KOLLMORGEN

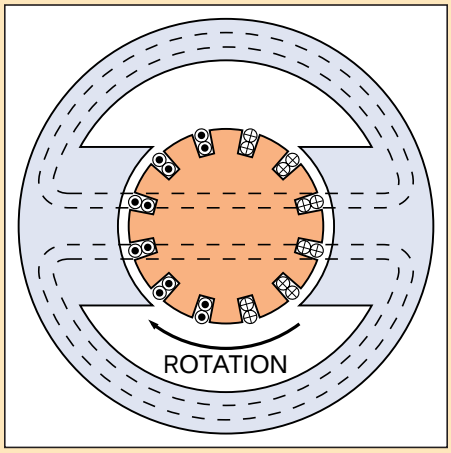
SERVODISC™ CATALOG

A new dimension in performance

If you are involved with high performance servomotor applications, there is an important motor technology which you should know about. It's the technology found in ServoDisc motors from Kollmorgen.

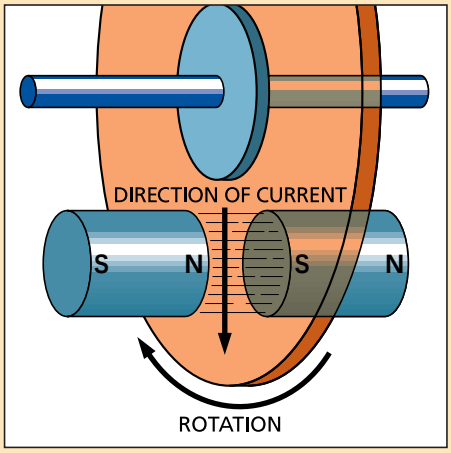
What separates the ServoDisc motor from conventional DC servos is its ironless disc armature. As we shall see, this difference enables ServoDisc motors to deliver a level of performance, in both incremental motion and continuous speed applications, which is not attainable with conventional ironcore motor designs.

In addition to performance advantages, ServoDisc motors have a unique compact shape that can be an attractive alternative when solving tight packaging problems.



Ironcore Motor

A conventional ironcore motor uses a radial design with magnets placed concentrically around the shaft in such a way as to produce a radial magnetic field. (Fig. 1) The armature consists of slotted steel laminations wound with coils of wire which interact with the magnetic field to produce torque. As the motor rotates a commutator automatically maintains the correct current flow. A ServoDisc motor uses entirely different physical construction. The motor is designed with the magnetic field aligned axially, parallel to the shaft. (Fig. 2) The conductors in the armature have a current flow which is perpendlcular to the magnetic field (radial to the shaft). This produces a torque perpendicular to both the magnetic field and the current (the left-hand rule). This force rotates the shaft. This construction approach is much more efficient than the radial design of conventional ironcore motors and eliminates the heavy iron armature and the electrical losses associated with it. The large number of commutations possible with Kollmorgen's unique flat armature produce dramatically smoother torque output.



ServoDisc Motor

Unique ironless design

In a conventional slot-wound servomotor, the armature is constructed from a heavy, laminated ironcore wound with coils of wire. In a ServoDisc motor, the armature has no iron. Instead, it is constructed from several layers of copper conductors in a unique flat-disc configuration.

Not only are the armature designs completely different, so is the shape and internal construction. In a conventional servo, the permanent magnets are mounted on the motor shell creating a radial magnetic field, perpendicular to the shaft (Fig. 1). Because the magnet pairs are so far apart, the iron core of the armature is needed to contain and focus the lines of magnetic flux. Motors of this type are typically long, thin and heavy.

In a ServoDisc motor, the magnets are mounted on the end plates creating an axial magnetic field, parallel to the shaft. This leads to a very small air gap be tween the magnets, separated only by the thickness of the disc armature - a very clean and effective design approach. Torque is created when the current flowing radially through the copper conductors interacts directly with the field of the permanent magnets (Fig. 2). This configuration is a very efficient way of producing torque. These different approaches produce dramatically different motors (Fig. 3).

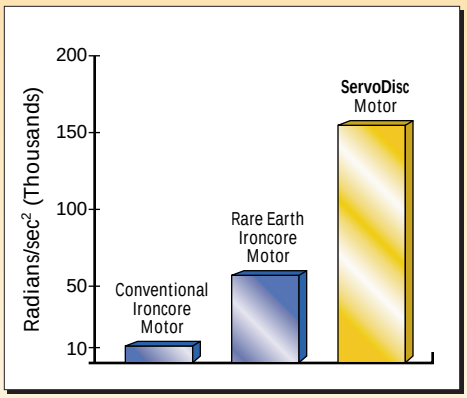
Outdistances other DC servos

The iron-free ServoDisc armature provides some significant performance advantages for motion control applications.

COMPARISON OF PERFORMANCE FEATURES

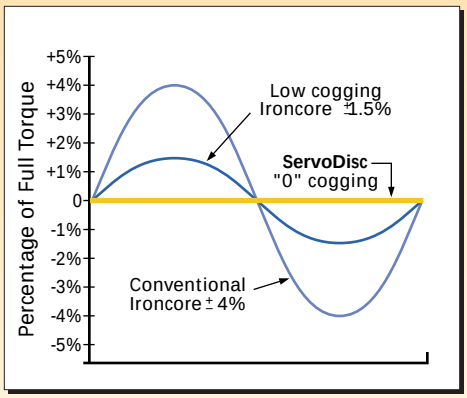
Size

The ServoDisc armature is much smaller and lighter than bulky ironcore designs of equivalent output.



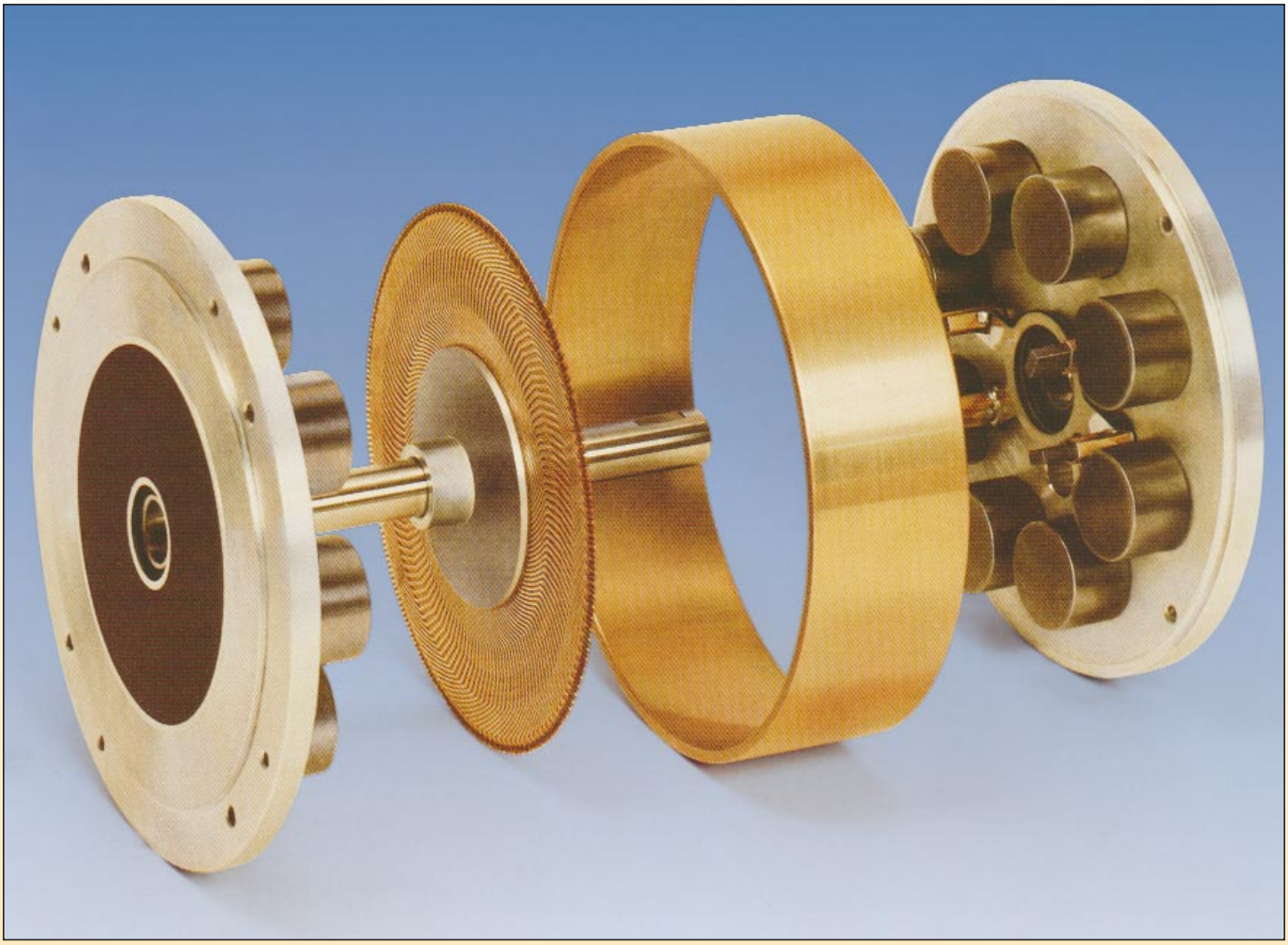
Acceleration

ServoDisc motors accelerate up to 10 times faster than conventional servo motors.



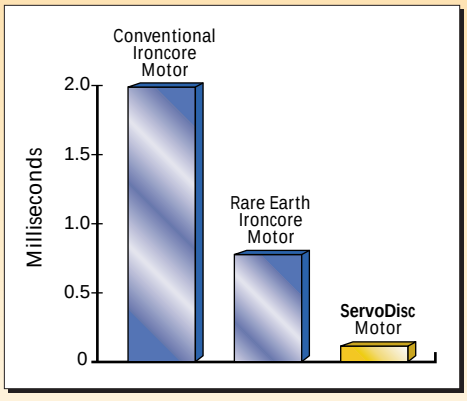
Cogging

The ironless ServoDisc armature has absolutely no cogging at any speed of operation.



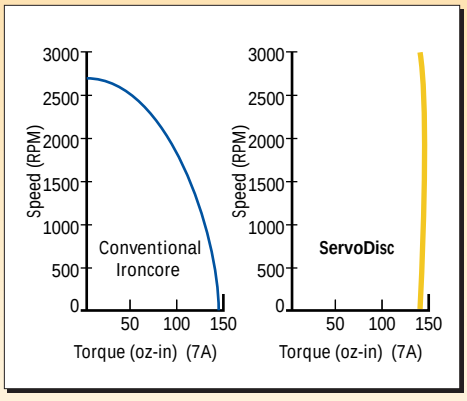
Faster acceleration

The thin, low-inertia armature design leads to exceptional torque-to-inertia ratios. This translates into blazing acceleration (Fig. 4). A typical ServoDisc motor can accelerate from 0 to 3000 rpm in only 60 degrees of rotation. In some applications, the entire move can be performed in less than 10 milliseconds. This means shorter cycle times, more moves per second and higher throughput. For incremental motion applications, this translates into higher productivity and more profitability.



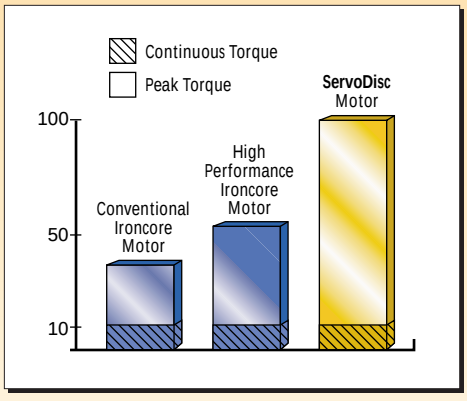
Electrical Time Constant

A very low electrical time constant results in torque much sooner than with conventional wire-wound motors.



Torque-Speed Curves

With full torque from 0 to full speed, ServoDisc motors solidly outperform conventional motors.



Peak Torque Capability

High peak torque capability means more throughput than is available from standard servos.

Perfectly smooth rotation

If you rotate a conventional motor when it is unpowered, you will notice that it pulls into certain preferred positions. This occurs when the iron laminations in the arma ture line up with the permanent magnets on the stator. This phenomenon is called “cogging.” It also occurs when the motor is powered and shows up as torque disturbances which can be a serious problem in critical applications. The ServoDisc armature, being ironless, is not attracted by the magnets and. consequently, has intrinsically zero cogging (Fig. 5). The result is ultra-smooth rotation at any speed.

Long brush life

Because there is no iron, there is nearly no inductance. The result is no arcing, because there is no stored energy in the armature to be dissipated during commutation. In an ironcore motor. a lot of energy is stored in the magnetic field of each coil. When this field collapses, the energy may be discharged by arcing to the brushes. Arcing, not friction, is the major cause of brush wear. The elimination of arcing leads to very long brush life in most applications. In fact, depending on the application, it is possible for the brushes to last as long as the bearings.

High speed capability

No arcing also means no commutation limits due to speed. In a conventional motor, arcing increases as speed increases and eventually causes motor operation to become erratic. ServoDisc motors do not suffer from this problem and can run to 4000 rpm and above.

Instantaneous torque

Low inductance provides another advantage...low electrical time constant. This is a measure of how long it takes for current to flow into the armature. For ServoDisc motors, this is much less than one millisecond (Fig. 6). This means full torque almost instantly; a key to fast moves and accurate tracking.

Full torque from 0 to 4000 rpm

In a conventional motor there are losses associated with rotating the iron armature in a magnetic field. These losses increase with speed, so as the motor goes faster, it uses more and more of its available torque just to keep itself turning. Consequently, less torque is left to deliver to the output shaft (Fig. 7A). ServoDisc motors do not have these iron-associated losses and, as a result, deliver more torque over their entire speed range. In fact, the torque is almost constant from 0 to 4000 rpm (Fig. 7B). Compare this performance with the torque-speed characteristics of a conventional motor.

When sizing a conventional motor, the torque drop-off with speed may require you to select the next higher size to get sufficient torque at high speed. You will never have this problem with a ServoDisc motor.

Extra torque on call

For rapid acceleration and deceleration, higher than normal torque is usually required. To produce this temporary peak torque, a peak current is applied to the motor. In an iron-core design, the magnetic field of the armature can interact with and demagnetize the permanent magnets. Because of this effect, peak current is generally limited to 2 or 3 times the continuous current rating. With the non-magnetic ServoDisc armature and axial magnetic field, this problem is virtually eliminated. Most ServoDisc motors are rated for peak current of 10 times the continuous rating (Fig. 8).

Sizes for every application

ServoDisc motors use a very “well behaved” technology. As a result, products have been developed which cover a wide range of package sizes and power levels. Motors are presently available with torques from 10 oz-in to 20 lb-ft and power outputs from 30 watts to 4.5 kilowatts. This means a product match for nearly every application .

Easy to design in

The disc armature design leads to a unique flat motor package. This is generally easier to design in than much longer conventional motors. From a performance standpoint, this shape provides closer physical coupling and better torsional stiffness. These key factors can optimize your mechanical design.

Ferrite Series ServoDisc

PERFORMANCE DATA

Gearmotor Types		Rated Speed (RPM)	Continuous Torque (in-lb/N-m)	Peak Torque (in-lb/N-m)	Gear Ratio	Motor Voltage (Volts)	Motor Current (amps)
10:1	9FGCHD/10:1	315	8.0/0.9	32	9.53:1	13.8	6.2
10:1	9FGCHDT/10:1	315	7.5/0.8	32/3.6	9.53:1	13.8	6.2
15:1	9FGT/15:1	208	8.0/0.9	16/1.8	14.4:1	11.4	5.2
	9FG/15:1	208	9.9/1.1	16/1.8	14.4:1	12.4	5.2
	9FGHDT/15:1	200	12/1.4	36/4.1	15.1:1	14.4	6.6
	9FGHD/15:1	200	13.6/1.5	36/4.1	15.1:1	14.6	6.7
	9FGCHD/15:1	200	12.8/1.4	38/4.3	15.1:1	13.8	6.2
	9FGCHDT/15:1	199	12/1.4	38/4.3	15.11:1	13.8	6.2
	12FGT/15:1	189	27.9/3.2	68/7.7	16.06:1	19.4	7.4
	12FG/15:1	189	31.2/3.5	68/7.7	16.06:1	21.2	6.9
25:1	9FGT/25:1	125	13.4/1.5	26/2.9	24:1	11.4	5.2
	9FG/25:1	125	16.5/1.9	26/2.9	24:1	12.4	5.2
	9FGHDT/25:1	116	19.2/2.2	62/7	25.85:1	14.4	6.6
	9FGHD/25:1	116	22/2.5	62/7	25.85:1	14.6	6.7
	9FGCHD/25:1	116	20.6/2.3	69/7.3	25.85:1	13.8	6.2
	9FGCHDT/25:1	116	19.2/2.2	65/7.3	25.85:1	13.8	6.2
	12FGT/25:1	123	42.8/4.8	103/11.6	24.48:1	19.4	7.4
	12FG/25:1	123	47.2/5.3	103/11.6	24.48:1	21.2	6.9
37:1	12FGT/37:1	81	64.5/7.3	156/17.6	36.99:1	19.4	7.4
	12FG/37:1	81	72/8.1	156/17.6	36.99:1	21.2	6.9
50:1	9FGHDT/50:1	61	36/4.1	116/13.1	48.96:1	14.4	6.6
	9FGHD/50:1	61	42/4.7	116/13.1	48.96:1	14.6	6.7
	9FGT/50:1	60	27.5/3.1	49/5.6	48.95:1	11.4	5.2
	9FG/50:1	60	33.7/3.8	49/5.5	48.95:1	12.4	5.2
	9FGCHD/50:1	61	39/4.4	124/14	48.96:1	13.8	6.2
	9FGCHDT/50:1	61	36.4/4.1	124/14	48.96:1	13.8	6.2
	12FGT/50:1	60	87/9.8	210/23.7	49.96:1	19.4	7.4
	12FG/50:1	60	97/11	210/23.7	49.96:1	21.2	6.9
80:1	9FGT/80:1	38	44.3/5	59/6.7	77.29:1	11.4	5.2
	9FGHDT/80:1	38	56.8/6.4	149/16.8	79.2:1	14.4	6.6
	9FG/80:1	38	53.2/6	59/6.7	77.29:1	12.4	5.2
	9FGHD/80:1	38	65/7.3	149/16.8	79.2:1	14.6	6.7
	9FGCHD/80:1	38	60/6.8	120	79.2:1	13.0	6.2
	9FGCHDT/80:1	38	56.8/6.4	120/13.6	79.20:1	13.0	16.2
	12FGT/80:1	36	139/15.7	229/25.9	82.73:1	19.4	7.4
	12FG/80:1	36	155/17.5	229/25.9	82.73:1	21.2	6.9
100:1	9FGT/100:1	31	50/5.6	94/10.6	95.93:1	11.4	5.2
	9FG.100:1	31	59/6.7	94/10.6	95.93:1	12.2	5.0
	9FGHDT/100:1	30	71/8.0	151/17.1	99:1	14.6	6.6
	9FGHD/100:1	30	81.2/9.2	151/17.1	99:1	14.5	6.7
	9FGCHD/100:1	30	60/6.8	121	99.0:1	12.0	5.1
	9FGCHDT/100:1	30	60/6.8	120/13.6	99.0:1	12.0	5.1
	12FGT/100:1	30	169/19.1	237/26.8	99.77:1	19.4	7.4
	12FG/100:1	30	187/21.1	237/26.8	99.77:1	21.2	6.9
150:1	9FG/150:1	21	59/6.7	94/10.6	148.54:1	10.9	3.7
	9FGT/150:1	21	59/6.7	94/10.6	148.54:1	10.5	4.3
	9FGHD/150:1	20	92/10.4	152/17.2	148.51:1	12.9	5.2
	9FGHDT/150:1	20	92/10.4	152/17.2	148.51:1	13.6	6.0
	9FGCHD/150:1	20	60/6.8	125	148.5:1	10.8	3.8
	9FGCHDT/150:1	20	60/6.8	120/13.6	148.5:1	10.8	3.8
	12FG/150:1	21	200/22.6	243/27.5	153:1	19.2	5.2
	12FGT/150:1	21	200/22.6	243/27.5	153:1	17.8	6.0

Legend: FG - Gearmotor
FGHD - Gearmotor, Heavy Duty
GFCHD - Gearmotor, Compact Heavy Duty
FGT - Gearmotor, Integral Tachometer
FGHDT - Gearmotor, Heavy Duty, Integral Tachometer

PERFORMANCE DATA

		Units	9FG	9FGT	9FGHD	9FGCHD	9FGHDT	12FG	12FGT
1.0	Maximum Inertia (2)	oz-in-sec^2	0.0052	0.0082	0.0052	0.0053	0.0082	0.0192	0.0252
		g-cm^2	367	579	367	374	579	1356	1780
2.0	Radial Load @	lb	25	25	70	30 to 50	70	125	125
	Distance from Mounting Surf.	in	0.75	0.75	0.75	0.75	0.75	1.00	1.00
3.0	Axial Load	lb	5	5	80	45 to 55	80	150	150
4.0	Basic Weight (3)	lb	3.30	3.50	3.20	3.2	3.40	5.85	6.20
5.0	Basic Lenght (3)	in	1.92	2.00	2.81	2.29	2.88	3.75	3.80

Motor electrical and mechanical specifications are subject to change without notice. Please consult a Kollmorgen Sales Office.

Notes:

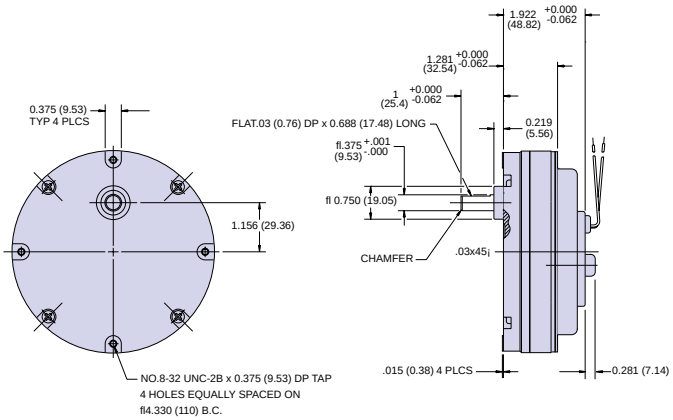
1. Mounted on 8” x 16” x 3/8” aluminum heatsink.
2. Motor plus gearhead, measured at motor shaft.
3. Weights and lengths will vary with options. Please consult a Kollmorgen Sales Office.
4. Gearmotors can be mounted in any position.

FERRITE GEARMOTOR OPTIONS

- Rear Shaft Extension
- Prepared for Encoder
- M23 Optical Encoder (See Options Section for details)
- Intergal Analog Tachometer
- Brake

DIMENSIONS

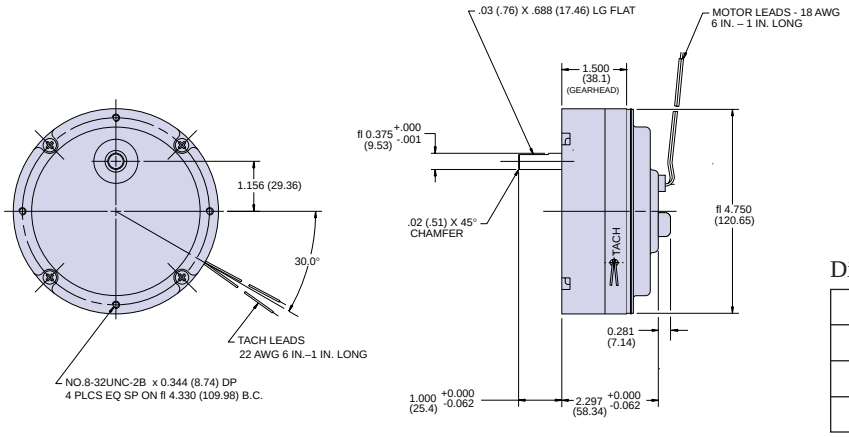
9FG, 9FGT



Dimensions in inches.

Models	9FG	9FGT
A	1.92 ±.06	2.00 ±.06
B	1.28 ±.06	1.34 ±.06

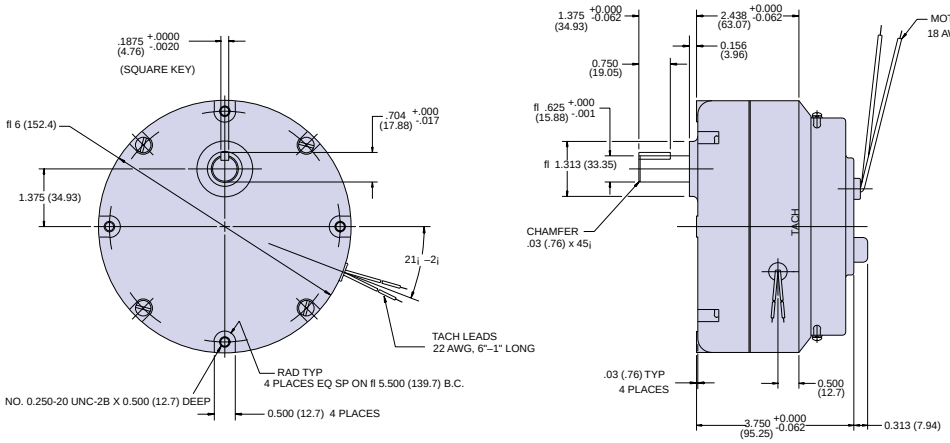
9FGHD, 9FGCHD, 9FGHDT (Heavy Duty and Compact Models)



Dimensions in inches.

Models	9FGHD	9FGCHD	9FGHDT
A	2.81 ±.06	2.29 ±.06	2.88 ±.06
B	2.19 ±.06	1.65 ±.06	2.25 ±.06
C (DIA)	.500	.375	.500

12FG, 12FGT

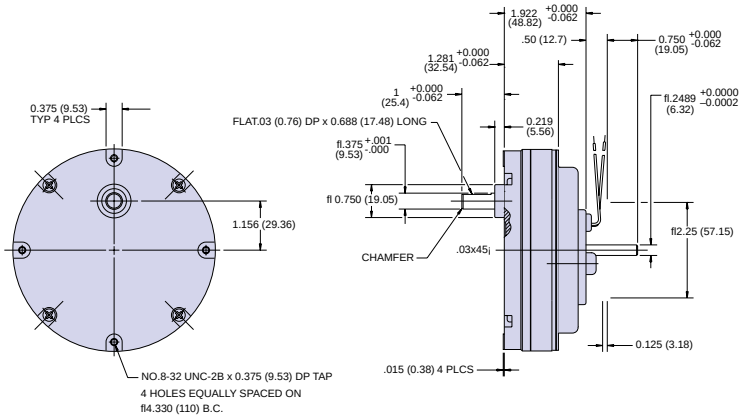


Dimensions in inches.

Models	12FG	12FGT
A	3.75 ±.06	3.80 ±.06

DIMENSIONS - Rear Shaft Extension

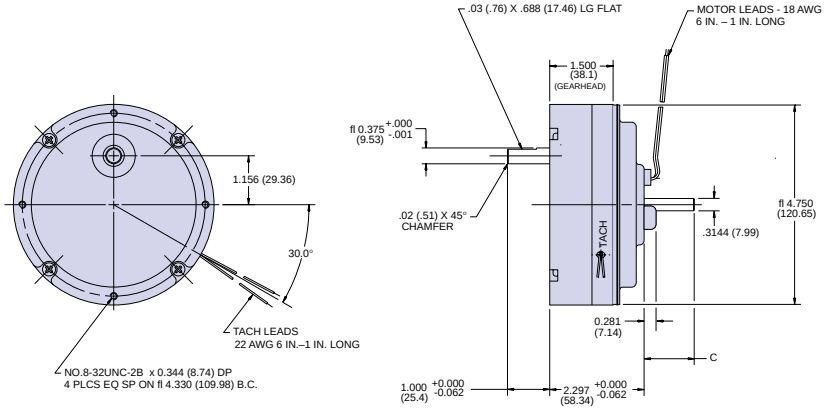
9FG, 9FGT



Dimensions in inches.

Models	9FG	9FGT
A	1.92 ±.06	2.00 ±.06
B	1.28 ±.06	1.34 ±.06
C	1.06 ±.06	1.25 ±.06

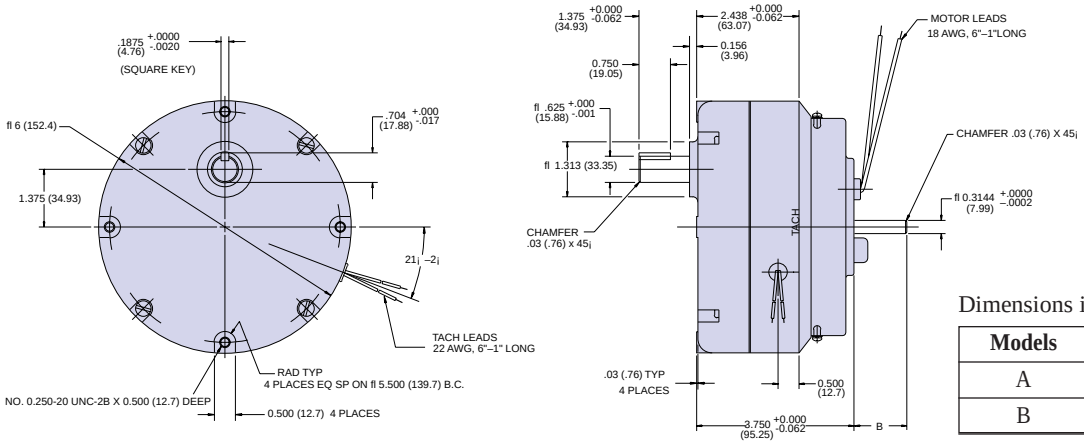
9FGHD, 9FGHDT, 9FGCHD (Heavy Duty and Compact Models)



Dimensions in inches.

Models	9FGHD	9FGHDT	9FGCHD	9FGCHDT
A	2.81 ±.06	2.88 ±.06	2.29	2.31
B	2.19 ±.06	2.25 ±.06	1.65	1.67
C	1.23 ±.03	1.20 ±.03	1.23	1.20
D (DIA)	.500	.500	.375	.375

12FG, 12FGT

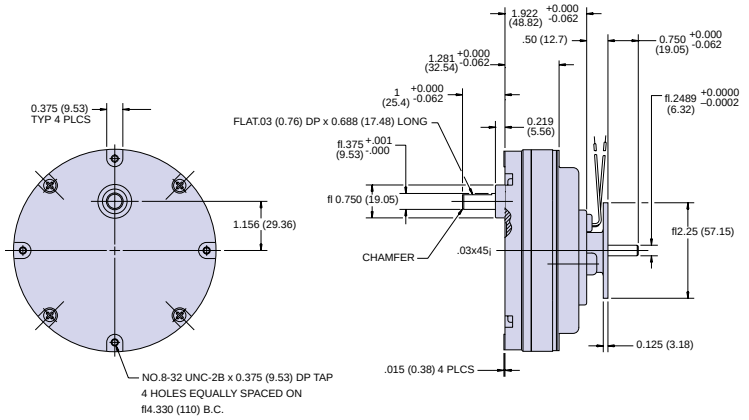


Dimensions in inches.

Models	12FG	12FGT
A	3.75 ±.06	3.80 ±.06
B	1.06 ±.06	1.50 ±.06

DIMENSIONS - Prepared for Encoder

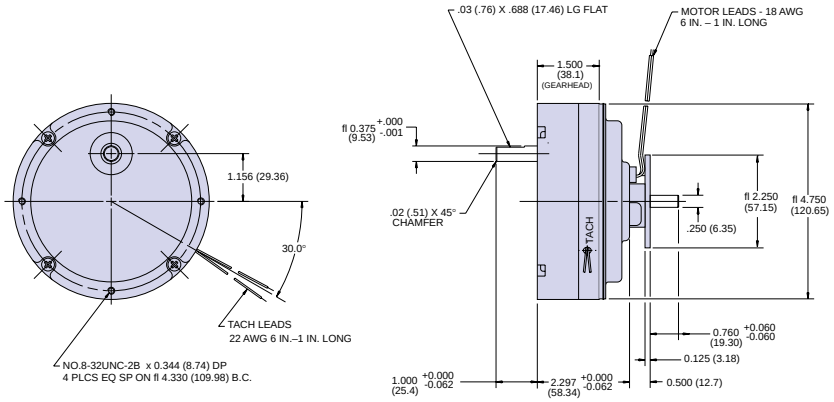
9FG, 9FGT



Dimensions in inches.

Models	9FG	9FGT
A	1.92 ±.06	2.00 ±.06
B	1.28 ±.06	1.34 ±.06

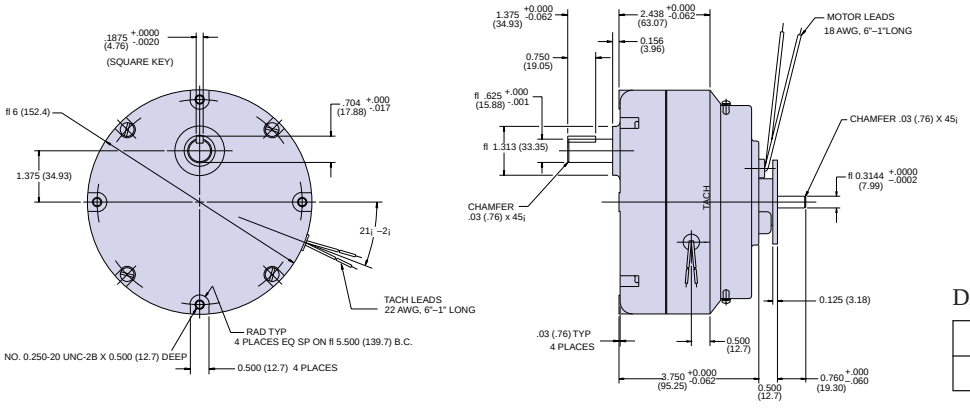
9FGHD, 9FGCHD, 9FGHDT, 9FGCHDT (Heavy Duty and Compact Models)



Dimensions in inches.

Models	9FGHD	9FGCHD	9FGHDT	9FGCHDT
A	2.81 ±.06	2.29 ±.06	2.88 ±.06	2.31
B	2.19 ±.06	1.65 ±.06	2.25 ±.06	1.67
C (DIA)	.500	.375	.500	.375

12FG, 12FGT

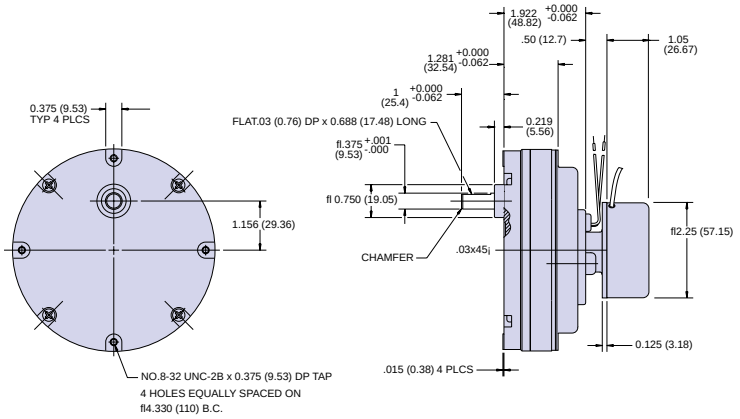


Dimensions in inches.

Models	12FG	12FGT
A	3.75 ±.06	3.80 ±.06

DIMENSIONS - with Encoder

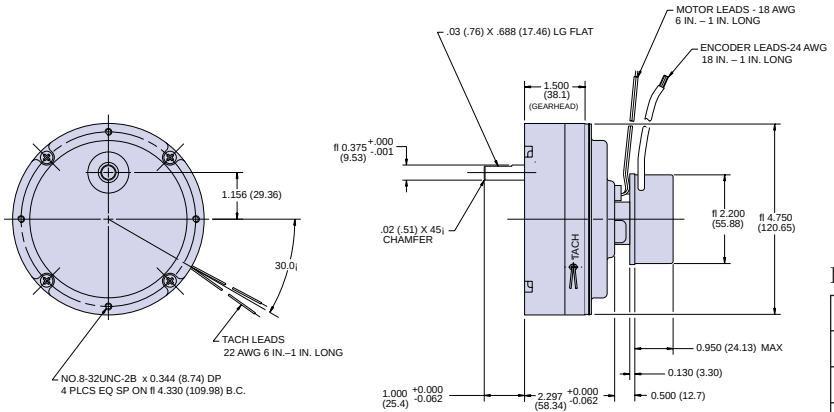
9FG, 9FGT



Dimensions in inches.

Models	9FG	9FGT
A	1.92 ±.06	2.00 ±.06
B	1.28 ±.06	1.34 ±.06

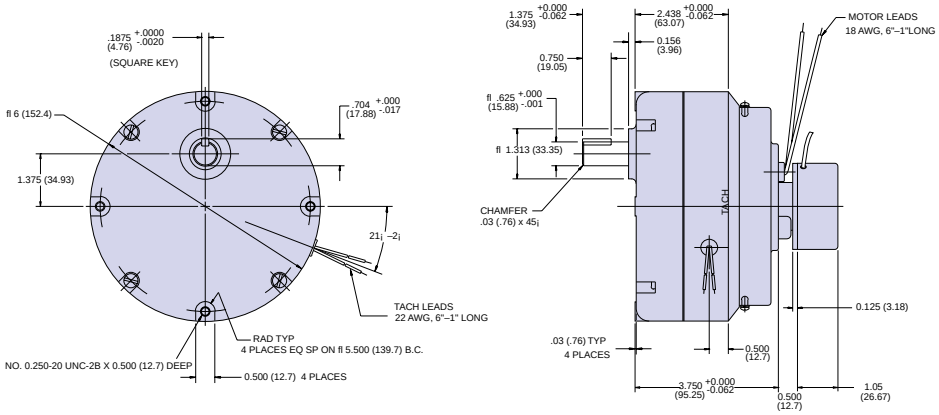
9FGHD, 9FGHDT, 9FGCHD (Heavy Duty Models)



Dimensions in inches.

Models	9FGHD	9FGHDT	9FGCHD	9FGCHDT
A	2.81 ±.06	2.88 ±.06	2.29	2.31
B	2.19 ±.06	2.25 ±.06	1.65	1.67
C (DIA)	.500	.500	.375	.375

12FG, 12FGT



Dimensions in inches.

Models	12FG	12FGT
A	3.75 ±.06	3.80 ±.06

Disk armature technology brings new dimensions of performance to dc servo motor applications

Where it works best

Certain types of applications are naturals for ServoDisc technology. Let's look at the categories where the benefits are the greatest.

a) **Fast moves**
Incremental motion (rapid, repetitive moves) is a natural for the outstanding acceleration of these products. If you need to make many moves a second, this is the right technology. If you must get to speed quickly or stop quickly, ServoDisc will do it best.

b) **Smooth Rotation**
ServoDisc products are perfect when precise and smooth speed control is required. Applications such as tape or film handling or recording, machining, rotating mirrors or scanners. The total lack of cogging and the rapid response of these motors gives near perfect rotation.

c) **Operation over a wide speed range**
If you need 1 rpm, then 1000, then 4000, no other product can deliver the precise rotation, constant torque and trouble-free commutation which are characteristic of ServoDisc products. Low speed is not limited by cogging and high speed is not limited by arcing and commutation problems.

d) **Compact Size**
When space is at a premium, the unique ServoDisc package may be the answer. Its flat profile and high power output make it easier to design in than conventional motors. This may be just the edge you need to put your design ahead of the competition.

A Track Record of Success

The unique technology and superior performance of the ServoDisc motor make it the best choice for a tremendous range of servo applications. Increased throughout, better accuracy, improved packaging, longer life; these are just a few of the benefits that can be realized with this exciting technology.

a) **Automation and robotics**
Speed and acceleration capabilities separate ServoDisc motors from the conventional motor pack. Apply these products to packaging, sorting, labeling, component insertion, precision winding…any application where throughput is critical. Compact size and high torque make these motors ideal for robot axis drives. Compact ServoDisc precision gearmotors combine exceptional performance with innovative packaging. The same features make them great for robotic positioning tables.

b) **Instrumentation**
Superior technology is called for when performance and accuracy are critical. Inspection equipment, x-y stages, chromatography equipment, ultrasonic and optical scanners, plotters, shutter actuation…all of these applications can benefit from the rapid response and precise motion which is characteristic of ServoDisc products.

c) **Process control**
Extraordinary responsiveness and cog-free rotation have earned ServoDisc products an important niche in process control applications. They can deliver fast, accurate metering of chemicals or fluids. The unparalled smoothness is perfect for handling continuous materials such as tape, film, paper, textiles or optical fibers. In fact any application involving continuous webs is a natural for this technology. Which accounts for its extensive use in the film, paper, printing and textile industries. Textile applications also include fabric cutting and stitching equipment.

d) **Information handling**
No cogging and the ability to maintain precise speed and phase lock are perfect features for audio, video, analog and digital recording. ServoDisc motors have an impressive track record in tape mastering and duplication equipment, instrumentation recorders and studio-grade recording equipment. They have also made their mark in the growing video disk industry.

e) **Biomedical equipment**
Portability, reliability and superior performance have made a name for ServoDisc motors in many medical life-support analysis applications. Blood pumps, blood analyzers, kidney dialysis, respirators and ultrasonic scanners are all candidates for this advanced technology.

f) **Semiconductor manufacturing**
ServoDisc motors are an excellent match for the demanding performance requirements of the semiconductor manufacturing industry. For die and wire bonding, wafer handling, cleaning, testing and dicing, and laser trimming, the high throughput, perfectly smooth rotation and precision of these motors can really crank up productivity.

g) **Business automation**
Demand is increasing inthe business community for increased performance and productivity from office automation equipment. The application of ServoDisc technology to check sorters, imprinters, document readers, high speed printers and collating equipment has answered the call.

h) **Military applications**
Rugged design, reliability, long life, compact packaging and outstanding performance have put ServoDisc products in the front lines. Gun turrets, gun loaders, fire control drives, smoke generators and antenna rotation drives are just some of the applications where we serve.