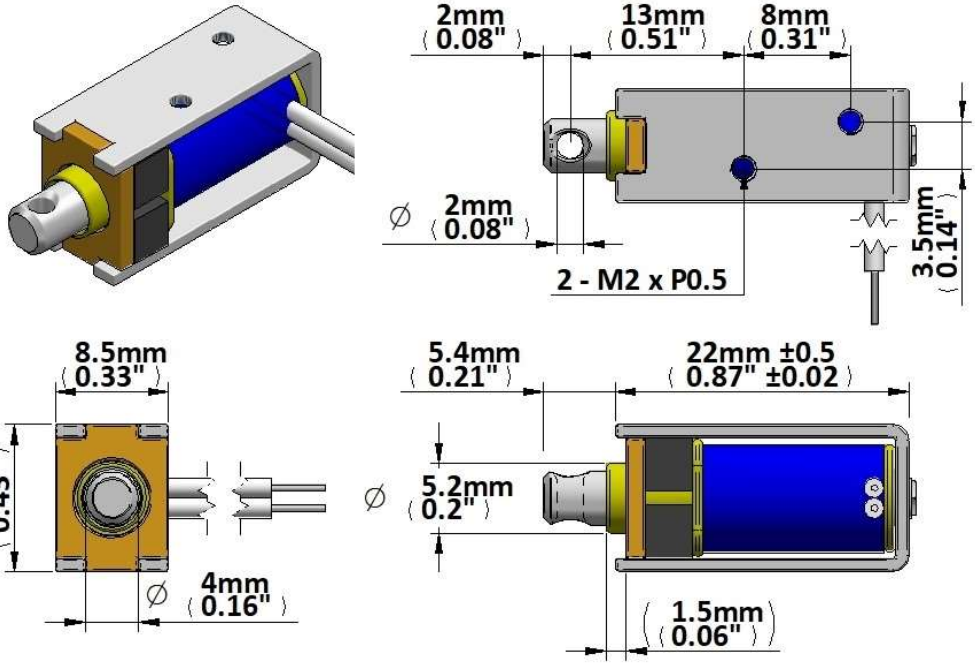
Duty Cycle = "on" time / ("on" time + "off" time) x 100%

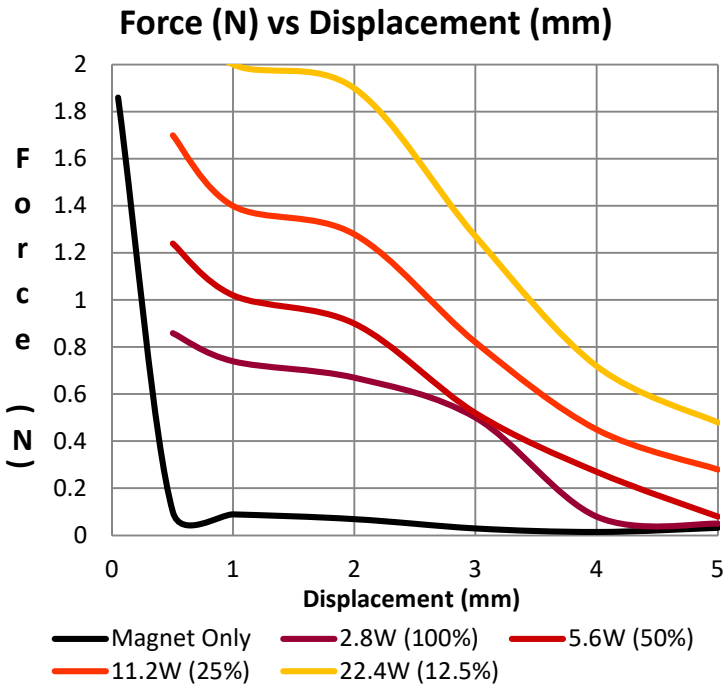
	100% ED
Maximum "on" time in seconds	∞
Watts at 20°C	2.8
Ampere-Turns at 20°C	225

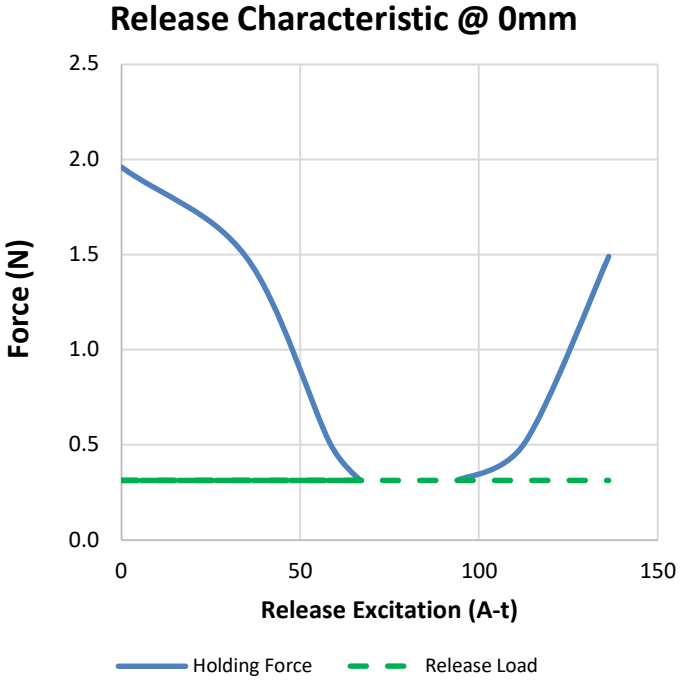
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0422-6v	12.9 Ω	480	6	465 mA
T1L-0422-12v	51.4 Ω	940	12	233 mA
T1L-0422-24v	206.0 Ω	1890	24	117 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	10.0 grammes
Plunger Mass	2.0 grammes
Leadwires 200mm (7.87")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	







GEEPLUS T1L-0625-xxV

Coil Data

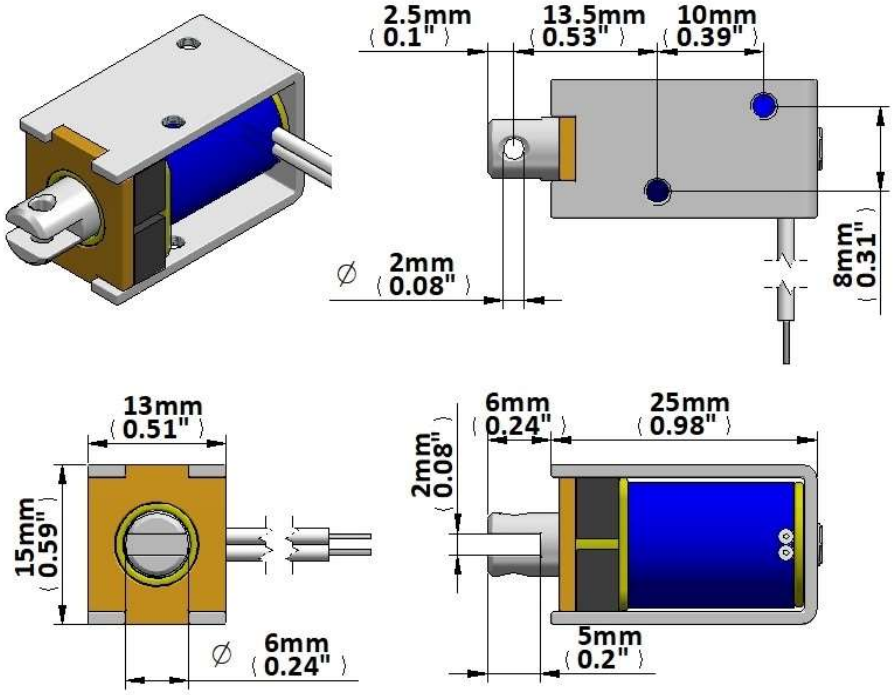
Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 50% ED

Maximum "on" time in seconds	8
Watts at 20°C	5.3
Ampere-Turns at 20°C	402

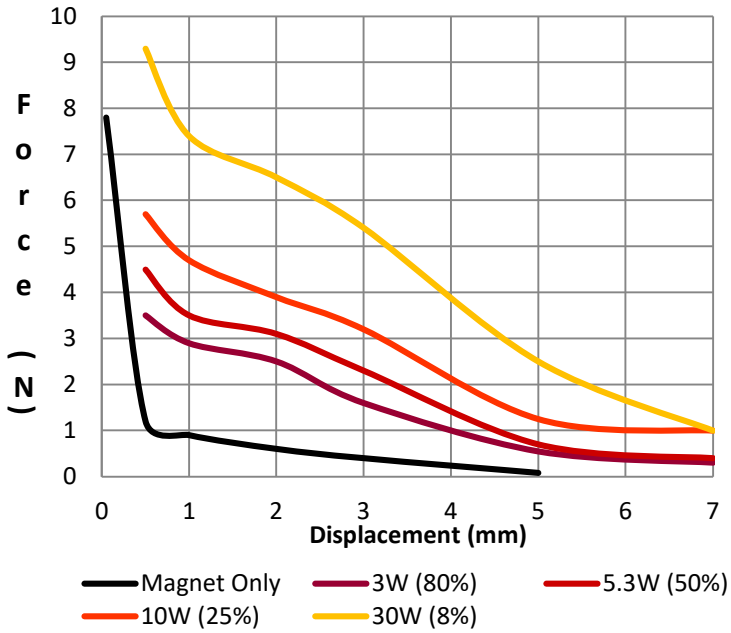
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0625-6v	6.8 Ω	456	6	882 mA
T1L-0625-12v	27.0 Ω	896	12	444 mA
T1L-0625-24v	108.0 Ω	1790	24	222 mA

General Parameters

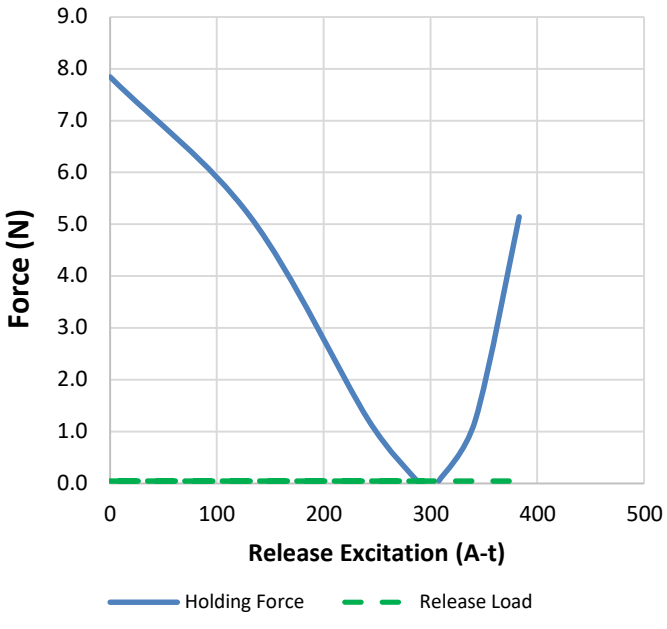
Life Expectancy (Cycles)	200,000
Mass	26 grammes
Plunger Mass	4.6 grammes
Leadwires 200mm (7.87")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS T1L-0730-xxV

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 50% ED

Maximum "on" time in seconds — 10

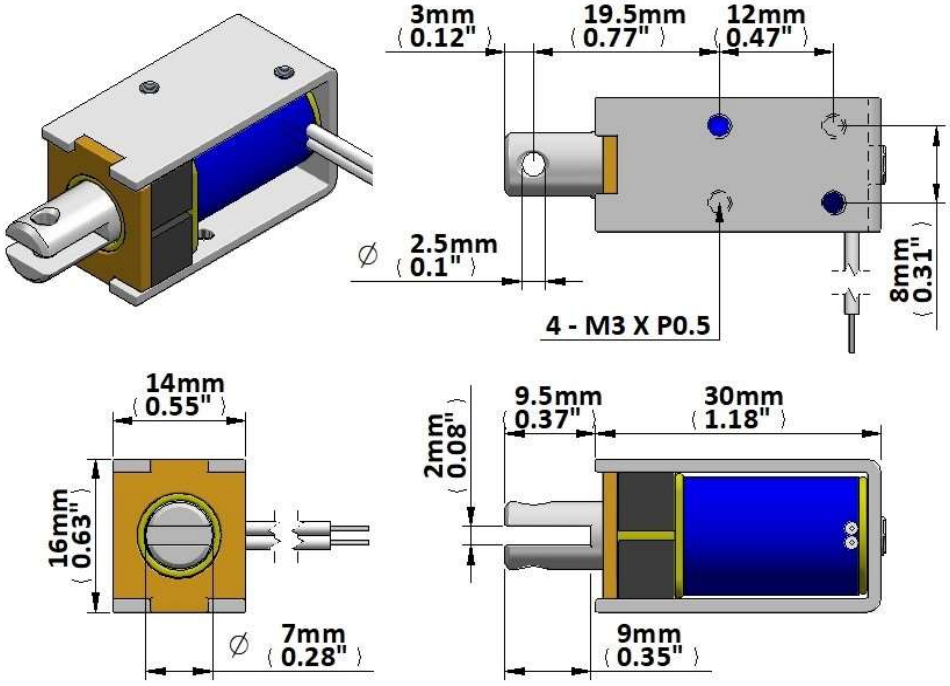
Watts at 20°C — 4.8

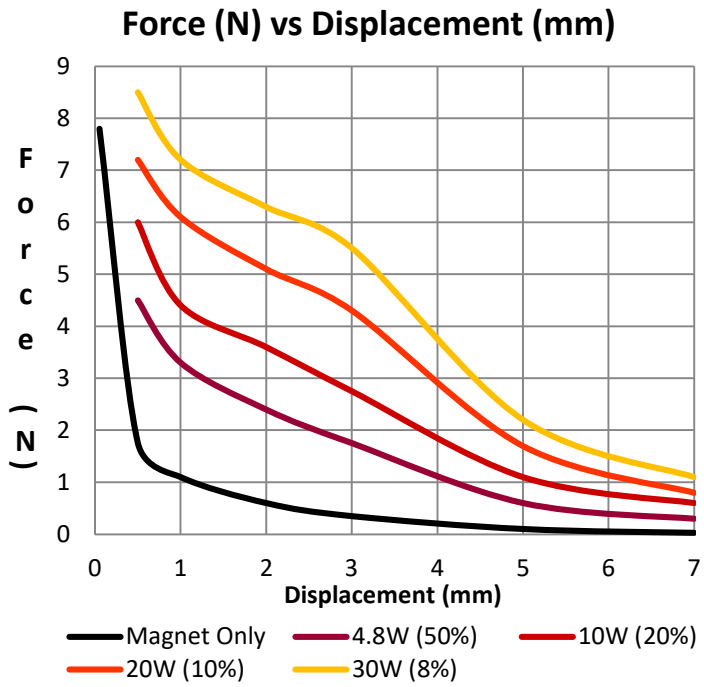
Ampere-Turns at 20°C — 360

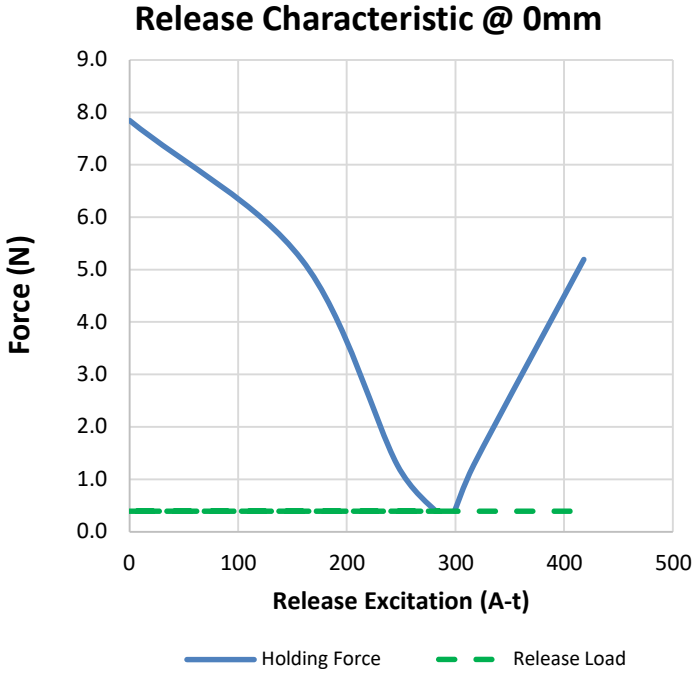
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0730-6v	7.5 Ω	450	6	800 mA
T1L-0730-12v	30.0 Ω	880	12	400 mA
T1L-0730-24v	120.0 Ω	1860	24	200 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	58 grammes
Plunger Mass	10.0 grammes
Leadwires 200mm (7.87")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	







Coil Data

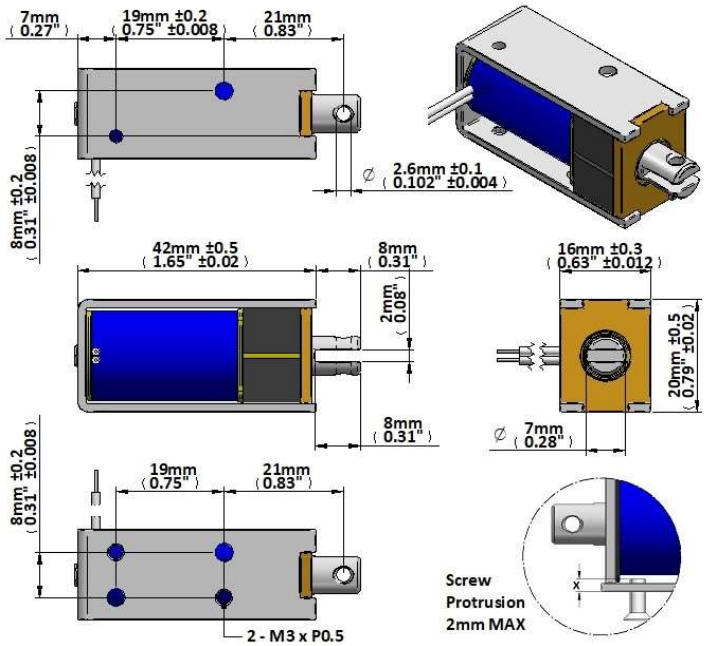
Duty Cycle = "on" time / ("on" time + "off" time) x 100%

	100% ED
Maximum "on" time in seconds	∞
Watts at 20°C	2
Ampere-Turns at 20°C	363

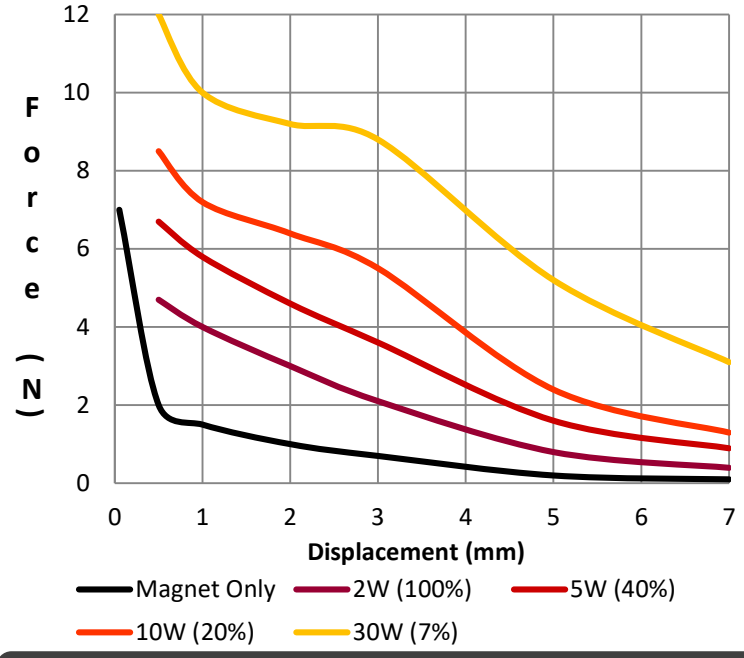
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-0742-6v	18.0 Ω	1090	6	333 mA
T1L-0742-12v	72.0 Ω	2080	12	167 mA
T1L-0742-24v	288.0 Ω	4086	24	83 mA

General Parameters

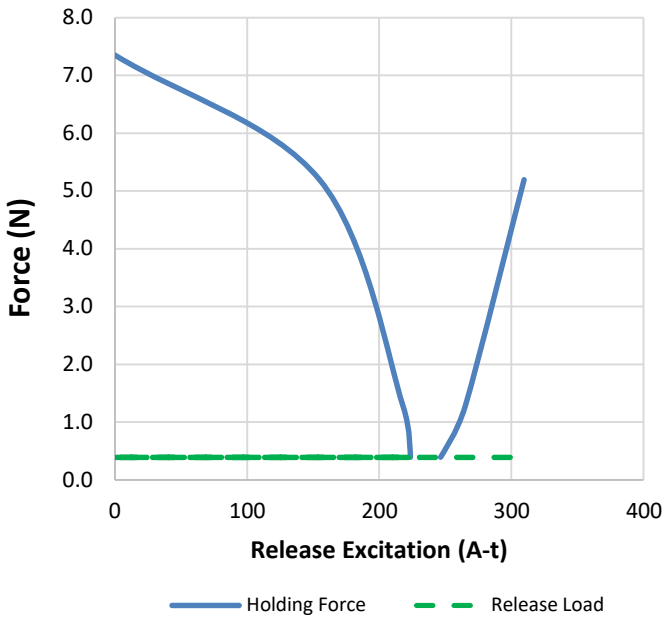
Life Expectancy (Cycles)	200,000
Mass	58 grammes
Plunger Mass	10.0 grammes
Leadwires 200mm (7.87")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS T1L-1037-xxV

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 25% ED

Maximum "on" time in seconds — 7

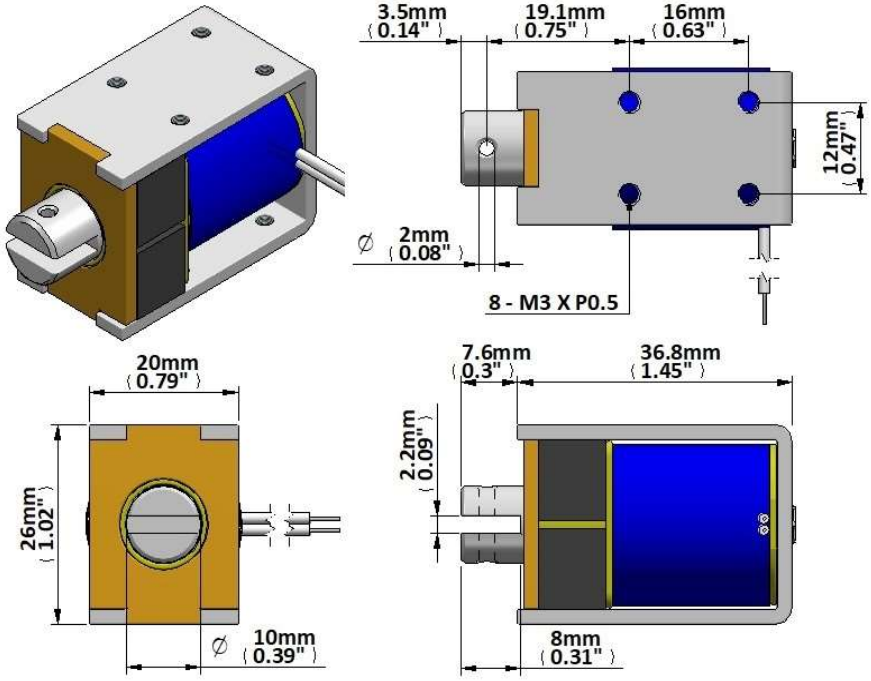
Watts at 20°C — 12

Ampere-Turns at 20°C — 675

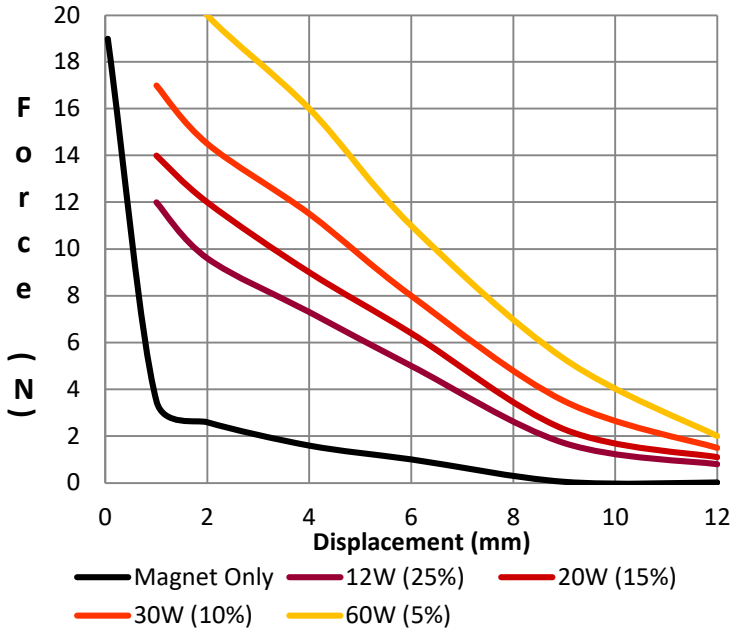
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-1037-6v	3.0 Ω	333	6	2000 mA
T1L-1037-12v	12.0 Ω	680	12	1000 mA
T1L-1037-24v	48.0 Ω	1350	24	500 mA

General Parameters

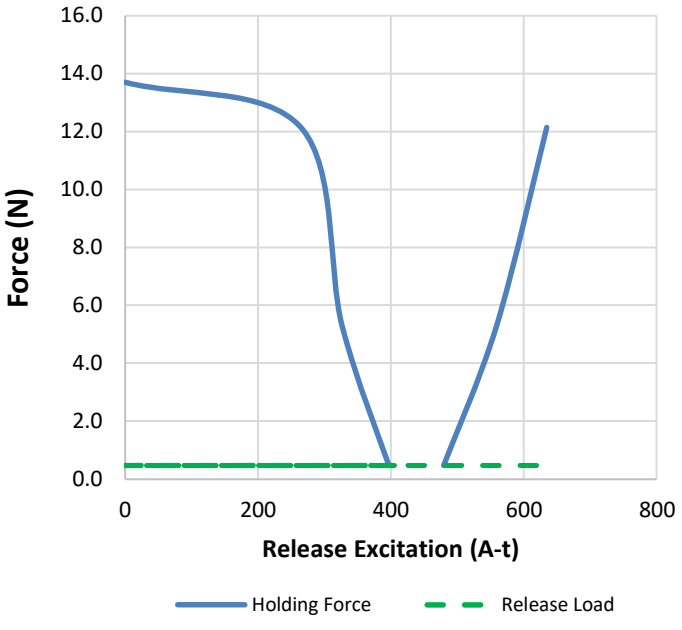
Life Expectancy (Cycles)	200,000
Mass	91 grammes
Plunger Mass	18.3 grammes
Leadwires 200mm (7.87")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	



Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 50% ED

Maximum "on" time in seconds — 15

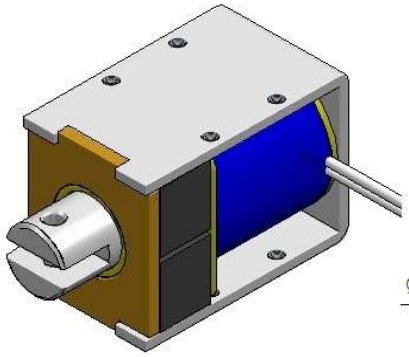
Watts at 20°C — 8

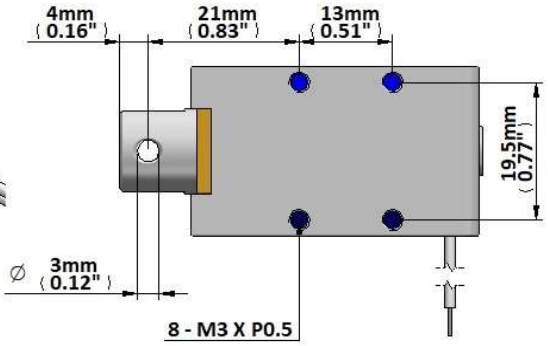
Ampere-Turns at 20°C — 620

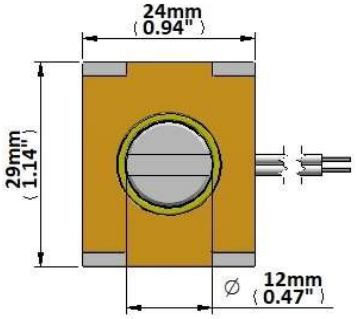
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-1240-6v	4.5 Ω	450	6	1333 mA
T1L-1240-12v	18.0 Ω	920	12	667 mA
T1L-1240-24v	72.0 Ω	1900	24	333 mA

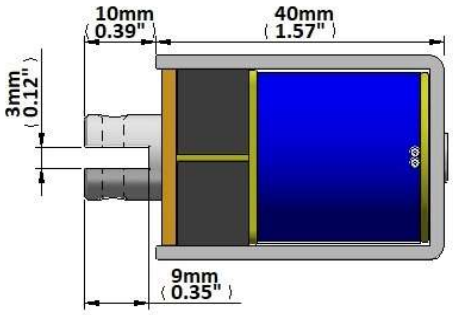
General Parameters

Life Expectancy (Cycles)	200,000
Mass	139 grammes
Plunger Mass	31.0 grammes
Leadwires 200mm (7.87")min, UL1007, AWG24	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	

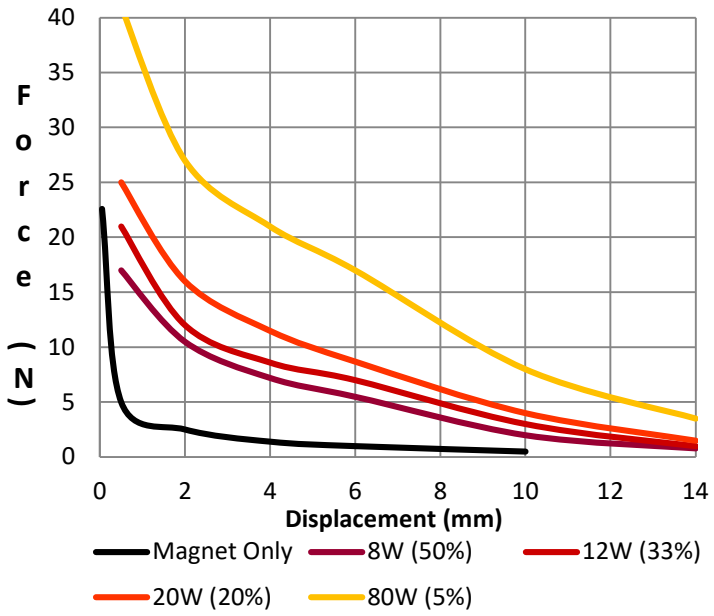




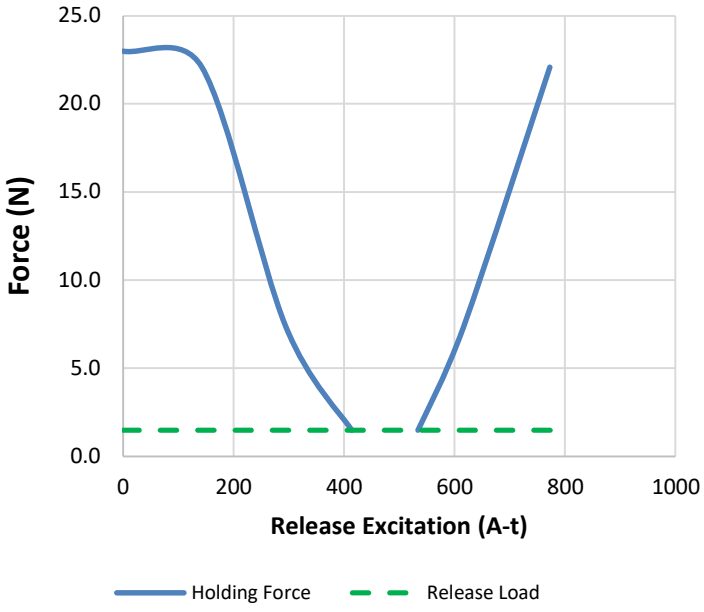




Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



GEEPLUS T1L-1253-xxV

Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 50% ED

Maximum "on" time in seconds — 20

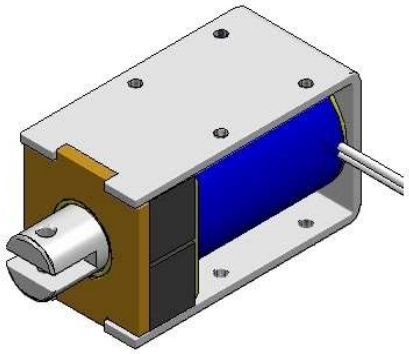
Watts at 20°C — 10

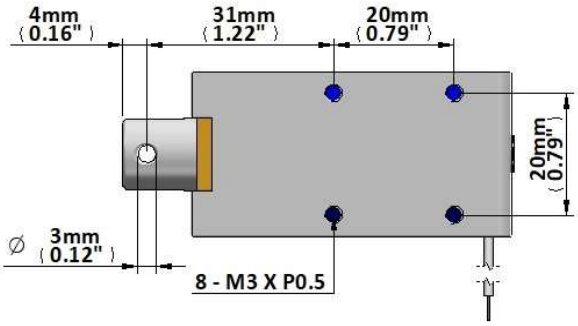
Ampere-Turns at 20°C — 840

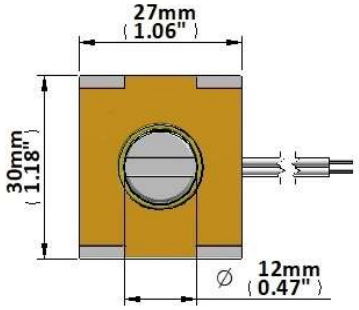
P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
T1L-1253-6v	3.6 Ω	515	6	1670 mA
T1L-1253-12v	14.4 Ω	1020	12	830 mA
T1L-1253-24v	57.6 Ω	2050	24	420 mA

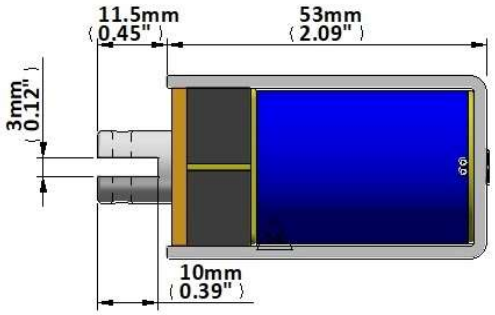
General Parameters

Life Expectancy (Cycles)	200,000
Mass	216 grammes
Plunger Mass	42.8 grammes
Leadwires 200mm (7.87")min, UL1007, AWG24	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >50MΩ, 500V DC Megger	

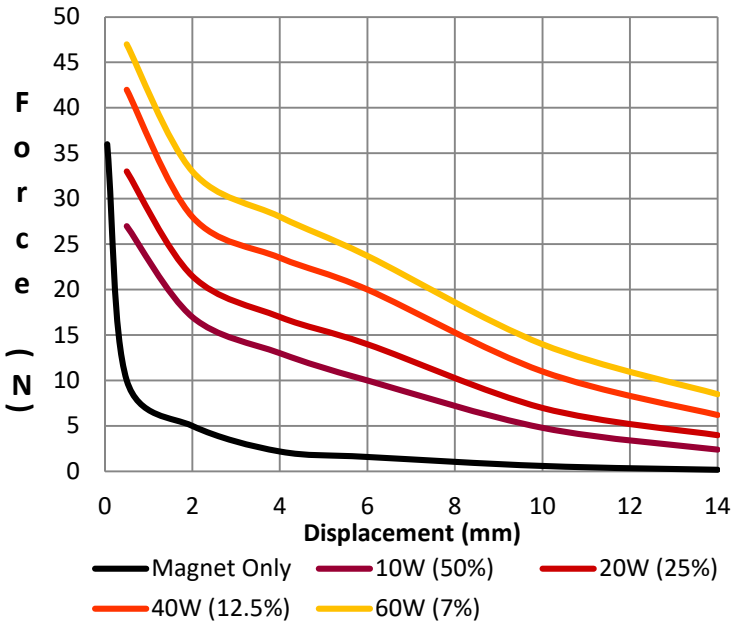




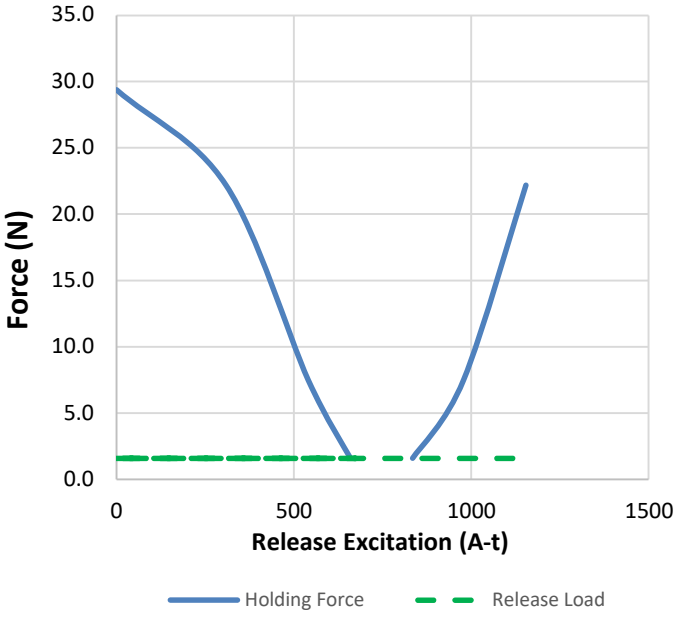




Force (N) vs Displacement (mm)



Release Characteristic @ 0mm



Coil Data

Duty Cycle = "on" time / ("on" time + "off" time) x 100% — 5% ED

Maximum "on" time in seconds — 2

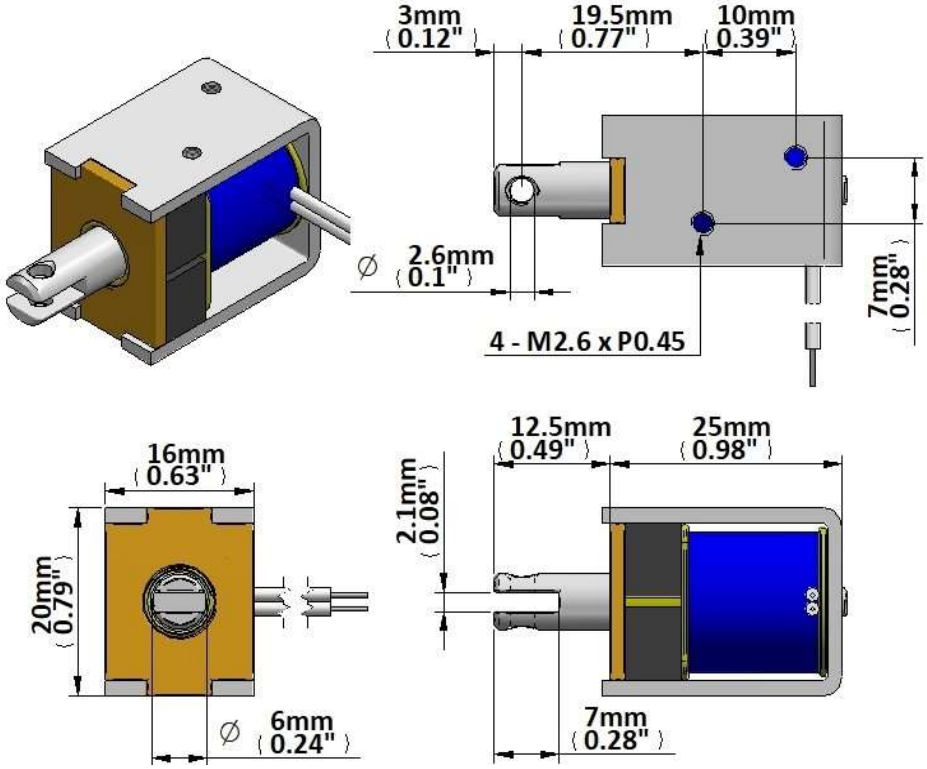
Watts at 20°C — 42

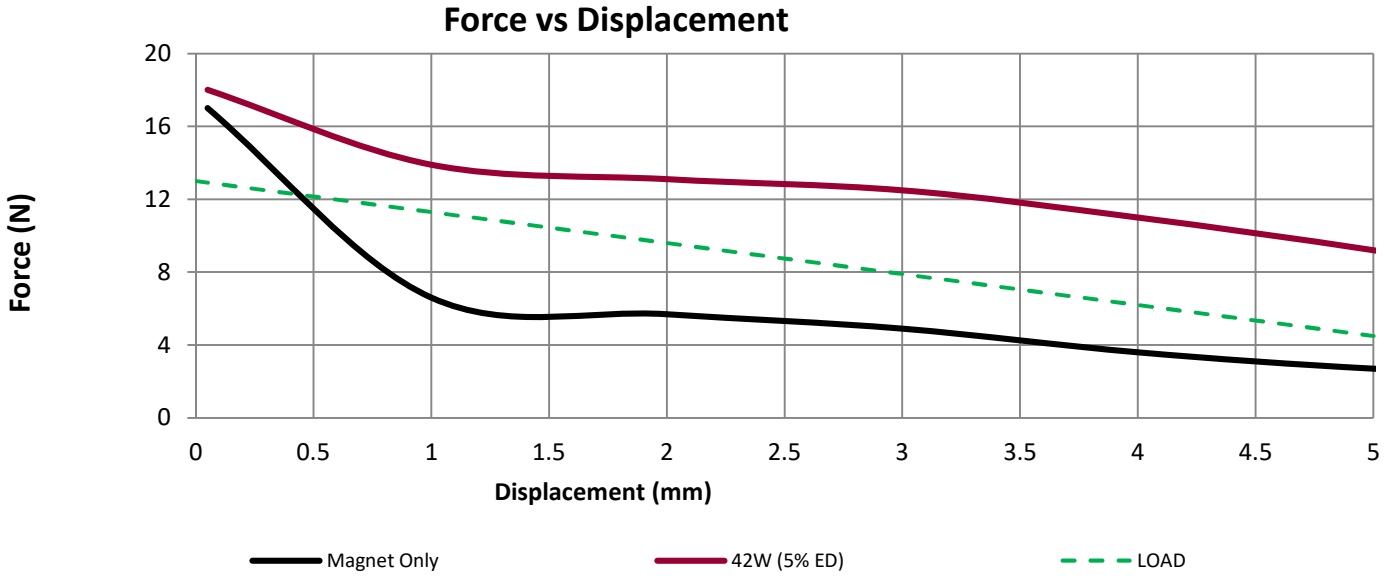
Ampere-Turns at 20°C — 350

P/N	Resistance ±10% @ 20°C	Coil Turns	Volts DC	Release Current
RD-1LRE0625-6V	0.7 Ω	219	6	8570 mA
RD-1LRE0625-12V	3.4 Ω	450	12	3520 mA
RD-1LRE0625-24V	16.0 Ω	950	24	1500 mA

General Parameters

Life Expectancy (Cycles)	200,000
Mass	37.0 grammes
Plunger Mass	4.0 grammes
Leadwires 300mm (11.81")min, UL1007, AWG26	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	

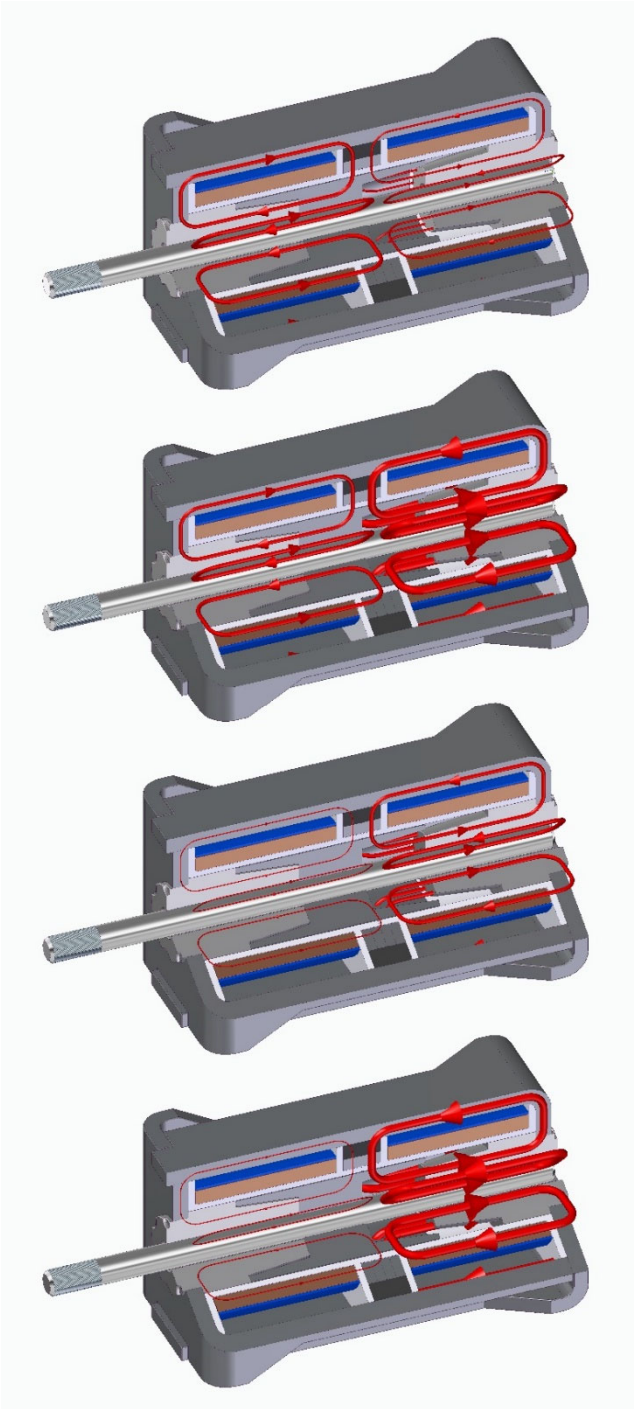




2-COIL LATCHING SOLENOID

The 2-coil latching solenoid is constructed and should be driven as described below.

The top view shows the solenoid in the de-energised condition (with no power applied). As drawn the plunger is in the left-most position. Permanent magnets in the centre of the solenoid drive magnetic flux into the plunger, the flux flows through the plunger into the polepiece at either end or returns through the steel frame around the solenoid. The gap between the plunger and polepiece is shorter at the left-most side, this results in smaller magnetic reluctance. More flux flows on this side and the solenoid holds this position without power. The solenoid can be driven to the right in one of the following three ways:



1. If the right-most coil is energised with forward polarity, the excitation will increase the flux flowing around this end of the solenoid, when this becomes larger than the flux flowing around the left end, then more force will be developed, and the plunger will be pulled across to the right end.
2. If the leftmost coil is energised with reverse polarity, the excitation will oppose the field due to the magnets and reduce the magnetic flux flowing in this end. As the current increases this will reduce further, when the flux is smaller than that flowing in the right end the plunger will be drawn to the right end.
3. If the right coil is energised with the current of forward polarity, and the left coil with the current of reverse polarity, then the magnetic flux in the left end will reduce, and flux in the right end will increase. The maximum force is developed when flux in the left end reduces to zero, and high flux is induced with forward current in the right coil.

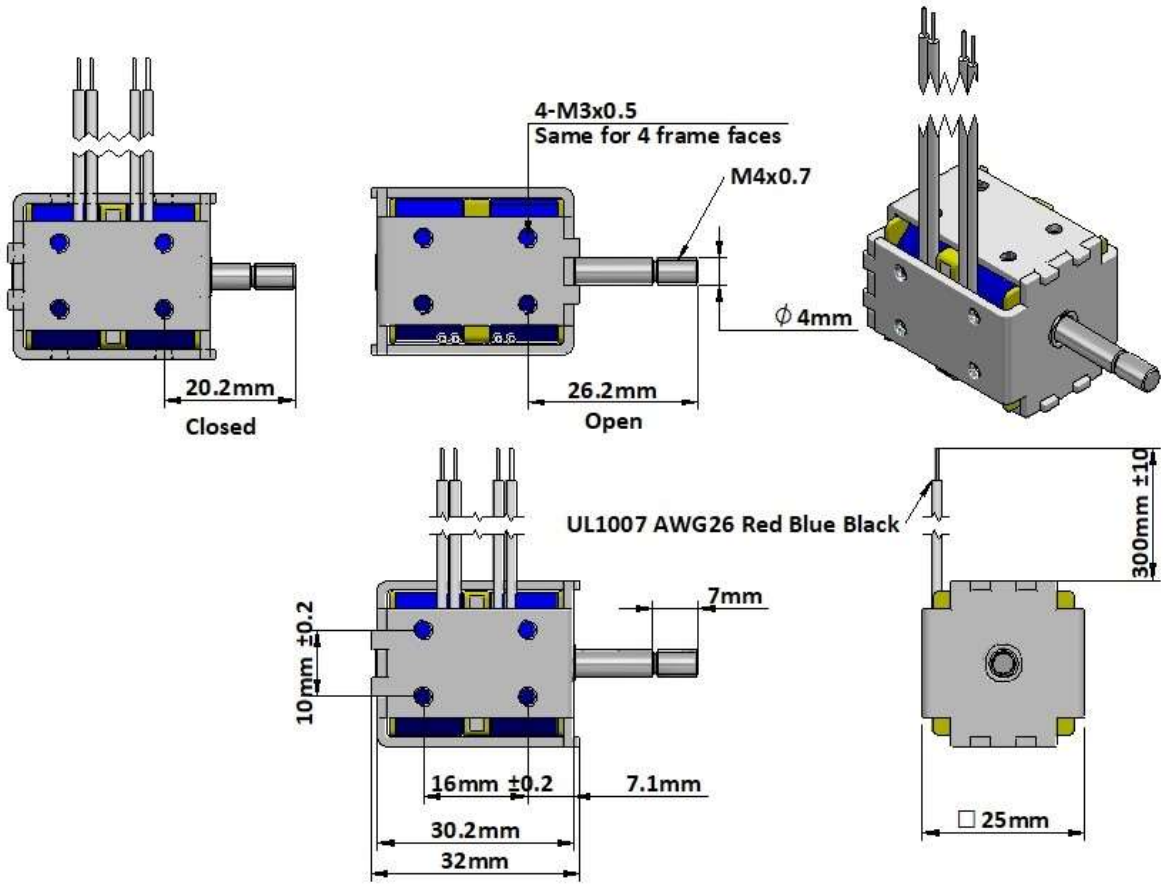
GEEPLUS RD2L-0932-24v

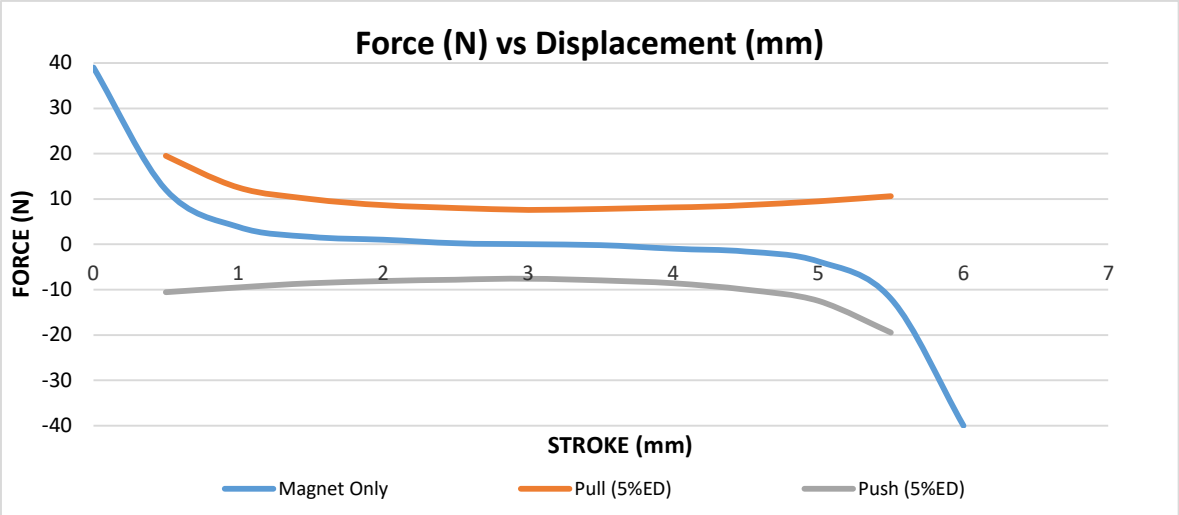
Coil Data

P/N			5% ED	
	Maximum "on" time in seconds		70ms	
	Watts at 20°C		72	
	Ampere-Turns at 20°C		-	
RD2L-0932-24v	Resistance ±10% @ 20°C	Amp-turns	Volts DC	Wire Colour
Coil 1	8 Ω	TBA	24	Red-Blue
Coil 2	8 Ω	TBA	24	Red-Black

General Parameters

Life Expectancy (Cycles)	500,000
Mass	86g
Leadwires 300mm (12")min, UL1007, AWG28	
Insulation Class	E (120°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



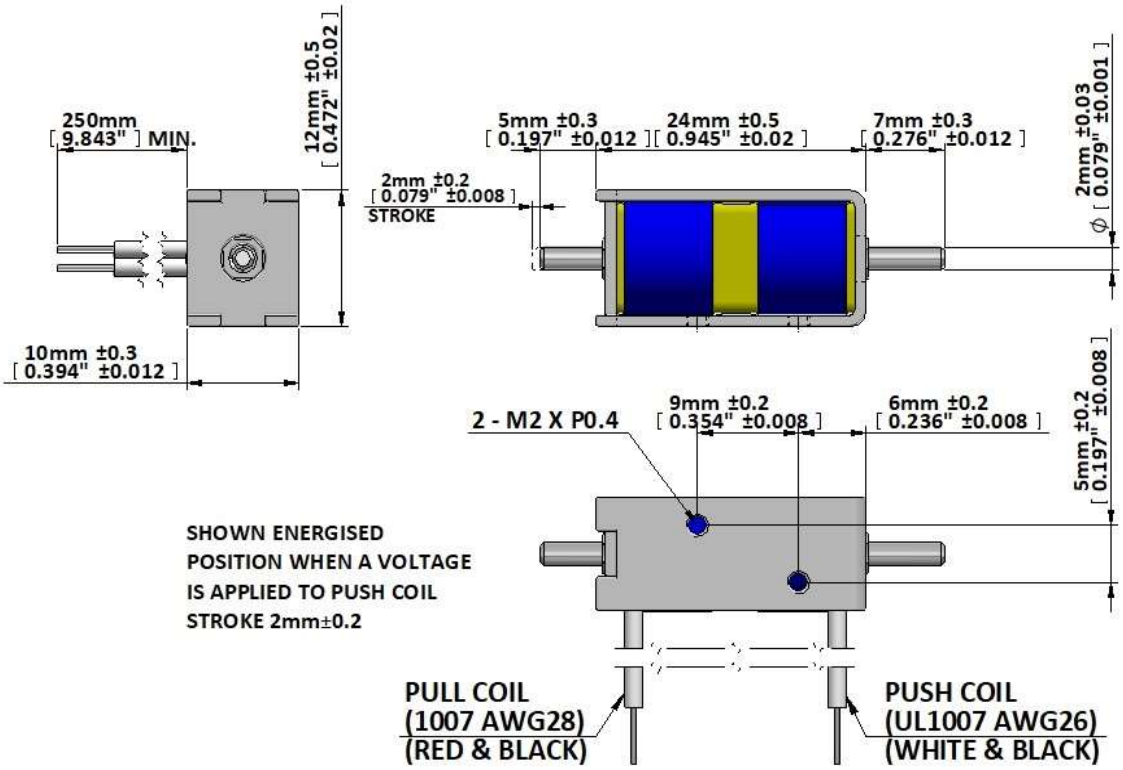


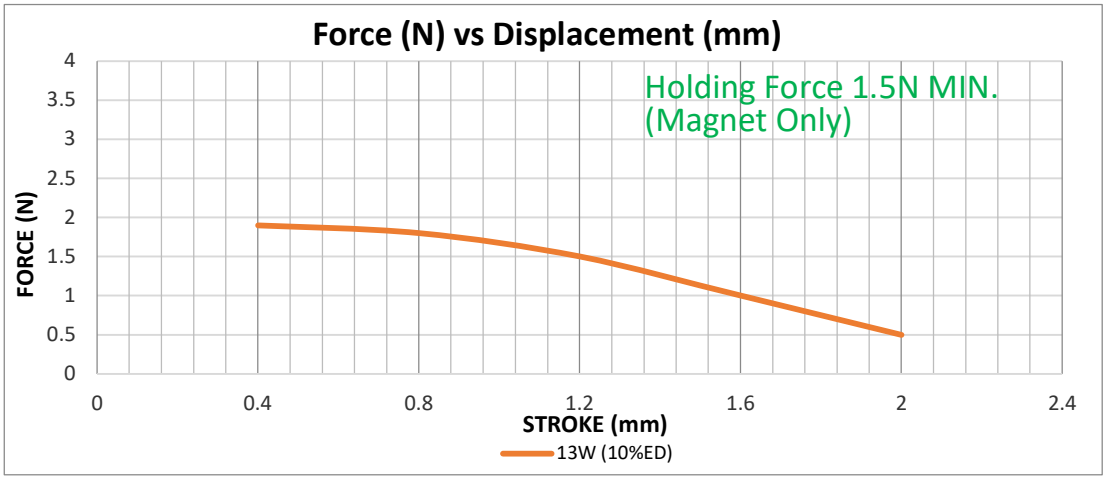
Coil Data

P/N	Duty Cycle = "on" time / ("on" time + "off" time) x 100%		10% ED
	Maximum "on" time in seconds		1
	Watts at 20°C		13
	Ampere-Turns at 20°C		364
SH2LC-0524-XXv	Resistance ±10% @ 20°C	Amp-turns	Volts DC
SH2LC-0524-06v	2.8Ω	166	6
SH2LC-0524-12v	11.1Ω	345	12
SH2LC-0524-24v	44.3Ω	670	24

General Parameters

Life Expectancy (Cycles)	200,000
Mass	15g
Plunger Mass	3g
Leadwires 250mm (9.84")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



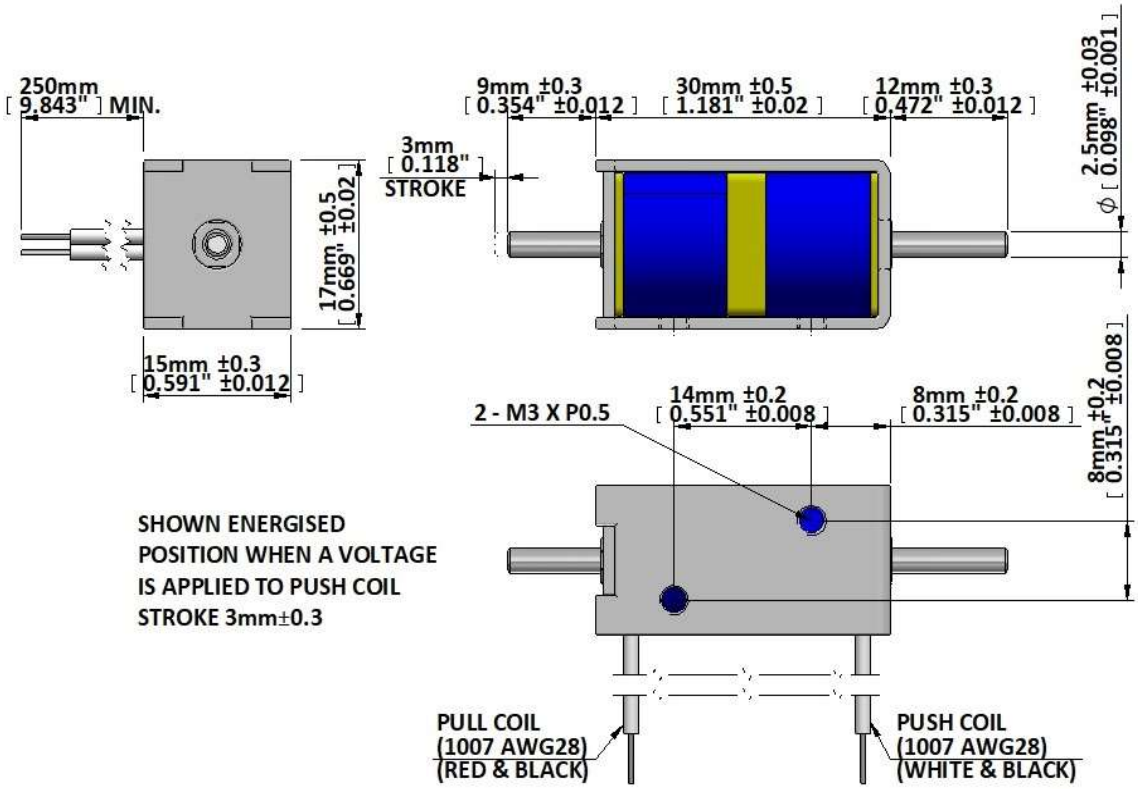


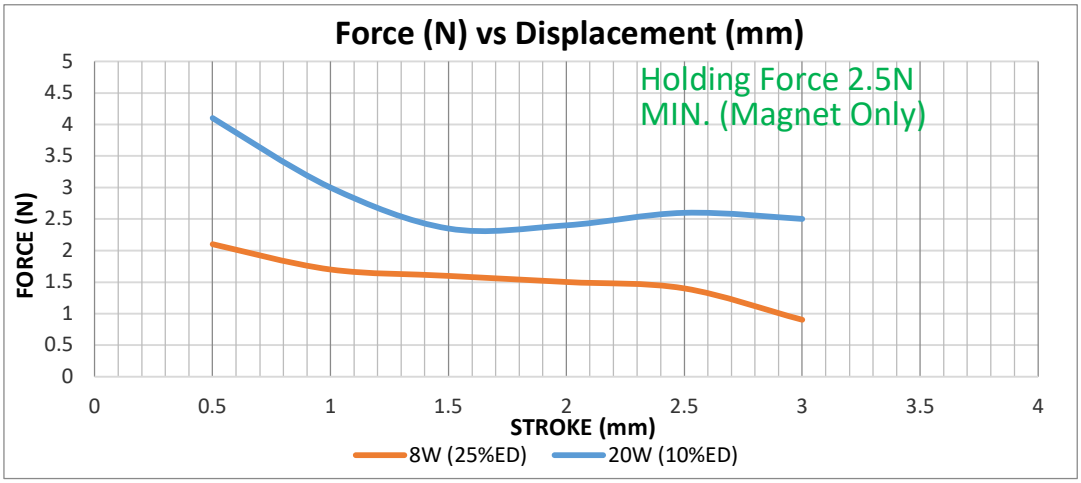
Coil Data

P/N	Duty Cycle = "on" time / ("on" time + "off" time) x 100%		10% ED
	Maximum "on" time in seconds		2
	Watts at 20°C		8
	Ampere-Turns at 20°C		368
SH2LC-0730-XXv	Resistance ±10% @ 20°C	Amp-turns	Volts DC
SH2LC-0730-06v	4.5Ω	285	6
SH2LC-0730-12v	18Ω	540	12
SH2LC-0730-24v	72Ω	1100	24

General Parameters

Life Expectancy (Cycles)	200,000
Mass	35g
Plunger Mass	3g
Leadwires 250mm (9.84")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	



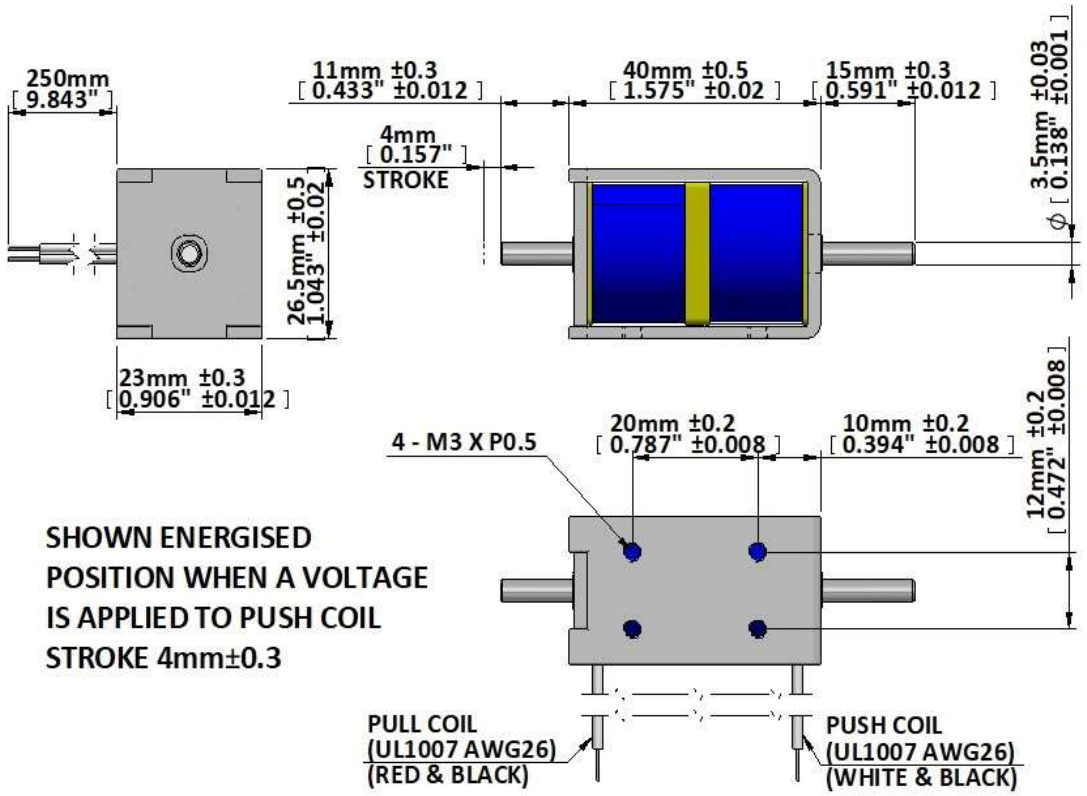


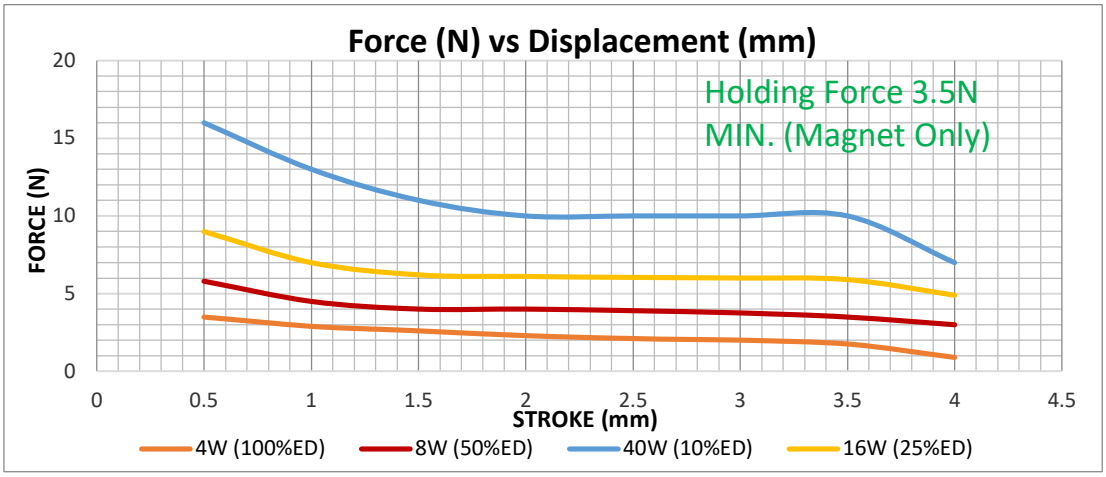
Coil Data

P/N	Duty Cycle = "on" time / ("on" time + "off" time) x 100%		10% ED
	Maximum "on" time in seconds		3
	Watts at 20°C		16
	Ampere-Turns at 20°C		691
SH2LC-1140-XXv	Resistance ±10% @ 20°C	Amp-turns	Volts DC
SH2LC-1140-06v	2.3Ω	265	6
SH2LC-1140-12v	9Ω	525	12
SH2LC-1140-24v	36Ω	1025	24

General Parameters

Life Expectancy (Cycles)	200,000
Mass	115g
Plunger Mass	21g
Leadwires 250mm (9.84")min, UL1007, AWG28	
Insulation Class	A (105°C)
Dielectric Strength 1000V AC, 50/60Hz, 1min	
Insulation Res >100MΩ, 500V DC Megger	





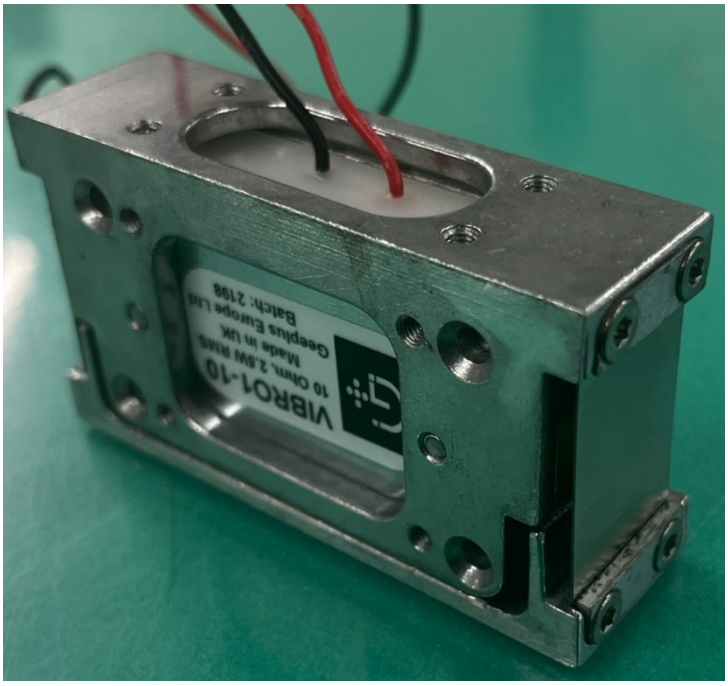
VIBRATION ACTUATORS

GEEPLUS Vibration Actuators

There are a number of applications where vibrating motion is required, for which simple solenoid actuators are not ideally suited, and for which moving coil actuators although technically suitable are a costly option. Geeplus offers some simple bidirectional actuators to address such requirements.

These devices are based on a laminated stator assembly with multiple poles for good force generation, and a simple armature assembly comprising a steel plate with multiple magnets forming the poles.

The devices are offered as a set of stator and armature parts for incorporation into customers own assembly, or as an integrated module with steel flexures allowing linear motion and maintaining separation between the two.



Where separate stator and armature are used, it should be noted that a strong attraction force is developed between these, and the support structure must withstand this force and maintain separation between the two parts.

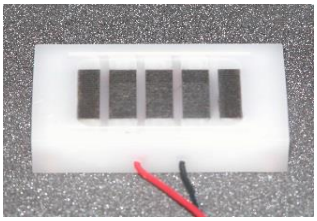
Amplitude will be larger if the assembly is driven near to its resonant frequency. Applications include linear conveyors, liquid mixing, or powder compacting devices.

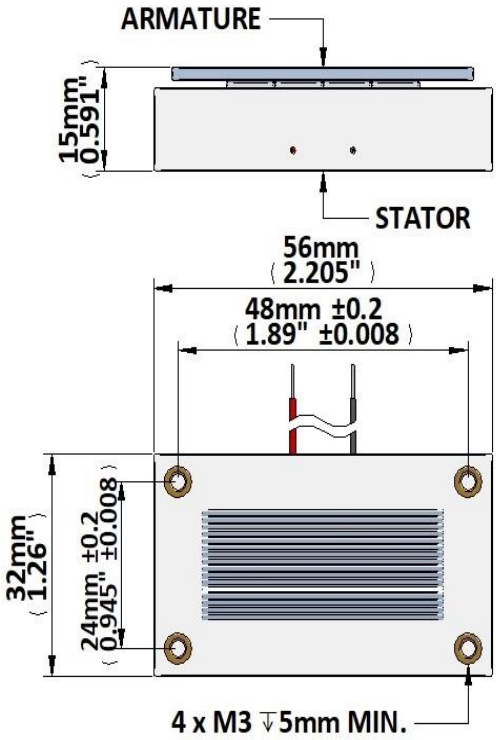
P_{100} is the continuous (100% ED) excitation power at which the coil attains temperature T_{max} with the part mounted to a massive heatsink at 20°C

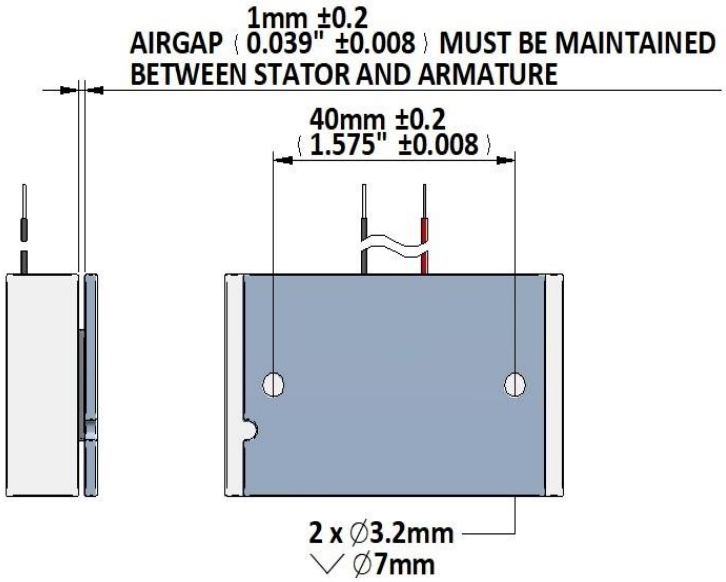
P_{100}	2.5 W	Total Mass	150 g
T_{max}	80 °C	Moving Mass	52 g

Model No.	Resistance R_{20}	Inductance
HAP56-10	10.0 Ω	6.8 mH

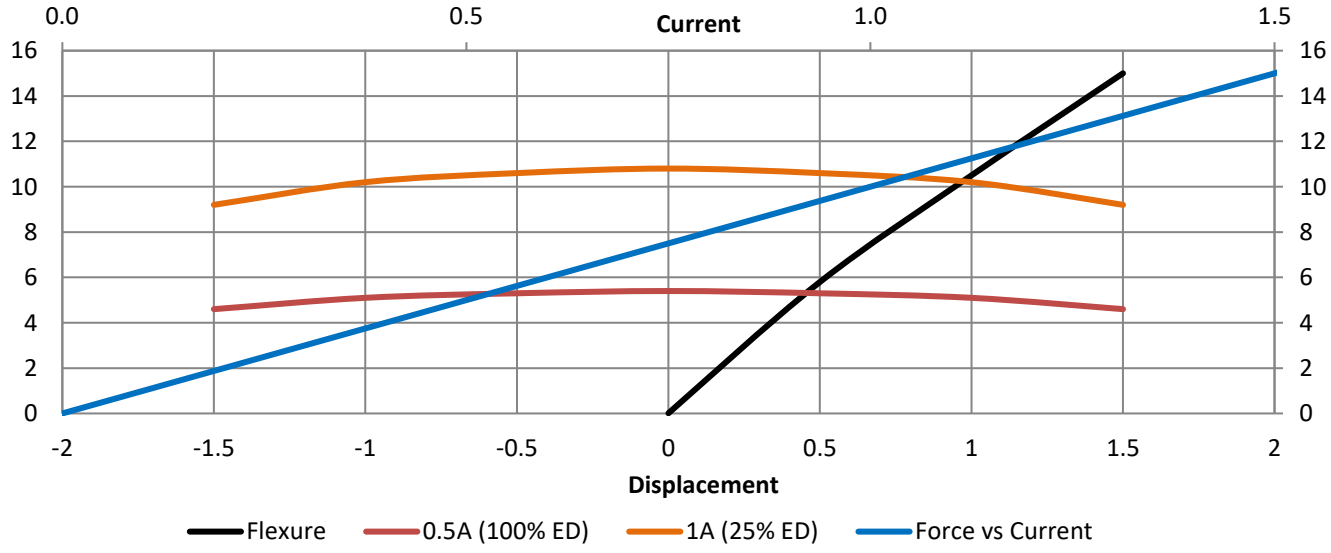
The HAP56 actuator is designed to generate linear vibration when energised with an AC signal. It will develop a high force over displacement of 3-4mm for excitation power of only a few watts. It can be used to generate tactile feedback for MMI applications, or as a motion generator for linear conveyors / component feeders







Typical Force Characteristic



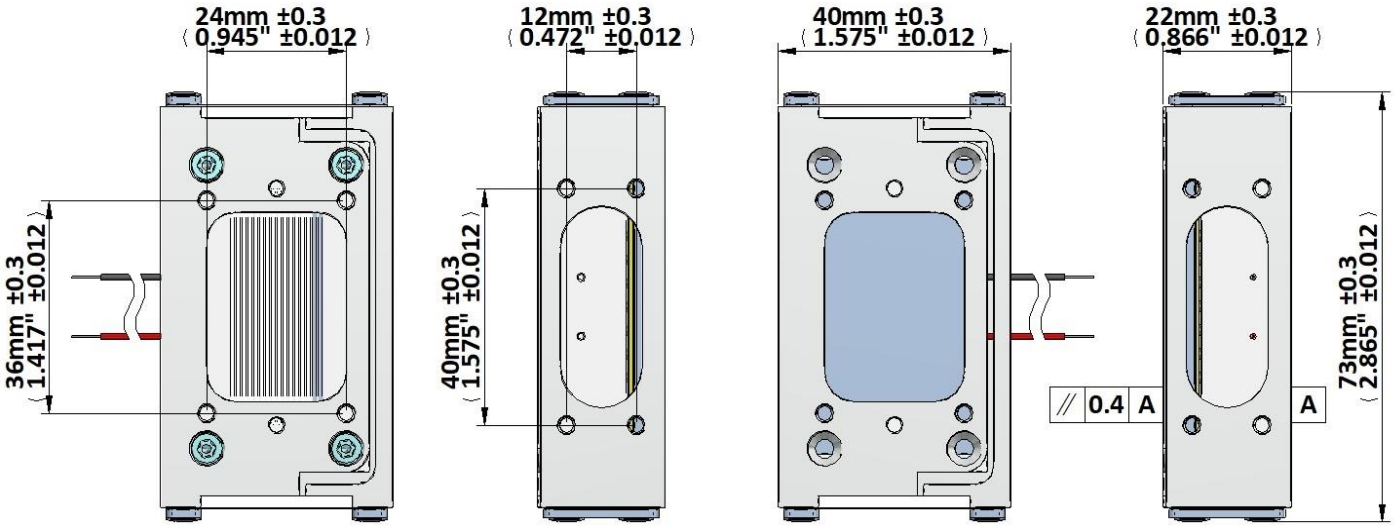
P_{100}	2.5 W	Total Mass	150 g
T_{max}	80 °C	Moving Mass	52 g

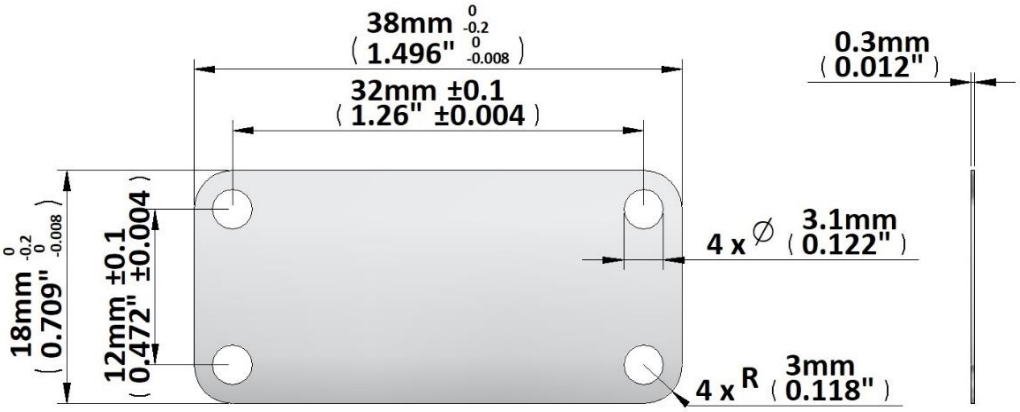
P100 is the continuous (100% ED) excitation power at which the coil attains temperature Tmax with the part mounted to a massive heatsink at 20°C

Model No.	Resistance R_{20}	Inductance
VIBRO1-10	10.0 Ω	6.8 mH

The VIBRO1 incorporates a HAP56 actuator in an easily mounted cast body with steel flexures for support. The VIBRO1 facilitates simple implementation of small vibratory assemblies.

4 x mounting holes in each face are M3 x P0.5, Maximum ↧ 3mm





87-1044

The steel flexure 87-1044 can be used to provide support to vibrating loads driven by the VIBRO1 or HAP56 actuator devices. Either end should be securely clamped between flat surfaces.

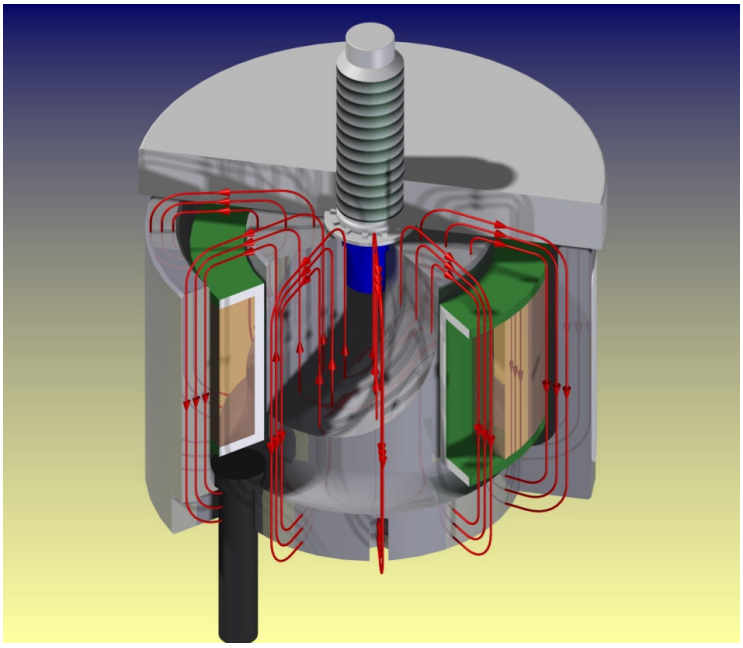
HOLDING MAGNETS

Electromagnet

The electromagnet is a simple holding device, when energised it will attach itself to a flat steel surface with high force. When de-energised the attracting force is switched off. Related devices include the following:

- Holding magnets – employ a permanent magnet to attach to a flat ferromagnetic surface with high force
- HMER (Holding Magnet Electrical Release) – combines the function of holding and electromagnet to hold to a flat ferromagnetic surface with high force when no power is applied, and release from the surface when energised

Construction



The most common construction for electromagnets is illustrated, the device comprises of a steel pot core with a coil fitted in an annular groove in the face of the electromagnet, the coil is commonly potted in place for environmental protection and improved thermal contact with the pot.

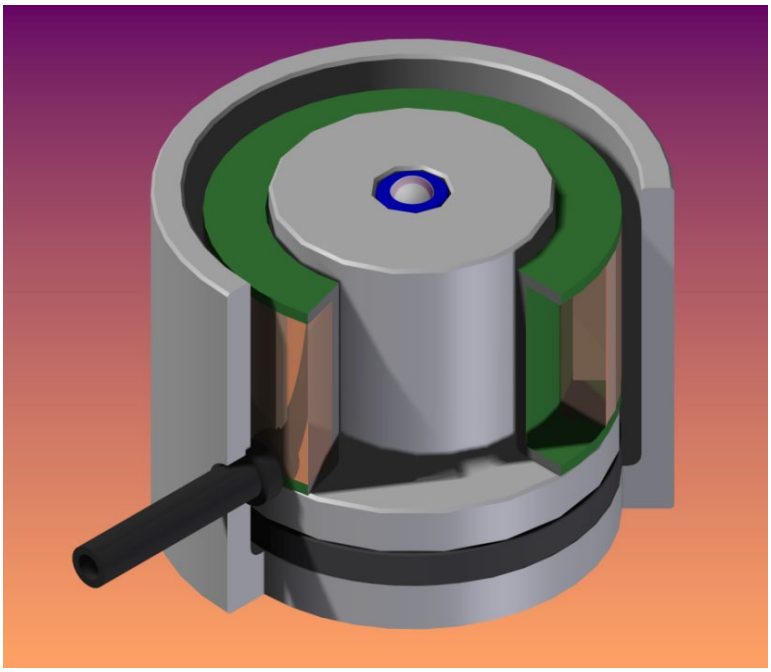
The armature plate shown on top of the device is an optional accessory, as is the ejector pin fitted in the centre of the part illustrated.

The electromagnet is not intended to act over an extended distance, very high force is developed when in direct contact with a flat steel component, this force will reduce rapidly as separation between the electromagnet and steel surface increases.

The surface of the mating component should be made as flat as possible and should be kept free of contamination which may cause separation of the two parts and consequent reduction in holding force.

When de-energised, some residual magnetism may remain, in cases where this is problematic a spring-loaded ejector pin can be fitted to the device to separate this from the electromagnet when de-energised.

HMER – Holding Magnet Electrical Release



HMER devices incorporate a permanent magnet so that high holding force is developed to a flat ferromagnetic component without external power being applied. Power is applied to the device with reverse polarity to counter the field due to the permanent magnet and release the 'keeper' component.

Applications

Electromagnets find application as holding devices in machinery, as latching devices in security systems, and as door holdback devices in large buildings such as hospitals where doors are held open to permit easy access but must be released to close if fire alarms are triggered, or in the case of power failure.

HMER devices are used in applications such as cash drawers, drug dispensing trolleys, or key boxes / safes in secure environments where a limited level of security is needed to trace use of materials or prevent misappropriation.

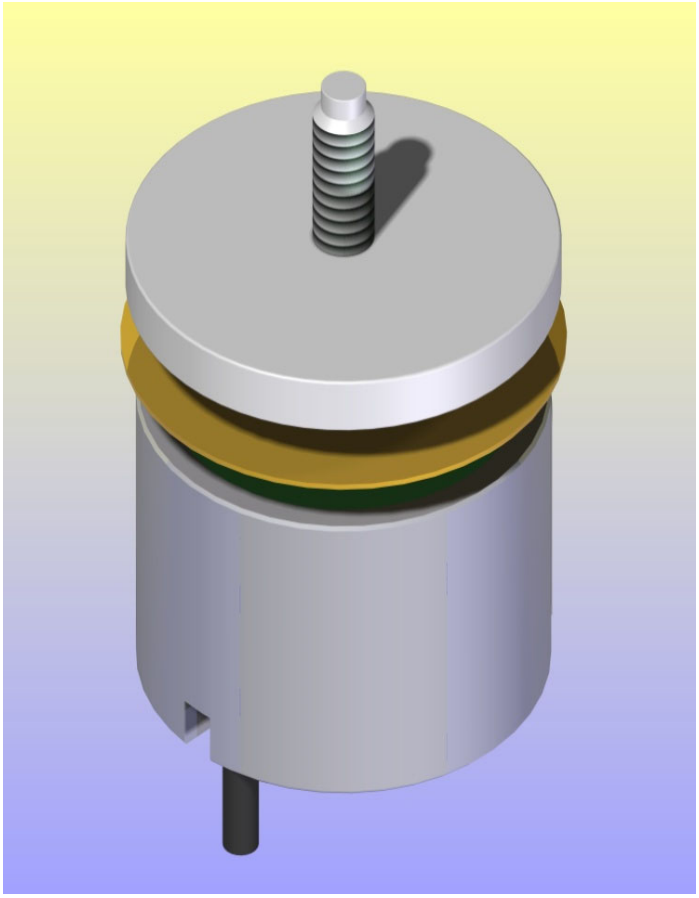
Due to the high forces and low power requirements, both constructions can find use as selection elements in applications where power is limited, or heat dissipation a problem such as shutter mechanisms, or selection mechanisms in textiles machinery.

In handling and installation, and in many of the applications where they are employed, the device can be subject to harsh treatment which can deform the surface and impair holding force. Geeplus electromagnets can be supplied with a hardened surface finish which makes them highly resistant to such damage, this will become standard for most such devices for future production.

Installation Precautions

It is important that the Electromagnet and/or armature plate have some compliance in mounting allowing them to align parallel and ensure forces act normal to the interface between them.

Testing



Electromagnets are tested with a shim of non-magnetic material inserted between holding face of the electromagnet and the armature (or a flat steel surface) to simulate a gap between the two. The electromagnet is energised, and increasing force applied until the two parts separate, the maximum force recorded is taken as the holding force. The influence of the gap represented by the shim is similar to that of dirt, paint, or contamination on either surface, or to separation caused by damage to the surface. The influence of any likely contamination and separation this could cause should be considered when evaluating data on parts, in environments where contamination causing separation is likely, it may be desirable to choose a larger device which can achieve the required force at a separation corresponding to that caused by expected contamination.

Data

For most parts data is shown for 3 different current levels. The current value shown for 100% ED operation is the (HOT) current value achieved once the internal coil temperature stabilises with rated voltage applied, at a temperature approximately 60°C above ambient temperature (worst case), corresponding to an absolute coil temperature of 80°C in an ambient temperature of 20°C. The excitation current, power consumption, and holding force will be higher in the cold condition. The current value shown as 200% ED corresponds to excitation with half as much power, and 400% ED corresponds to quarter as much power, and are included to give some indication of performance at these reduced power levels if this is necessary due to high ambient temperature, or low supply power conditions.

Modification

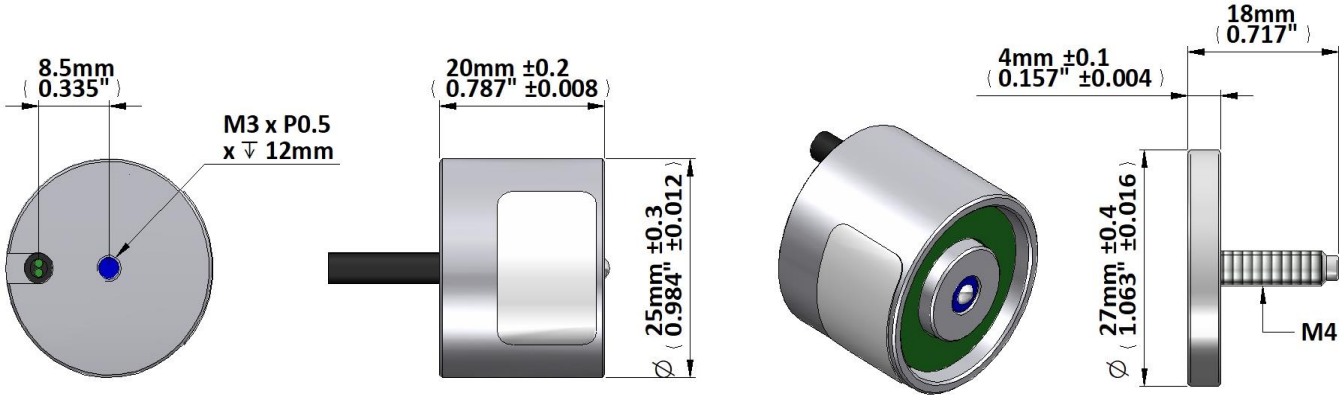
The following modifications are possible to electromagnets:

- High Force / Efficiency – by grinding the mating faces of both electromagnet pot, and of the armature plate used to a very fine finish, the effective airgap can be reduced, enabling higher force to be achieved for a given input power.

General Specifications	
Insulation Class	Class A (105°C)
Insulation Resistance >50MΩ, 500V DC	
Dielectric Strength 500V AC, 50/60 Hz, 1 minute	

Mass
EM0025
60g
AP27
20g

Part Number	Coil Resistance	Voltage	Included Options
EM0025-12	56 Ω	12 V	
EM0025-24	220 Ω	24 V	
EME0025-12	56 Ω	12 V	Ejector Pin
EME0025-24	220 Ω	24 V	Ejector Pin



Holding Force Data

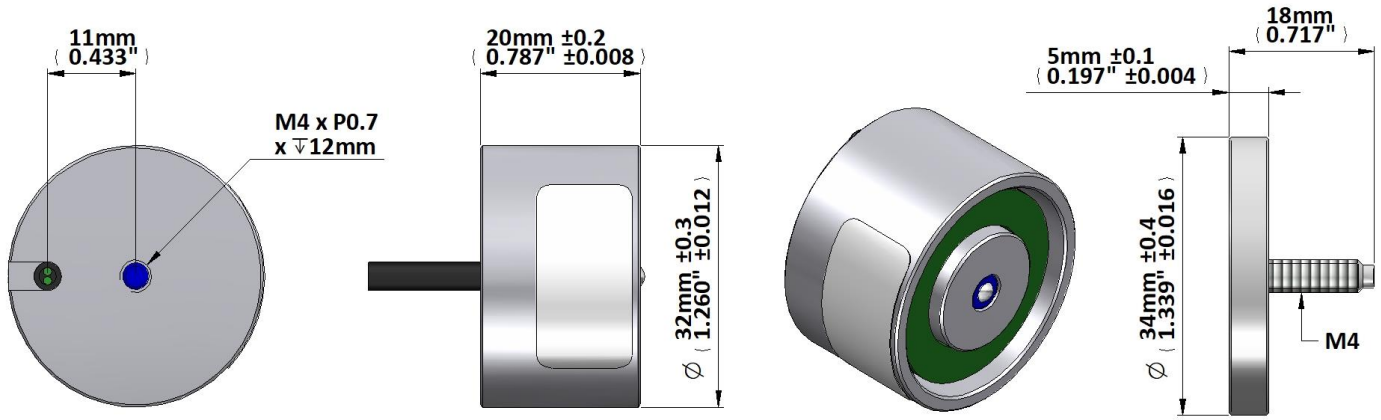
Separation (Airgap)	0.00 mm	0.05 mm	0.10 mm	0.20 mm	0.50 mm	1.00 mm
2.2W (100% ED)	110	105	40	14		
1.1W (200% ED)	85	77	18	6		
0.6W (400% ED)	80	51	5	3		

Holding force measured at 20°C to steel plate 8mm thick with surface Ra <1µm
100% ED Power rating results in coil temperature rise of 65°C max with good heatsinking
Force exerted by ejector pin in fully compressed condition 5N

General Specifications	
Insulation Class	Class A (105°C)
Insulation Resistance >50MΩ, 500V DC	
Dielectric Strength 500V AC, 50/60 Hz, 1 minute	

Mass
EM0032
95g
AP34
40g

Part Number	Coil Resistance	Voltage	Included Options
EM0032-12	48 Ω	12 V	
EM0032-24	190 Ω	24 V	
EME0032-12	48 Ω	12 V	Ejector Pin
EME0032-24	190 Ω	24 V	Ejector Pin



Holding Force Data						
Separation (Airgap)	0.00 mm	0.05 mm	0.10 mm	0.20 mm	0.50 mm	1.00 mm
3W (100% ED)	170	115	97	33	2	0.8
1.5W (200% ED)	150	60	37	15		
0.75W (400% ED)	80	60	21	5		

Holding force measured at 20°C to steel plate 8mm thick with surface Ra <1µm

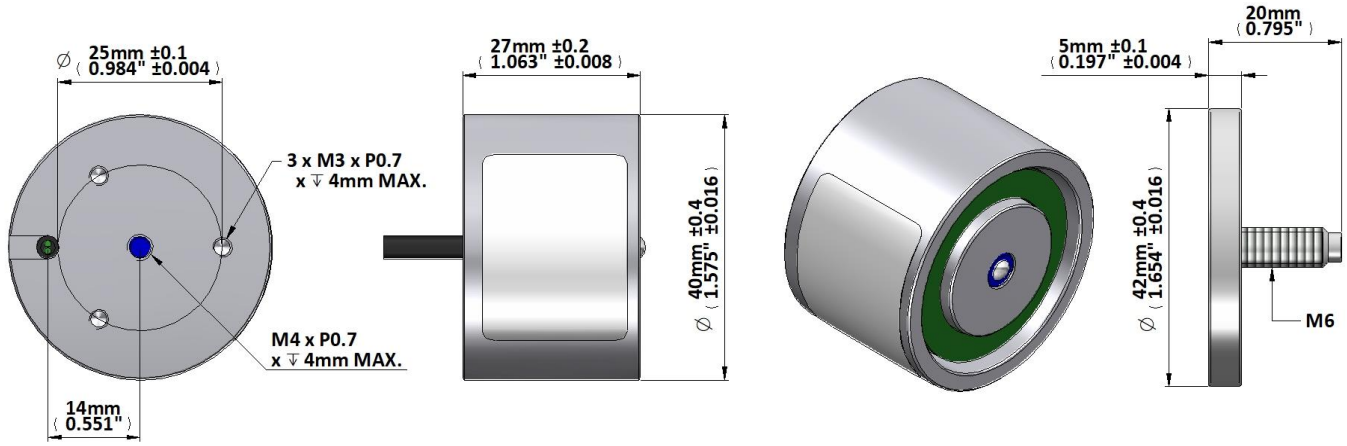
100% ED Power rating results in coil temperature rise of 65°C max with good heatsinking

Force exerted by ejector pin in fully compressed condition 5N

General Specifications	
Insulation Class	Class A (105°C)
Insulation Resistance >50MΩ, 500V DC	
Dielectric Strength 500V AC, 50/60 Hz, 1 minute	

Mass
EM0040
220g
AP42
60g

Part Number	Coil Resistance	Voltage	Included Options
EM0040-12	34 Ω	12 V	
EM0040-24	135 Ω	24 V	
EME0040-12	34 Ω	12 V	Ejector Pin
EME0040-24	135 Ω	24 V	Ejector Pin



Holding Force Data

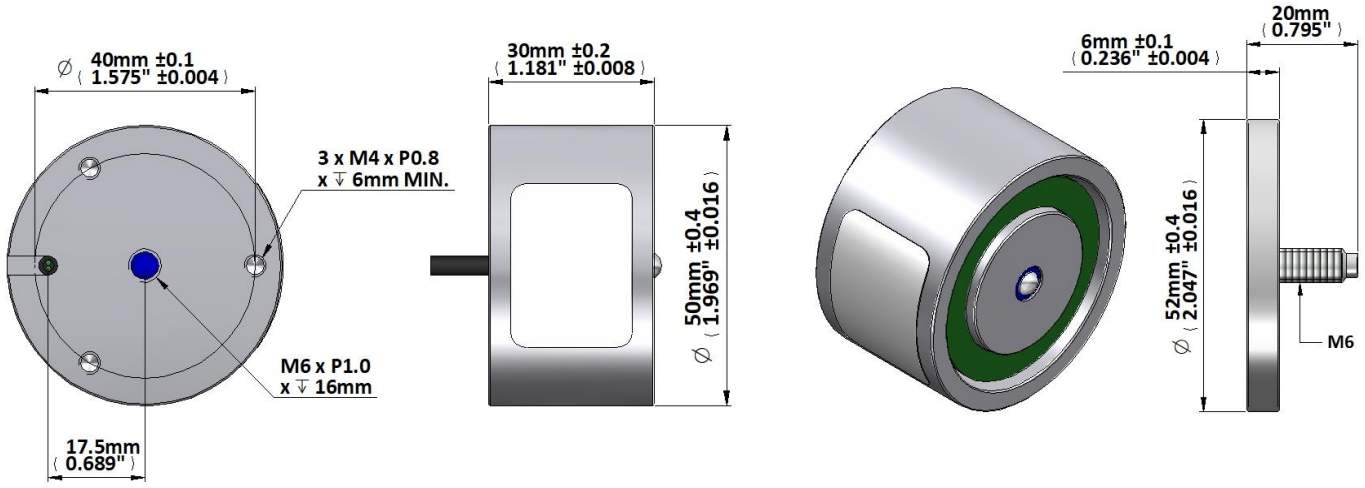
Separation (Airgap)	0.00 mm	0.05 mm	0.10 mm	0.20 mm	0.50 mm	1.00 mm
4.3W (100% ED)	440	350	168	101	17	5
2.15W (200% ED)	350	120	85	52	8	2
1.1W (400% ED)	280	90	85	16		

Holding force measured at 20°C to steel plate 8mm thick with surface Ra <1µm
100% ED Power rating results in coil temperature rise of 65°C max with good heatsinking
Force exerted by ejector pin in fully compressed condition 7N

General Specifications	
Insulation Class	Class A (105°C)
Insulation Resistance >50MΩ, 500V DC	
Dielectric Strength 500V AC, 50/60 Hz, 1 minute	

Mass
EM0050
0.38kg
AP52
0.11kg

Part Number	Coil Resistance	Voltage	Included Options
EM0050-12	32 Ω	12 V	
EM0050-24	130 Ω	24 V	
EME0050-12	32 Ω	12 V	Ejector Pin
EME0050-24	130 Ω	24 V	Ejector Pin



Holding Force Data

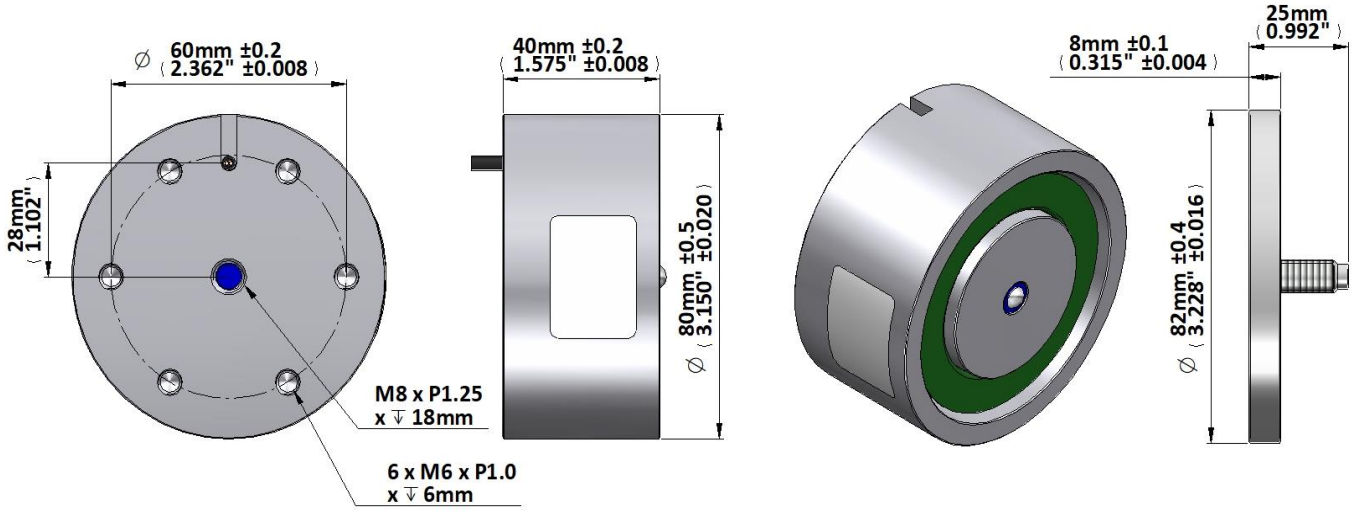
Separation (Airgap)	0.00 mm	0.05 mm	0.10 mm	0.20 mm	0.50 mm	1.00 mm
4.5W (100% ED)	875	800	435	170	20	7.7
2.25W (200% ED)	750	670	264	85	8	2.4
1.13W (400% ED)	630	420	84	54	3	

Holding force measured at 20°C to steel plate 8mm thick with surface Ra <1µm
100% ED Power rating results in coil temperature rise of 65°C max with good heatsinking
Force exerted by ejector pin in fully compressed condition 10N

General Specifications	
Insulation Class	Class A (105°C)
Insulation Resistance >50MΩ, 500V DC	
Dielectric Strength 500V AC, 50/60 Hz, 1 minute	

Mass
EM0080
1.30kg
AP82
0.34kg

Part Number	Coil Resistance	Voltage	Included Options
EM0080-12	15 Ω	12 V	
EM0080-24	60 Ω	24 V	
EME0080-12	15 Ω	12 V	Ejector Pin
EME0080-24	60 Ω	24 V	Ejector Pin



Holding Force Data

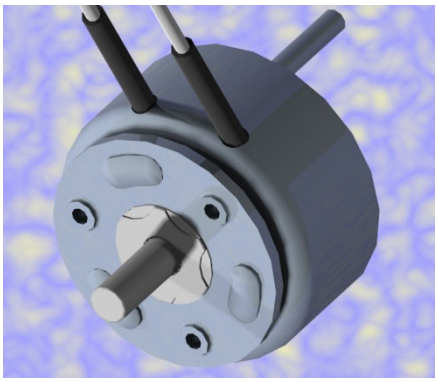
Separation (Airgap)	0.00 mm	0.05 mm	0.10 mm	0.20 mm	0.50 mm	1.00 mm
9.5W (100% ED)	2400	2130	1640	1300	325	230
4.8W (200% ED)	2140	1780	1430	1000	240	108
2.4W (400% ED)	2000	1400	1030	550	85	29

Holding force measured at 20°C to steel plate 8mm thick with surface Ra <1µm
100% ED Power rating results in coil temperature rise of 65°C max with good heatsinking
Force exerted by ejector pin in fully compressed condition 13N

3-BALL ROTARY SOLENOID

Selection Process for 3-Ball Rotary Solenoid

1. Metric (M prefix) and SAE (F prefix) screw thread options are available.
2. The solenoid size is determined from consideration of required torque and effective duty cycle from graphs for the required angle of rotation. This may also be influenced by available power, for a given angle, a larger solenoid will develop the required torque with less electrical power than a smaller device.
3. The coil requirements are determined from tables of coil gauge / duty cycle (ED) for the chosen size of device. Coil rating is specified as AWG size of the coil wire.
4. The mechanical configuration options are chosen to suit the mounting and mechanical attachment of load to the solenoid in the application. These are illustrated later in this selection guide, along with a table which shows how the mechanical options, angle, and direction of rotation are translated into a 3-digit sequence in the solenoid part number. Direction of rotation is defined looking towards the armature plate as shown in attached drawing.

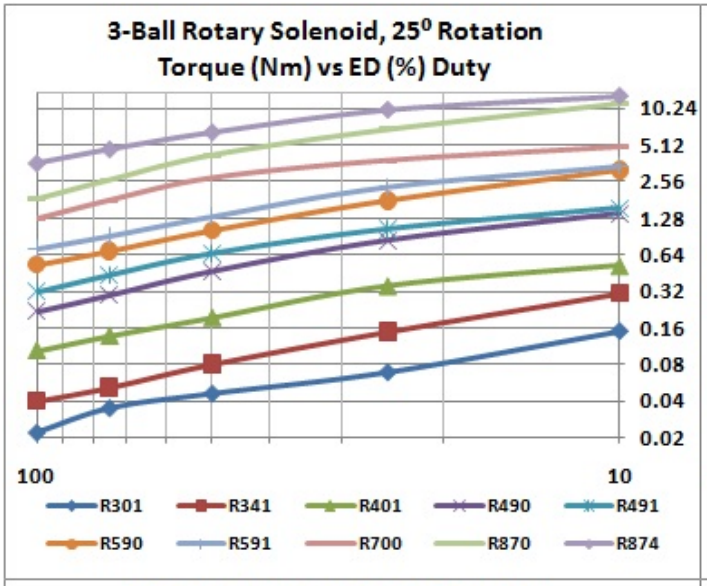


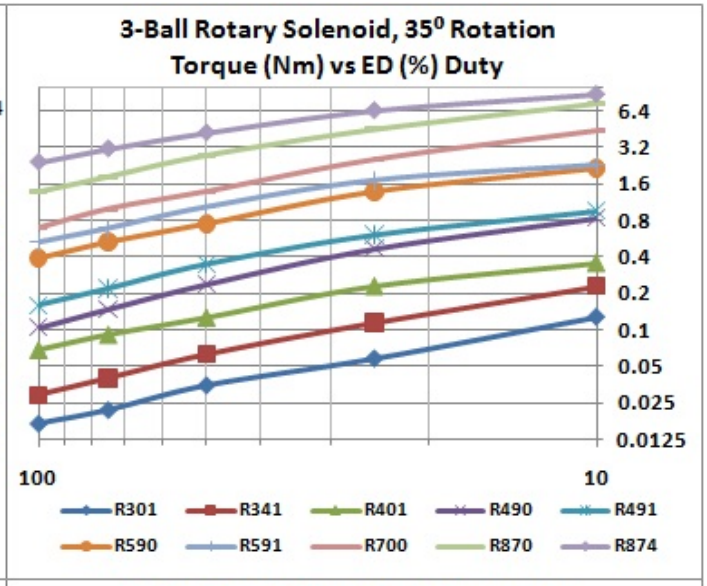
5. The life expectancy of the solenoid is specified by the suffix, R is standard life (2M cycles), RE is extended (10M cycles), RL is long life (50M cycles). Life will be reduced by excessive side loading, particulate contamination, corrosive or otherwise aggressive environments. Life expectancy should be verified under real operating conditions in the customer application to ensure this is sufficient for purpose.

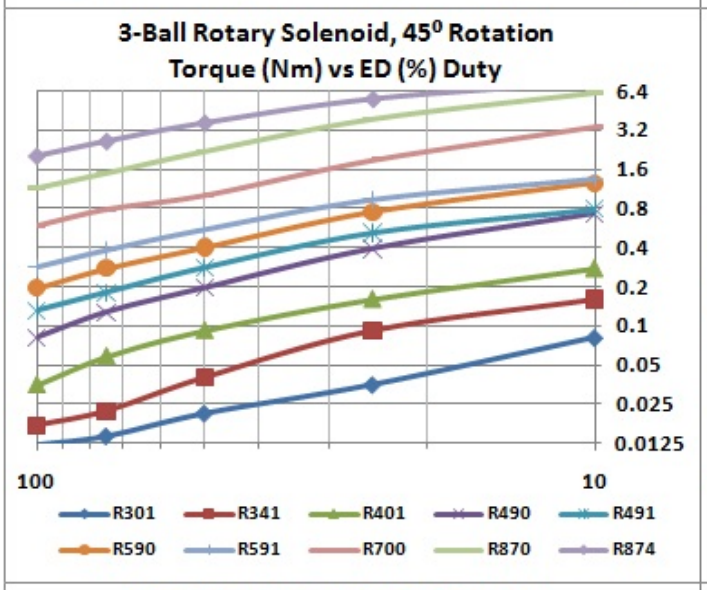
Part Number for 3-Ball Rotary Solenoids				
Example : **M491-28-282RE**				
Thread	**Size**	**Coil AWG**	**Options**	**Life**
M - Metric thread F - SAE thread	491	28	283	R - Standard Life RE - Extended Life RL - Long Life

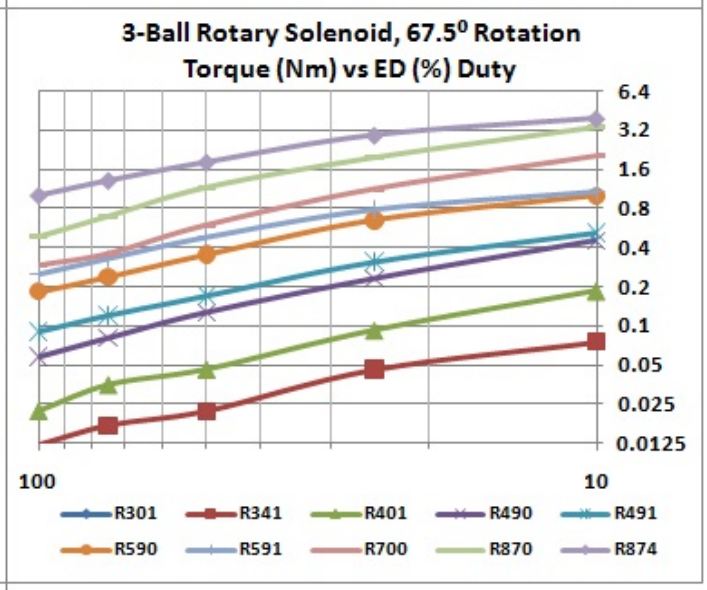
Size Determination

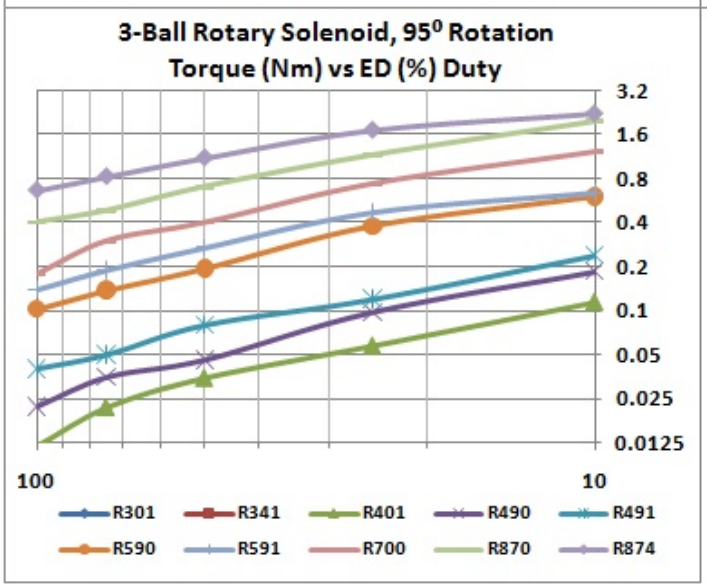
Device size is determined for the required torque and duty cycle from the tables below, torque is shown on the vertical axis vs ED on the horizontal











Specifying Coil AWG

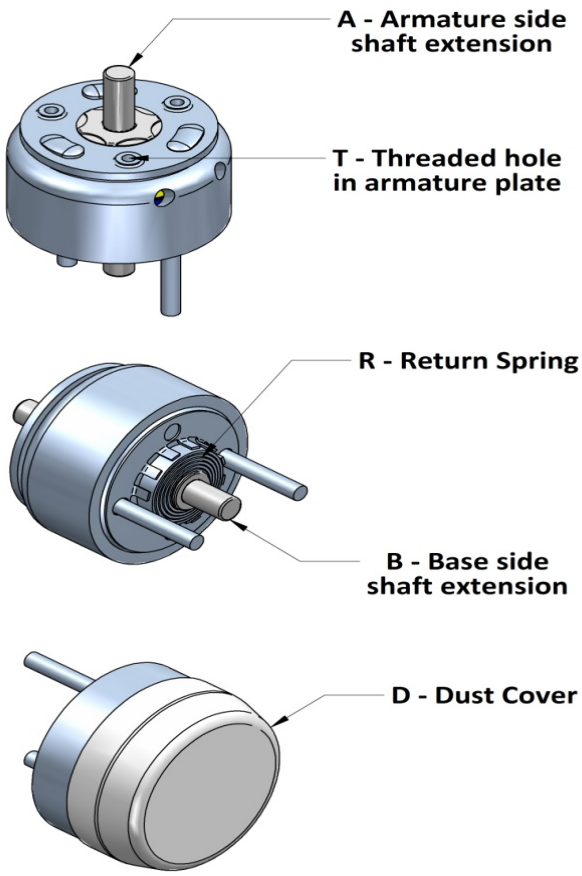
Duty Cycle (%ED)			100%	50%	25%	10%
Maximum 'ON' time			∞	100	36	7
Watts at 20º C			7	14	28	70
ampere-turns at 20º C			425	602	849	1350
AWG no	Resistance	no. turns	Nominal Voltage			
26	1.96	231	3.5	5	7.1	11
27	3.16	296	4.5	6.3	8.9	14
28	5.1	378	5.6	8	11	18
29	6.94	423	7.1	10	14	22
30	11	530	8.9	13	18	28
31	16.9	649	11	16	22	36
32	28.3	858	14	20	28	45

- The coil AWG is determined from tables of coil data for the given part, in the column corresponding to chosen duty cycle, the voltage closest to user supply is picked, and coil AWG corresponding to this is indicated in the LH column (example shows selection for a part operated from 12v supply at 25% duty cycle)
    - In the example illustrated, the selection of a device having higher nominal voltage than the supply is conservative, for maximum torque and speed the 28AWG coil might be more appropriate (see also point below)
    - Allowance should be made for voltage drops in switching devices, and resistive drops in wiring harness when determining the nominal voltage which will be applied to the solenoid.

Mechanical Configuration

- The direction of rotation of the solenoid is defined looking at the armature plate.
- The standard accessories are shown in the adjacent drawing.
- The dust-cover option is recommended in any application where the solenoid is exposed to dust which can clog or cause abrasive wear to the inclined raceways. This precludes use of the T option.

When you have selected mechanical options required, the last 3 numbers of solenoid P/N can be determined from the table below.



Accessories	25º CW	35º CW*	45º CW	67.5º CW	95º CW	25º CCW	35º CCW	45º CCW	67.5º CCW	95º CCW
A	070	071	072	073	074	075	076	077	078	079
A,T	100	101	102	103	104	105	106	107	108	109
A,T,R	110	111	112	113	114	115	116	117	118	119
A,D	120	121	122	123	124	125	126	127	128	129
A,D,R	130	131	132	133	134	135	136	137	138	139
A,R	140	141	142	143	144	145	146	147	148	149
T	170	171	172	173	174	175	176	177	178	179
T,R	180	181	182	183	184	185	186	187	188	189
B	220	221	222	223	224	225	226	227	228	229
A,B	230	231	232	233	234	235	236	237	238	239
A,B,T	260	261	262	263	264	265	266	267	268	269
A,B,T,R	280	281	282	283	284	285	286	287	288	289
A,B.D	290	291	292	293	294	295	296	297	298	299
A,B,D,R	300	301	302	303	304	305	306	307	308	309
A,B,R	310	311	312	313	314	315	316	317	318	319
B,T	340	341	342	343	344	345	346	347	348	349
B,T,R	360	361	362	363	364	365	366	367	368	369
B,D	370	371	372	373	374	375	376	377	378	379
B,D,R	380	381	382	383	384	385	386	387	388	389
B,R	390	391	392	393	394	395	396	397	398	399

*** 30º rotation in the case of the 191 solenoid**

Thermal Considerations

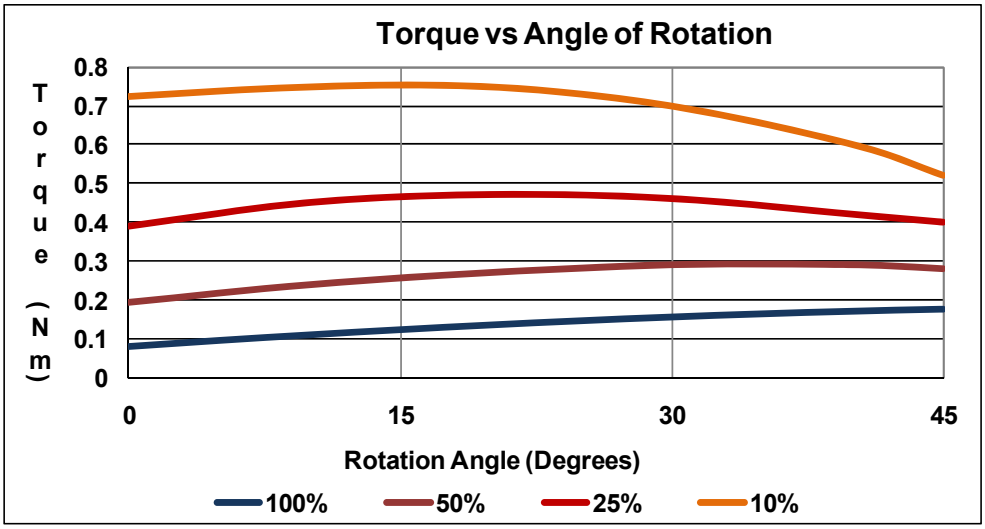
The coil data for rotary solenoids is based on performance at an ambient temperature of 20°C, with the solenoid mounted on a heatsink as described in individual data sheets. When the solenoid is energised with voltage and duty cycle as specified in the data tables, the coil will reach thermal equilibrium with a coil temperature rise of 85°C above ambient temperature. Standard materials will withstand operation at temperatures of up to 120°C. If ambient temperature or heatsinking conditions are other than indicated, it is advisable that coil temperature is measured under worst case operating conditions by measurement of coil resistance rise in the energised condition.

Starting Torque

Figures given for starting torque in the solenoid data are gross starting torque with the solenoid energised at 20°C. When a return spring is fitted, the net starting torque will be equal to the gross starting torque minus the spring torque.

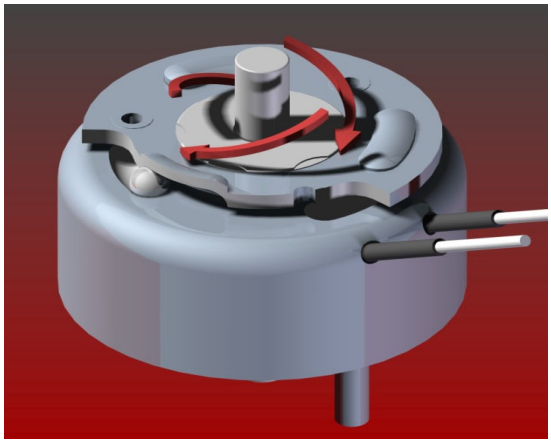
Torque vs Angle Characteristic

The 3-Ball Rotary Solenoid develops rotary torque through mechanical conversion, magnetically the solenoid develops high linear pull-in force along the axis over a short displacement. The rotary torque is produced by 3 helical ball races between the case and armature plate of the solenoid. The inclination of the ball races is not constant, the interaction of this and the magnetic attraction produces a torque which is approximately constant with rotation angle at 25% ED, at 100%ED torque increases as angle increases, at 10%ED torque decreases as rotation angle increases, this is illustrated by the graph below and is typical of all sizes / angles.



Axial Displacement

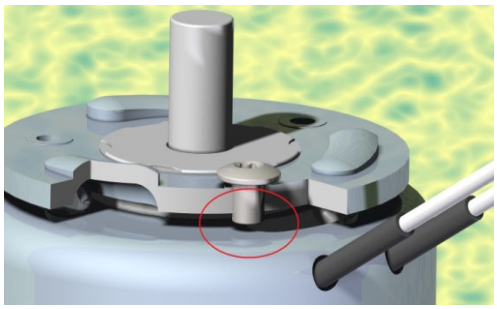
A small axial displacement is associated with the rotation of the 3-Ball Rotary Solenoid. The axial displacement developed in different sizes is given in the table below. This is inherent to the design of the 3-Ball rotary solenoid and must be accommodated in the end application.



Axial Displacement of 3-Ball Rotary Solenoid								
Solenoid Size	**190**	**301**	**341**	**401**	**490 491**	**590 591**	**700**	**870 874**
Axial Displacement (mm)		0.7	0.9	1.2	1.5	1.6	2.3	2.6
Axial Displacement (")	0.00	0.03	0.04	0.05	0.06	0.06	0.09	0.10

Use of threaded (A) holes in the Armature Plate

Where the threaded holes in the armature plate are used to attach accessories to the solenoid, caution must be taken that screws are not too long, and do not protrude through the armature plate where they can inhibit linear travel and rotation of the solenoid.



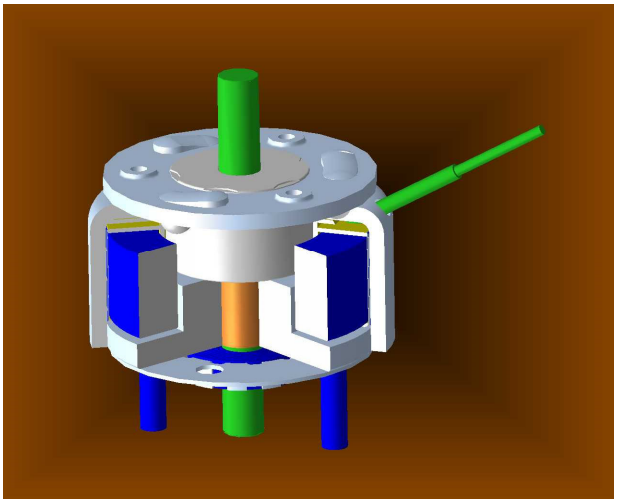
Restricting the Angle of Rotation

If an application requires an operating angle intermediate to the standard options available, it is possible to limit the rotation angle of the solenoid with an external end-stop, however the following precautions must be observed:

- The external stop should be fitted to limit rotation in the energised direction
- The solenoid must be allowed to return fully to the inbuilt stops in the de-energised position, end stops must not under any circumstances be fitted so as to limit rotation in both directions

Failure to observe these precautions will result in accelerated failure and invalidates any warranty on the life expectancy of the solenoid.

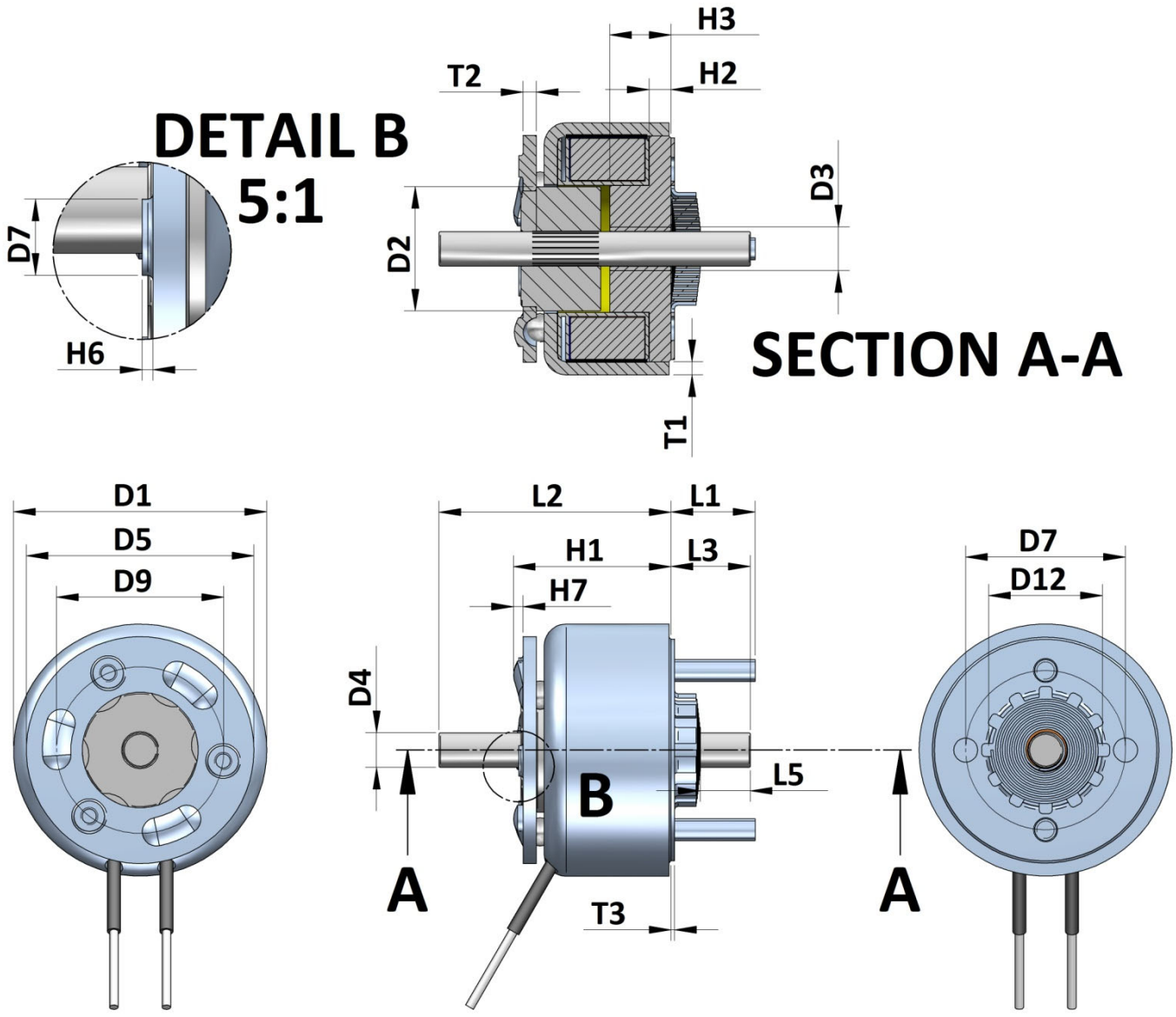
Customisation of the 3-Ball Rotary Solenoid



- The drawing indicates which components can be easily modified
    - Parts shown in green can be readily modified to customer requirement
    - Parts shown in Blue can be modified subject to selection from a range of available components limited by material size (eg length and thread size of mounting studs is constrained by standard sizes available)
- Modified Shaft – shaft modification is a common requirement, and is possible for qty >100pcs
    - Longer / shorter shaft
    - Flat (D-cut) on shaft
    - Cross-hole through shaft
    - External screw thread
    - Internal screw thread
    - Circlip (E-ring) grooves
    - Splines / knurling for press-fit to load
- Mounting Studs – longer or shorter mounting studs or other thread forms can be supplied subject to availability of suitable materials for qty >100pcs
- Coil Modification – the following are possible subject to confirmation
    - Higher or lower winding resistance
    - Double winding for pick & hold operation
    - High temperature windings up to 180^{o}C
- Return Spring – weaker or stronger return springs are available for qty >100pcs
- Different angle of rotation – this requires significant tooling modification, but may be possible on request for qty >5k-10k pcs
- Leadwires – longer or shorter leadwires can be offered for qty >100pcs
- Modified Armature plate – modification to the armature plate to add crank arms, tabs or other feature is possible for qty >5k-10k pcs
- Drive Pin – addition of drive pins to the armature plate for linkage to the load may be possible for qty >100pcs

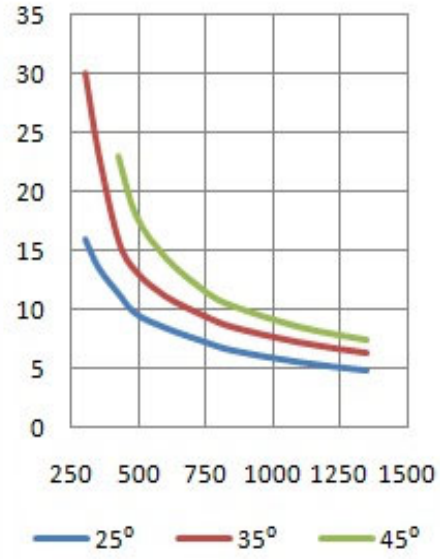
Specifying Modifications

If requesting mechanical modifications to a rotary solenoid, it will be helpful if changes can be specified based on the drawing below. For normal tolerances on different parameters, please refer to tolerances for the standard part on which design is based.

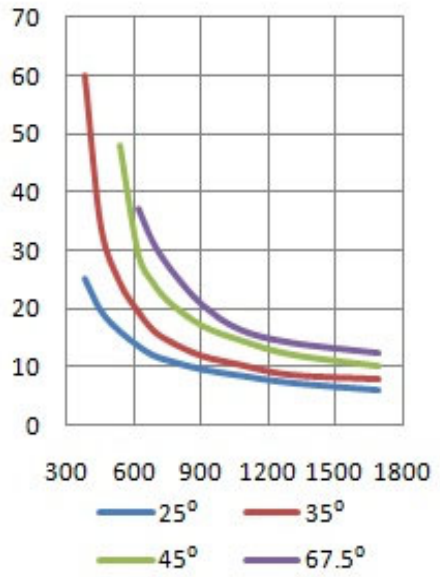


GEEPLUS Rotary Solenoid Response Time

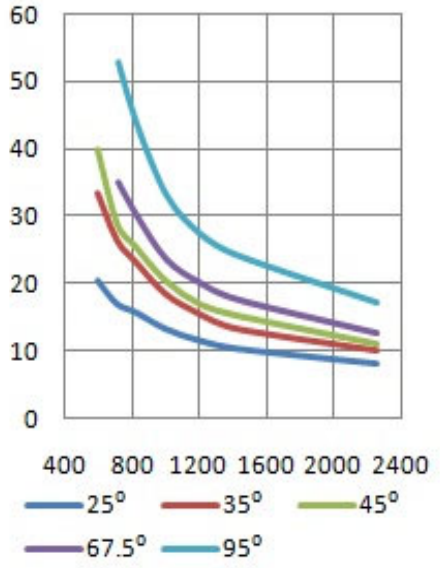
Size 301



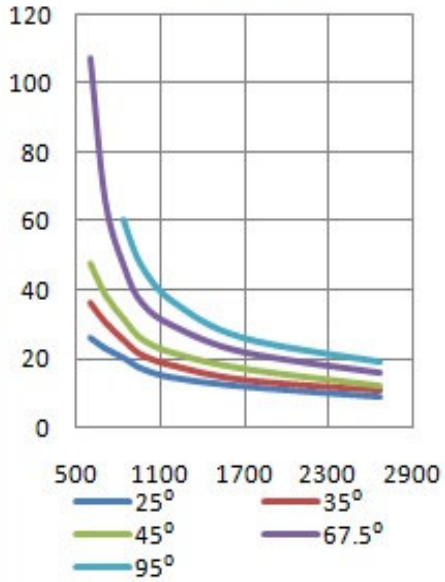
Size 341



Size 401



Size 490



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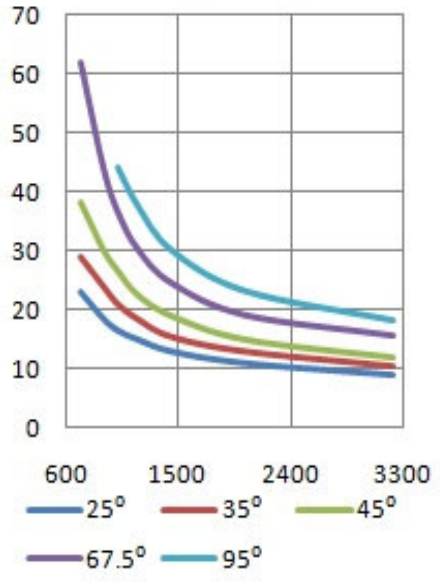
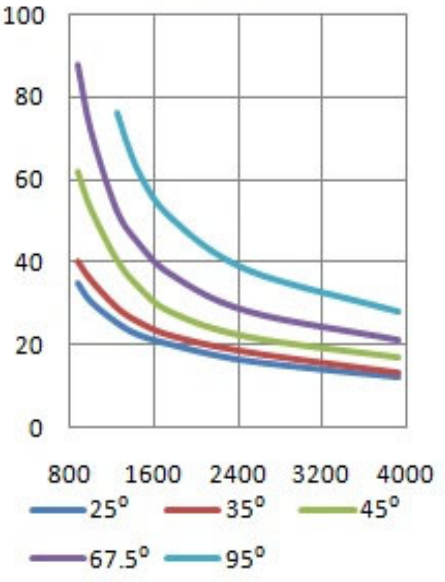
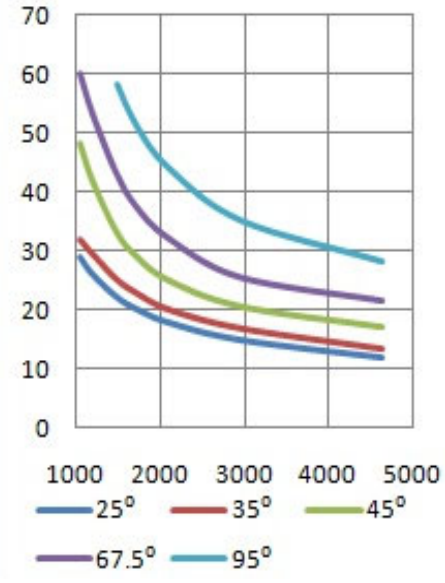


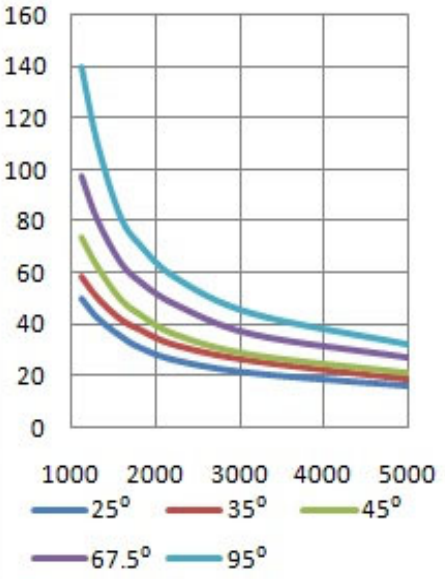
Size 590



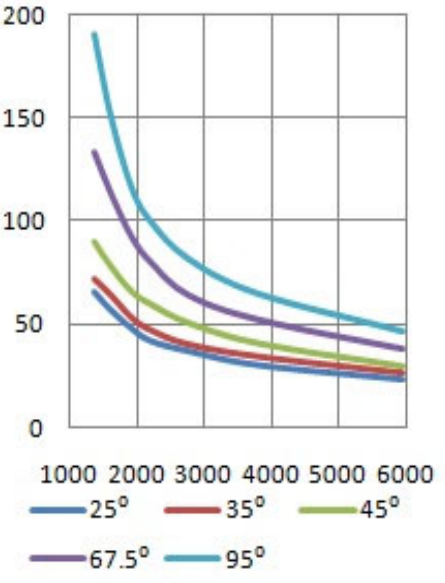
Size 591



Size 700



Size 870

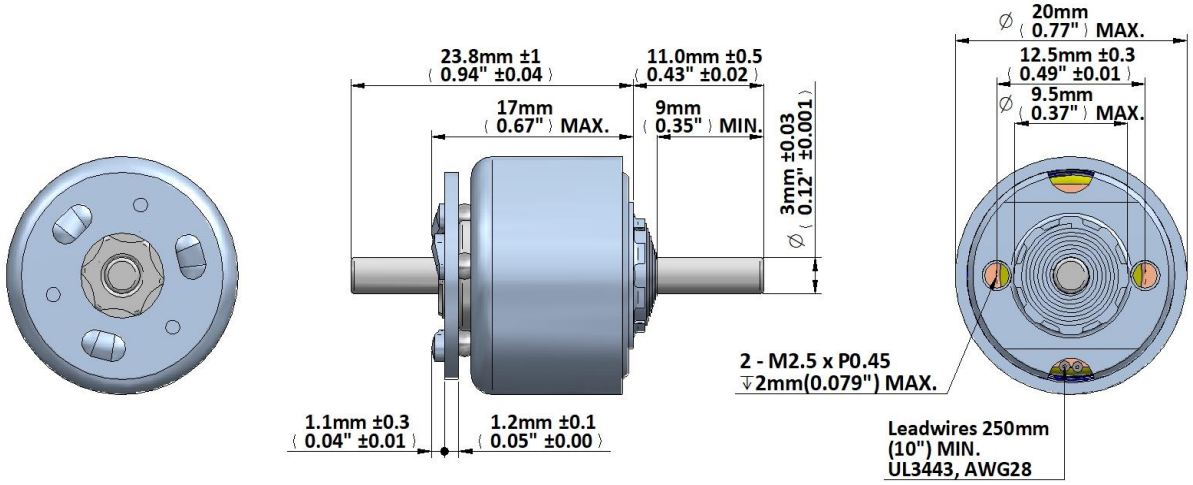


GEEPLUS Rotary Solenoid size 190

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R)

Available angle options:
30° (CW)
Mass 27 grammes

Note: the M190R rotary solenoid is only manufactured with a 30° rotation angle in mechanical options designated M190-xx-311R, M190-xx-231R & M190-xx-181R, where xx denotes nominal supply voltage at 25% duty cycle.



Data at 20°C , device connected to heatsink 60x60x3mm aluminum — return spring 2 ~ 4 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds		-	10	3	1
watts at 20°C		-	8	16	40
ampere-turns at 20°		-	382	540	854
Gross starting torque	30°	-	0.01	0.02	0.04

type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC		
M190-6V-xxxR F190-6V-xxxR	2.3	210	-	4.2	6.0	9.5
M190-12V-xxxR F190-12V-xxxR	9.0	420	-	8.5	12	19
M190-24V-xxxR F190-24V-xxxR	36	800	-	17	24	38
M190-48V-xxxR F190-48V-xxxR	144	1600	-	34	48	76

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

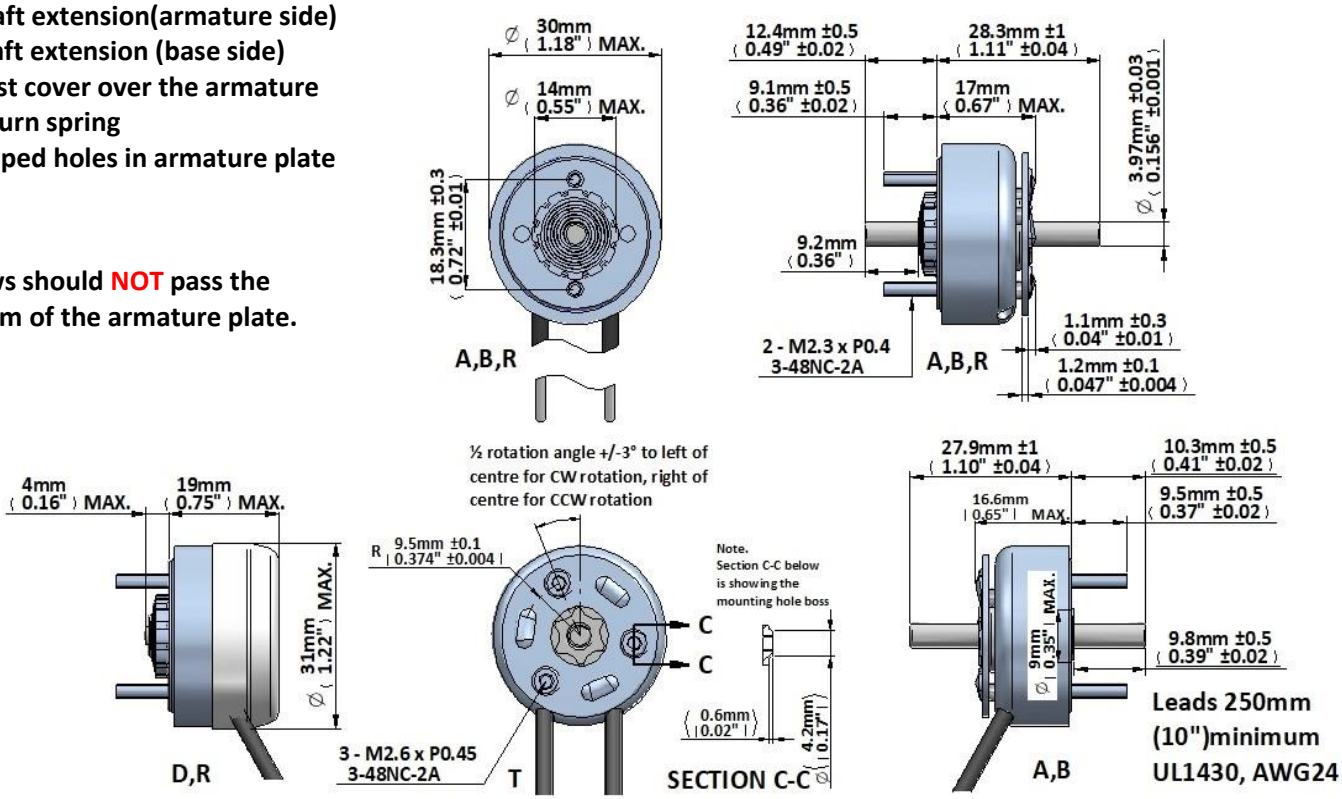
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 301

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45° (CW/CCW)
Mass 56 grammes



Data at 20°C , device connected to heatsink 90x90x3mm aluminum — return spring 5,5 ~ 9 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	105	100	36	7
watts at 20°C		7	9.3	14	28	70
ampere-turns at 20°		425	490	602	849	1350
Gross starting torque at 20°C (Nm)	25°	0.022	0.035	0.046	0.069	0.150
	35°	0.017	0.022	0.035	0.058	0.127
	45°	0.012	0.014	0.021	0.035	0.081
	67,5°	-	-	-	-	-
	95°	-	-	-	-	-

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
26	1.96	231	3.5	4.1	5.0	7.1	11
27	3.16	296	4.5	5.1	6.3	8.9	14
28	5.10	378	5.6	6.5	8.0	11	18
29	6.94	423	7.1	8.1	10	14	22
30	11.0	530	8.9	10	13	18	28
31	16.9	649	11	12	16	22	36
32	28.3	858	14	16	20	28	45
33	42.8	1036	18	20	25	35	56
34	69.6	1312	22	26	32	45	71
35	112	1674	28	32	39	56	89
36	148	1765	35	41	50	71	112
37	221	2090	35	51	63	89	142
38	352	2650	56	65	80	112	178
39	568	3380	71	81	100	141	224
40	882	4200	89	102	126	178	283

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

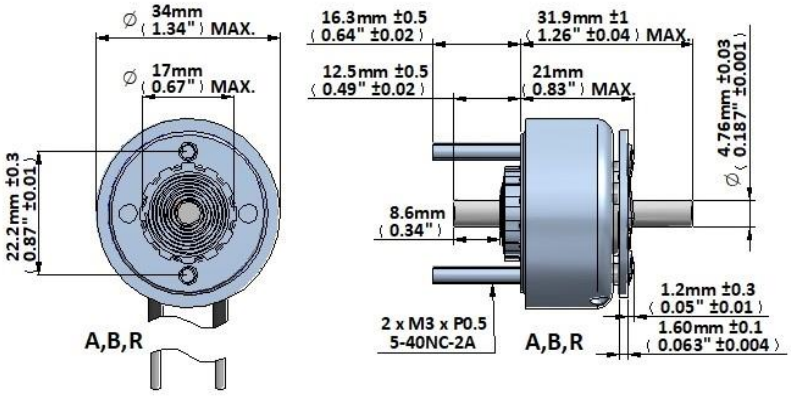
Class E (120°C) insulation class

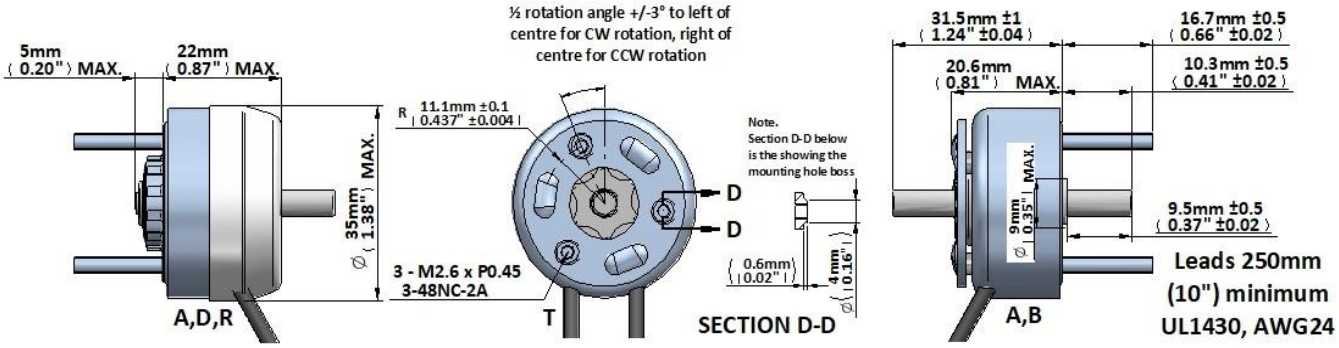
GEEPLUS Rotary Solenoid size 341

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5° (CW/CCW)
Mass 97 grammes





Data at 20°C , device connected to heatsink 120x120x3mm aluminum return spring 11 ~ 17 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	107	100	36	8
watts at 20°C		9	12	18	36	90
ampere-turns at 20°		535	618	756	1070	1690
Gross starting torque at 20°C (Nm)	25°	0.040	0.052	0.081	0.150	0.310
	35°	0.029	0.040	0.063	0.115	0.230
	45°	0.017	0.022	0.040	0.092	0.16
	67,5°	0.012	0.017	0.022	0.046	0.075
	95°	-	-	-	-	-

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
25	1.97	252	4.2	4.8	5.9	8.4	13
26	3.26	328	5.3	6.1	7.5	11.0	17.0
27	5.04	405	6.7	7.7	9.4	13.0	21.0
28	8.02	510	8.4	9.7	12.0	17	26
29	12.21	627	10	12	15	21	33
30	19.2	780	13	15	19	26	42
31	31.8	1008	17	19	24	33	53
32	47.0	1215	21	24	30	42	66
33	75.3	1530	26	31	37	53	84
34	120.5	1900	33	38	40	67	105
35	198	2486	42	48	59	84	133
36	280	2700	53	61	75	106	167
37	426	3350	67	77	94	133	210
38	648	4050	84	97	118	168	264
39	1020	5050	105	122	149	211	333
40	1667	6590	133	153	187	265	419

Insulation Resistance >100MΩ, 500VDC Megger Dielectric Strength 1000VAC, 50/60Hz, 1 minute

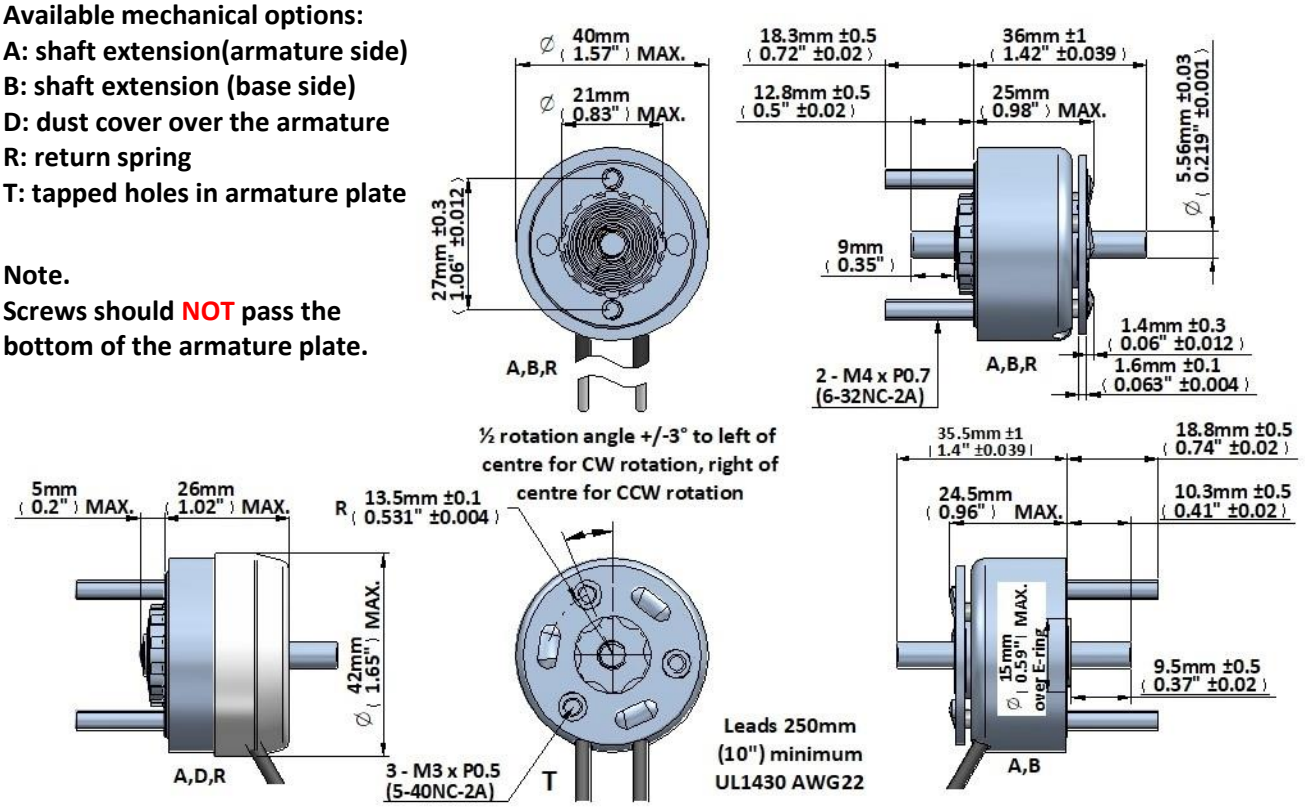
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 401

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 200 grammes



Data at 20°C , device connected to heatsink 160x160x3mm aluminum — return spring 16,5 ~ 24 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	108	100	36	9
watts at 20°C		12.5	16.5	25	50	125
ampere-turns at 20°		714	825	1000	1425	2250
Gross starting torque at 20°C (Nm)	25°	0.104	0.138	0.195	0.355	0.520
	35°	0.069	0.092	0.127	0.230	0.355
	45°	0.035	0.058	0.092	0.160	0.276
	67,5°	0.022	0.035	0.046	0.092	0.185
	95°	0.012	0.022	0.035	0.058	0.115

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
25	3.50	384	6.6	7.8	9.5	13	21
26	5.67	486	8.4	9.7	12	17	27
27	8.76	600	11	13	16	22	35
28	13.8	748	13	15	18	26	42
29	22.6	975	17	19	23	33	52
30	34.8	1190	21	25	30	42	67
31	56.7	1520	27	31	38	54	85
32	88.3	1908	35	41	49	70	110
33	138	2360	43	50	60	86	138
34	216	2904	53	61	75	106	168
35	351	3725	67	78	95	132	213
36	480	4000	85	98	119	169	268
37	720	9450	105	121	147	210	332
38	1150	6200	132	153	185	264	-
39	1920	8350	166	191	232	332	-
40	3000	10000	210	250	300	-	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

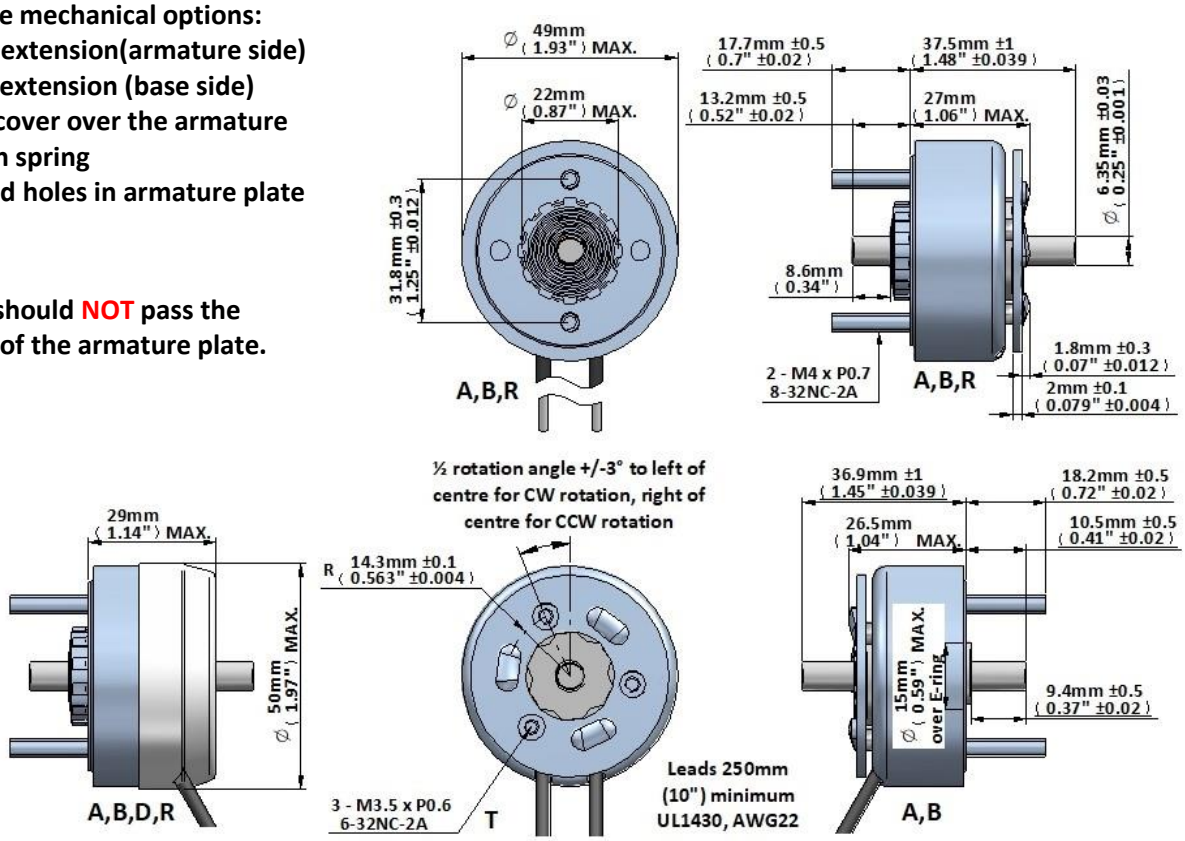
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 490

Device drawn in de-energised condition Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 250 grammes



Data at 20°C , device connected to heatsink 190x190x3mm aluminum — return spring 26 ~ 35 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	110	100	36	10
watts at 20°C		21	28	42	84	210
ampere-turns at 20°		842	966	1190	1685	2660
Gross starting torque at 20°C (Nm)	25°	0.220	0.3	0.47	0.84	1.39
	35°	0.104	0.15	0.24	0.47	0.84
	45°	0.081	0.127	0.195	0.390	0.725
	67,5°	0.058	0.081	0.127	0.230	0.450
	95°	0.022	0.035	0.046	0.098	0.185

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
24	3.20	360	7.6	8.7	11	15	24
25	4.91	440	9.5	11	13	19	30
26	7.72	550	12	14	17	24	38
27	11.1	636	15	17	21	30	48
28	18.8	840	19	22	27	38	60
29	30.5	1088	24	28	34	48	76
30	44.9	1275	30	34	43	60	95
31	70.9	1596	38	43	54	76	120
32	109	1974	48	56	67	95	150
33	175	2496	60	69	85	120	190
34	270	3042	76	87	107	151	239
35	414	3600	95	109	134	190	301
36	610	4200	122	140	173	245	386
37	940	5200	151	174	213	301	-
38	1560	6820	190	219	268	379	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

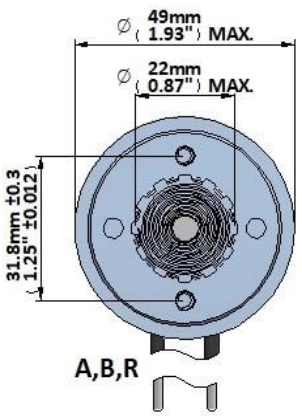
GEEPLUS Rotary Solenoid size 491

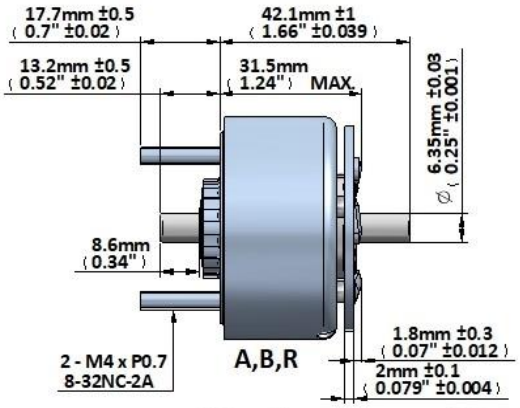
Device drawn in de-energised condition Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)

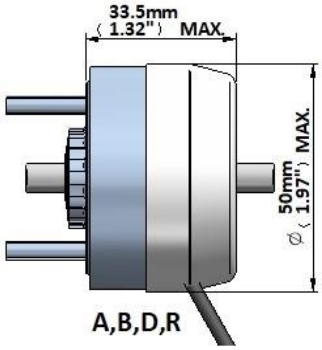
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

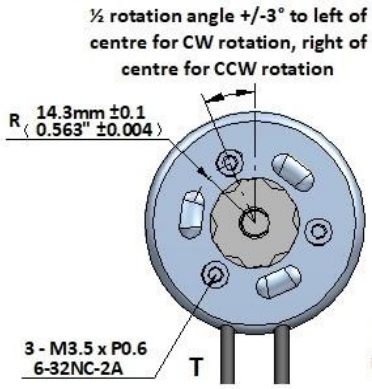
Note.
Screws should NOT pass the bottom of the armature plate.

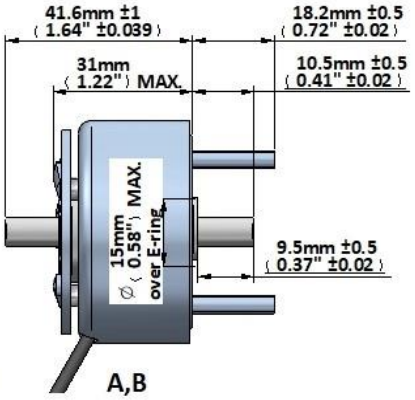
Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 330 grammes











Leads 250mm (10")minimum UL1430, AWG22

Data at 20°C , device connected to heatsink 190x190x3mm aluminum — return spring 26 ~ 35 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	110	100	36	10
watts at 20°C		21	28	42	84	210
ampere-turns at 20°		1015	1172	1440	2030	3210
Gross starting torque at 20°C (Nm)	25°	0.32	0.44	0.66	1.04	1.54
	35°	0.16	0.22	0.35	0.61	0.96
	45°	0.13	0.18	0.28	0.52	0.79
	67,5°	0.09	0.12	0.17	0.31	0.52
	95°	0.04	0.05	0.08	0.12	0.24

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
21	1.00	228	4.5	5.2	6.4	8.9	14.1
22	1.68	301	5.7	6.6	8.1	11.4	17.9
23	2.70	384	7.2	8.3	10.1	14.3	23
24	4.30	486	9.0	10.4	12.7	18	28
25	6.66	590	11.5	13.2	16.2	23	36
26	10.3	737	14.0	16.1	20	28	44
27	15.7	900	17.7	20.4	25	35	56
28	26.6	1190	23	27	32	45	72
29	38.0	1380	28	32	40	56	89
30	62.1	1768	36	41	51	71	113
31	96.1	2166	45	52	64	90	143
32	157	2816	57	66	80	113	179
33	241	3432	71	82	101	143	226
34	364	4108	90	104	128	180	285
35	566	4920	117	136	166	234	370
36	910	6340	146	168	207	292	462
37	1224	6800	183	211	260	366	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

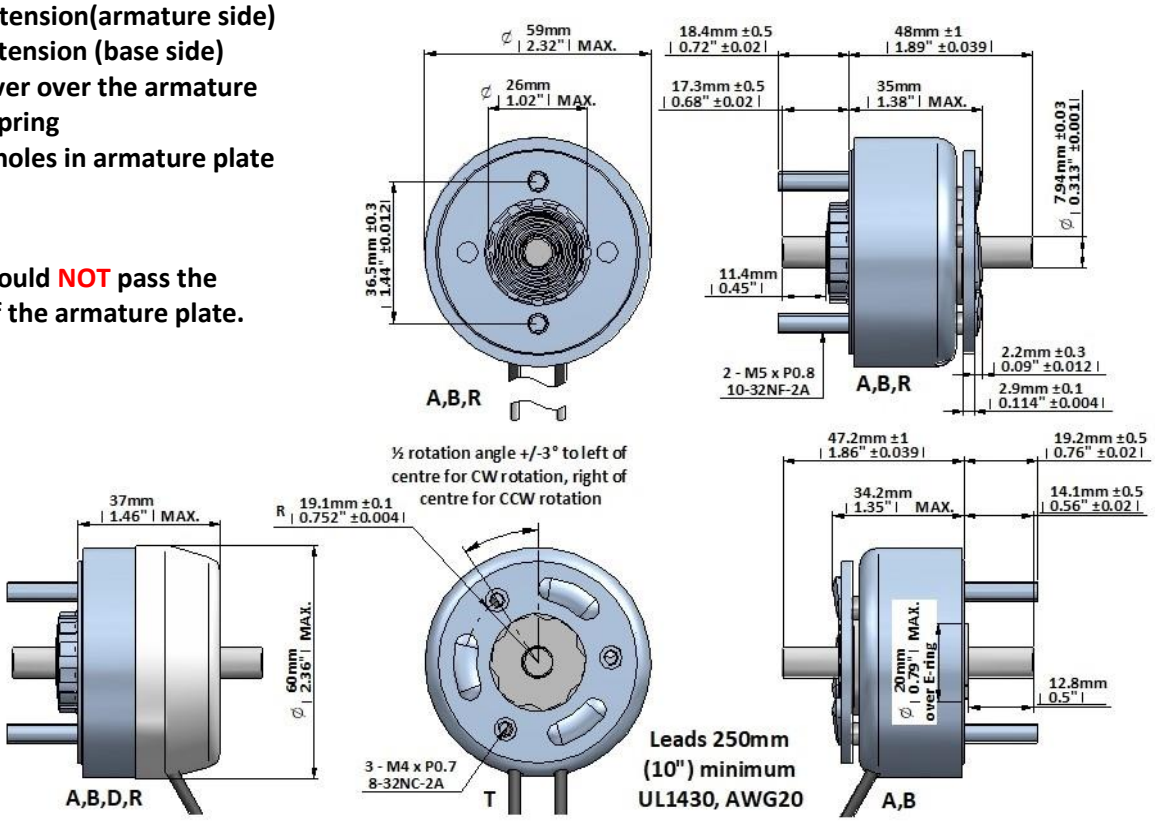
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 590

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 506 grammes



Data at 20°C , device connected to heatsink 310x310x3mm aluminum — return spring 45 ~ 65 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	115	87	36	13
watts at 20°C		29	38.5	58	116	290
ampere-turns at 20°		1240	1440	1760	2490	3920
Gross starting torque at 20°C (Nm)	25°	0.53	0.69	1.02	1.8	3.2
	35°	0.39	0.53	0.75	1.38	2.14
	45°	0.195	0.276	0.40	0.75	1.26
	67,5°	0.184	0.240	0.355	0.65	1.00
	95°	0.103	0.138	0.195	0.38	0.60

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
22	2.23	336	8.3	9.6	12	16	26
23	3.60	432	10	12	15	21	33
24	5.24	500	13	15	18	26	41
25	9.51	708	16	19	23	33	52
26	14.4	858	21	24	29	41	66
27	23.7	1110	26	30	37	52	83
28	38.2	1411	33	38	47	66	104
29	54.7	1638	41	48	59	83	131
30	93.7	2184	52	61	74	104	165
31	143	2645	66	76	93	131	207
32	223	3328	83	96	117	165	261
33	338	4004	104	121	147	208	329
34	550	5088	131	152	185	262	-
35	790	5860	165	192	233	330	-
36	1233	7260	208	242	294	-	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

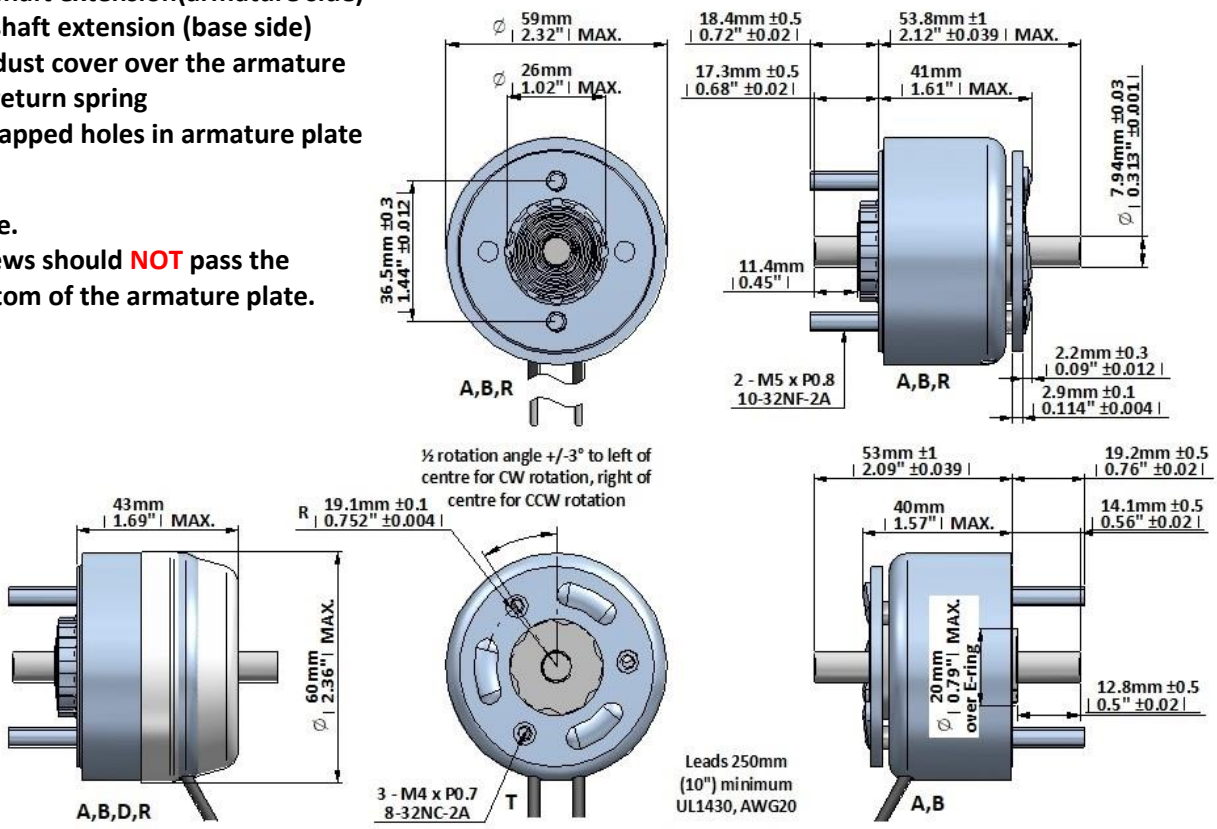
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 591

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 615 grammes



Data at 20°C , device connected to heatsink 310x310x3mm aluminum — return spring 45 ~ 65 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	95	87	36	13
watts at 20°C		32	43	64	128	320
ampere-turns at 20°		1480	1710	2080	2940	4620
Gross starting torque at 20°C (Nm)	25°	0.72	0.92	1.33	2.33	3.45
	35°	0.53	0.69	1.03	1.70	2.27
	45°	0.28	0.38	0.55	0.94	1.36
	67,5°	0.25	0.33	0.48	0.78	1.07
	95°	0.14	0.19	0.27	0.47	0.64

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
20	1.23	295	6.2	7.1	8.7	12.3	19.3
21	1.75	340	7.6	8.8	10.7	15.1	24
22	2.79	446	9.3	10.7	13.0	18.4	29
23	4.54	567	11.9	13.7	16.7	24	37
24	6.93	690	14.9	17.2	21	30	46
25	12.5	910	20	24	29	40	63
26	18.4	1120	24	28	34	48	76
27	33.4	1500	33	38	46	65	103
28	36.4	1750	39	45	55	78	122
29	74.5	2232	49	57	69	98	154
30	125.5	2940	63	73	89	126	197
31	199	3611	82	94	115	162	255
32	302	4350	103	119	144	204	321
33	417	5010	123	142	173	245	385

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

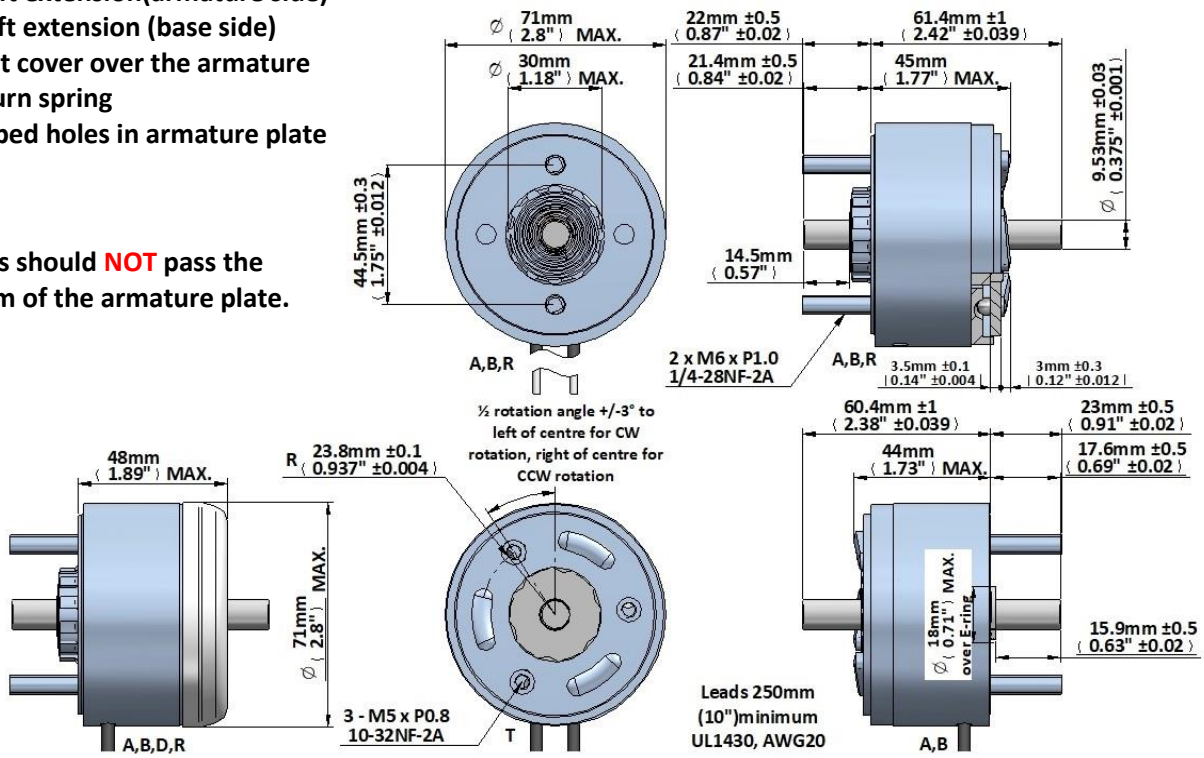
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 700

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 1013 grammes



Data at 20°C , device connected to heatsink 390x390x3mm aluminum — return spring 75 ~ 105 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	112	80	37	16
watts at 20°C		35	46.5	70	140	350
ampere-turns at 20°		1570	1800	2230	3150	5000
Gross starting torque at 20°C (Nm)	25°	1.27	2.12	2.74	3.8	4.9
	35°	0.69	0.99	1.38	2.53	4.37
	45°	0.58	0.78	1.0	1.88	3.42
	67,5°	0.288	0.355	0.59	1.12	2.01
	95°	0.178	0.3	0.4	0.735	1.21

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
20	1.88	368	8	9.3	11	16	26
21	3.01	468	10	11	14	20	32
22	4.82	580	13	15	18	26	41
23	8.1	780	16	19	23	33	52
24	12.3	949	20	23	29	41	65
25	19	1148	26	30	37	52	83
26	30.8	1472	33	38	46	66	105
27	48.8	1854	41	47	59	83	132
28	81.1	2436	52	60	75	105	166
29	121	2944	64	74	92	130	206
30	190	3650	82	94	118	166	264
31	275	4175	104	119	147	209	331
32	440	5792	119	137	170	240	-
33	735	7000	165	191	235	331	-
34	995	7600	204	239	288	-	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

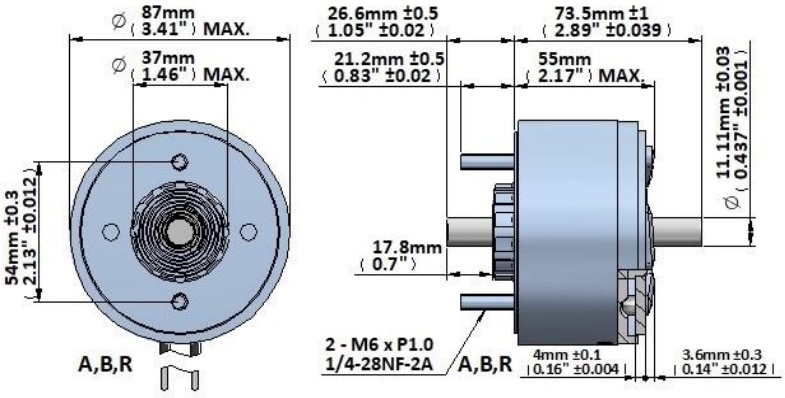
Class E (120°C) insulation class

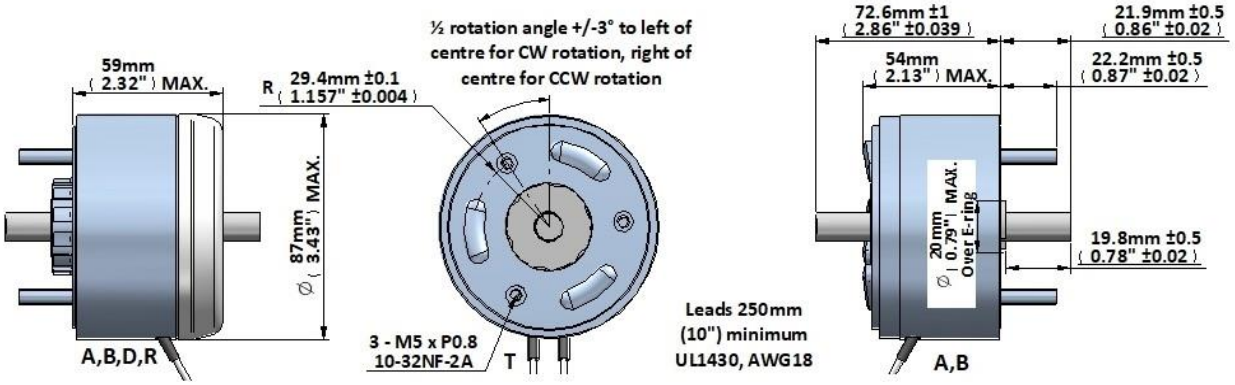
GEEPLUS Rotary Solenoid size 870

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 1885 grammes





Data at 20°C , device connected to heatsink 520x520x3mm aluminum — return spring 90 ~ 140 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	85	72	43	20
watts at 20°C		41	54.5	82	164	410
ampere-turns at 20°		1910	2190	2750	3810	5950
Gross starting torque at 20°C (Nm)	25°	1.84	2.65	4.25	6.9	11.300
	35°	1.38	1.84	2.76	4.5	7.35
	45°	1.15	1.5	2.2	3.9	6.2
	67,5°	0.48	0.69	1.15	1.95	3.34
	95°	0.4	0.48	0.7	1.15	1.95

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
18	1.47	368	7.6	8.7	11	15.0	24.0
19	2.3	459	9.6	11	14	19.0	30.0
20	3.64	580	12	14	17.0	24.0	37.0
21	5.57	704	15	17	22	30	47
22	9.5	936	19	22	28	39	30
23	14.3	1134	24	28	35	48	75
24	23.3	1456	30	35	44	61	95
25	37.1	1836	39	44	56	77	120
26	58.6	2300	49	56	70	97	152
27	89.8	2816	61	70	88	121	189
28	139	3456	76	88	111	153	239
29	227	4480	98	111	138	193	300
30	376	5792	124	143	177	248	387
31	515	6600	148	170	212	297	-
32	785	7850	188	220	275	385	-
33	1130	9050	237	271	339	-	-

Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

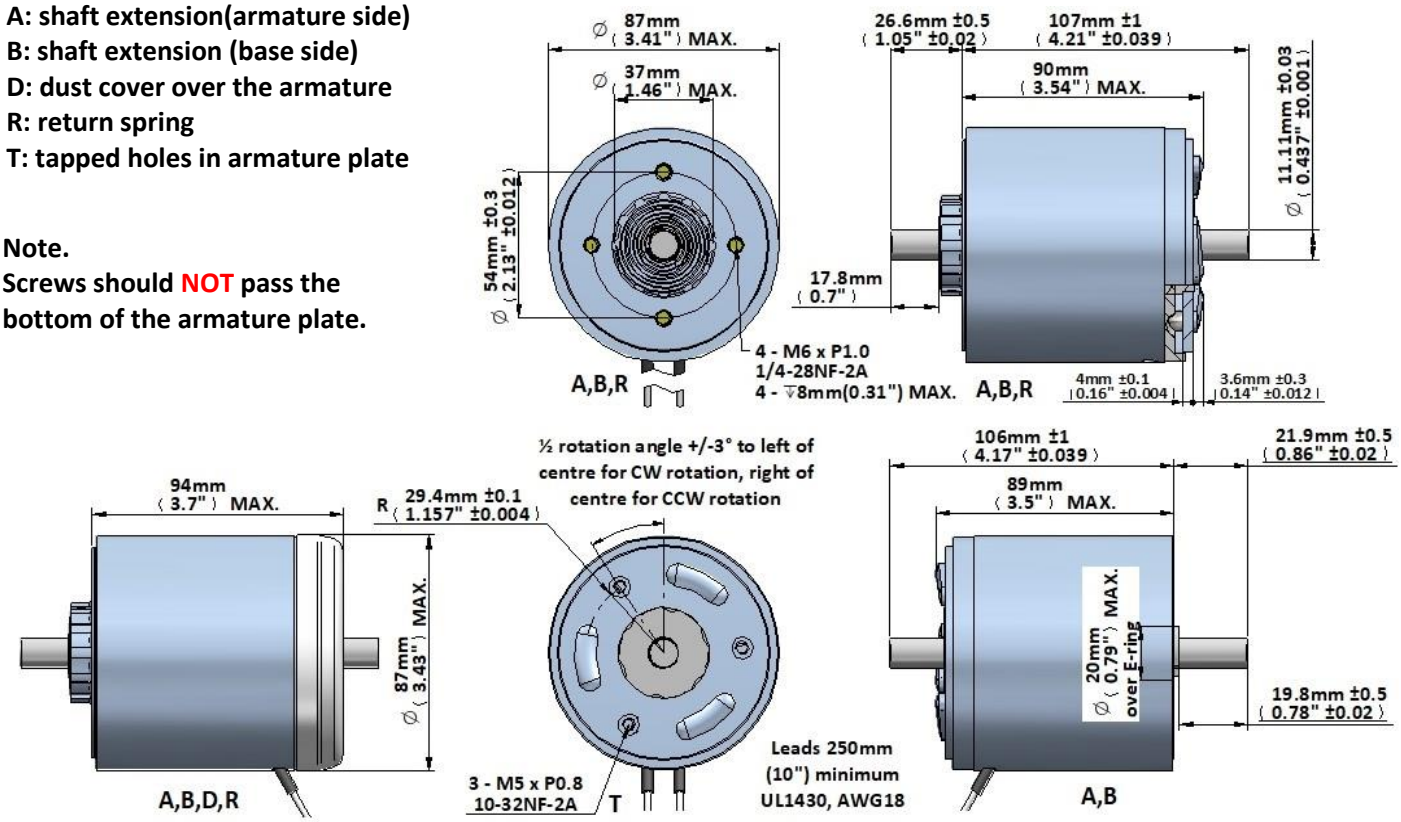
Class E (120°C) insulation class

GEEPLUS Rotary Solenoid size 874

Device drawn in de-energised condition
Life Expectancy (cycles): >2M (-R), >10M (-RE), >50M (-RL)
Available mechanical options:
A: shaft extension(armature side)
B: shaft extension (base side)
D: dust cover over the armature
R: return spring
T: tapped holes in armature plate

Note.
Screws should NOT pass the bottom of the armature plate.

Available angle options:
25°, 35°, 45°, 67,5°, 95° (CW/CCW)
Mass 3056 grammes



Data at 20°C , device connected to heatsink 520x520x3mm aluminum — return spring 190 ~ 140 mNm

duty cycle = "on" time / ("on" time + "off" time) x 100%		100% cont.	75% or less	50% or less	25% or less	10% or less
Max. "on" time in seconds		∞	85	72	43	20
watts at 20°C		41	54.5	82	164	410
ampere-turns at 20°		2590	2990	3663	5180	8190
Gross starting torque at 20°C (Nm)	25°	3.6	4.7	6.5	10	13
	35°	2.4	3.1	4.2	6.4	8.7
	45°	2.0	2.6	3.6	5.5	7.4
	67,5°	1.0	1.3	1.8	2.9	3.9
	95°	0.66	0.82	1.1	1.7	2.2

AWG no.	resistance Ω±10% (at 20°C)	number of turns	volts DC				
18	2.54	630	10	12	15	21	33
19	4.15	828	13	15	18	26	41
20	6.38	1047	16	18	22	32	50
21	11.14	1408	20	24	29	41	65
22	16.8	1723	25	29	36	51	80
23	25.8	2046	33	38	46	65	103
24	42.5	2711	41	47	57	81	128
25	66.3	3279	52	60	74	105	166
26	105	4151	66	76	93	131	207
27	165	5190	82	95	116	165	260
28	261	6500	104	120	147	208	329
29	422	8340	131	151	185	262	-
30	664	10230	168	194	238	336	-
31	968	12410	202	233	286	-	-
32	1520	15200	259	299	366	-	-

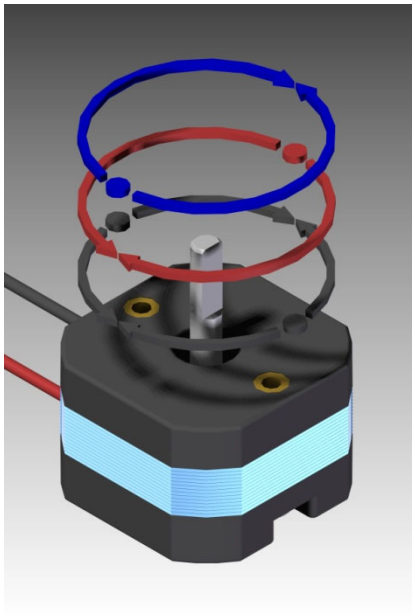
Insulation Resistance >100MΩ, 500VDC Megger — Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

BI-STABLE ROTARY SOLENOIDS

Bistable Rotary Solenoid

The bistable rotary solenoid changes state with the application of a momentary pulse of electricity and then remains in the changed state without power applied until a further pulse of reverse polarity is applied to drive it in the opposite direction. Because energy is only applied in short pulses, high power can be applied to develop high torque for fast operation without leading to heating problems. Response time of <<10ms is possible for some of these devices.



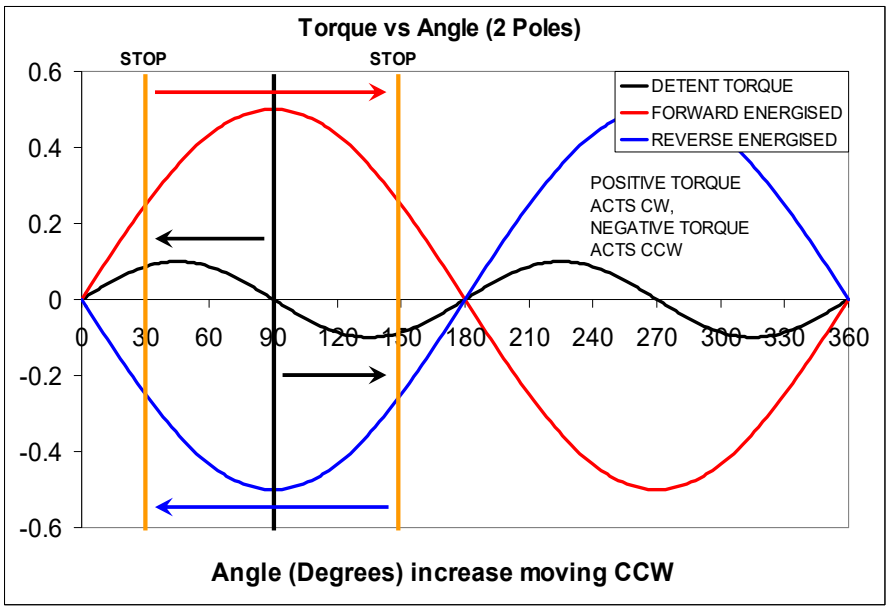
Referring to the image and graph, the device is drawn in the mid-position (90° on the graph below), and torque in the de-energised condition is represented by the black curve and arrows. Without stops, the device will try to turn towards stable equilibrium points (where two arrowheads meet) located at 0° and at 180°, and away from unstable equilibrium points (represented as a black dot) located at 90° and at 270°.

For all parts, devices are drawn in the mid-position. This is an unstable point in the de-energised position and is halfway between the stable points in the de-energised condition.

In the forward energised state, the device tries to turn towards a single stable equilibrium point at 180°, in the reverse energised state it tries to turn towards a single stable equilibrium point at 0°.

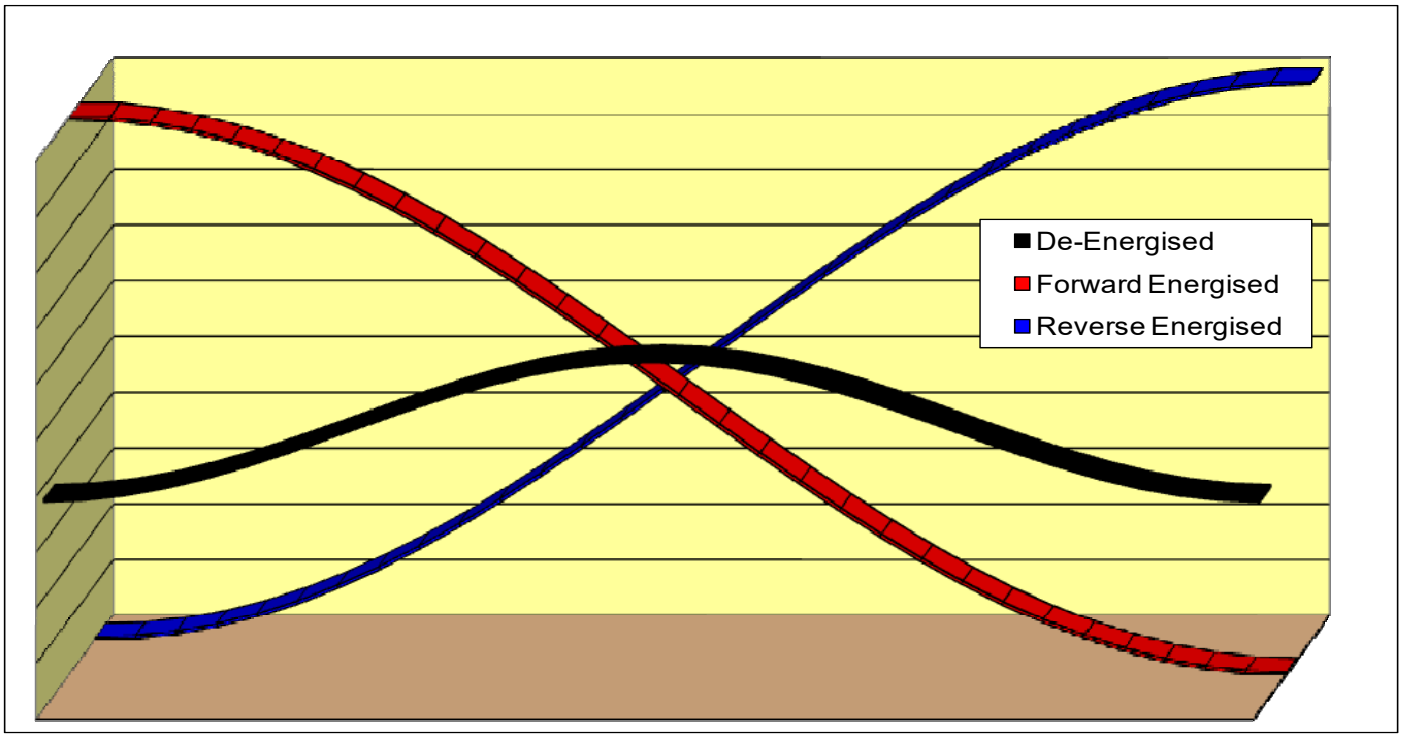
Bistable rotary solenoids do not normally incorporate end stops within the device; a stop should be incorporated externally in the customer application. The stop positions are represented as vertical orange lines in the graph.

The mechanical end stops restrict rotation so the device cannot turn all the way to the equilibrium points (which are zero torque points), they should restrict motion to a region where developed torque is sufficient to turn the load at required speed or to hold the load. For more efficient operation, the shape of the torque curves may be modified to optimise behaviour for a particular rotation angle.



Subjectively, the torque behaviour may more easily be understood by considering the analogy of a surface down which a ball bearing is rolled. The surfaces representing the different excitation states of the solenoid are illustrated below, in the case of a 2-pole device the region shown would represent 180° of movement.

- The de-energised state is represented by the black surface, the ball-bearing will try to roll towards either end-position. As it is moved further from the end position, the force trying to restore it will initially increase, but will then reduce as it approaches the mid-position. This is an unstable equilibrium point where no force is developed, however if displaced to either side it will roll away from this point towards the end position.
- The Forward energised condition is represented by the red surface, the ball-bearing will try to roll to the right. The end positions are zero-force points, the force moving it rightwards will be a maximum somewhere close to the mid-position.
- The Reverse energised condition is represented by the blue surface, this is a mirror image of the red surface, the ball-bearing will try to roll to the left.



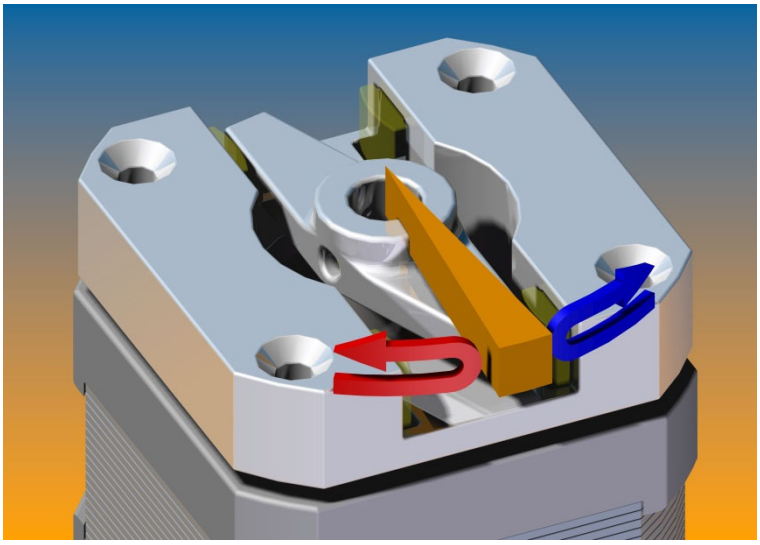
Behaviour About the Mid Position

The mid position in which bistable solenoids are normally drawn is the nominal centre half-way position between two (stable equilibrium in de-energised state) endpoints. This position is defined in relation to a locating feature (typically a flat or keyway) on the shaft of the solenoid, and to mounting features on the body of the solenoid.

In practical terms, the magnetic rotor of the solenoid may not be perfectly aligned in relation to the mid position, the centre of the magnetic operation of the solenoid will be referred to as the neutral position. In the manufacture of these devices, it is normally expected that the neutral position should be aligned within +/-5° of the mid position.

If the solenoid in the de-energised condition is pushed from one end towards the other, it can usually be pushed through the mid-position until it reaches a point where it 'flips' towards the other end position. If this is done in both directions, the point halfway between these two 'flipping' points is the neutral position. There may be a region around the neutral position where the rotor will 'stick' with zero torque if forced to this position. Caution should be exercised in making judgements on this behaviour as the position of the 'flipping' points may be influenced by the excitation history of the solenoid.

When the solenoid is driven by electrical excitation to its end position, the magnetic field induced in the iron may leave some residual field when the excitation is turned off. This remanence will help hold the solenoid in a 'preferred' stable end position. If the solenoid is deflected from this preferred position through a small angle towards the neutral position, and then released, the solenoid will return towards the preferred position. If this is repeated with increasing angle, then eventually a point will be established from which the solenoid will not return to the preferred position. Because of the remanence, this point may be beyond the neutral position, and this position may vary depending on the magnitude of the excitation current. If an excitation with the opposite polarity is then applied to drive the solenoid to the other end position, then a similar point can be determined in the opposite direction.



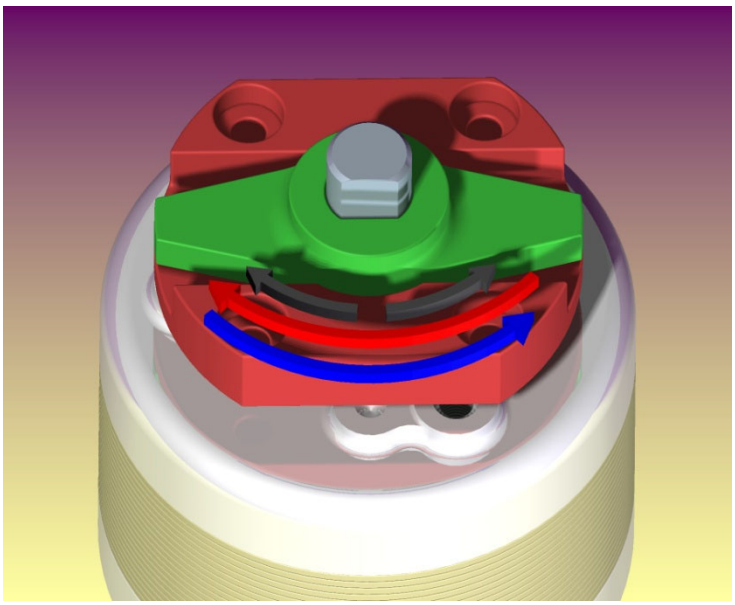
The angle between these points is the Minimum Stable Angle of the solenoid under applied excitation conditions. If these points occur before the neutral position (as represented by arrows in the drawing) then the Minimum Stable Angle is positive, if these points occur beyond the neutral position, it is negative. It may vary under different excitation conditions, and it is expected to become smaller (more negative) as the excitation (and magnetic flux) when the solenoid reaches the end position increases.

The smallest angle over which the solenoid can be used reliably will be determined by the sum of the Minimum Stable Angle, and the range of variation between mid and neutral positions.

Installation and Use

The illustration shows a BRS5045 solenoid in its mid-position. The solenoid has a stop fitted (the green part mounted on the shaft, and the red part mounted to the body of the solenoid) which limits the range of movement to 30°, 15° to either side of the mid-position (shown in this position).

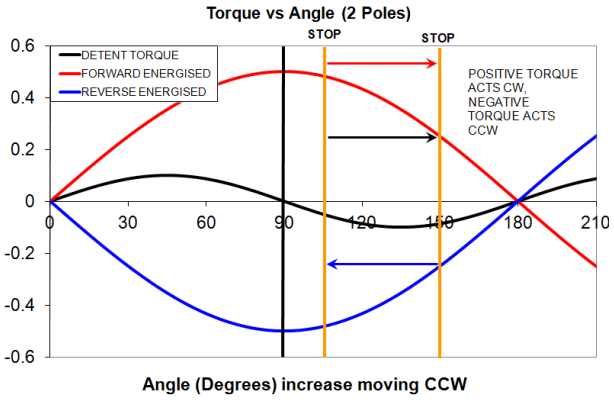
Without any power applied, this is an unstable position, if the shaft is turned in either direction from this mid-position, the residual torque will drive the solenoid further away from the mid-position until it comes to rest against the end-stop. This is represented by the black arrows.



A pulse of electrical power applied in the forward direction will cause the solenoid to develop torque acting in the clockwise direction, and to turn in this sense until it comes to rest against the stop. This excitation condition is represented by the red arrow. If power is then removed the detent torque will cause the solenoid to remain in this position.

A pulse of electrical power applied in the reverse direction will cause the solenoid to develop torque acting in the counterclockwise direction, and to turn in this sense until it comes to rest against the stop. This excitation condition is represented by the blue arrow. If power is then removed the detent torque will cause the solenoid to remain in this position.

- For bistable operation it is important that the solenoid is mounted so that the mid-position (parts are normally drawn in this position) is located mid-way between the end stops
- End stops are normally required to be fitted by the customer. These devices are not normally supplied with internal stops, although these may be offered as an option for some models.
- Without end-stops to limit rotation of the solenoid, it will naturally try to turn into a magnetic detent position, these positions are zero-torque positions, the solenoid will develop little or no torque if energised in these positions.
- If both end stops are positioned to the same side of the mid-position, a ‘fail-safe’ design can be realised. As shown in the graph, in the case of power failure, the detent torque will drive the device clockwise, it can be energised with forward excitation to drive more quickly to this position. The device must be energised in the reverse direction to drive to the CCW position and must be kept energised to hold in this position.

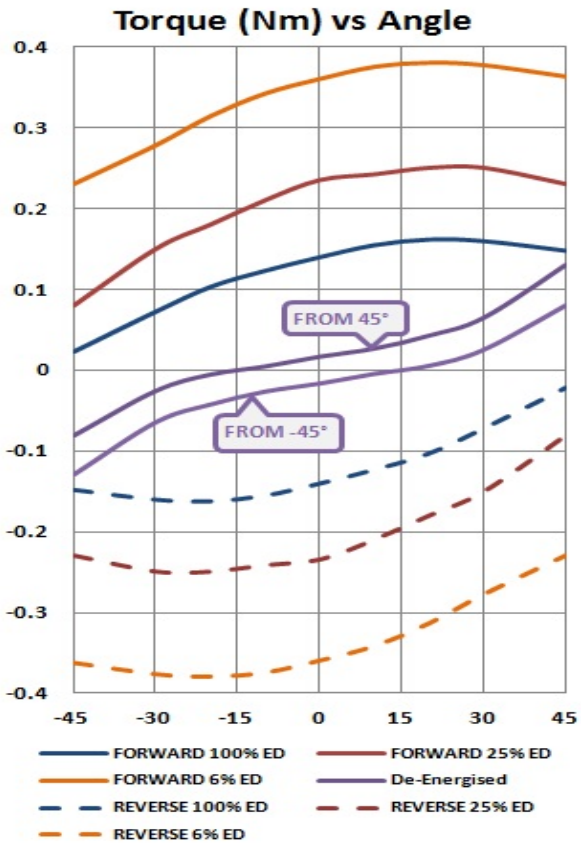


Torque Data

Torque data is measured statically, the solenoid is mounted to a rotary table with a torque arm acting against a load cell to measure torque. To obtain stable data, response time is measured with the part energised from a regulated current source. Current regulation stabilises the response time of the solenoid against variations in supply voltage or operating temperature. The solenoid is energised with specified current conditions and is rotated whilst monitoring torque output to derive the torque curves. The torque is measured turning in either direction and the lower of the two measured values is taken for data to allow for hysteresis (a combination of mechanical friction and magnetic hysteresis)

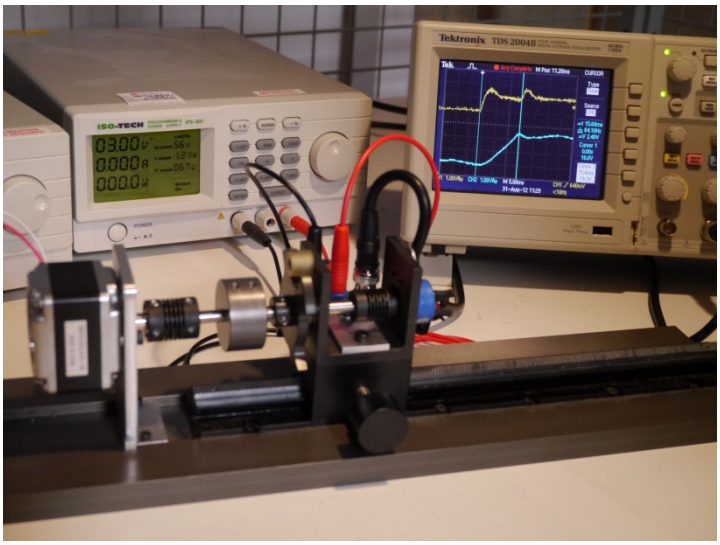
A typical torque characteristic is shown, the graph illustrating this shows torque in both the forward energised (+ve torque acting CW), and reverse energised (-ve torque acting CCW) states. The behaviour in either direction is symmetrical, so is only normally shown for the forward energised condition.

There are two curves representing torque in the de-energised condition. Due to magnetic hysteresis, after the solenoid is driven to either end position, there will be some residual magnetism in the steel which causes the solenoid to favour this end position even moving slightly beyond the centre position towards the other end – this phenomenon aids the stability of bistable operation.



Response Time Data

To obtain stable data, response time is measured with the part energised from a regulated current source with a current of 80% of the nominal value (the current drawn by the solenoid in the cold 20°C condition when the stated voltage is applied). Current regulation stabilises the response time of the solenoid against variations in supply voltage or operating temperature. The stated voltage in response speed data is the source voltage from which the current regulator works. The measured performance corresponds to the behaviour that will be achieved with excitation at the nominal voltage when the coil temperature is elevated to approximately 80°C. It should be noted that the source voltage influences the rise time of the current to reach rated value – a high source voltage will enable shorter electrical rise time and faster actuation times.



End stops are positioned equidistant on either side of the mid-position of the solenoid under test.

In addition to the moment of inertia of the shaft and stop configuration of the test rig, additional masses may be mounted to the shaft to measure response time under different load conditions.

A resistor of low ohmic value relative to the coil resistance of the device under test is installed in series with the coil, and the voltage across this (corresponding to the coil excitation current) is measured with an oscilloscope.

In most cases a potentiometer is mounted to the test rig with a constant voltage applied across the end terminals and the potential measured on the wiper of the potentiometer (corresponding to position) is displayed on another channel of the oscilloscope (this may be omitted for very small devices where friction in the potentiometer has a significant impact on response speed of the device)

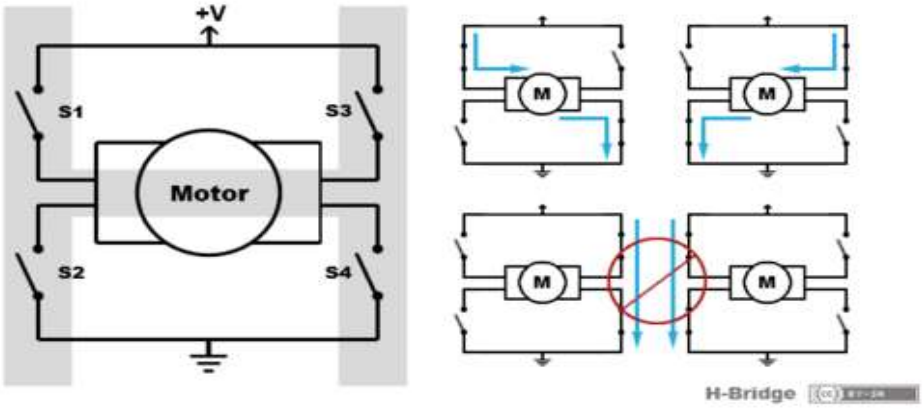
When the device is energised, the current waveform will show an exponential curve as the current rises and will show a ‘spike’ in this curve as the rotor of the actuator impacts the end stop and bounces.

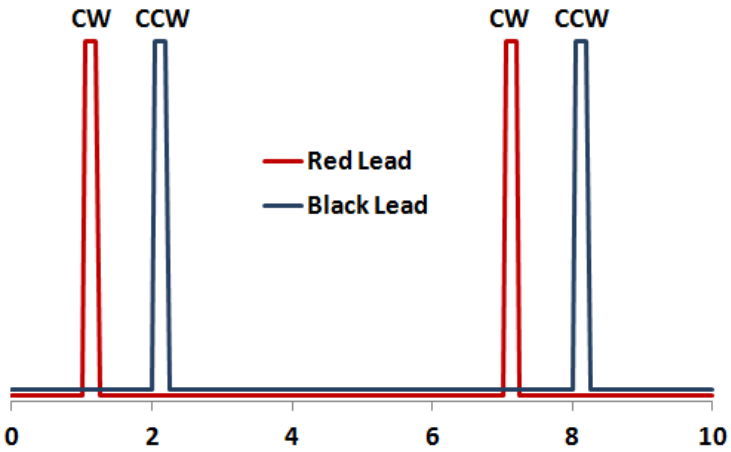
Response time data is usually given in the form of a graph plotting response time against load inertia, with several lines representing different rotation angles and excitation conditions.

The response time is taken to be the time taken from the application of power to the solenoid, until the assembly first contacts the end-stop at the limit of rotation, this is judged as the point where the assembly is seen to start decelerating. This does not include the time taken for the device to settle and for any rebound to die down, as the end-stop conditions will vary with customer implementation and are not under Geeplus control.

Electrical Drive

To drive a bistable rotary solenoid, a circuit configuration known as an H-Bridge is normally required. This is shown schematically. This is normally implemented using solid-state switches (transistors), a number of integrated devices are available to simplify the implementation of such a circuit.

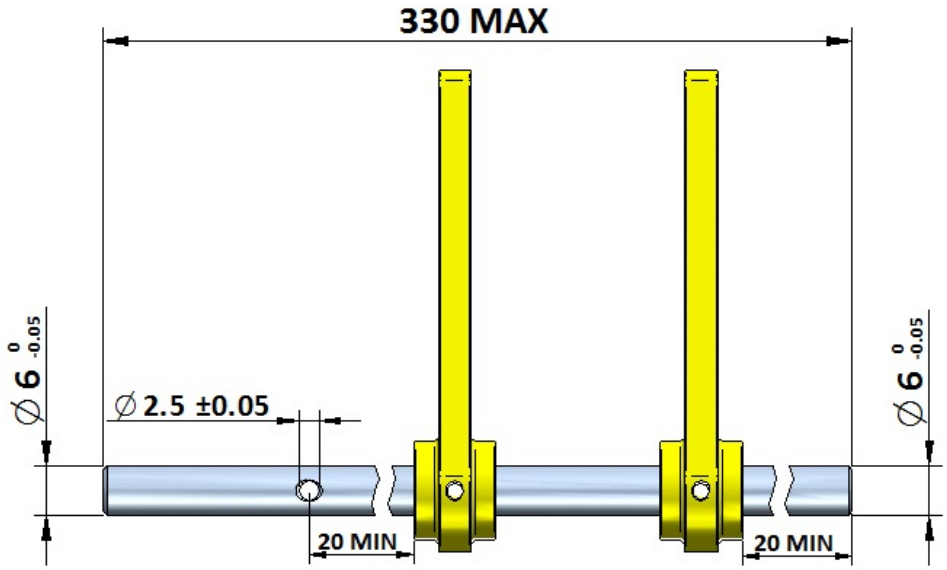




By closing either S1 and S4 or S2 and S3 while the other switches are open, the current can be caused to flow through the solenoid coil in either the forward or the reverse direction. With momentary excitation pulses as depicted in the timing diagram, the solenoid can be driven CW or CCW, remaining in either position with no power applied in between.

Response Speed Testing with Customer Diverter

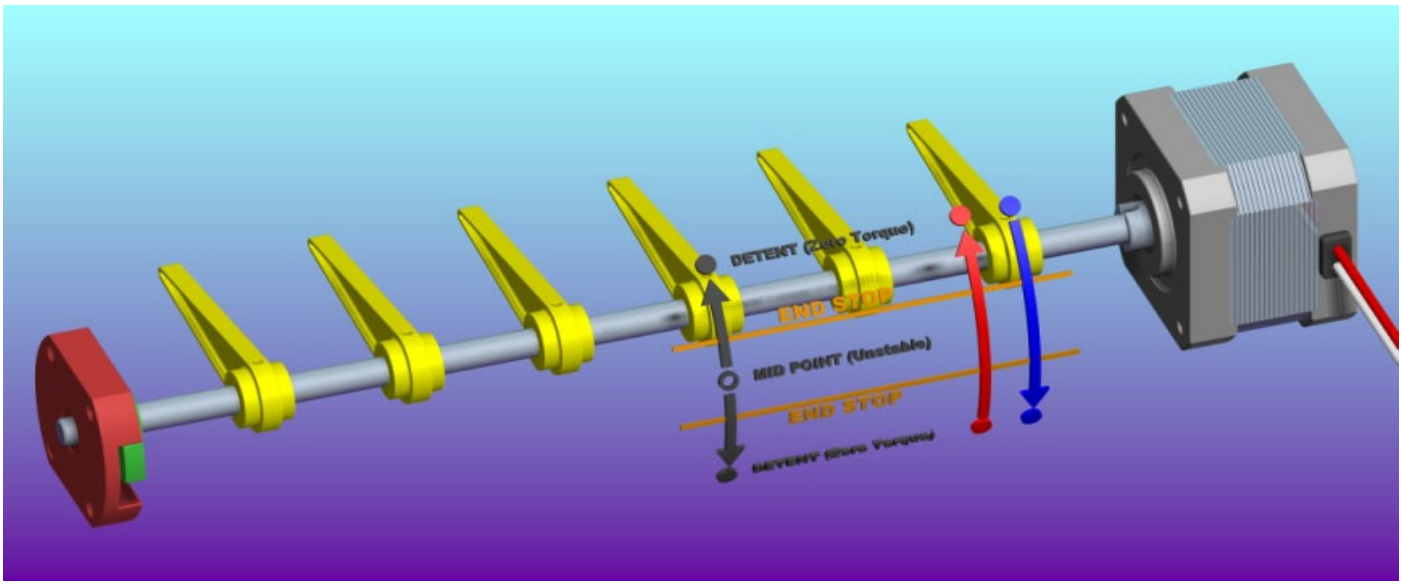
As a chargeable service, if a diverter gate and end-stop are supplied with appropriate mounting features to mount on Geeplus test fixtures, we can undertake a series of response tests for a solenoid with user-supplied load mounted, with results supplied as an oscillogram showing position vs time. Mechanical mounting features should be as below. For test purposes, parts can be energised with supply voltage in the range 0v-60v, and current in the range 0A-10A.



BRS42xx for Diverter Applications

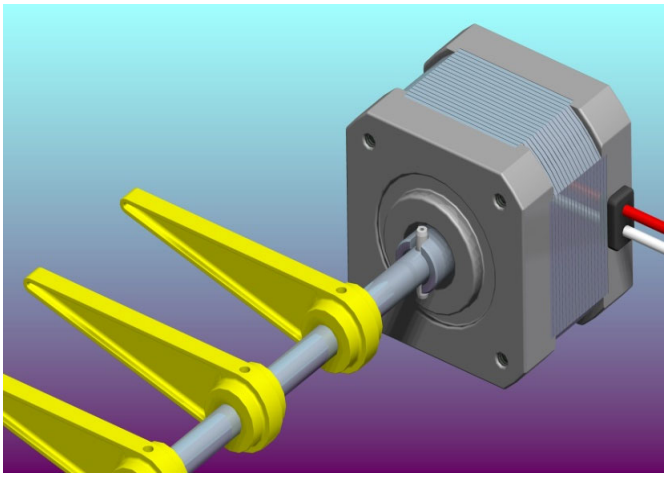
The BRS42 Bistable Rotary Solenoid is designed for fast, limited angle actuation of diverter gates in paper, banknote, or document handling equipment. Implementation of diverter designs is simplified with reduced installation time and cost, and with reduced energy consumption reducing system heat dissipation and running costs.

The solenoid incorporates bearings to support the shaft of the diverter mechanism on one side of the machine and is designed for a simple assembly where the solenoid is fitted over the end of the diverter shaft and engages with a roll pin fitted through the shaft to transmit torque.



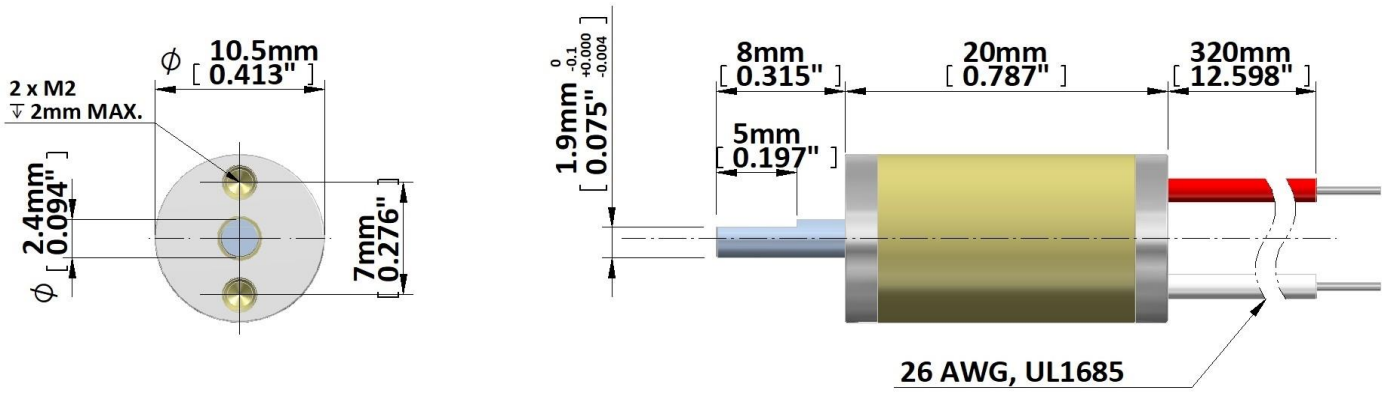
The user must implement end stops within the diverter mechanism to limit rotation within the operating region of the solenoid. End-stop design needs to take into consideration of rebound of the diverter gate from the stop which can compromise operation.

For the most consistent operation, the device should be energised with a constant current driver.



GEEPLUS BRS1020-13

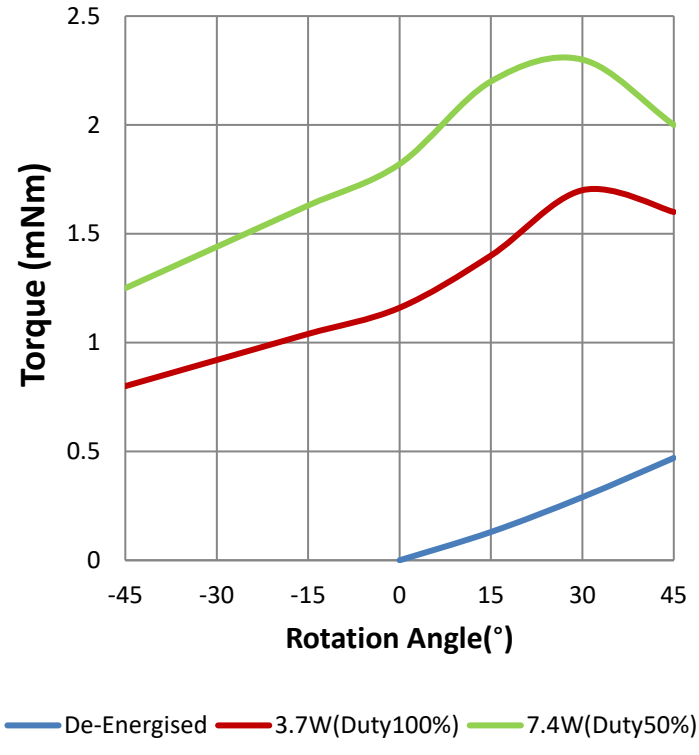
Device drawn with shaft aligned to mid position
Nominal 13Ω, 0.6mH for operation at 380mA, 100%ED
Rotor Inertia 0.017 gcm²
Life Expectancy >10M cycles, load
Optimal roation +/-30°, Mass 8 grammes
Insulation Resistance >100MΩ, 500VDC Megger
Dielectric Strength 500vAC, 50/60Hz, 1 minute



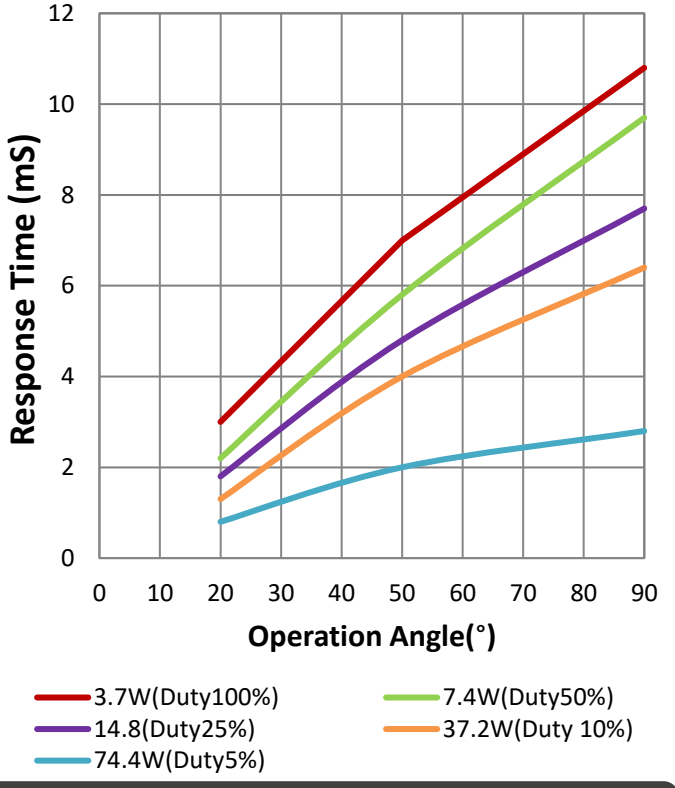
The above drawing shows the rotary shaft positioned in the center (0°) of its rotation range.

When a positive electrode (+) is connected to the Red lead wire, and a negative electrode (-) to the White lead wire, the shaft rotates clockwise

Torque (mNm) vs Angle

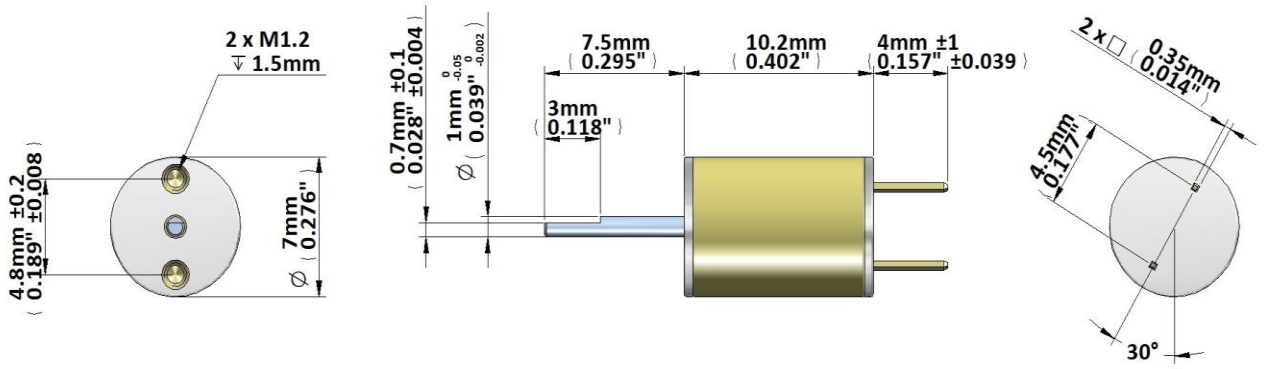


Response (ms) vs Angle (Load Inertia 0.45gcm²)



Device drawn with shaft aligned to mid position
Nominal 9.5Ω, 180mH for operation at 315mA, 100%ED
Rotor Inertia 0.15 gmm²
Life Expectancy >10M cycles, no load
Optimal rotation is +/-30°, Mass 1.5 grammes
Insulation Resistance >5MΩ, 500VDC Megger
Dielectric Strength 250vAC, 50/60Hz, 1 minute

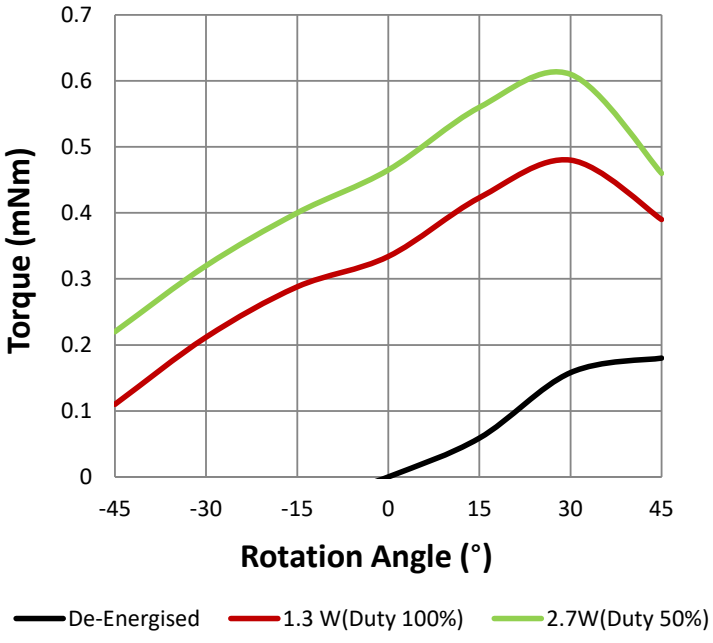
Class E (120°C) insulation class



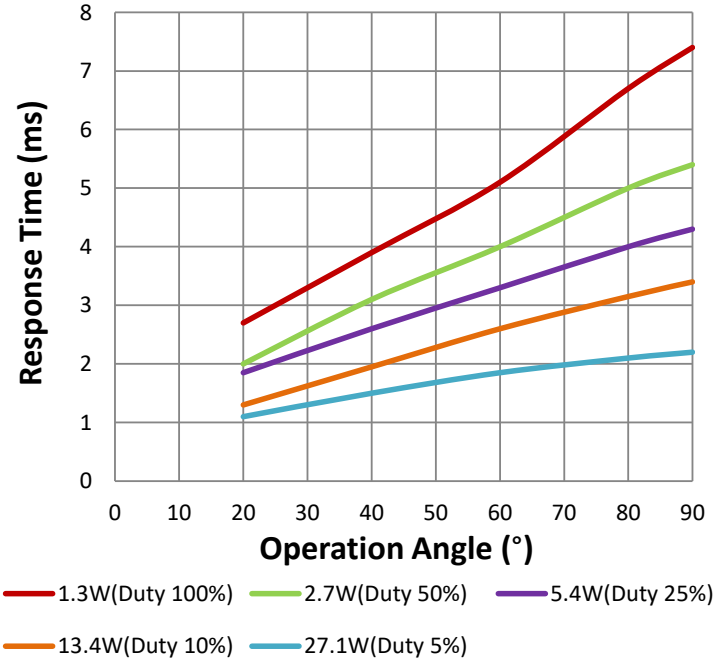
The above drawing shows the rotary shaft positioned in the center (0°) of its rotation range.

When a positive electrode (+) is connected to the lower pin , and a negative electrode (-) to the upper pin, the shaft rotates clockwise.

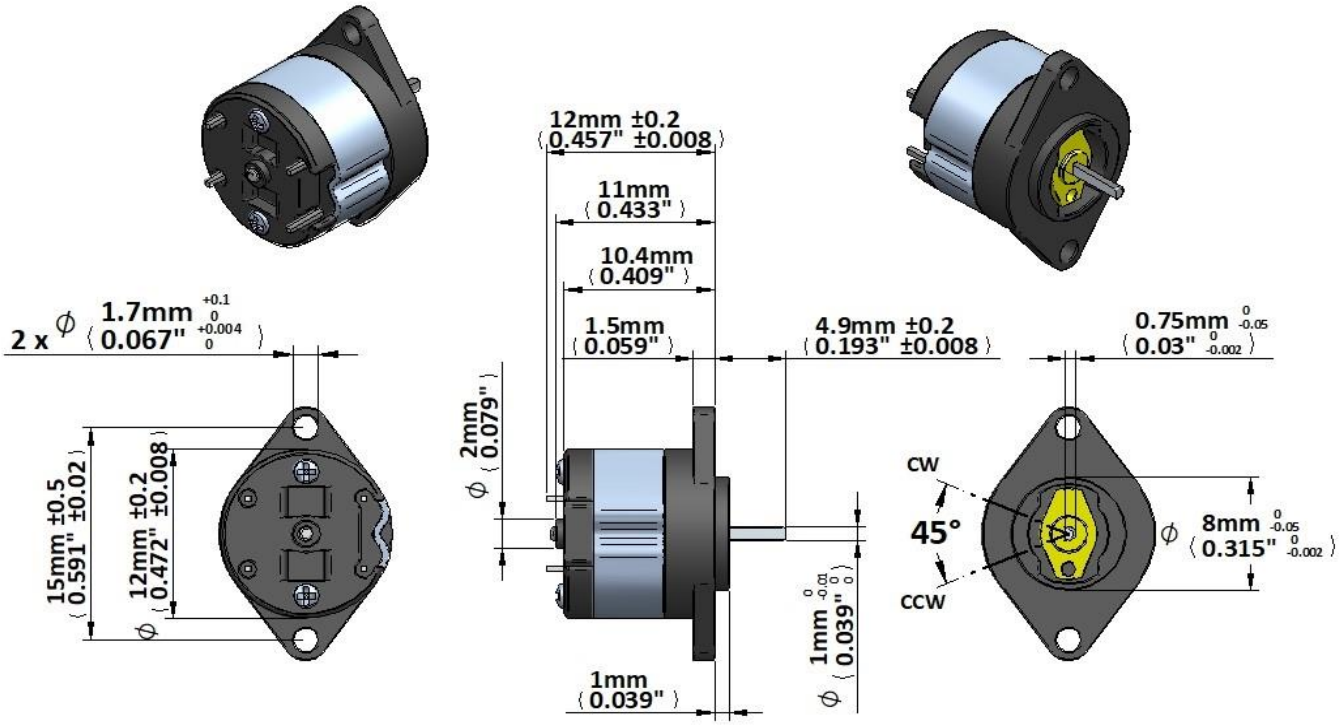
Torque (mNm) vs Angle



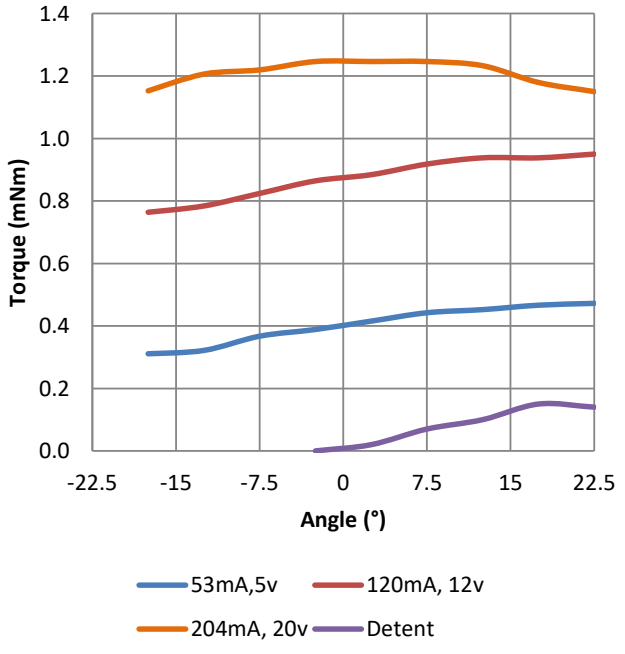
Response (ms) vs Angle (Load Inertia 0.27gmm²)



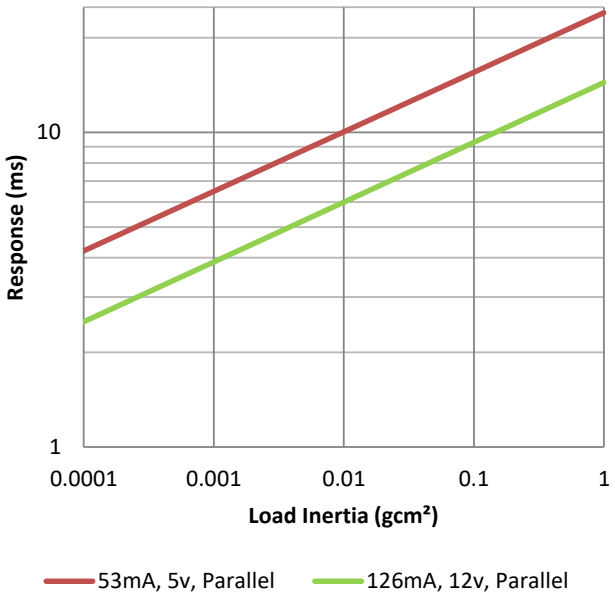
Device drawn with shaft aligned to mid position
Nominal 95Ω parallel, 380Ω series connection
Rotor Inertia 0.035 gcm²
Life Expectancy >100k cycles, 1gcm² load
Life Expectancy >1M cycles, no load
Optimal rotation+/- 22.5° , Mass 3.5 grammes
Insulation Resistance >50MΩ, 500VDC Megger
Dielectric Strength 300vAC, 50/60Hz, 1 second



Typical Torque (mNm) vs Angle

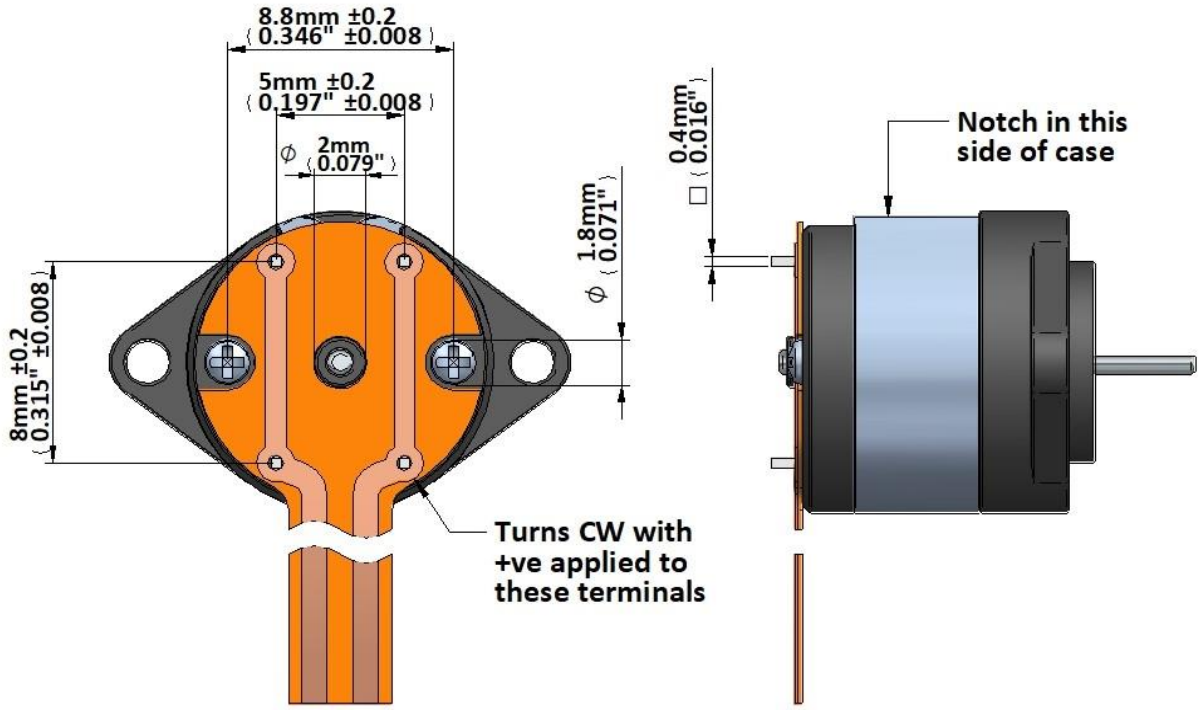


Typical Response (ms) vs Load Inertia (gcm²)

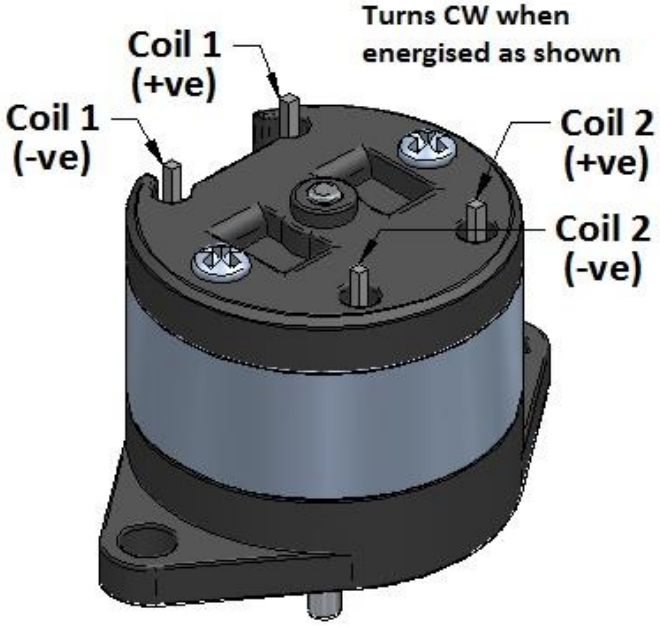


Termination with flexible circuit is reccomended as this places minimal stress on the terminal pins. Parallel connection is shown below.

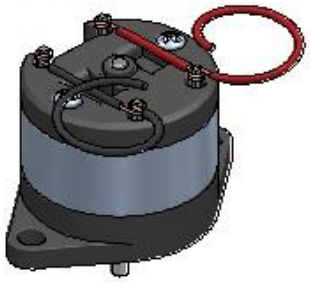
Rotor Inertia 0.035 gcm²



The drawing below shows termination with leadwire and shows both parallel and series connection configurations



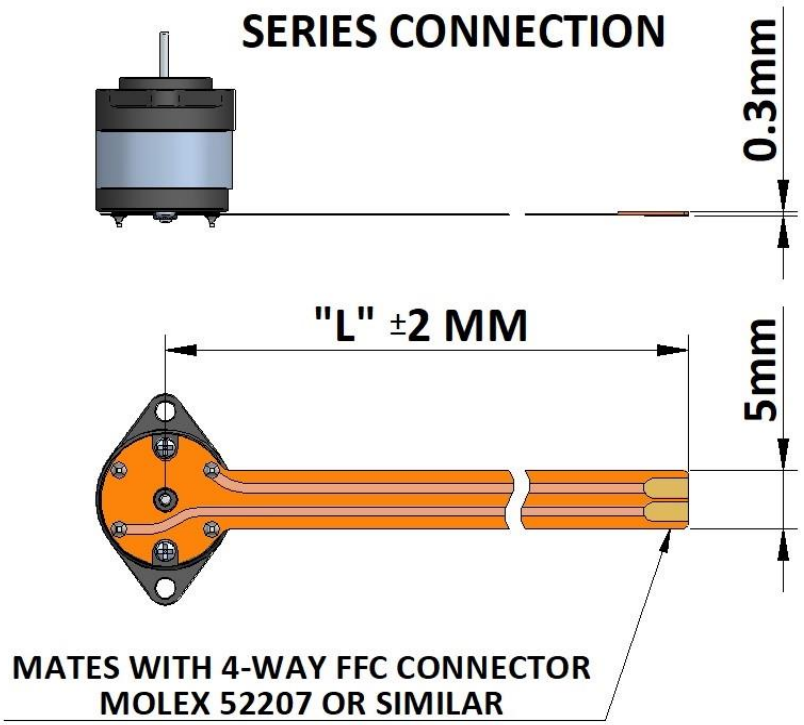
Parallel

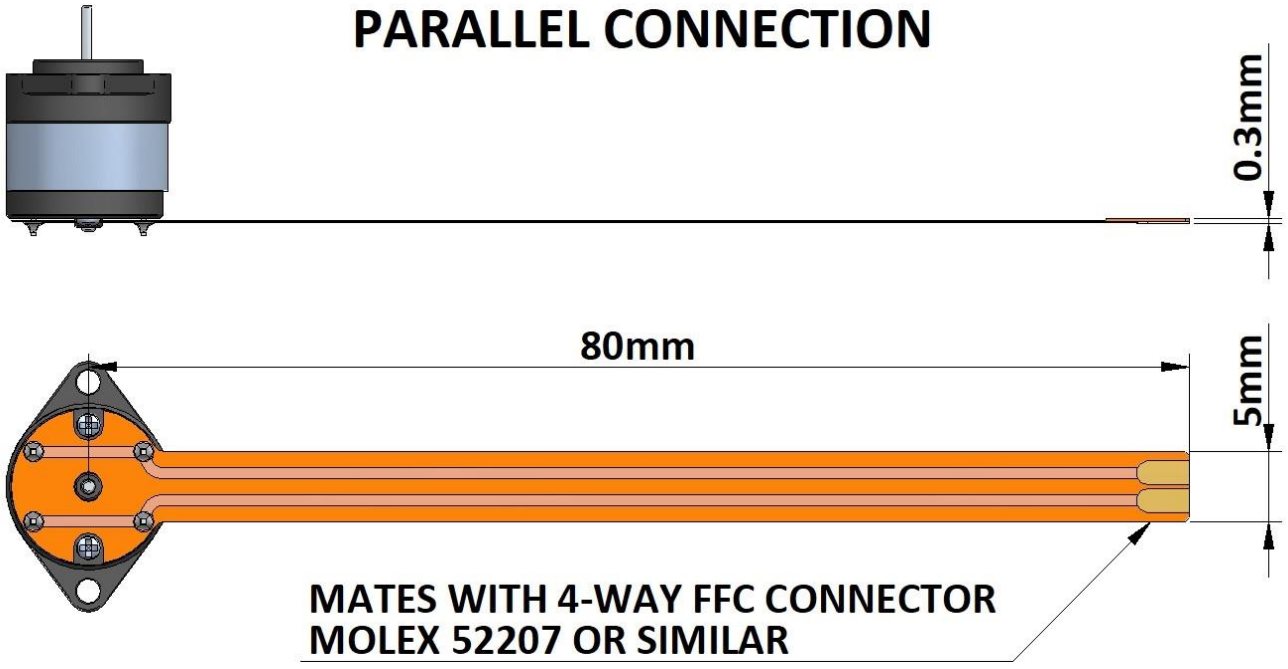


Series

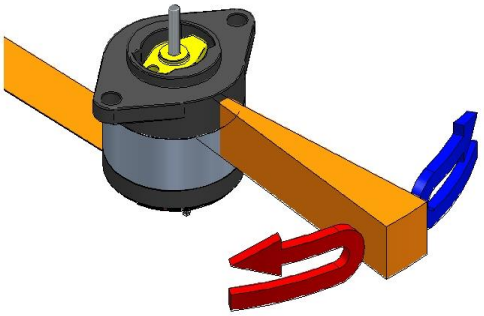
Termination with flexible circuit is reccomended as this places minimal stress on the terminal pins. The drawing below shows termination with flex circuit and shows both parallel and series connection configurations options

BRS1212 FLEXIBLE CIRCUIT TERMINATION OPTIONS				
PART NUMBER	CONNECTION	COIL RESISTANCE (Ω)	LENGTH (MM)	CONNECTOR
BRS1212-C10443	PARALLEL	95	80	FFC, 1MM, 4-WAY
BRS1212-C10457	SERIES	380	80	FFC, 1MM, 4-WAY
BRS1212-C10464	SERIES	380	406	FFC, 1MM, 4-WAY



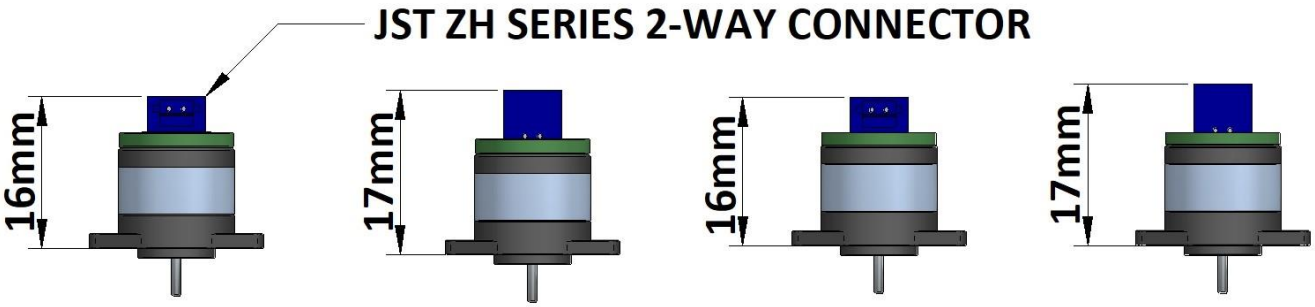


WITH POSITIVE VOLTAGE APPLIED AS SHOWN THE DEVICE WILL TURN CLOCKWISE AS VIEWED LOOKING AT MOUNTING FACE (DIRECTION SHOWN BY RED ARROW)



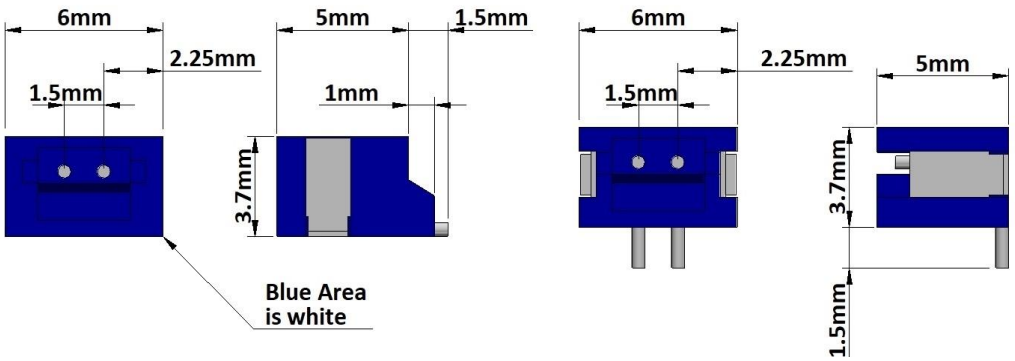
The drawing below shows termination with JST connector

BRS1212-95ZHH BRS1212-95ZHV BRS1212-380ZHH BRS1212-380ZHV



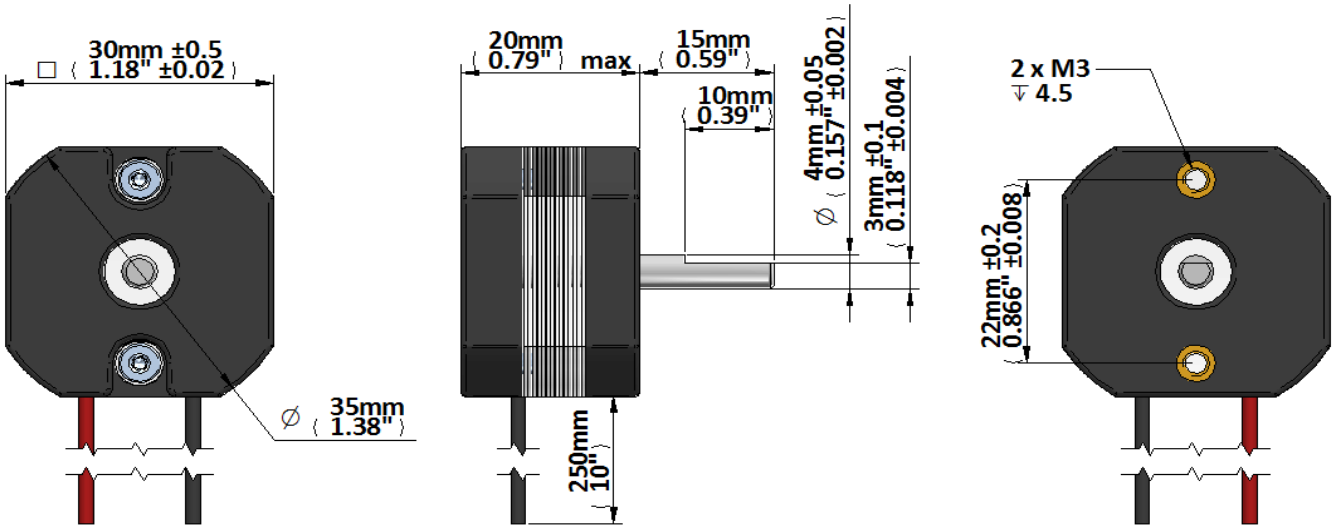
PRODUCTS NAME : S2B-ZR-SM4A-TF
SIDE ENTRY TYPE FOR :
BRS1212-95ZHH , BRS1212-380ZHH

PRODUCTS NAME : B2B-ZR-SM4A-TF
TOP ENTRY TYPE FOR :
BRS1212-95ZHV , BRS1212-380ZHV

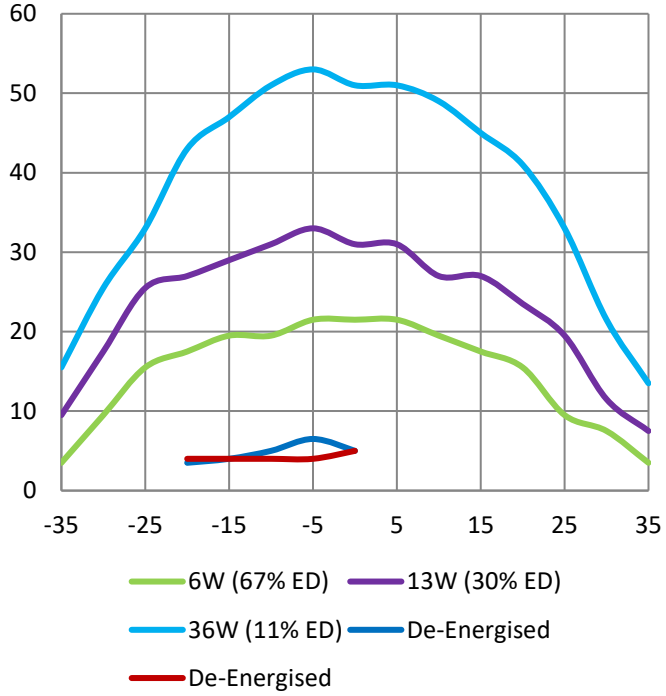


GEEPLUS RM301-4P-06

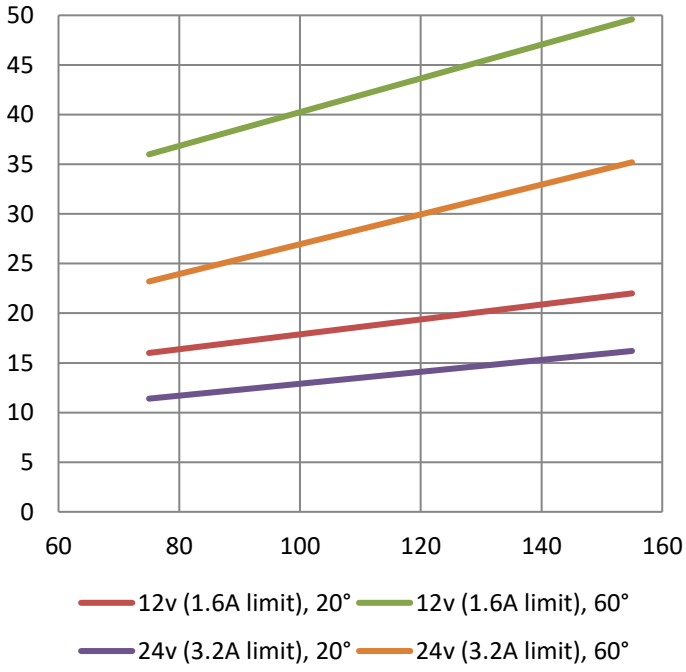
Device drawn with shaft aligned to mid position
Suffix 06, 12, 24 for operation at 6v, 12v, 24v, 100%ED
Rotor Inertia 2.1 gcm²
Life Expectancy >10M cycles, no load
Optimal rotation +/- 15° , Mass 62 grammes
Insulation Resistance >50MΩ, 500VDC Megger
Dielectric Strength 500vAC, 50/60Hz, 1 minute
Class E (120°C) insulation class



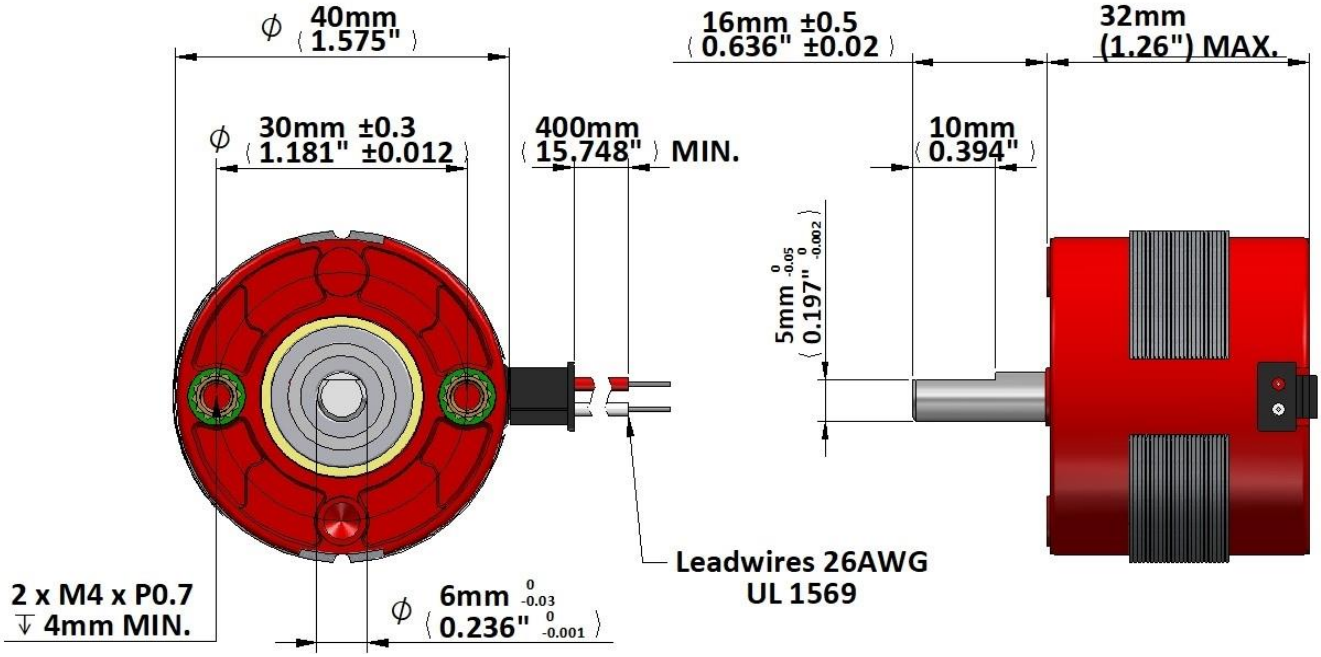
Torque (mNm) vs Angle



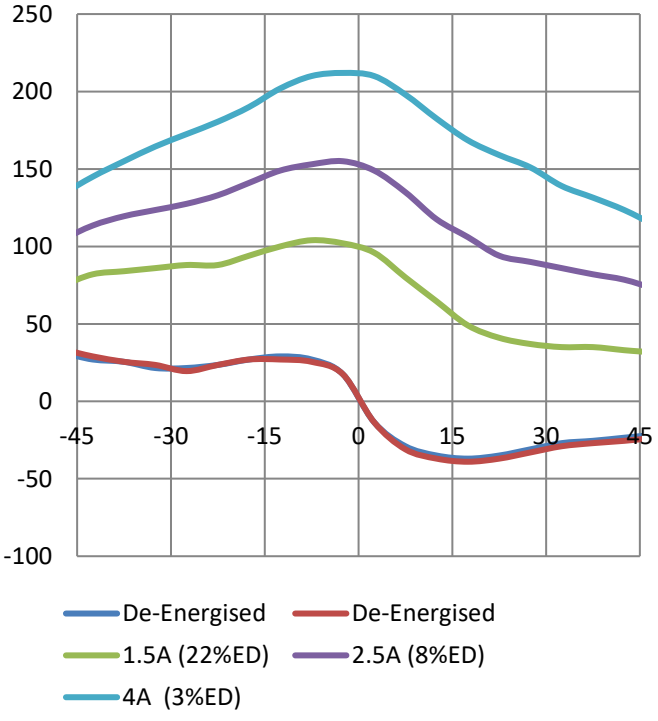
Response (ms) vs Load Inertia (gcm²)



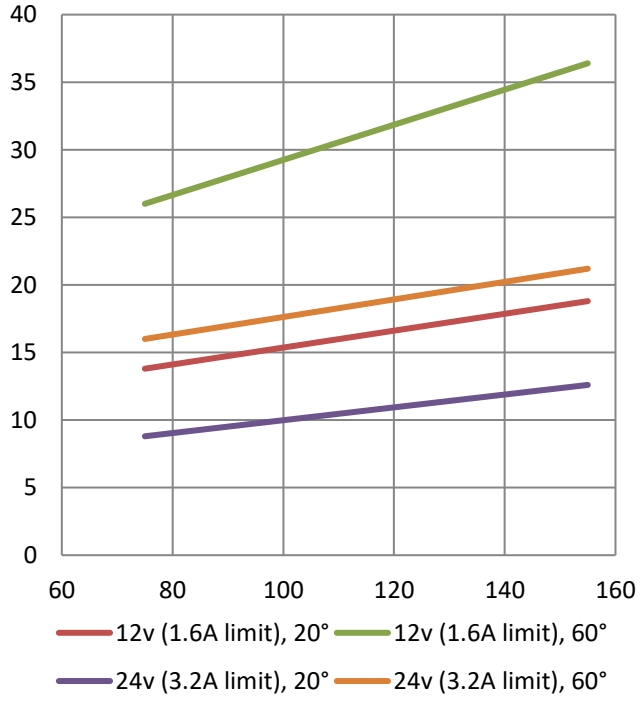
Device drawn with shaft aligned to mid position
Nominal 10Ω, 8mH (At 0°) for operation at 24v, 9%ED
Rotor Inertia 6.5 gcm²
Life Expectancy >10M cycles, no load
Optimal rotation +/- 30°, Mass 155 gramms
Turns CW from position shown, +ve applied to Red lead
Leadwires AWG26 stranded leads



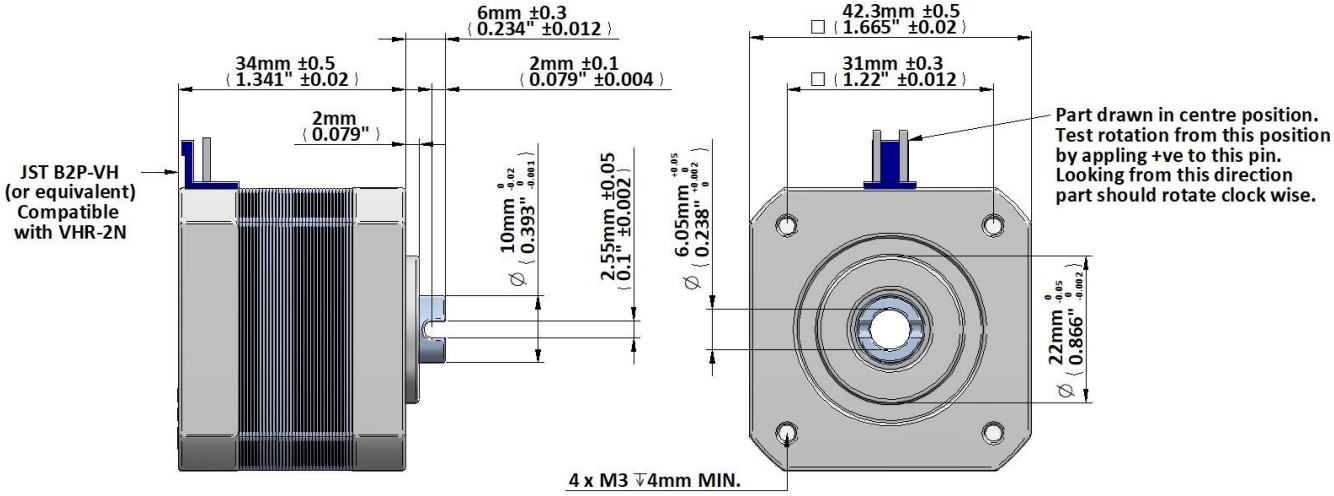
Torque (mNm) vs Angle



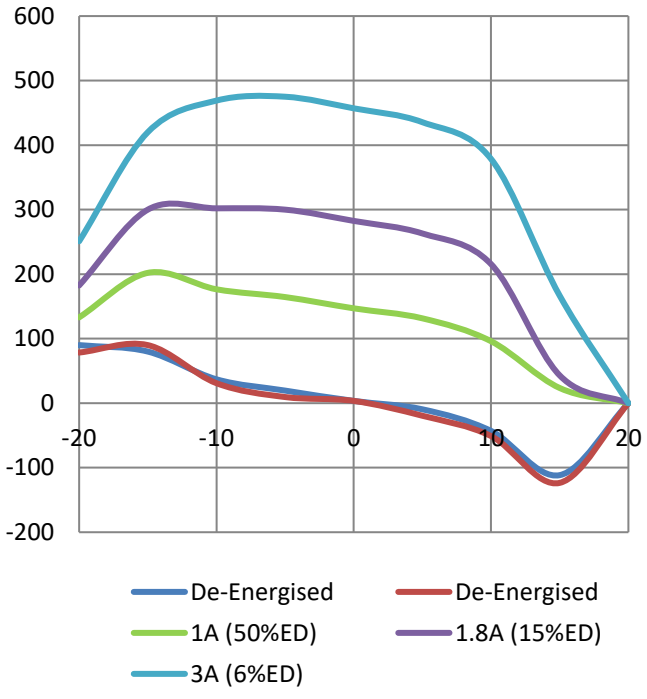
Response (ms) vs Load Inertia (gcm²)



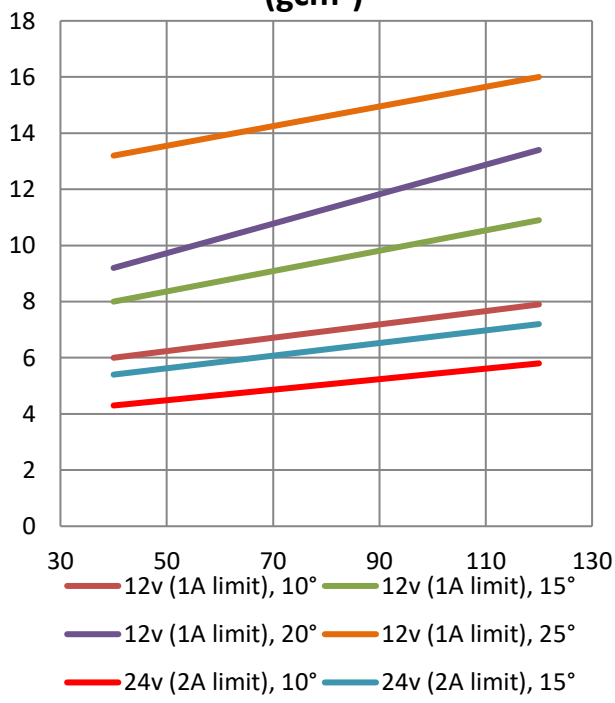
Device drawn with shaft aligned to mid position
Nominal 10Ω, ??mH for operation at 12v, 50%ED
Rotor Inertia 36 gcm²
Life Expectancy >20M cycles, no load
Optomal rotation +/-10⁰ , Mass 150 grammes
Turns CCW from position shown, +ve applied to Red lead
JST B2P-VH (Lead Assy supplied with 450mm, AWG20)



Torque (mNm) vs Angle

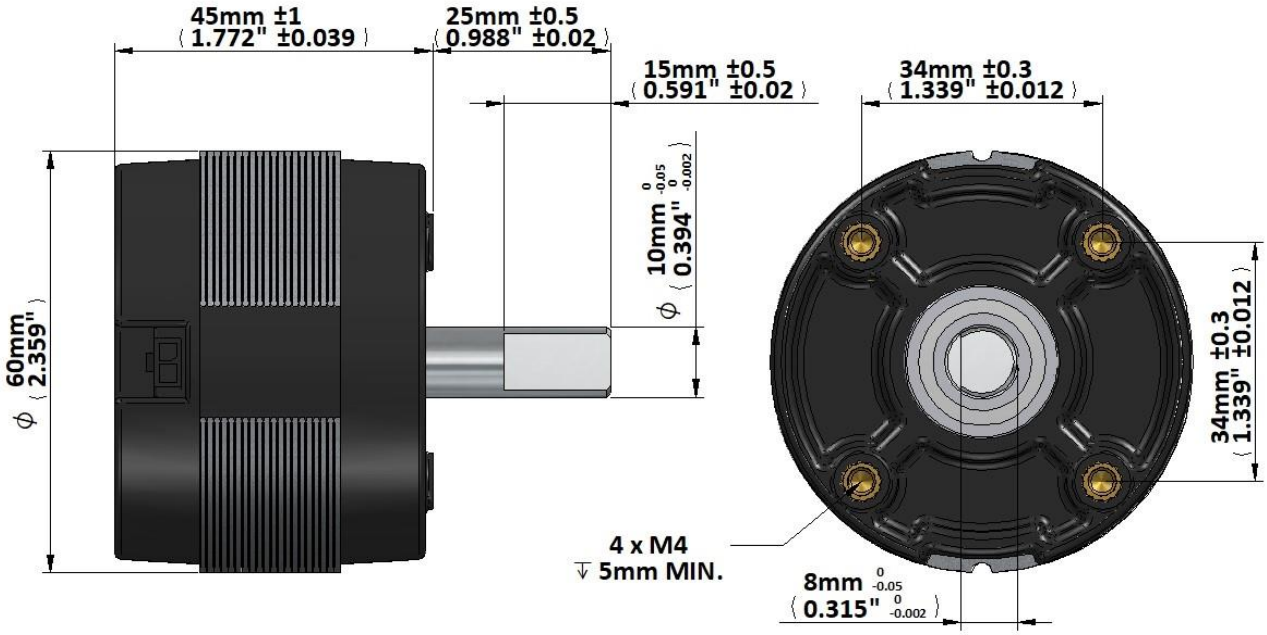


Response (ms) vs Load Inertia (gcm²)

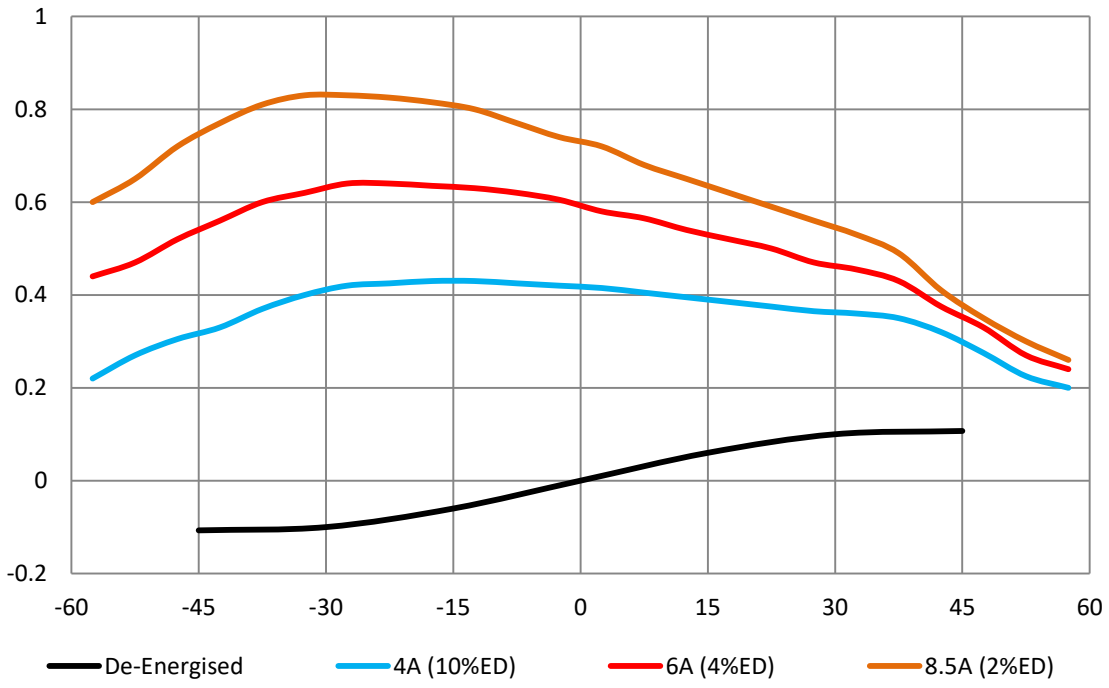


GEEPLUS BRS6045G-6 (N-S MAGNET)

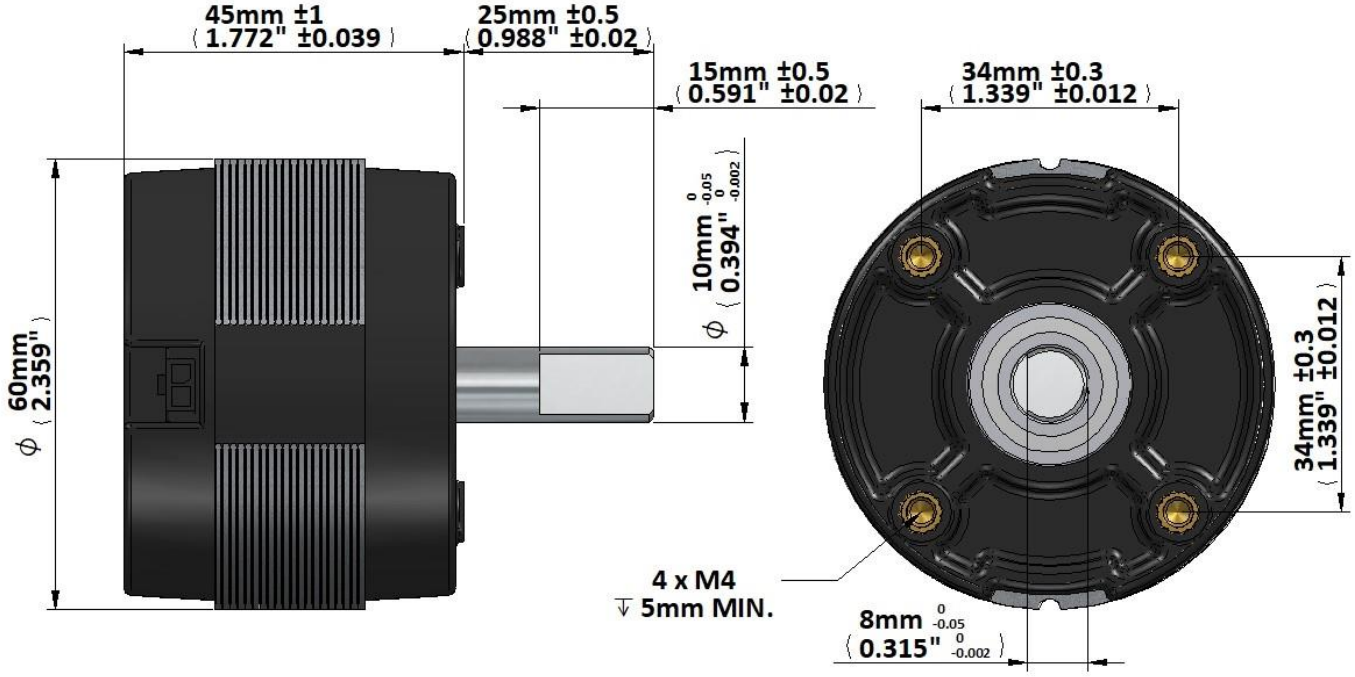
Device drawn with shaft aligned to mid position
Nominal Coil |Resistance 6Ω,
Rotor Inertia 42 gcm²
Life Expectancy >10M cycles, no load, 90° rotation
Connector compatible with Molex 43645-0200 connector
Leadsets are available, P/N MF3-2H-L ('L' is length in mm)
Mass 450 grammes



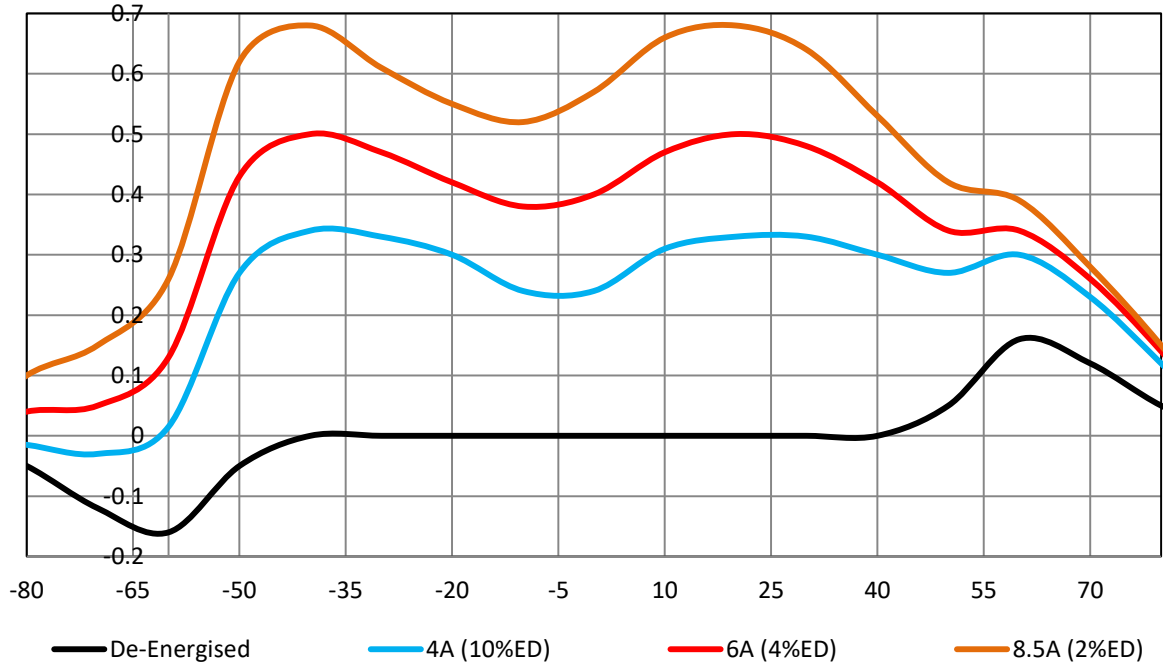
Torque (Nm) vs Angle



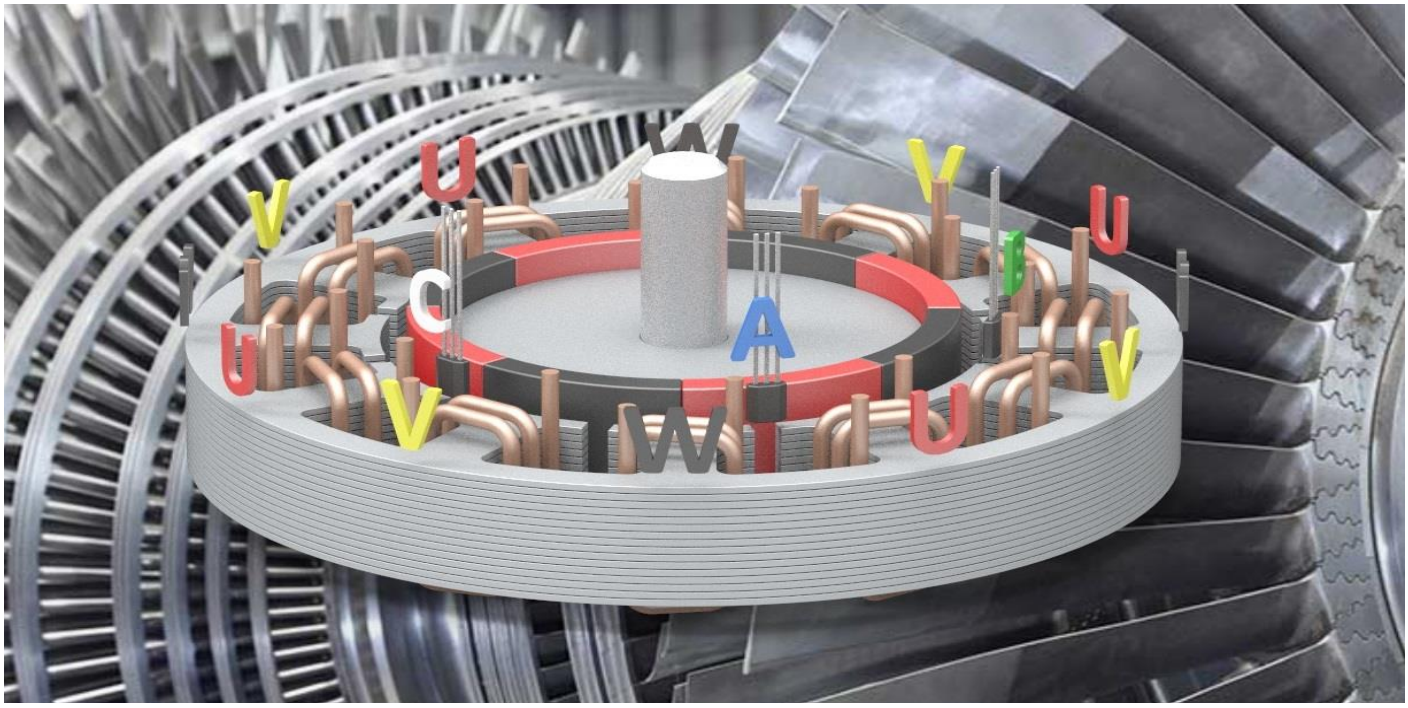
Device drawn with shaft aligned to mid position
Nominal Coil |Resistance 6Ω,
Rotor Inertia 42 gcm²
Life Expectancy >10M cycles, no load, 90° rotation
Connector compatible with Molex 43645-0200 connector
Leadsets are available, P/N MF3-2H-L ('L' is length in mm)
Mass 450 grammes



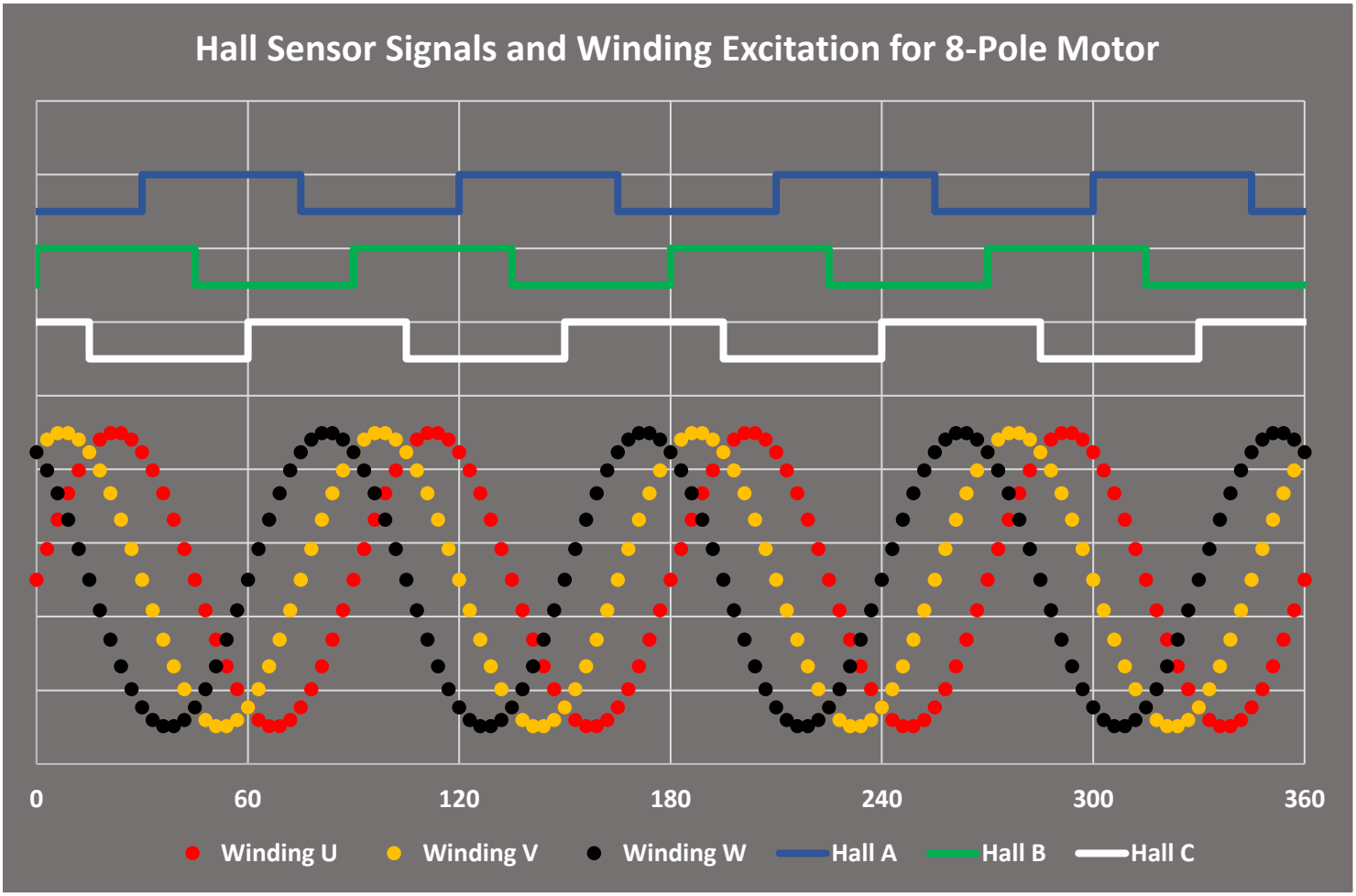
Torque (Nm) vs Angle



BRUSHLESS DC MOTORS



A brushless DC motor (BLDC) is constructed as shown in the above image. Coils are wound on a number of poles on a laminated stator. The rotor has alternate North and South poles around it's circumference.
The motor illustrated has an 8-pole construction. There are 4 pairs (a pair comprises a North and a South pole) of poles on the rotor, and each of the stator windings has 4 poles. This is a three phase motor with three windings designated U, V, and W.
There are three hall-effect sensors designated A, B, and C which are oriented at 60° intervals and detect the position of the rotor.
The windings are shown separately, but in practise all of the U windings would be connected in series, similarly the V and W windings.
The motor controller switches (or varies in a sinusoidal manner) the current applied to the three windings, each winding is energised with a waveform 60° out of phase with the others, this causes a magnetic field to be generated by the stator which rotates, and which causes the rotor to rotate. The phase of the excitation waveforms is controlled by the position signals derived from the hall sensors.
This control of the excitation currents is effected electronically, without the use of brushes, hence the term brushless - elimination of the brushes enables a great improvement in reliability compared to brushed motors.


Hall Sensor Signals and Winding Excitation for 8-Pole Motor
0
60
120
180
240
300
360
Winding U
Winding V
Winding W
Hall A
Hall B
Hall C

Brushless DC Motors - Customisation

There are a number of ways in which the BLDC motors can be customised to optimise for a customer application. These possibilities include (but are not limited to) the following:

Custom Flange – the end housings of the motors are cast and machined in tolerance critical areas. If a custom mounting is advantageous (eg to fit the motor with screws inserted from the rear of the motor), then custom housings are possible. Tooling cost for straightforward modifications of this kind are typically <$5000USD. Once tooling is made the impact on unit cost is small.

Shaft Modification – flats, keyways, splines, leadscrew form, pinion or rear shaft extension are common modifications. The shaft is a machined component so tooling is not normally required, although some setup charges or MOQ may apply. The impact on unit cost depends on the complexity of modifications, and on tolerances required.

Encoders – Encoders can be added to provide position feedback. Encoders can provide relative or absolute position information. Mounting encoders typically requires shaft and housing modifications.

Lead-wire Modification – longer or shorter lead-wires, cable (with outer sheath), or addition of connectors are common modifications. Different lead-wire material is possible to conform to standards in different countries / applications. Impact on unit cost depends on material and labour costs. Tooling may be required for some such modifications.

Insulation System – higher temperature class (may also require magnet and bearing changes), or higher isolation class are usually straightforward. Impregnation or over-moulding of motor windings can improve heat transfer from coil windings to stator, enhance isolation, and improve resistance to vibration, and to hostile environments / corrosion. Changes which require modification of moulded insulation components can require tooling charges.

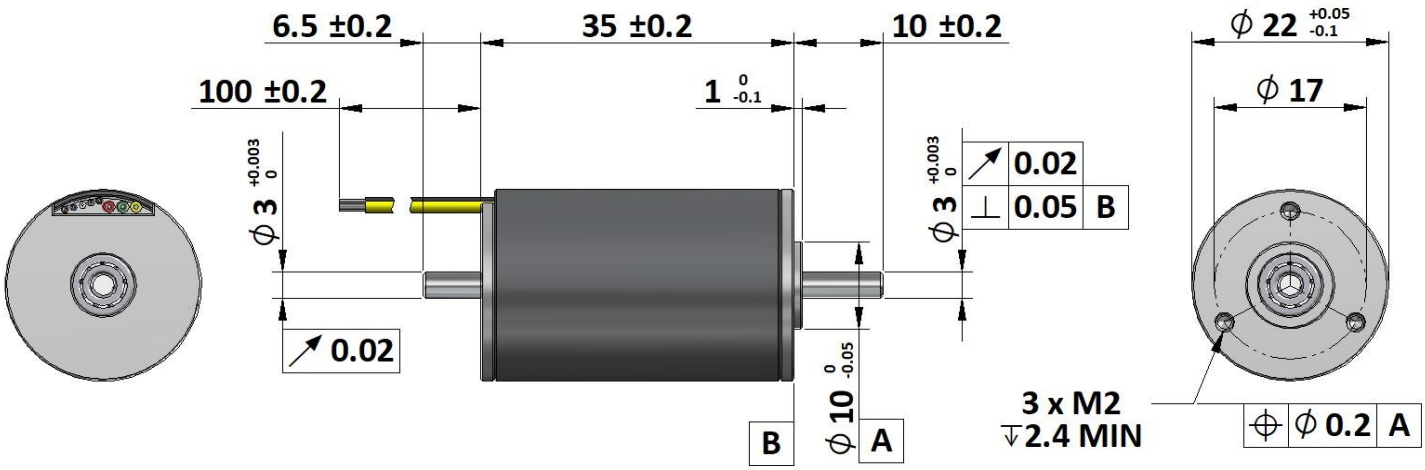
Bearing Changes – Bearings can be changed to withstand higher radial or axial loading, to accommodate a custom shaft, to use corrosion resistant material, to withstand higher or lower temperatures, or to incorporate seals for better sealing.

Winding Change – Motor windings can be changed to modify the motor speed and torque characteristics, and / or to optimise for best compatibility with a chosen drive.

Temperature Range – Metal parts of the motor will normally withstand a fairly wide temperature range. Insulation materials, magnets, bearings, and lubricating grease or oil may need to be changed to withstand wide temperature variations.

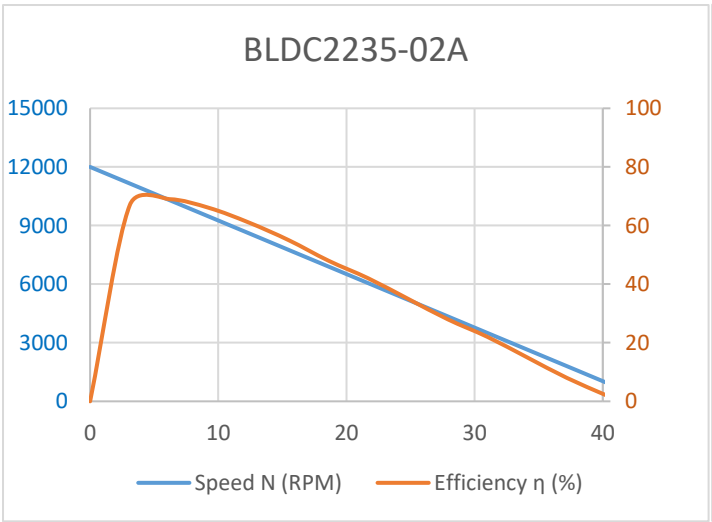
Sealing – modified housings, seals, sealing coatings are possible to improve resistance of the motor to aggressive environmental conditions.

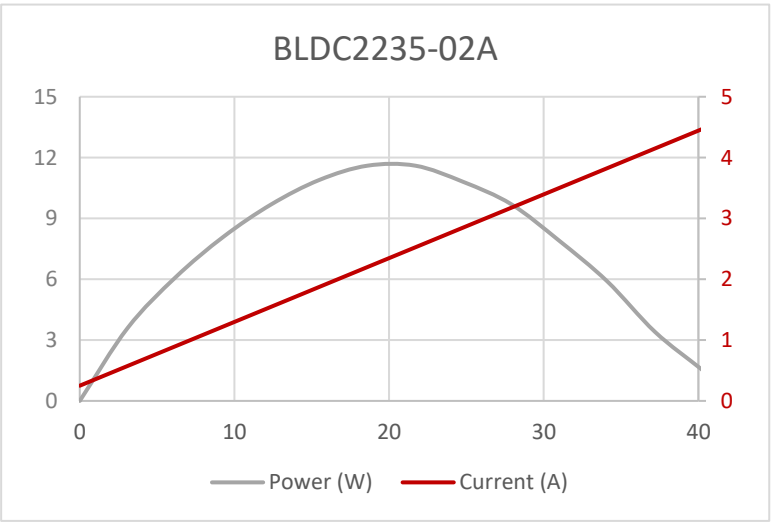
GEEPLUS BLDC2235



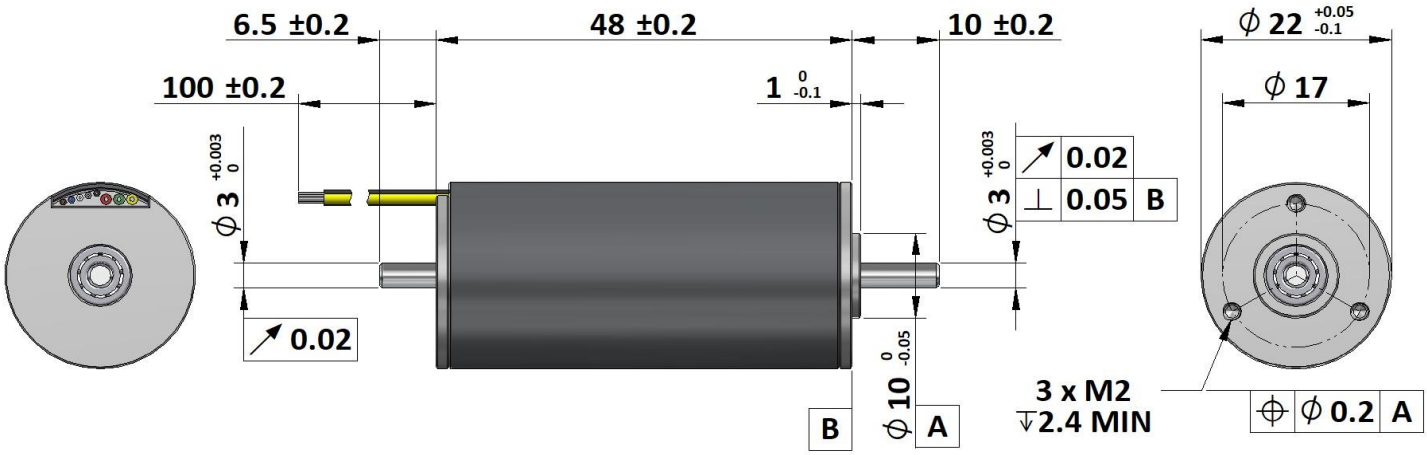
Phase Leads, TBDmm², PE			Hall Sensor Leads, 0.15mm², PTFE				
U	**V**	**W**	**5V**	**GND**	**A**	**B**	**C**
Red	Green	Yellow	Brown	Black	Blue	White	Grey

Motor Winding Option	02A	02B	02C	
Motor Poles	2	2	2	
Voltage (VDC)	12VDC	24VDC	36VDC	
No-Load Speed (RPM)	12000	24000	36000	
Rated Torque (mNm)	13.4	10.8	5.8	
Rated Speed (RPM)	8228	21060	34436	
Rated Current (A)	1.62	1.33	0.81	
Rated Input Power (W)	19.4	31.8	29.1	
Rated Output Power (W)	11.6	23.8	20.9	
Rated Efficiency (%)	59.5	74.9	71.9	
Max Efficiency (%)	66.8	75.2	78.3	
Stall Current (A)	5	10	14	
Stall Torque (mNm)	44	90	136	
Speed Constant (RPM/V)	1000	1000	1000	
Torque Constant (mNm/A)	9.23	9.38	9.42	
Resistance (Phase to Phase) Ω	2.5	2.5	2.5	
Mechanical Time Constant (ms)	5.1	4.9	4.9	
Rotor Inertia (g-cm²)	1.5	1.5	1.5	
Ambient Temperature -40°C to +125°C				



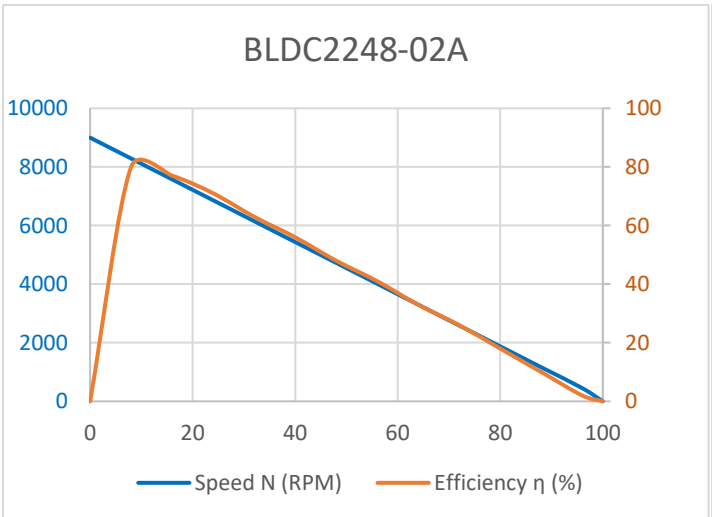


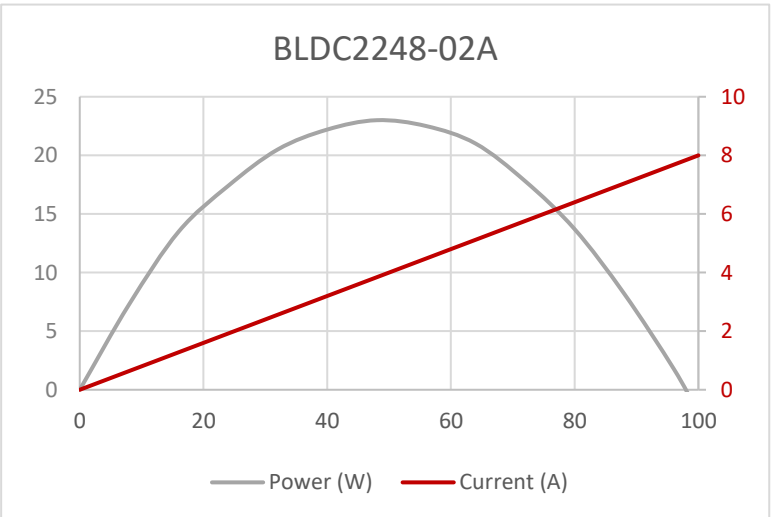
GEEPLUS BLDC2248



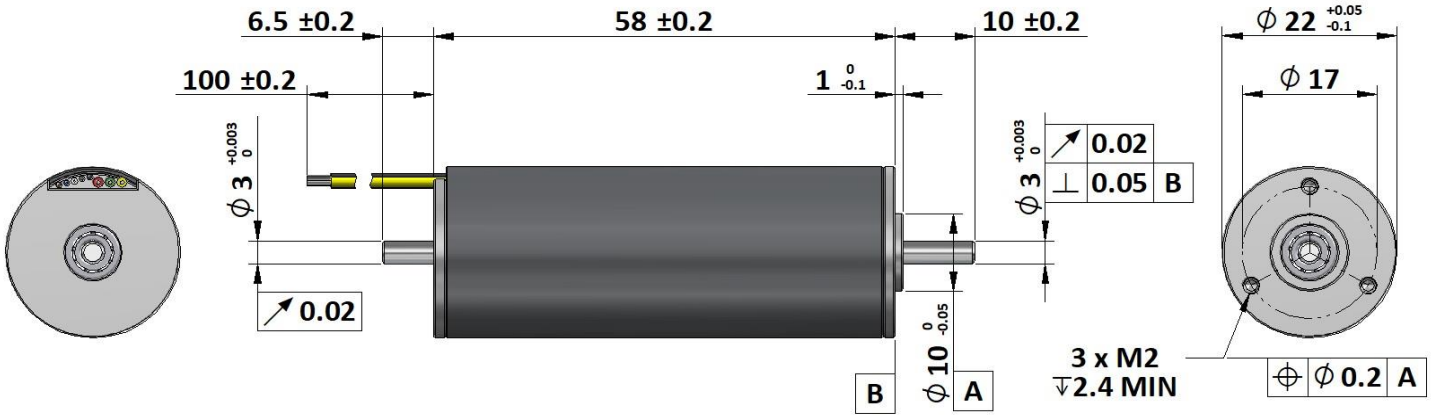
Phase Leads, TBDmm², PE			Hall Sensor Leads, 0.15mm², PTFE				
U	**V**	**W**	**5V**	**GND**	**A**	**B**	**C**
Red	Green	Yellow	Brown	Black	Blue	White	Grey

Motor Winding Option	02A	02B	02C	02D
Motor Poles	2	2	2	3
Voltage (VDC)	12VDC	24VDC	36VDC	48VDC
No-Load Speed (RPM)	9000	18000	27000	36000
Rated Torque (mNm)	31.1	27.2	20.1	12.1
Rated Speed (RPM)	6162	15545	25192	34914
Rated Current (A)	2.6	2.31	1.78	1.16
Rated Input Power (W)	31.3	55.5	64.2	55.6
Rated Output Power (W)	20.1	44.4	53.1	44.3
Rated Efficiency (%)	64.3	79.9	82.6	79.6
Max Efficiency (%)	77	81.6	83	84.8
Stall Current (A)	8	16	24	32
Stall Torque (mNm)	100	202	303	405
Speed Constant (RPM/V)	750	750	750	750
Torque Constant (mNm/A)	12.54	12.61	12.63	12.65
Resistance (Phase to Phase) Ω	1.5	1.5	1.5	1.5
Mechanical Time Constant (ms)	2.8	2.8	2.8	2.8
Rotor Inertia (g-cm²)	2.6	2.6	2.6	2.6
Ambient Temperature -40°C to +125°C				



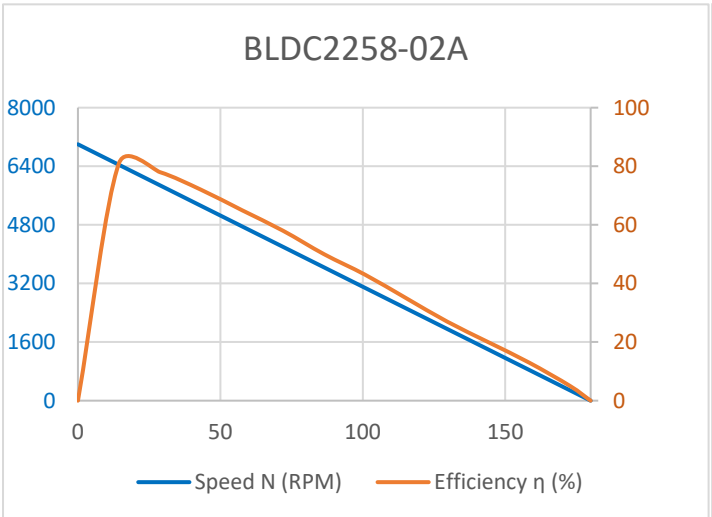


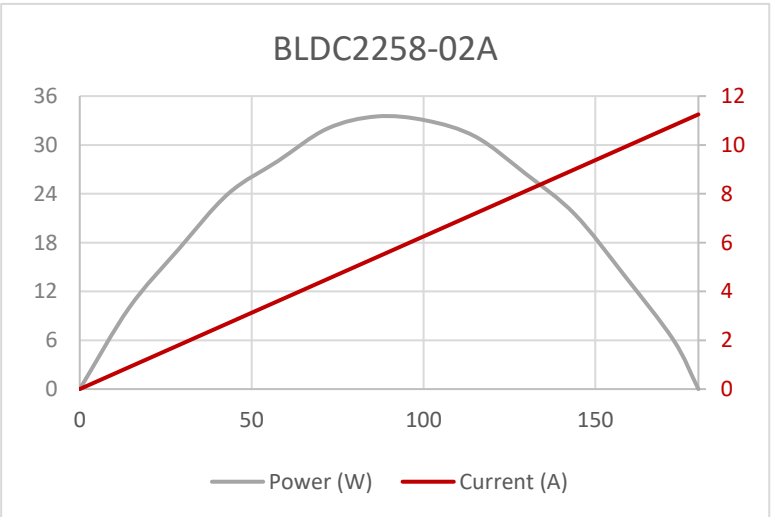
GEEPLUS BLDC2258



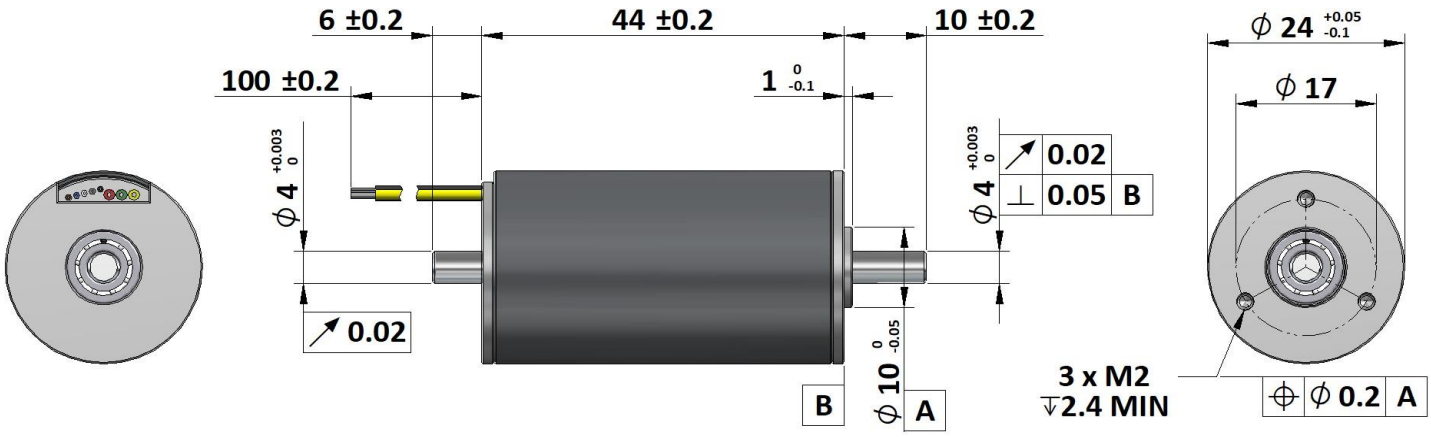
Phase Leads, TBDmm², PE			Hall Sensor Leads, 0.15mm², PTFE				
U	**V**	**W**	**5V**	**GND**	**A**	**B**	**C**
Red	Green	Yellow	Brown	Black	Blue	White	Grey

Motor Winding Option	02A	02B	02C	02D
Motor Poles	2	2	2	3
Voltage (VDC)	12VDC	24VDC	36VDC	48VDC
No-Load Speed (RPM)	7000	14000	21000	28000
Rated Torque (mNm)	53.2	48	39.5	30.2
Rated Speed (RPM)	4960	12177	19505	26859
Rated Current (A)	3.43	3.12	2.62	2.06
Rated Input Power (W)	41.2	74.8	94.2	98.7
Rated Output Power (W)	27.6	61.3	80.7	85
Rated Efficiency (%)	67.1	81.9	84.6	86.2
Max Efficiency (%)	79.1	84	85.7	87.2
Stall Current (A)	11	23	34	46
Stall Torque (mNm)	185	372	558	745
Speed Constant (RPM/V)	583	583	583	583
Torque Constant (mNm/A)	16.17	16.26	16.28	16.3
Resistance (Phase to Phase) Ω	1.05	1.05	1.05	1.05
Mechanical Time Constant (ms)	1.5	1.5	1.5	1.5
Rotor Inertia (g-cm²)	3.3	3.3	3.3	3.3
Ambient Temperature -40°C to +125°C				



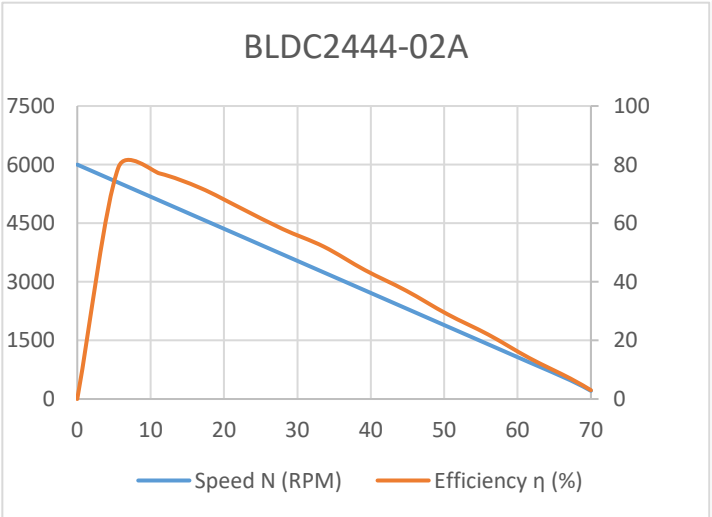


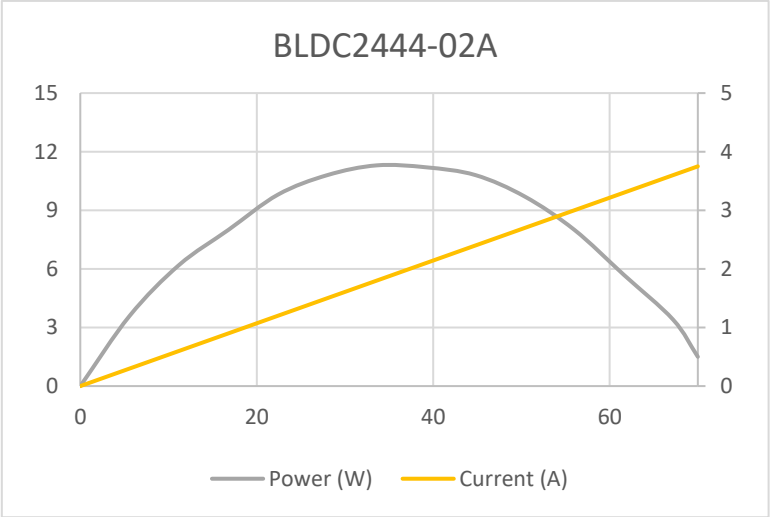
GEEPLUS BLDC2444



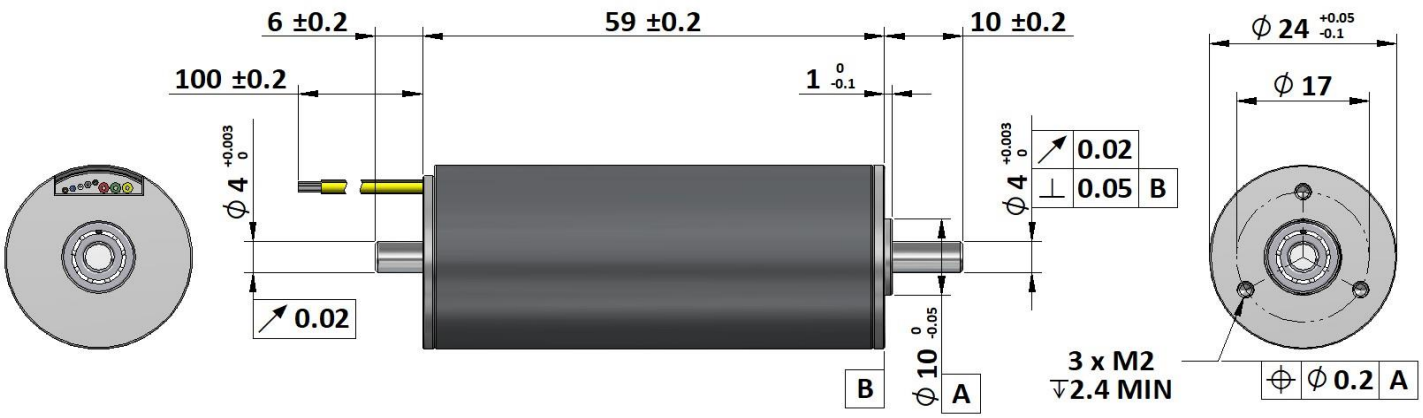
Phase Leads, TBDmm², PE			Hall Sensor Leads, 0.15mm², PTFE				
U	**V**	**W**	**5V**	**GND**	**A**	**B**	**C**
Red	Green	Yellow	Brown	Black	Blue	White	Grey

Motor Winding Option	02A	02B	02C	02D
Motor Poles	2	2	2	3
Voltage (VDC)	12VDC	24VDC	36VDC	48VDC
No-Load Speed (RPM)	6000	12000	18000	24000
Rated Torque (mNm)	33.7	30.5	25.3	17
Rated Speed (RPM)	3238	9537	15965	22630
Rated Current (A)	1.88	1.73	1.48	1.07
Rated Input Power (W)	22.6	41.5	53.3	51.5
Rated Output Power (W)	11.4	30.4	42.3	40.4
Rated Efficiency (%)	50.6	73.3	79.3	78.4
Max Efficiency (%)	73.7	77.9	79.6	80.4
Stall Current (A)	4	8	12	16
Stall Torque (mNm)	75	151	227	302
Speed Constant (RPM/V)	500	500	500	500
Torque Constant (mNm/A)	18.72	18.84	18.88	18.9
Resistance (Phase to Phase) Ω	3	3	3	3
Mechanical Time Constant (ms)	6.1	6	6	5.9
Rotor Inertia (g-cm²)	6.2	6.2	6.2	6.2
Ambient Temperature -40°C to +125°C				



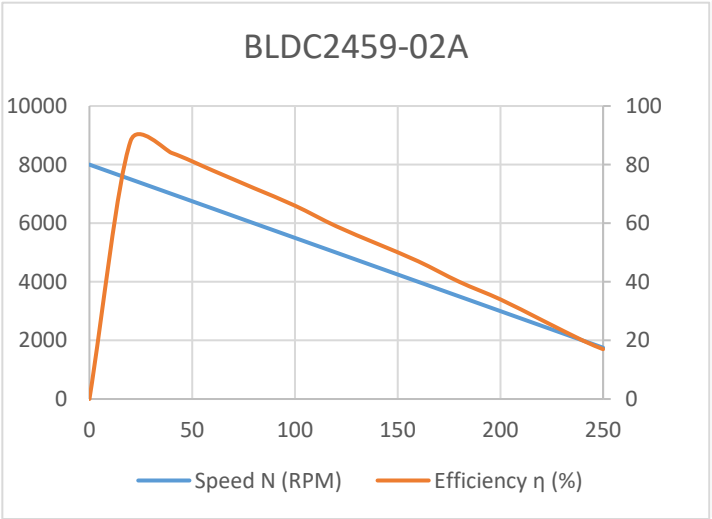


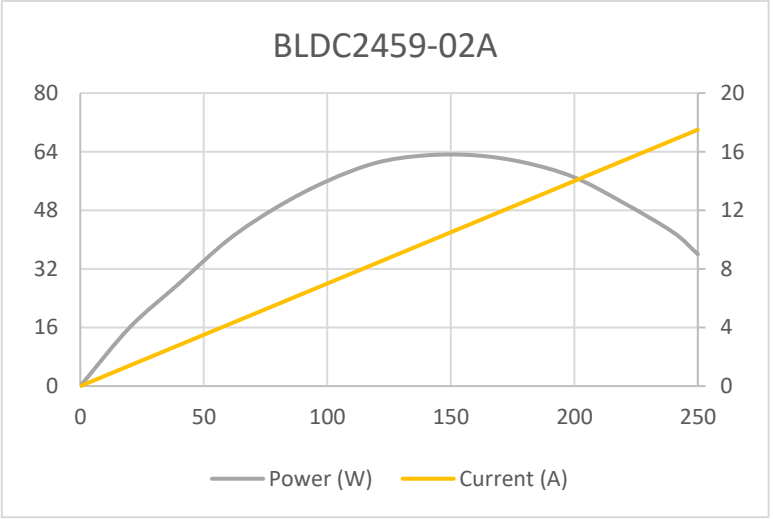
GEEPLUS BLDC2459



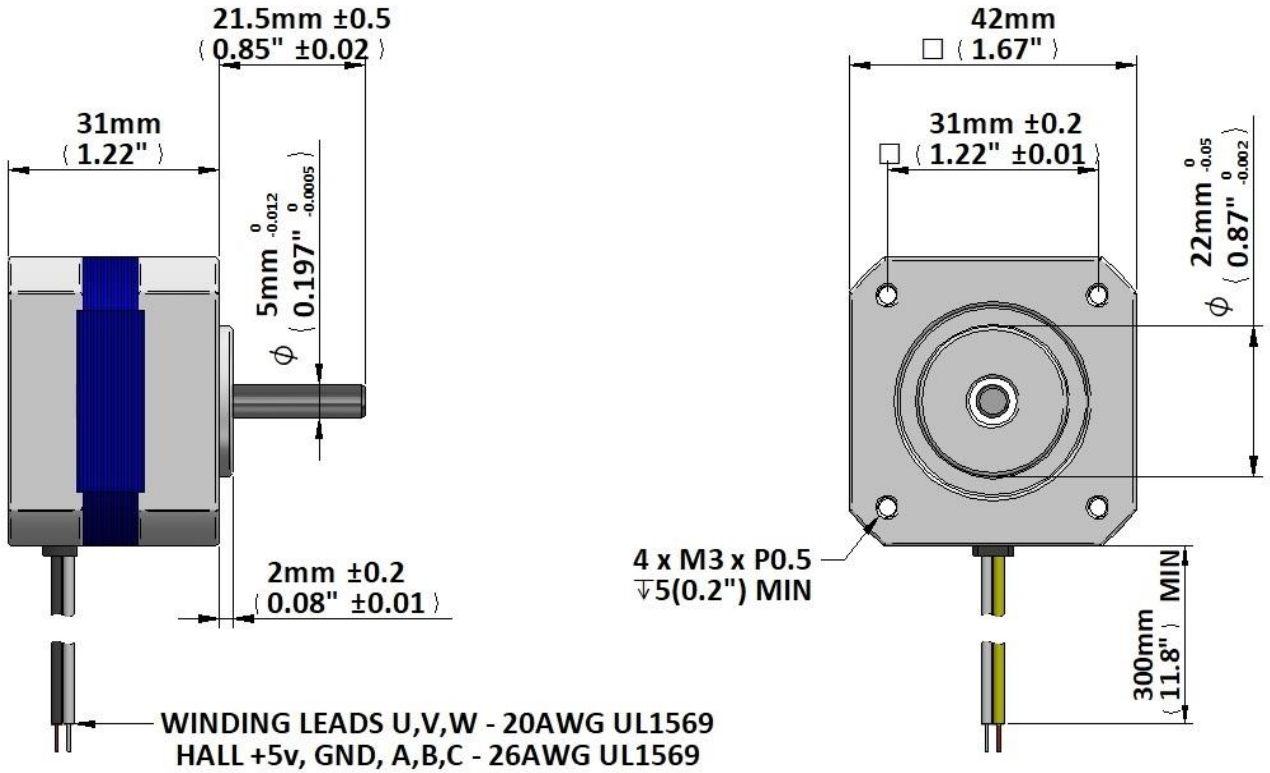
Phase Leads, TBDmm², PE			Hall Sensor Leads, 0.15mm², PTFE				
U	**V**	**W**	**5V**	**GND**	**A**	**B**	**C**
Red	Green	Yellow	Brown	Black	Blue	White	Grey

Motor Winding Option	02A	02B		02D
Motor Poles	2	2		3
Voltage (VDC)	12VDC	24VDC		48VDC
No-Load Speed (RPM)	8000	12000		24000
Rated Torque (mNm)	70.8	63.7		42.7
Rated Speed (RPM)	6137	10313		22873
Rated Current (A)	5.07	3.5		2.44
Rated Input Power (W)	60.8	83.9		117.3
Rated Output Power (W)	45.5	68.8		102.2
Rated Efficiency (%)	74.8	82		87.1
Max Efficiency (%)	86.8	85.3		87.5
Stall Current (A)	12	24		48
Stall Torque (mNm)	306	456		913
Speed Constant (RPM/V)	667	500		500
Torque Constant (mNm/A)	14.26	18.99		19.02
Resistance (Phase to Phase) Ω	0.56	1		1
Mechanical Time Constant (ms)	3.2	3.2		3.2
Rotor Inertia (g-cm²)	10	10		10
Ambient Temperature -40°C to +125°C				





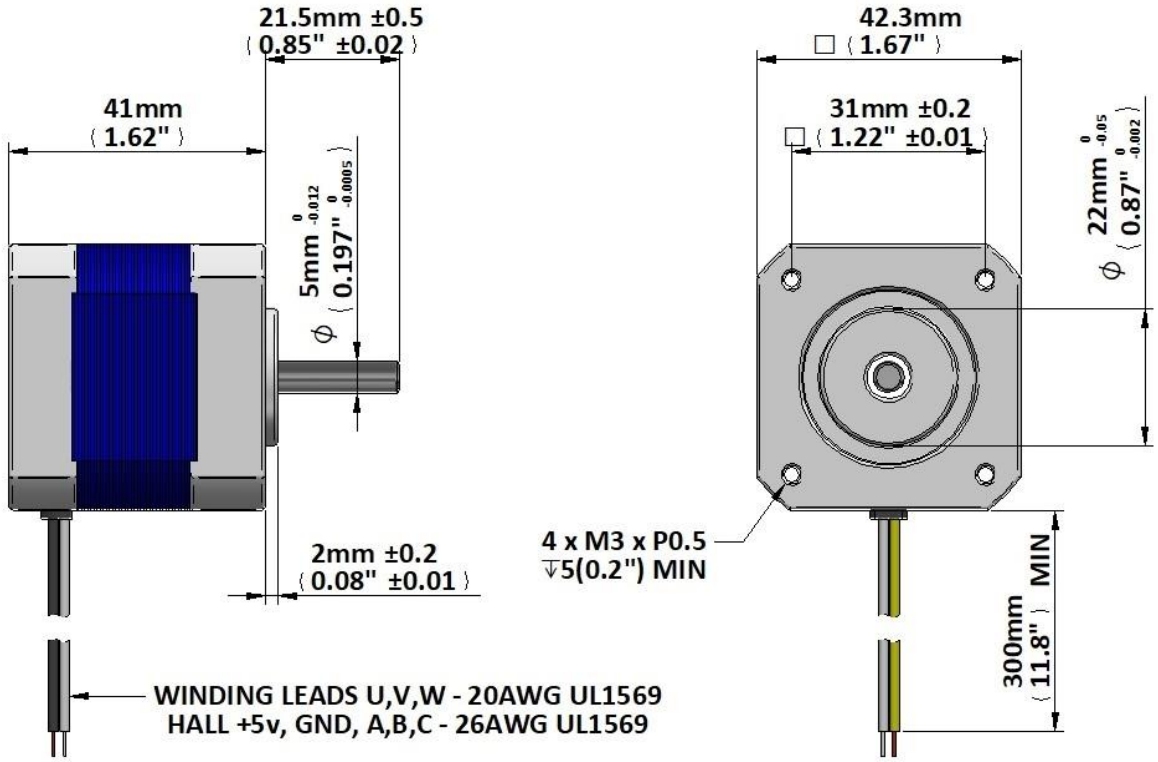
GEEPLUS BLDC4231



Phase Leads, 20AWG, UL1569			Hall Sensor Leads, 28AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	8		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5000 ±10%		
Rated Torque (Nm)	0.02		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	<1		
Rated Power (W)	10		
Max (Stall) Torque (Nm)			
Back-EMF Constant (V/kRPM)			
Torque Constant (Nm/A)			
Resistance (Ω)			
Mass (kg)	0.25		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -10°C to +40°C			

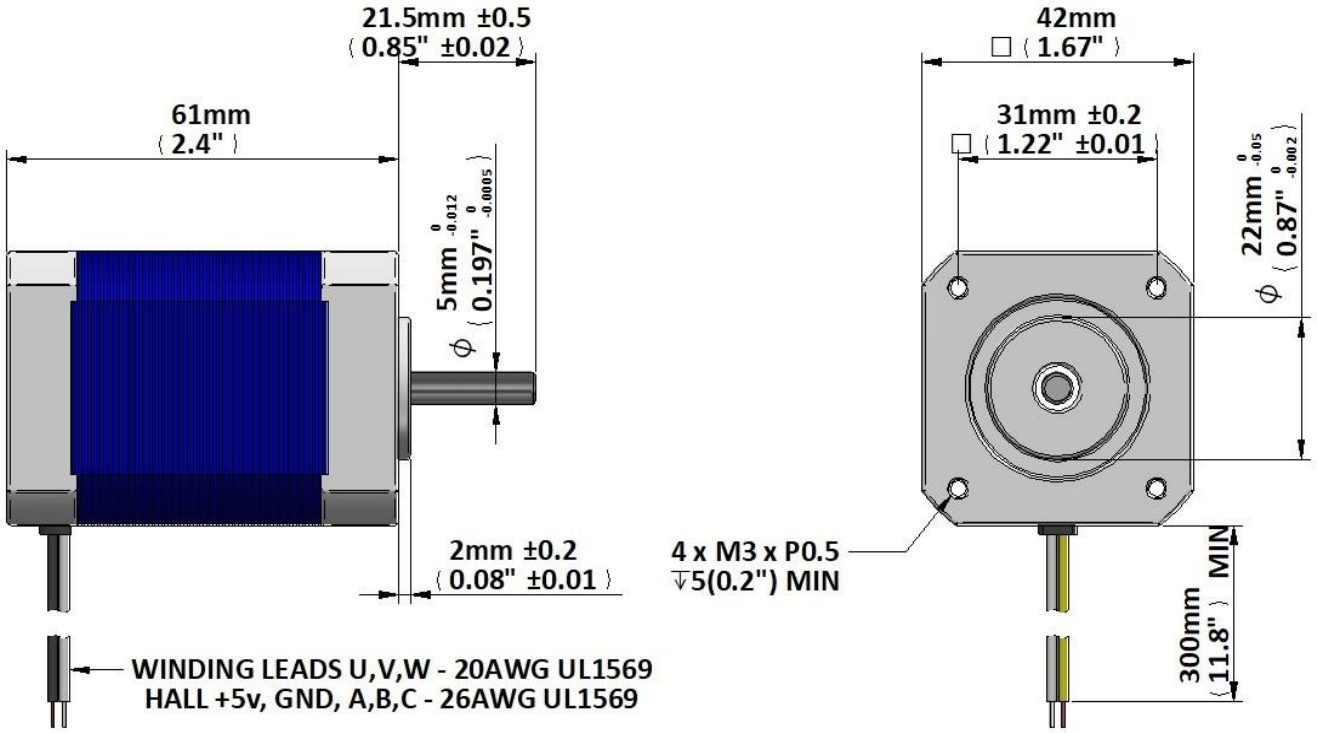
GEEPLUS BLDC4241



Phase Leads, 20AWG, UL1569			Hall Sensor Leads, 28AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	8		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5000 ±10%		
Rated Torque (Nm)	0.063		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	<2		
Rated Power (W)	25		
Max (Stall) Torque (Nm)	0.19		
Back-EMF Constant (V/kRPM)	3.13		
Torque Constant (Nm/A)	0.039		
Resistance (Ω)	1.5		
Mass (kg)	0.3		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -10°C to +40°C			

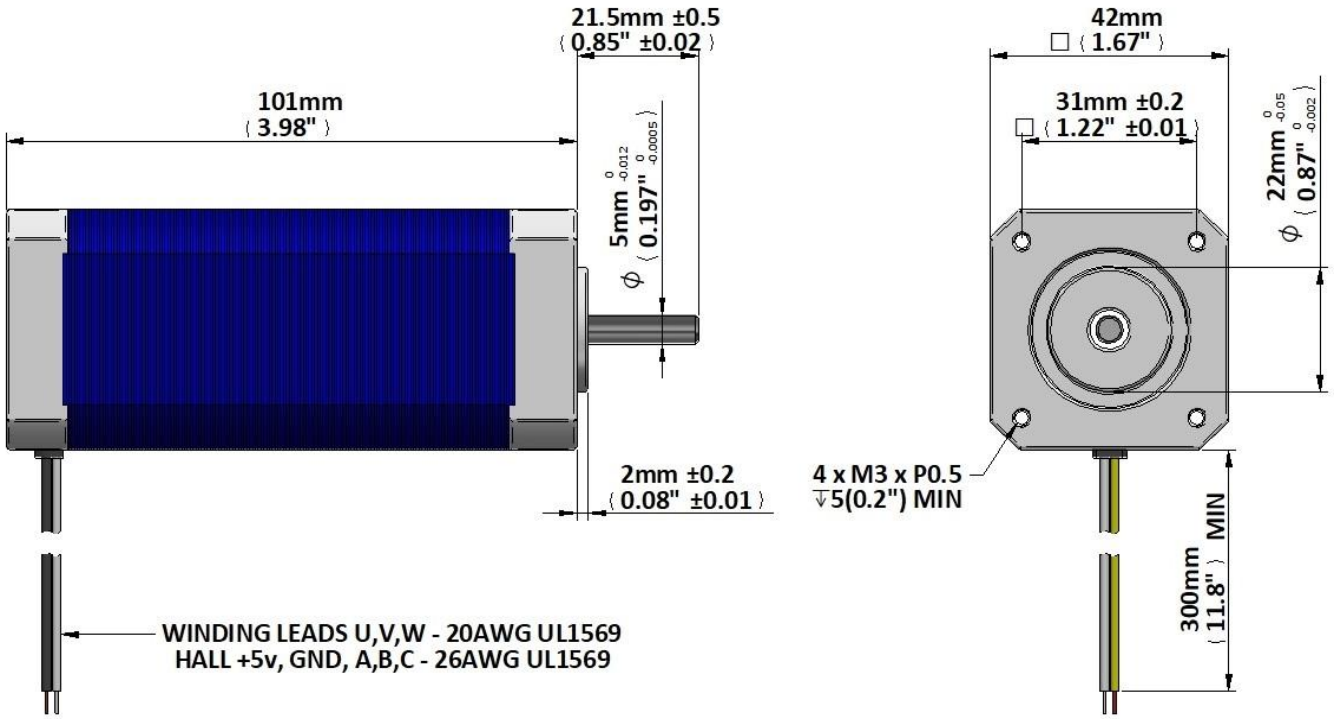
GEEPLUS BLDC4261



Phase Leads, 20AWG, UL1569			Hall Sensor Leads, 28AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	8		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5000 ±10%		
Rated Torque (Nm)	0.125		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	<3.5		
Rated Power (W)	50		
Max (Stall) Torque (Nm)	0.38		
Back-EMF Constant (V/kRPM)	3.15		
Torque Constant (Nm/A)	0.04		
Resistance (Ω)	0.74		
Mass (kg)	0.5		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -10°C to +40°C			

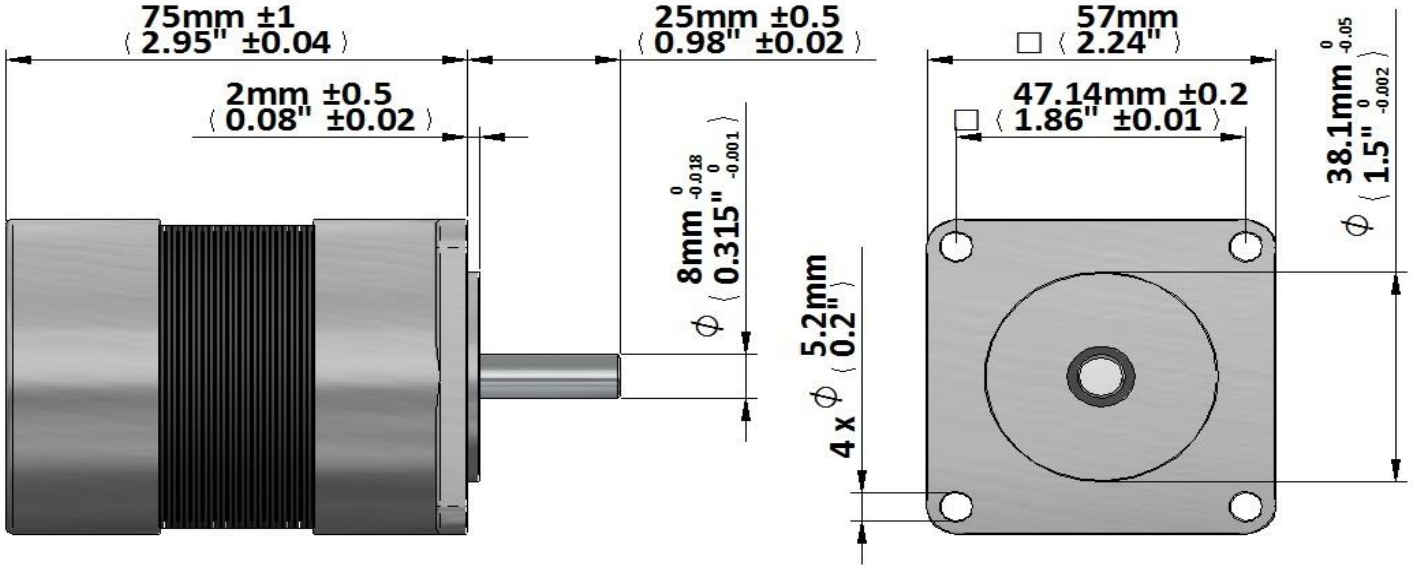
GEEPLUS BLDC42101



Phase Leads, 20AWG, UL1569			Hall Sensor Leads, 28AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	8		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5000 ±10%		
Rated Torque (Nm)	0.25		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	<7		
Rated Power (W)	100		
Max (Stall) Torque (Nm)			
Back-EMF Constant (V/kRPM)			
Torque Constant (Nm/A)			
Resistance (Ω)			
Mass (kg)	0.9		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -10°C to +40°C			

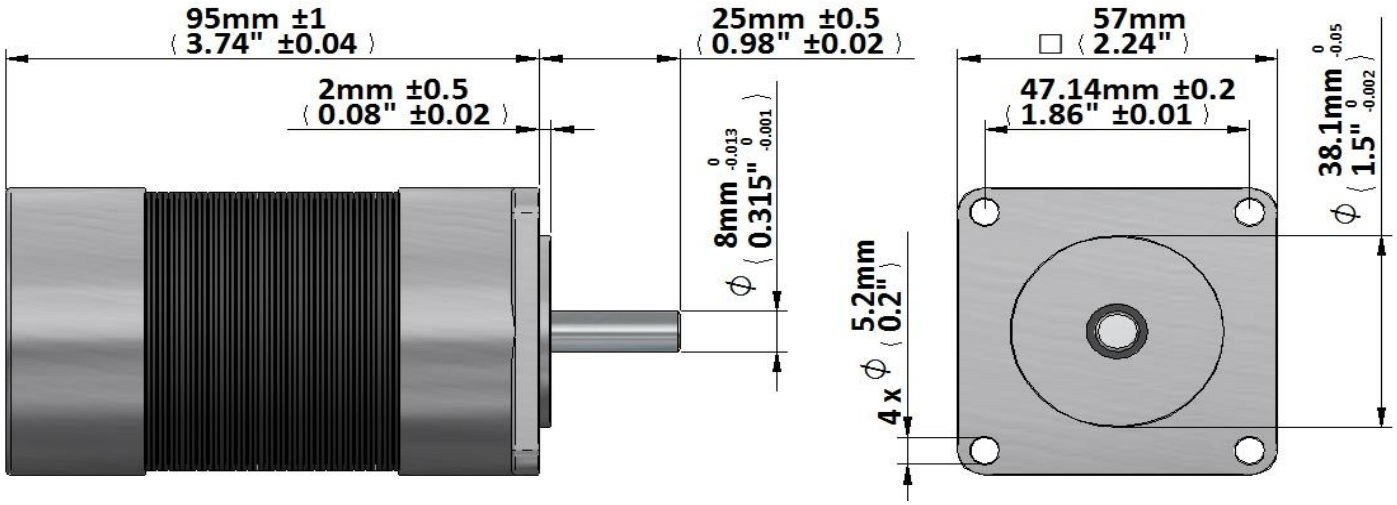
GEEPLUS BLDC5775



Phase Leads, 18AWG, UL1569			Hall Sensor Leads, 26AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	4		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	4900 ±10%		
Rated Torque (Nm)	0.22		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	5.2		
Rated Power (W)	90		
Max (Stall) Torque (Nm)	0.8		
Back-EMF Constant (V/kRPM)	3.15		
Torque Constant (Nm/A)	0.045		
Resistance (Ω)	1.22		
Mass (kg)	0.9		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -20°C to +40°C			

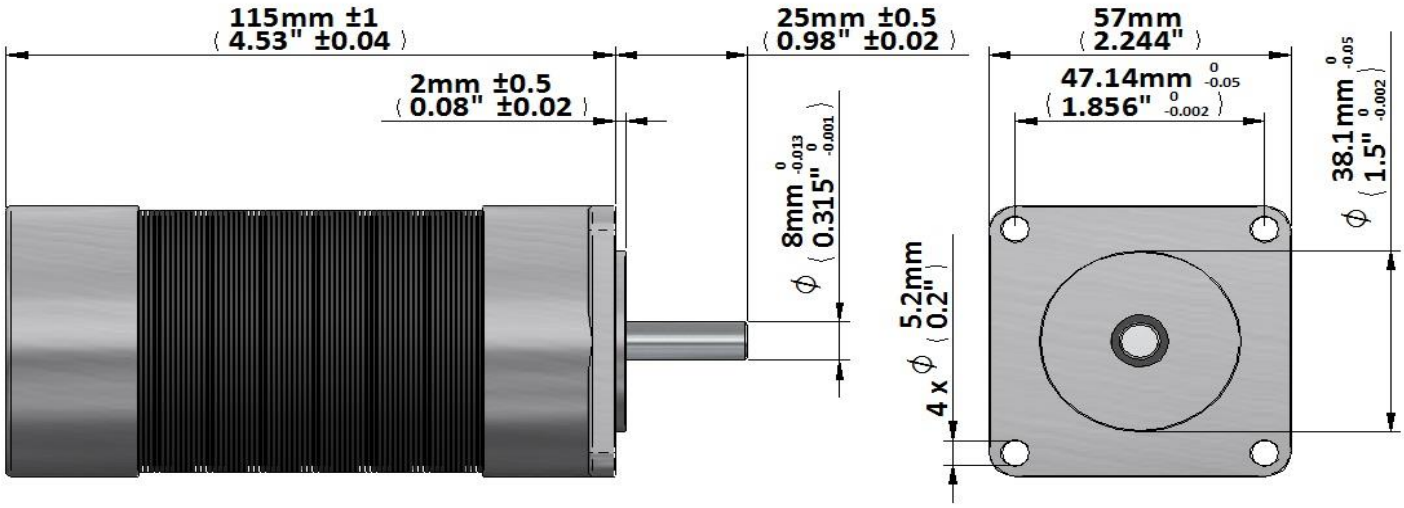
GEEPLUS BLDC5795



Phase Leads, 18AWG, UL1569				Hall Sensor Leads, 26AWG, UL1569			
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	4		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5200 ±10%		
Rated Torque (Nm)	0.32		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	7.4		
Rated Power (W)	130		
Max (Stall) Torque (Nm)	1.2		
Back-EMF Constant (V/kRPM)	3.13		
Torque Constant (Nm/A)	0.044		
Resistance (Ω)			
Mass (kg)			
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -20°C to +40°C			

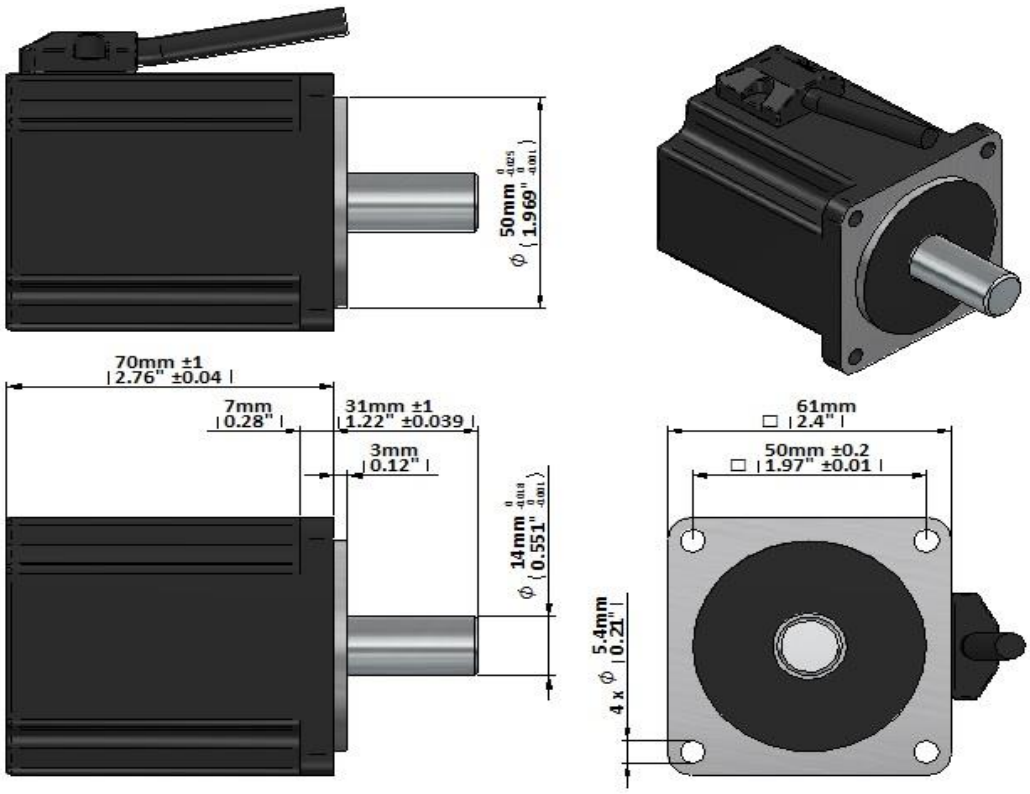
GEEPLUS BLDC57115



Phase Leads, 18AWG, UL1569				Hall Sensor Leads, 26AWG, UL1569			
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	4		
Voltage (VDC)	24VDC		
No-Load Speed (RPM)	5350 ±10%		
Rated Torque (Nm)	0.42		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	9.7		
Rated Power (W)	170		
Max (Stall) Torque (Nm)	1.7		
Back-EMF Constant (V/kRPM)	3.08		
Torque Constant (Nm/A)	0.043		
Resistance (Ω)			
Mass (kg)			
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -20°C to +40°C			

GEEPLUS BLDC6070



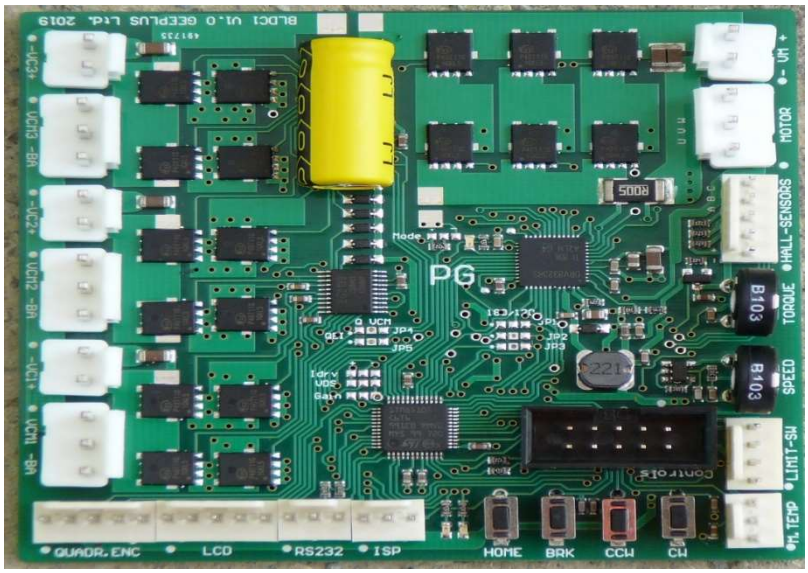
Phase Leads, 18AWG, UL1569			Hall Sensor Leads, 26AWG, UL1569				
U	**V**	**W**	**5v**	**GND**	**A**	**B**	**C**
Red	Yellow	Black	Red	Black	Blue	Green	White

Motor Winding Option	**01A**		
Motor Poles	8		
Voltage (VDC)	36VDC		
No-Load Speed (RPM)	5100 ±10%		
Rated Torque (Nm)	0.3		
Rated Speed (RPM)	4000 ±10%		
Rated Current (A)	5		
Rated Power (W)	80		
Max (Stall) Torque (Nm)	1		
Back-EMF Constant (V/kRPM)	4.35		
Torque Constant (Nm/A)	0.06		
Resistance (Ω)	???		
Mass (kg)	0.9		
Shaft Runout (mm MAX)	0.025		
Insulation Class B			
Dielectric Strength 500VDC for 1min			
Ambient Temperature -20°C to +40°C			

BLDC1 – Motor Controller

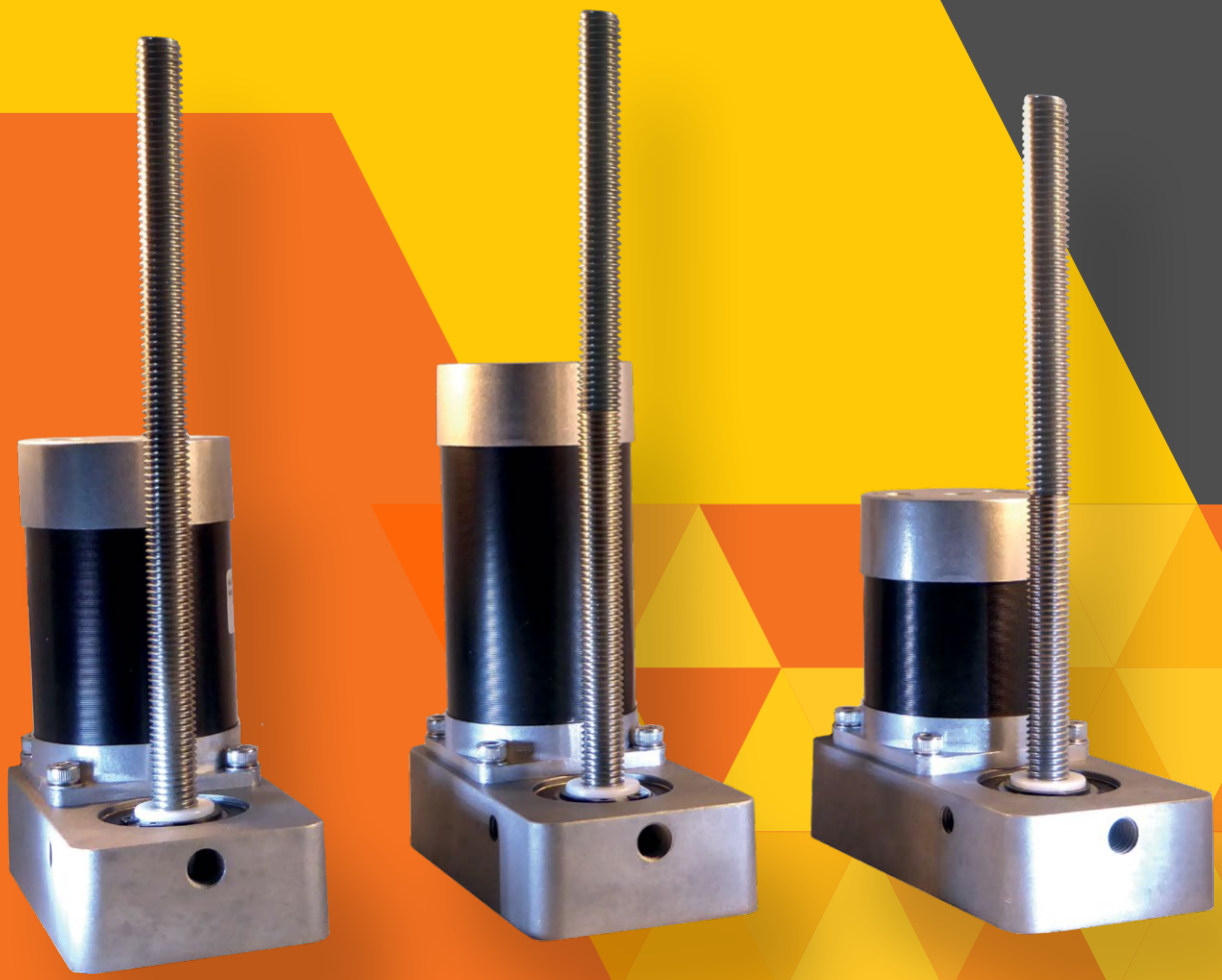
The Brushless DC Motor Controller BLDC1 provides basic control functions for motors with power up to approximately 1kW.

In addition, the controller can provide PWM current control for up to 3 bipolar devices (VCM or Bistable Solenoid) with source voltage 8-36 VDC and current output up to 40 Amps (12 Amps is maximum without heatsinking).



- Provides 3-phase drive for motors with hall-sensor 60˚ from poles, 120˚ trapezoidal commutation
- V supply 8-60V
- Motor Current 40 Amps max (12 Amps is maximum without heatsink)
- Over-current and under-voltage protection
- Controls – Turn CW, Turn CCW, Brake, Go Home
- LCD interface (SPI)
- Quadrature Encoder Input for VCM control (3rd VCM output is not available if this is used)
- Speed Control by on-board trimmer or 0-5v control signal
- Torque Control by on-board trimmer or 0-5v control signal
- RS232 interface for PC

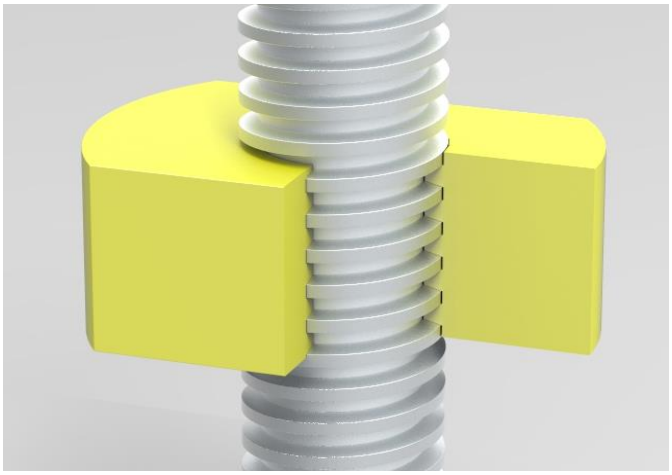
LEAD SCREW ACTUATORS



GEEPLUS Leadscrew Actuators

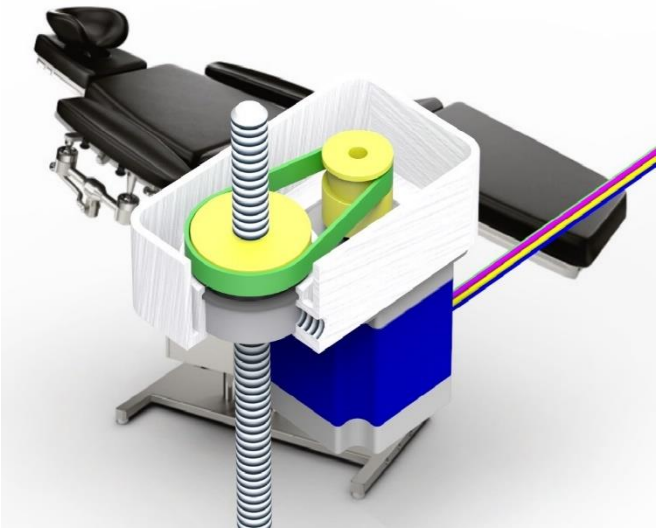
Leadscrew Actuators produce linear movement from the rotation of a rotary motor. They are used in applications including position adjustment of hospital beds and furniture, machine tool actuation, valve actuation, and others.

Options



The screw thread design, and materials and finish of the leadscrew and nut, can have a big impact on efficiency. A trapezoidal thread profile and rolled thread construction are desirable for good strength and efficiency. Low friction polymer material, or lubricated metal are desirable for the nut.

A small leadscrew diameter will reduce friction losses, but may result in higher pressure and faster wear between leadscrew and nut.



The rotating element of the actuator needs to be supported by a bearing having sufficient load capacity to support the axial load.

Different types of motor can be used. Stepping motors allow low-cost open-loop control, brushless DC motors produce less audible noise, and have higher rotational speed capability.

Where high linear forces are required, use of a timing belt reduction mechanism may be preferable to use of a small lead due to smaller friction losses. Timing belt drives are efficient and quiet.

Terminology & Design Considerations

Leadscrews and leadscrew behaviour may be described by the following terms.

Lead – the lead of a leadscrew is the linear distance moved by the non-rotating element when the other element is rotated through 1 complete revolution.

Starts – a leadscrew has one or more splines, a single-start leadscrew has one spline like a common machine screw, a twin-start or double start leadscrew has more. Larger leadscrews may have 3 or more starts. Multiple starts increase the surface area over which the load is distributed. A 3-start screw is pictured.

Thread root – for the leadscrew the thread root is the smallest diameter portion of the thread.

Thread crest – for the leadscrew the thread crest is the largest diameter portion of the thread.

Pitch – the pitch of a leadscrew is the linear distance between adjacent crests. For a single start leadscrew, this is equal to the lead. For a multiple start leadscrew with N starts, this is equal to 1/N x the lead.

Backdrive – When a force is applied to the moving element in a leadscrew system, it causes some torque to be developed which tries to turn the rotating element. In some leadscrew systems, this torque may be sufficient to overcome friction torque. A leadscrew system will be back-driven if the actuation torque is greater than the friction torque (T2 > T1). This may happen with the condition **$L > \pi \times \mu \times D$** :

- Diameter of the leadscrew is small
- Friction co-efficient is small
- Lead is large

Theory of operation

Leadscrew actuators are based on a threaded rod and matching nut. One of these two elements is turned by a motor, either mounted directly to the motor shaft, or coupled by gears, belt, or other mechanisms. The other element is attached to the component to be moved and constrained so it cannot rotate. The relative rotation of the two elements causes a linear movement along the axis.

There are two components to the torque required to turn the rotating element of a leadscrew.

Friction torque – the load (F) applied along the axis is assumed to be applied to the outside diameter (D) of the leadscrew, acting at a radius of D/2. Where the friction co-efficient between the two elements is μ, a friction torque component (T1) is calculated as follows:

$$T1 = \mu \times F \times D/2$$

Actuation torque – the actuation torque component (T2) is calculated by equating mechanical work (assuming 100% efficiency) for 1 revolution.

The mechanical work carried out in one revolution is calculated by multiplying the load force (F) by the lead (L) of the screw elements (the displacement produced for 1 revolution).

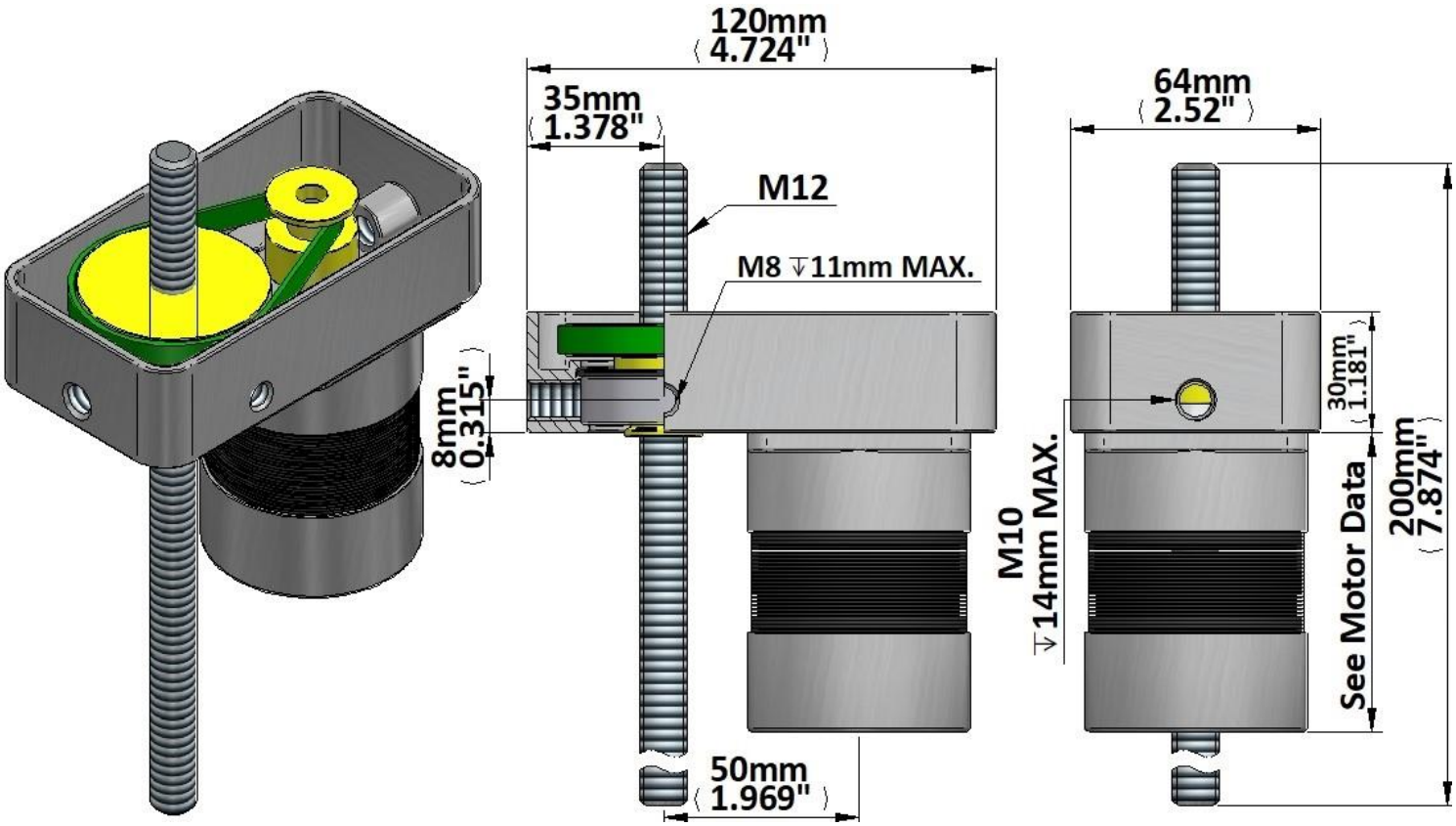
The rotary work is obtained by multiplying the actuation torque (T2) by the angle in radians (2 x π) translated in one revolution.

$$T2 = (F \times L)/(2 \times \pi)$$

So the total torque required to turn a leadscrew is given by:

$$T = 0.5 \times F \times ((\mu \times D)+(L/\pi))$$

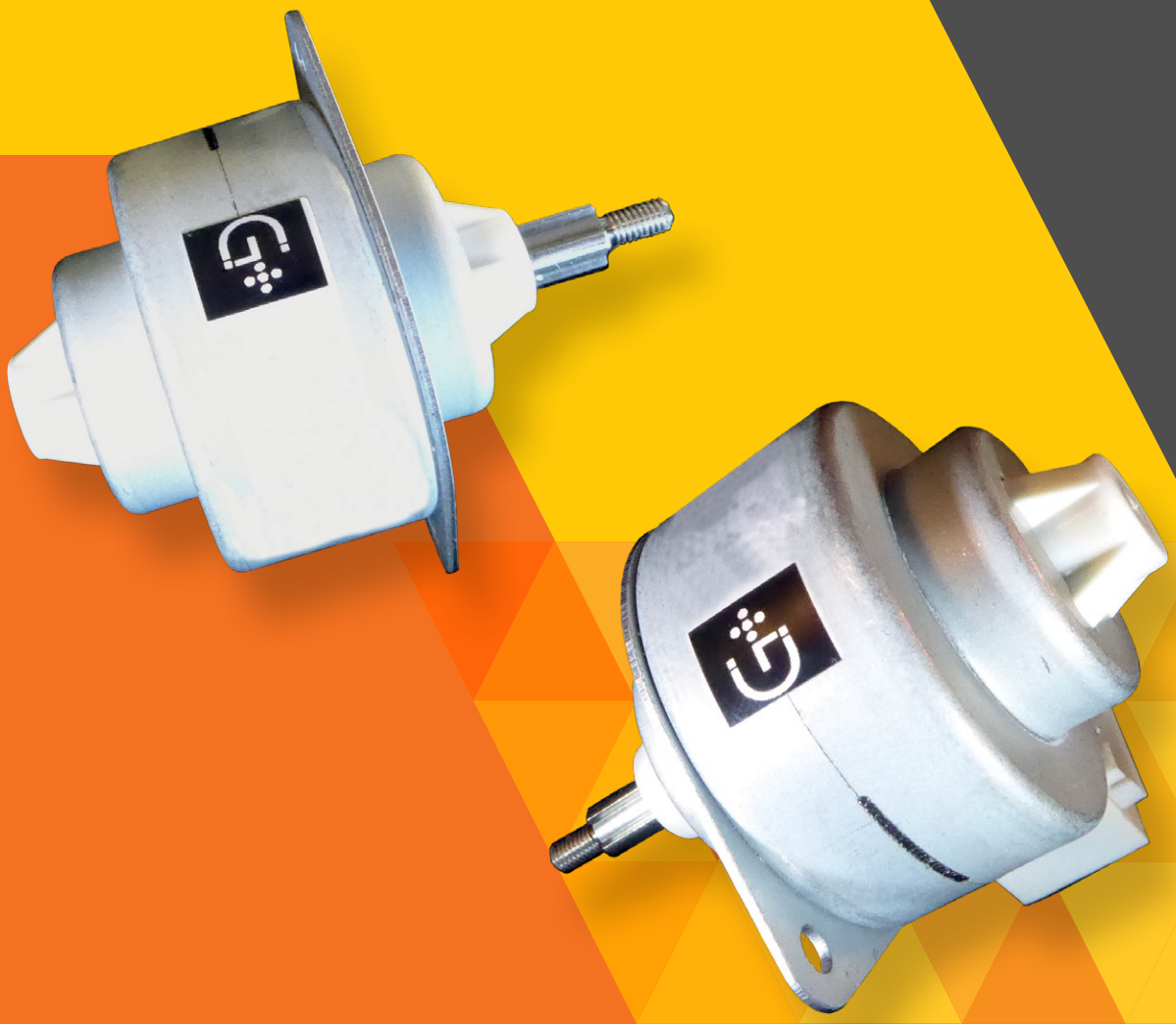
This equation simplifies the losses due to friction, efficiency may be worse than assumed in this.



LA64120 Configuration Options

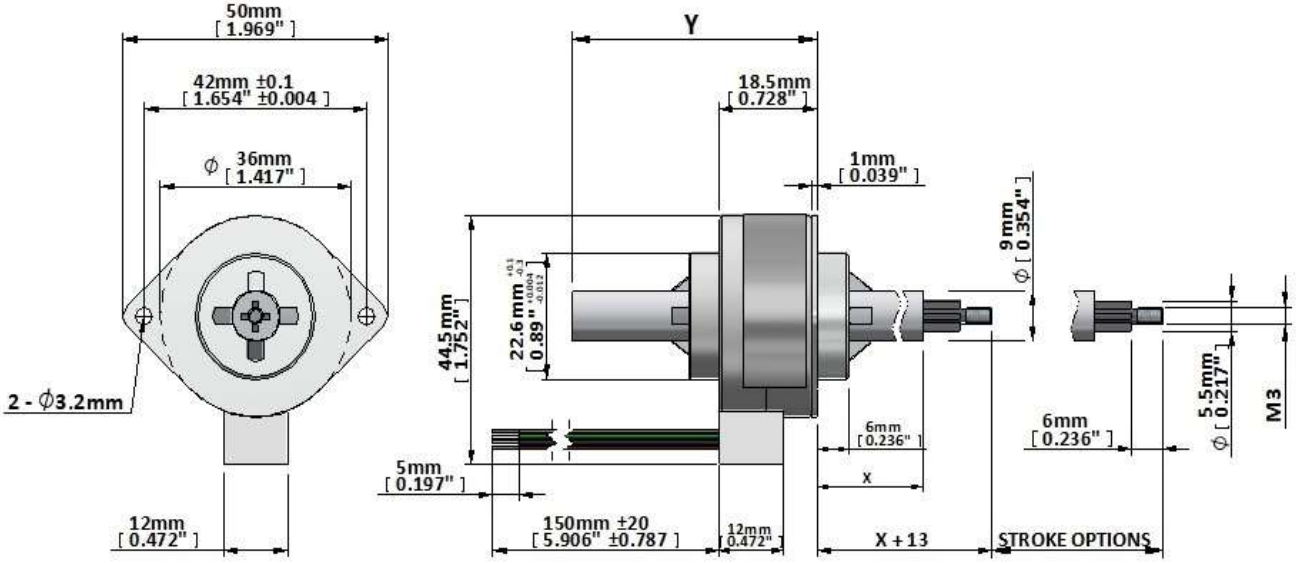
P/N	MOTOR	PULLEY RATIO	BEARING	SCREW	COMMENTS
LA64120-C10341	BLDC5775-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10342	BLDC5795-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10343	BLDC57115-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost
LA64120-C10343	BLDC57115-01A	4:1	6004-2RS	M12	Standard M12 threaded rod for lowest cost

STEPPING MOTORS



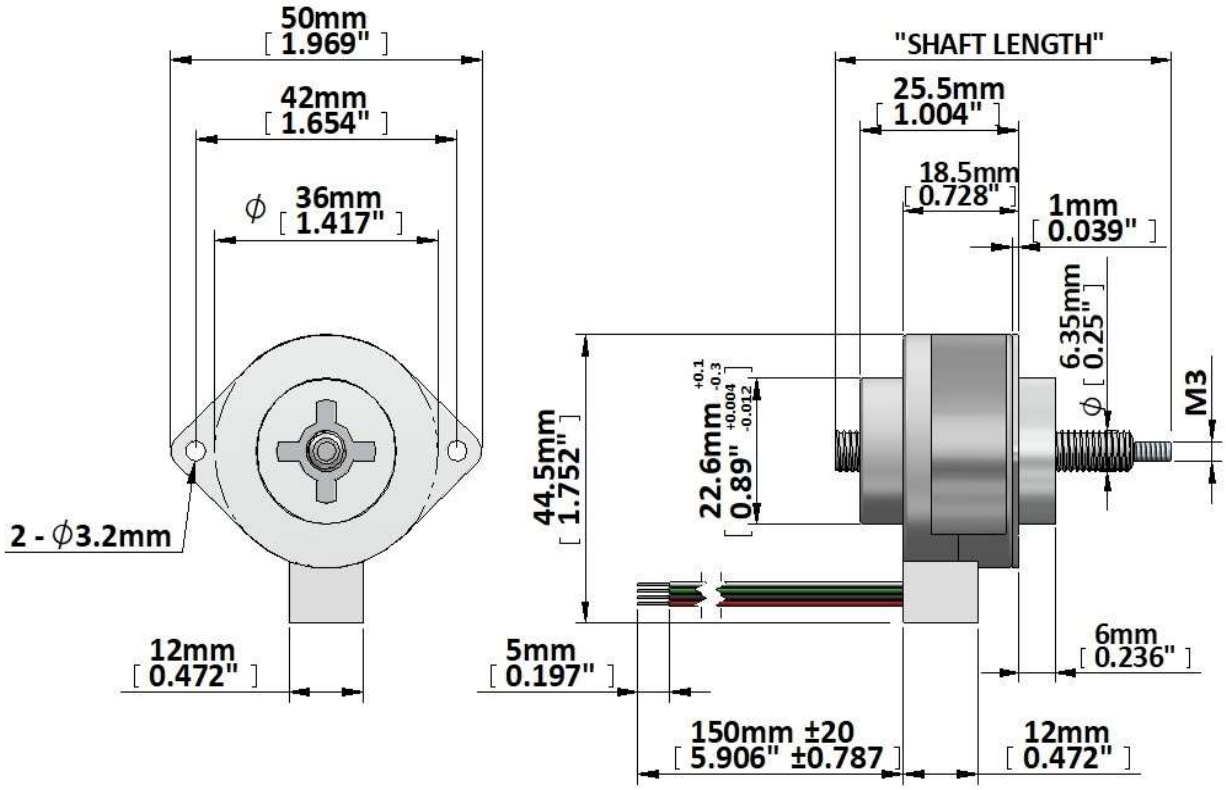
Part Number for Permanent Magnet stepping motors size Ø36mm					
Example : **PM36E-C-05-2B**					
Diameter	**Stroke**	**Nut type**	**Voltage**	**Step angle**	**Leadscrew Pitch**
PM36	E	C = Captive	5	2	B
Available Options	A = 16mm B = 20mm C = 25mm D = 34mm E = 38mm F = Custom	C = Captive N = Non-Captive E = External	05V 12V	1 = 7.5	A = 0.0127mm B = 0.0254mm C = 0.0508mm
				2 = 15	B = 0.0254mm C = 0.0508mm D = 0.1016mm

CAPTIVE NUT TYPE DIAGRAM

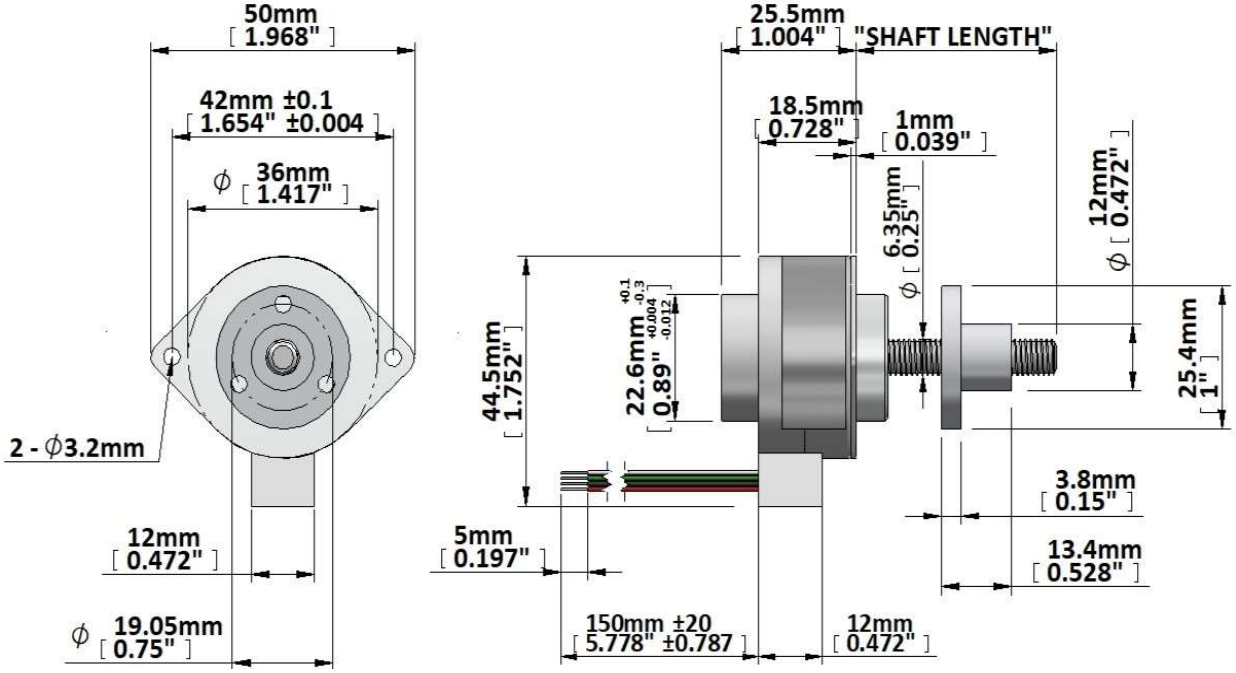


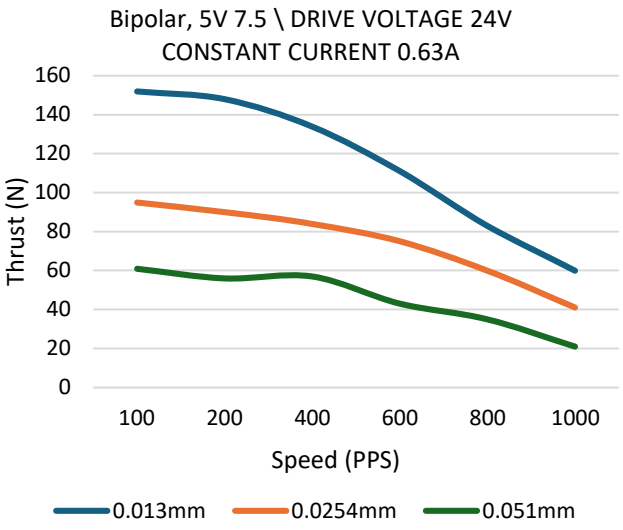
Stroke Options For Captive Nut	A = 16mm	B = 20mm	C = 25mm	D = 34mm	E = 38mm
X	12mm	16mm	21mm	30mm	34mm
Y	31.5mm	35.5mm	40.5mm	49.5mm	53.5mm

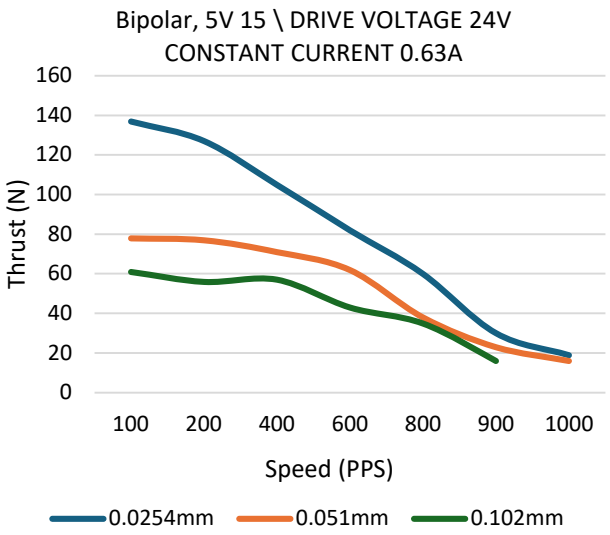
NON-CAPTIVE NUT TYPE DIAGRAM

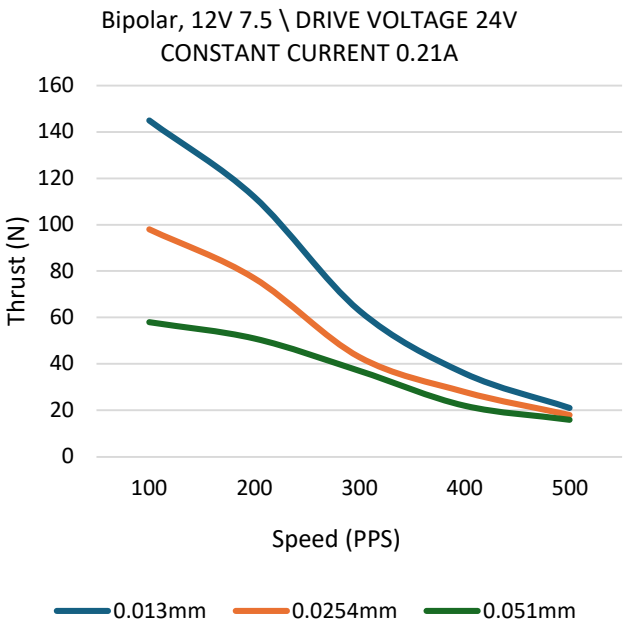


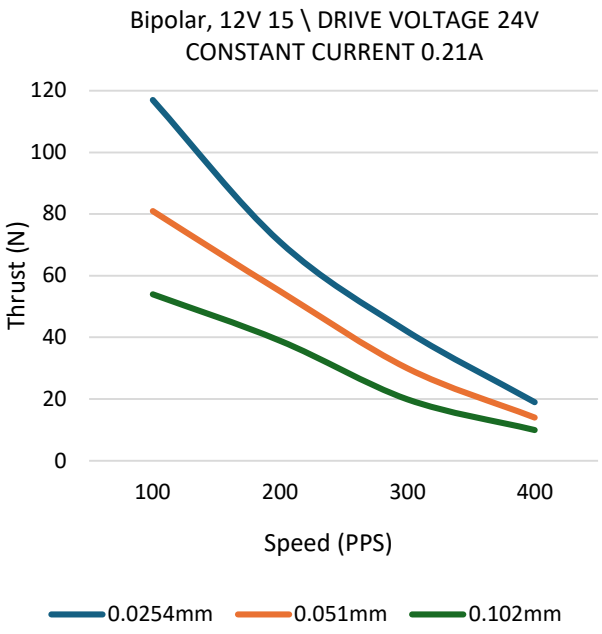
EXTERNAL NUT TYPE DIAGRAM




Bipolar, 5V 7.5 \ DRIVE VOLTAGE 24V
CONSTANT CURRENT 0.63A
Thrust (N)
160
140
120
100
80
60
40
20
0
100
200
400
600
800
1000
Speed (PPS)
0.013mm
0.0254mm
0.051mm


Bipolar, 5V 15 \ DRIVE VOLTAGE 24V
CONSTANT CURRENT 0.63A
Thrust (N)
160
140
120
100
80
60
40
20
0
100
200
400
600
800
900
1000
Speed (PPS)
0.0254mm
0.051mm
0.102mm


Bipolar, 12V 7.5 \ DRIVE VOLTAGE 24V
CONSTANT CURRENT 0.21A
Thrust (N)
160
140
120
100
80
60
40
20
0
100
200
300
400
500
Speed (PPS)
0.013mm
0.0254mm
0.051mm


Bipolar, 12V 15 \ DRIVE VOLTAGE 24V
CONSTANT CURRENT 0.21A
Thrust (N)
120
100
80
60
40
20
0
100
200
300
400
Speed (PPS)
0.0254mm
0.051mm
0.102mm

PINCH VALVES

Pinch Valve Data

Pinch valves facilitate opening and closing the flow of liquid through a tube without any contact between the liquid and the valve itself.

The tube is pinched between a fixed and a moving bar (pinch elements), as these are closed together the tube is pinched closed until flow is shut off.

Pinch Valve Types

Pinch Valves are described by 3 types, Normally Open (NO), Normally Closed (NC), and Changeover (CO).

A Normally Open Valve permits flow in the de-energised condition (without Power). When power is applied, a solenoid actuator closes the pinch elements to squeeze the tube closed and shut off flow.

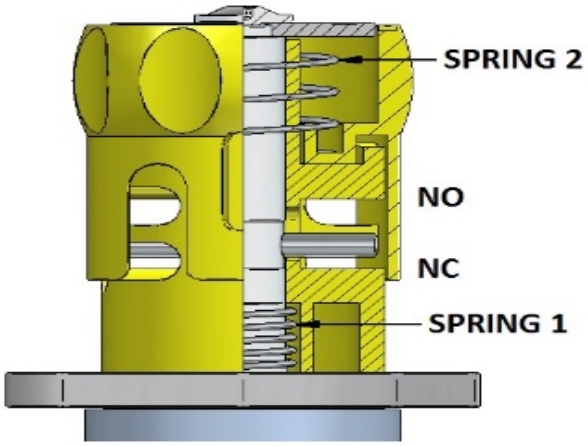
A Normally Closed Valve incorporates a spring which closes the pinch elements to shut off flow in the de-energised condition. When power is applied, a solenoid actuator opens the pinch elements to allow flow through the tubing.

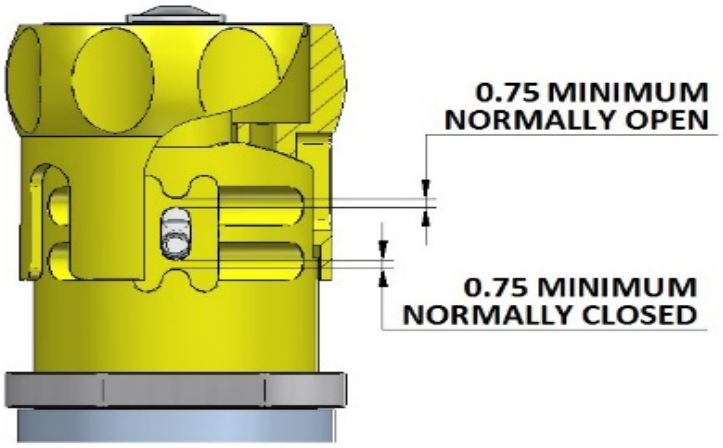
A changeover valve incorporates two channels, one of which is open, and the other closed in the de-energised condition. The individual channels of a changeover valve may be described as NO or NC type.

Operating Parameters

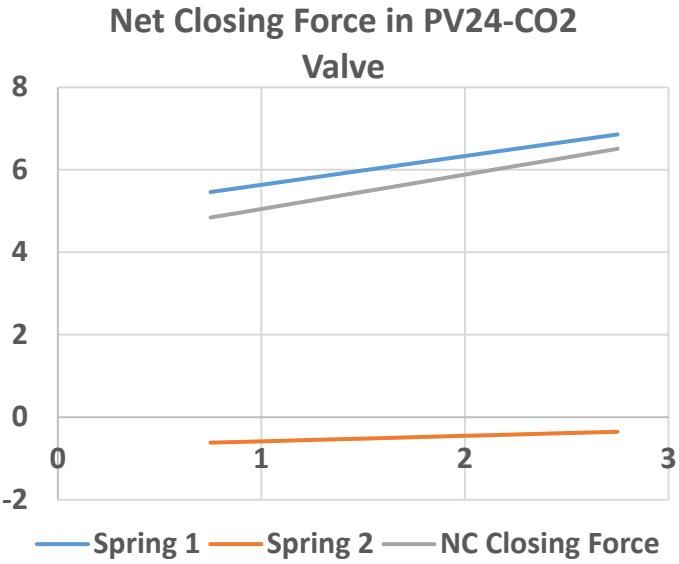
NC Closing Force

In an NC valve (or NC channel of a changeover valve), the force closing the tube is provided by a spring, or a combination of springs.





In the PV24-CO2 changeover valve, the spring configuration looks as above. The lower spring ‘Spring 1’ pulls down the pinch bar assembly and provides the closing force. The upper spring ‘Spring 2’ holds down the tube clamp to retain tubes in place, however, it also pushes upon the pinch bar assembly, reducing the overall pinch force. The combined effect of the two springs looks like the attached graph. This Net force is the value given in the specifications



The drawing also shows the minimum opening heights of the pinch area in NC and NO positions. These heights will determine what minimum wall-thickness of tubing can be used with the valve. In the case shown, the pinch elements will close up to a nominal height of 0.75mm, this should be sufficient to close a tube having 0.5mm or greater wall thickness.

NO Closing Force

In the NO valve (or NO channel of a changeover valve), the closing force is provided by a solenoid. The force developed by a solenoid tends to increase exponentially as the gap between pole-pieces reduces towards zero. This exponential increase can be a problem when using fragile tubing materials.

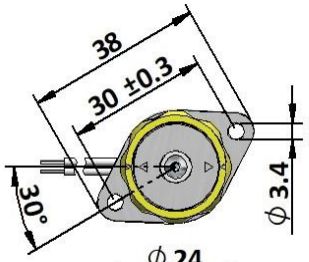
Tube Closing Force

The force required to close a given tube will be affected by tubing material, dimensions, environmental (some tubing materials harden at low temperature and become harder to close) and pressure conditions of the controlled liquid. Applying excessive pressure to the tubing can lead to high operating power requirement, and can damage the tubing leading to premature failure.

For optimum behaviour the force required should be determined by testing with the tubing to be used in the application under worst case conditions. With worst case conditions, the tube should be clamped between a pair of pinch elements similar to the valve to be used, and pressure applied to the pinch elements is increased until flow of liquid ceases.

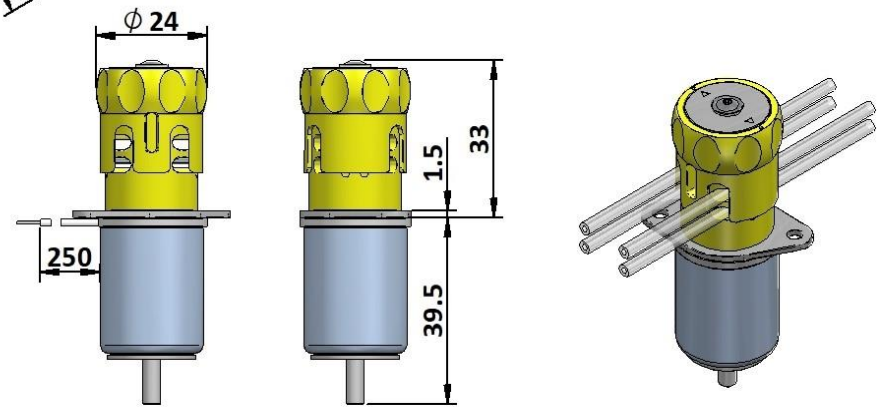
Geeplus has fixtures to measure clamping force and can carry out testing on samples of tubing to determine operating force

GEEPLUS Pinch Valve PV24-CO2-5N-yV

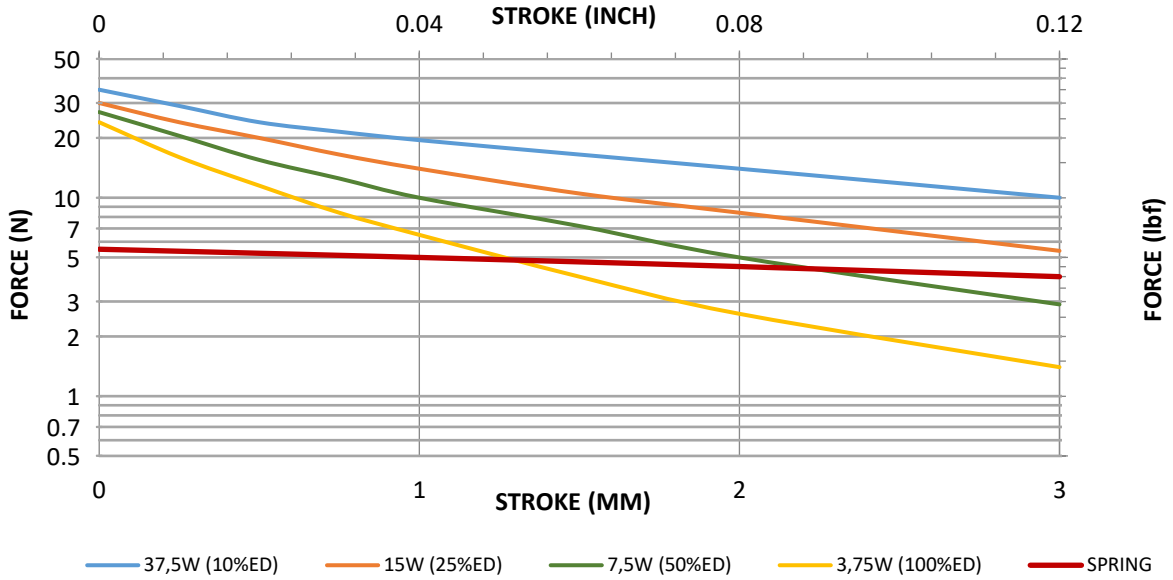


2NO / 2NC DESIGN TO SUIT TUBING UP TO 3MM ($\frac{1}{8}$") DIAMETER

SPRING CLOSING FORCE 4.5N @ 1MM PINCH HEIGHT



FORCE VS STROKE BEHAVIOUR



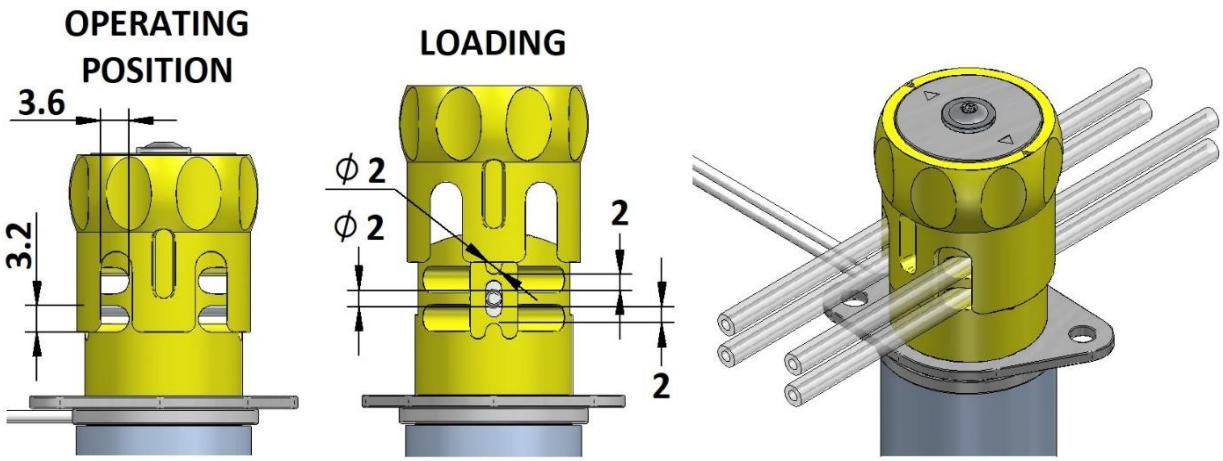
Data at 20°C , without heatsink

duty cycle = "on" time / ("on" time + "off" time) x 100%			100% cont.	50% or less	25% or less	10% or less
Max. "on" time in seconds			∞	100	36	7
watts at 20°C			3.75	7.5	15	37.5
ampere-turns at 20°			440	623	880	1393
type no.	resistance Ω±10% (at 20°C)	number of turns	volts DC			
3V	2.3	350	3.0	4.2	6.0	9.5
6V	10	750	6.0	8.5	12	19
12V	38	1460	12	17	24	38
24V	167	3060	24	34	48	76

Insulation Resistance >100MΩ, 500VDC Megger

Dielectric Strength 1000VAC, 50/60Hz, 1 minute

Class E (120°C) insulation class

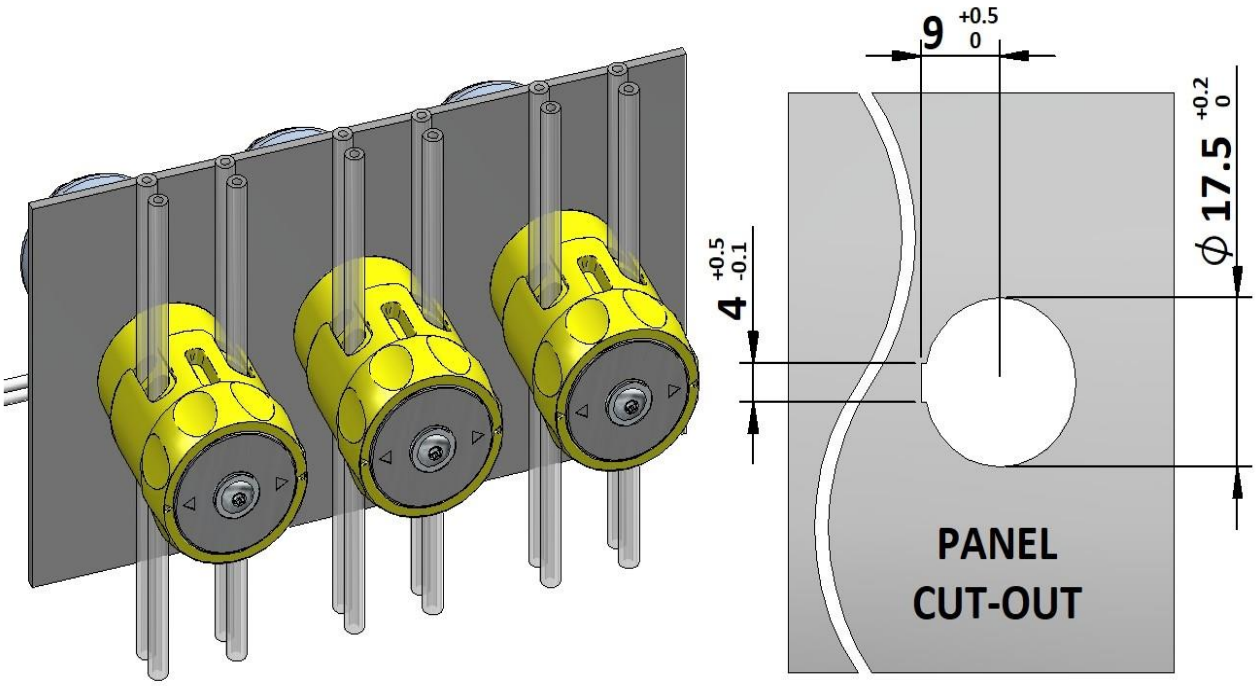


Part Number for Pinch Valves is made up as follows

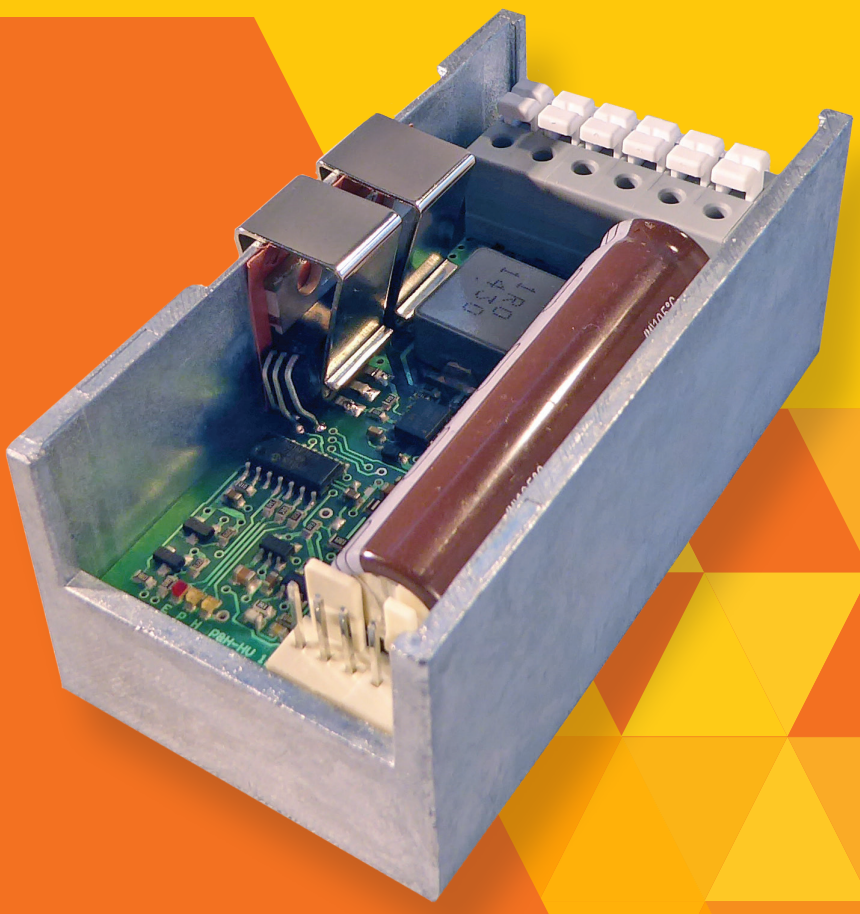
PV24-CO2-5N-6V

PV24	-	Pinch Valve & Nominal Diameter in mm
CO2	-	CO for changeover valve NC for normally closed valve NO for normally open valve 1…..N number of channels of each type
5N multiple	-	Spring force closing NC channel (shared between channels)
6V ED)	-	Nominal Operating Voltage of solenoid used (100%

PARTS CAN BE MOUNTED DIRECTLY IN A PANEL 1.4-1.6MM THICK AS SHOWN BELOW



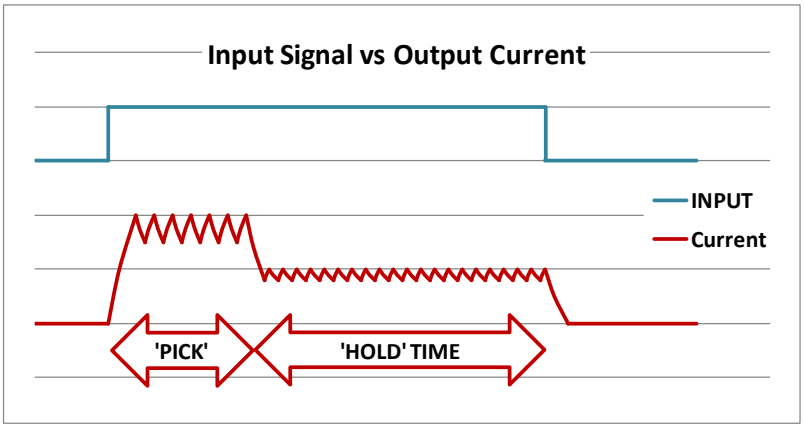
CONTROL CIRCUITS



PHu Pick & Hold Module

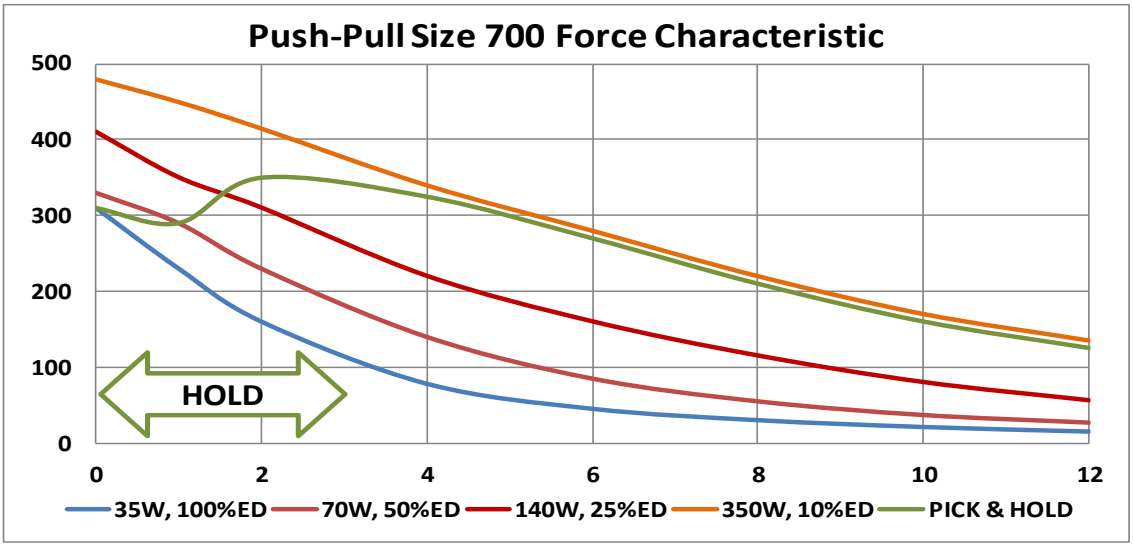
DESCRIPTION

A Pick & Hold circuit regulates current applied to a solenoid or motor, applying high initial current (PICK) to develop high initial force/torque for fast response, then reducing this after a preset time (PICK TIME) to a lower level (HOLD) to maintain operation. It can be used to reduce power consumption in applications with restricted power supply (eg battery or line-powered systems), to reduce heat and power dissipation (systems handling temperature-sensitive materials, or susceptible to thermal distortion), or to stabilise the performance of systems against fluctuations in supply voltage or ambient temperature.

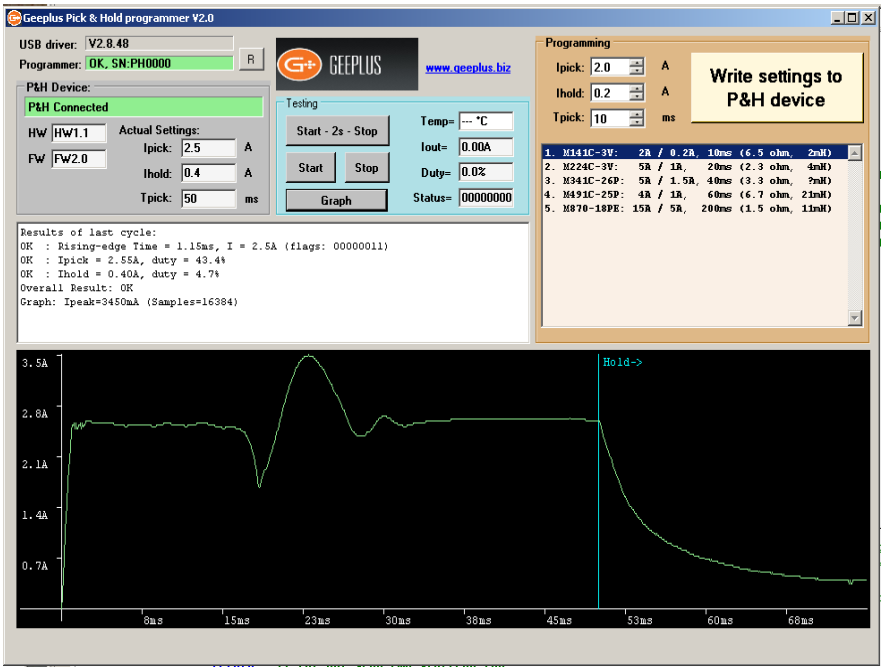


Geeplus PHu modules are microprocessor-controlled pick & hold modules which use intelligent algorithms to control a wide range of devices with simple user control of current and time parameters.

The graph below shows the characteristic force curves for a push-pull solenoid (the curves at different excitation power showing greater force with increasing excitation power, and the shape of the curve with force increasing as displacement reduces towards zero are similar for most linear solenoids), the use of a pick and hold circuit enables force to be realised at the extended position similar to an intermittent duty curve, with continuing excitation power comparable to (or even lower than) that of the 100% duty curve.



The PHu modules can be used to implement control of large solenoids in an end-user application, the user-friendly interface also makes them a superb development tool to explore the maximum performance achievable from a wide range of solenoids during product development.



When connected to a PC/Laptop a clear graphical display of the excitation current waveform can be observed. This helps users select an appropriately sized solenoid for the application and optimise the excitation current conditions to achieve the required force or speed with minimum power consumption and heat dissipation.

The PHu fulfils the PWM current regulator and oscilloscope functions, with ease of use via a simple USB connection to a PC.

While setting up parameters, the solenoid can be switched On or Off from the PC. The ‘Start-2s-Stop’ button energises the device for 2s only, this provides a degree of protection to small devices which can overheat rapidly if energised with excessive current.

The ‘Graph’ display shows the current vs time for an interval of 1.5x the chosen ‘Pick’ time. The graphical display allows the user to visualise the following parameters:

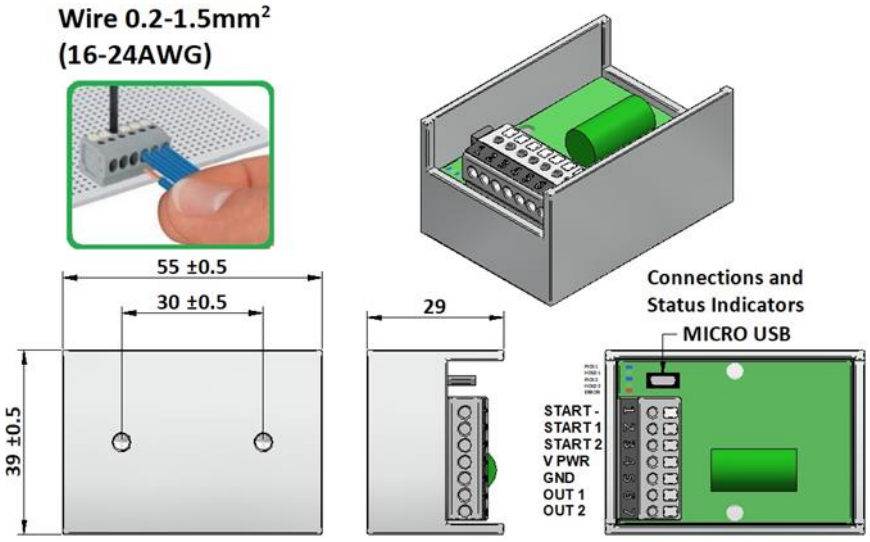
- Electrical rise time of the current.
- The ‘spike’ represents the impact at the end of the stroke so allows stroke time to be monitored.
- The reduction of current from ‘Pick’ to ‘Hold’ value can be monitored.

The text data shows the achieved current values and shows the duty cycle of the PWM current control in the Pick and Hold conditions. It provides some limited diagnosis of problems such as no load, and inadequate source supply.

When switched on for long periods, the screen also shows the duty cycle of PWM control, and the junction temperature of the power device in real time.

PHu Product Configurations

Phu50 – Mechanical Dimensions



The standard module configuration is mounted in a die-cast box and potted (encapsulated) with resin.

The Phu-50 module operate with supply voltage from 8vDC to 50vDC and has 4 different modes of operation as follows:

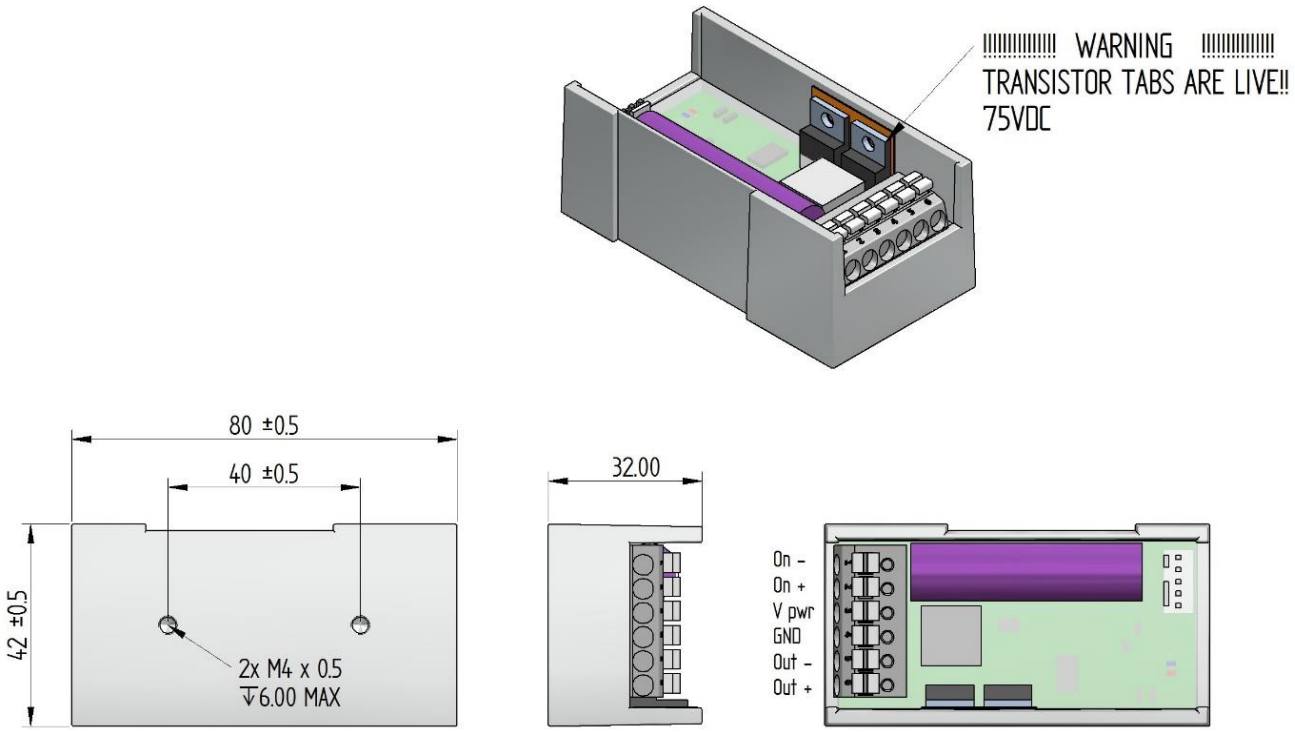
1. Bipolar mode (default): Able to deliver current in a forward or reverse polarity to a single load device.
2. SingleOut mode: Single output to a single device.
3. DualOut mode: Able to drive 2 unipolar devices independently or as a single output device with second output functionality not used with similar capability to the 2-output operation.
4. ParallelOut mode: Both outputs are connected in parallel to one unipolar device to reduce power loss or to deliver higher continuous current.

Connection to a PC for programming, or for control by the PC is via a micro-USB connector and in addition to the feature mentioned above the, the Phu 50 also allows the following:

- High speed camera synchronization to allow capture of high-speed movement.
- Actuation cycling and counting for life testing (and external sensor is recommended to ensure the device operates).

PHu150 – Mechanical Dimensions

Standard module configuration is mounted in a die-cast box and potted (encapsulated) with resin.



The standard module configuration is mounted in a die-cast box and potted (encapsulated) with resin.

The Phu-150 module operate with supply voltage from 35vDC to 75vDC is a unipolar device able to deliver current in one direction.

Phu REQUIREMENTS

To use/program a PHu device the following will be required:

Included

- PHu module
- Software PHprogrammer.exe V8

Not Included

- USB-Micro cable.
- PC/laptop.
- Load device – such as a solenoid.
- Power Supply - Appropriate to the application requirements and within the limitations of the PHu module being used.

Product Table

Available versions are detailed below.

Module P/N	Supply Range (V)	Load Constraints	Pick Current (Max)	Hold Current (Max)	Pick Time (ms)	Input	Mating Connector
PHu-50	10-50 VDC	1mH MIN	0.1-24 Amps	0.1-24 Amps	2-512 ms	5-24V isolated	Not Required
PHu-150	16-75 VDC	2mH MIN	0.1-24 Amps	0.1-24 Amps	2-510 ms	3-30v isolated	Not Required
PHu-50-PCB	Bare Phu-50 PCB, REQUIRES HEATSINKING to achieve maximum current output						
PHu-50	Module - Comprises PHU-50-PCB potted in die-cast heatsink case						
PHU-150-PCB	Bare PHU-PCB - REQUIRES HEATSINKING to achieve maximum current output						
PHu-150	Comprises PHU-150-PCB potted in diecast heatsink case						

Please note that the continuous excitation (Hold) current may be limited by heat dissipation.

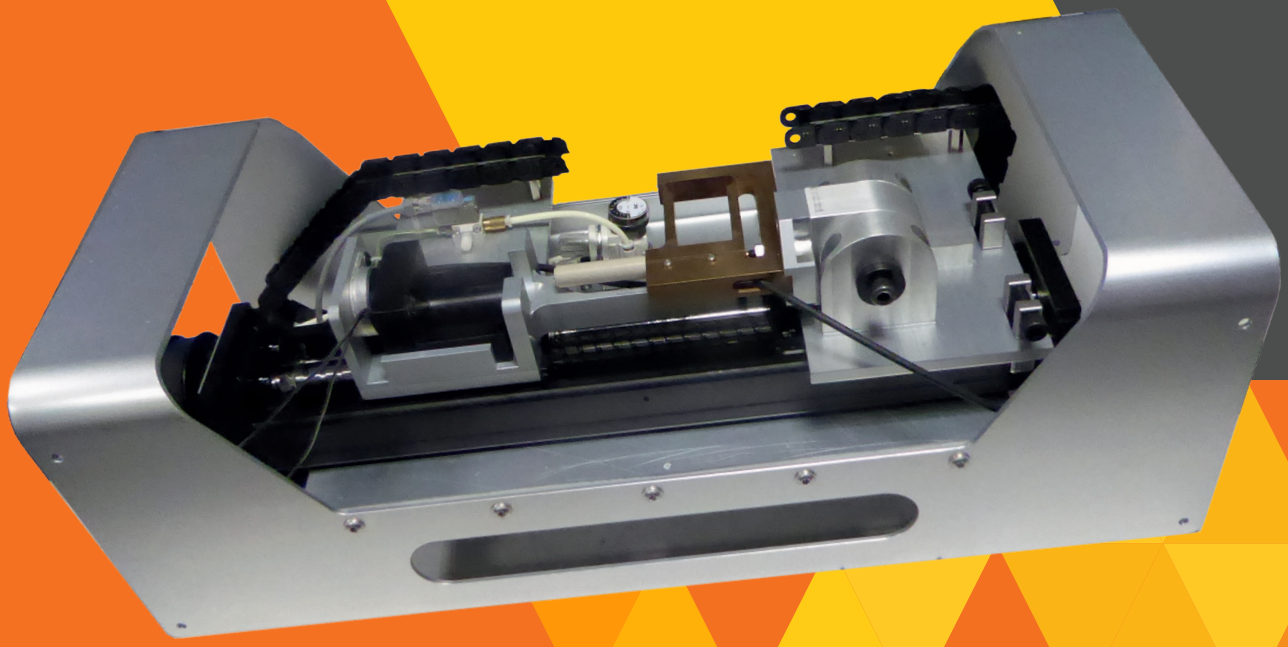
Warning – if maximum Supply Voltage is exceeded by more than 10% permanent damage may be caused to the module.

Setup

Both modules should be set up before use, using the Pick and Hold software and a micro-USB cable (Not included) which is included in the kit ver. A user-friendly interface allows current and time parameters to be set up and saved and allows monitoring of the switching device temperature to confirm operation is within safe limits in a wide range of ambient conditions.

Further information on our website - www.geeplus.com/control-circuits/

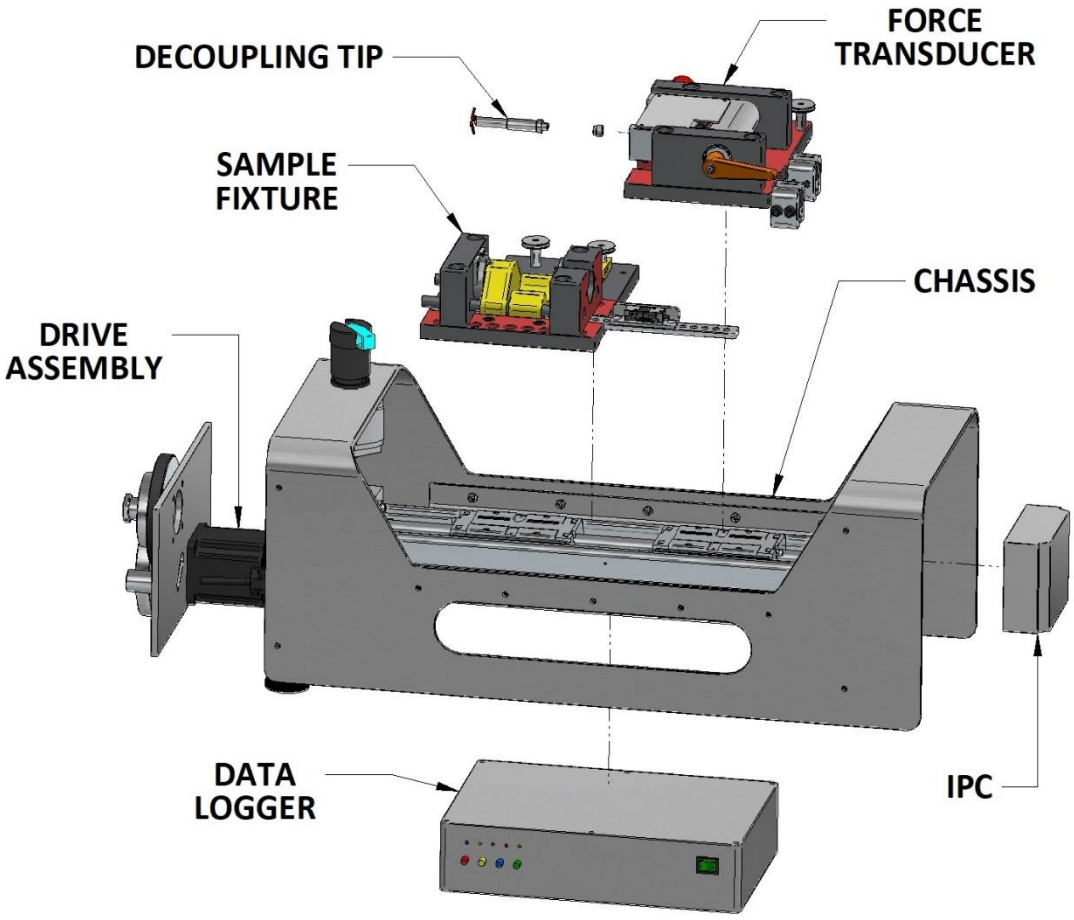
TEST RIGS



Test Rig

Geeplus offers test systems for measurement of electromechanical characteristics of devices and materials. These can be used for measurement of force vs displacement (characterisation of actuators, pull-off testing of electrical connectors, tensile testing of materials), measurement of electrical conductivity of materials, characterisation of magnetic fields, and for other application. These systems were developed initially for our own in-house testing and are offered for sale or lease to other parties.

An example of a test rig for testing force vs displacement characteristics is shown below:



The data logger is the heart of the test systems. This incorporates a motion controller, high precision current source, precision inputs for analogue bridge sensors or for digital quadrature signals. A PC based test program allows the user to define measurement routines and offers powerful features to set up test templates in a familiar Excel format to analyse and record data, and to make Pass / Fail judgements.

External components not shown here would typically include a keyboard, mouse, monitor, and label printer.

Data Logger

The Data Logger unit is purpose built for the test systems. It can be programmed to execute a controlled series of operations, recording data at defined intervals, and saving specified data into an Excel datasheet.

The use of Excel to present and evaluate the test data is one of the most powerful features of these systems, Excel has a powerful range of features to process numerical data, and to present data in a graphical format to facilitate visual interpretation.

An Excel Template is set up by the user to present and analyse data. As the test routine is developed, the defined test routine will populate data in specified columns in a copy of this template. The User can set up calculations and define graphs in the populated sheet to evaluate how the data can best be presented. When the user is happy with the data analysis, the cells populated by the test programme can be cleared, and the 'empty' copy renamed to use as template for future test runs

Pass / Fail criteria can be defined in the template, the template defines which cells should be used to make overall Pass / Fail judgement of the test sample.

The Excel template is interpreted by a piece of software which translates it into a form which can be interpreted by the data logger. Although the data is saved as an Excel datasheet, the pass / fail judgement is made within the datalogger based on this interpretation. There are a few Excel functions which may not be interpreted correctly by the data logger when making pass / fail judgements (*These functions can still be used in the Excel template and will be processed / judged correctly within the Excel sheet, but they can not be interpreted by the Data logger and cannot be used as Pass / Fail criteria for judgement of the test specimen*).

The Test Routine can be defined to save test data with a name including S/N, and to print a label which includes S/N when a part passes testing, then to increment the S/N for next part. If a part fails testing the S/N is not incremented, a label is not printed, and the user is offered the option to save 'failed' data and name this file if they wish to do so for analysis. Labels will not be generated for failed parts, and test data for failed parts will only be saved with operator intervention.

Chassis

The Chassis provides mounting and protection for the main test-rig components, and for the utilities (power, compressed air) needed for this. The chassis may also provide some degree of isolation from vibration which could disturb measurement.

IPC

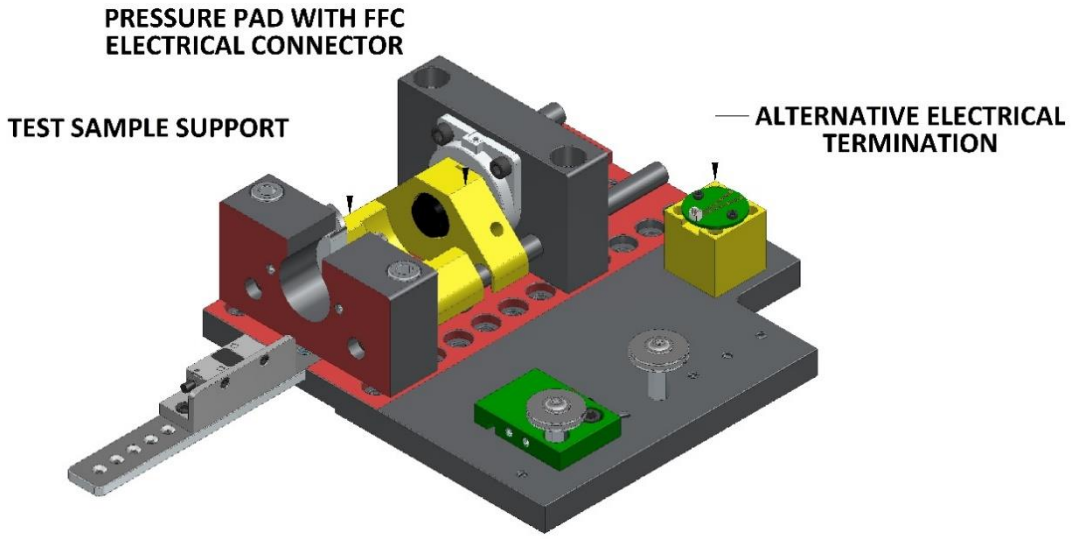
An Industrial Computer is used to control the test-rig. This is mounted within the chassis. A hinged door allows access to connections for this to connect peripherals such as keyboard, printer, monitor, mouse.

Drive Assembly

The drive assembly comprises a motor and a transmission (gears, pulleys, couplings). This is driven from the datalogger unit and controls movements within the test rig.

Sample Fixture

The sample fixture comprises mechanical fixturing to mount samples to the test rig for testing and may also incorporate electrical connection components to interface these samples and facilitate easy connection / disconnection. This may also incorporate transducers to monitor parameters such as displacement.



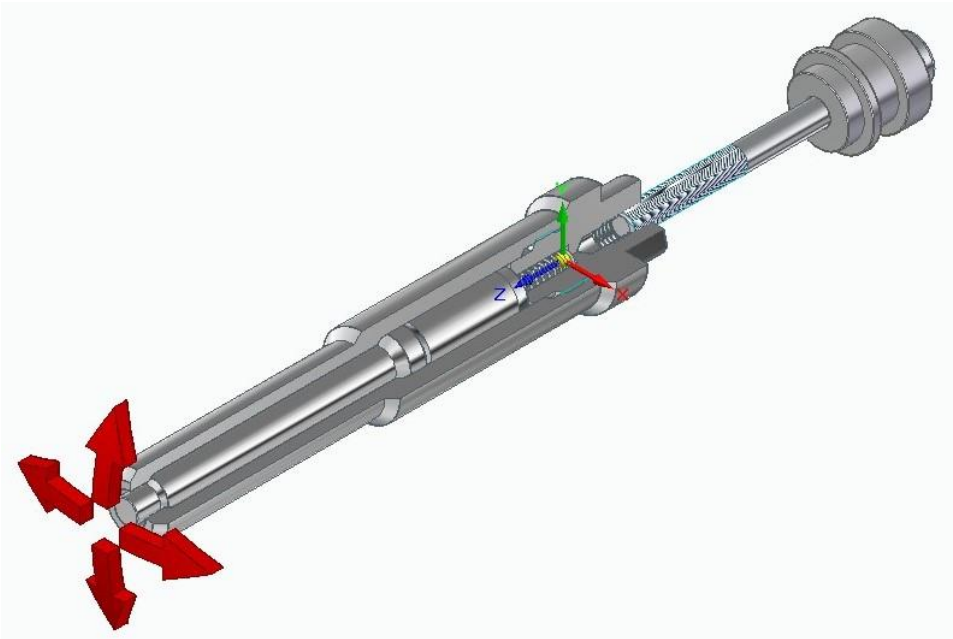
The main structure of the fixture shown is made up of standardised elements to keep cost reasonable for a very precise and robust fixture, however the labelled components are unique to a specific part which will be tested, these elements are unique to a particular customer application.

Load Transducer

A load transducer senses force. These typically involve a deflection element which flexes in a controlled and repeatable manner when subject to applied force, and a measurement element which measures this deflection. Geeplus has developed transducers with very low noise to be able to measure very small force variations for measurement of hysteresis in small actuator devices.

Decoupling Tip

For very precise measurement of actuator devices, a decoupling tip may be required to compensate for small misalignment between the force transducer and axis of the actuator which can contribute to hysteresis measurement.



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