TORQUE MOTORS

Torque motors are specially designed to provide high starting torque and operate over a wide speed range. They also provide stable operation in the low speed range or under a locked rotor condition.

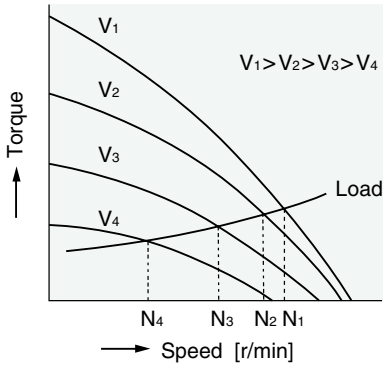
Gearhead shown in the photograph is sold separately.

GEAR SAFETY STD. AC INPUT

■ Features

●Speed can be varied over a wide range

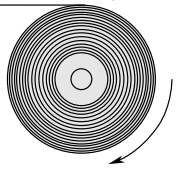
The motor torque is approximately proportional to the square of the voltage, allowing easy speed control simply by changing the voltage of the power supply.



●Suitable for winding applications

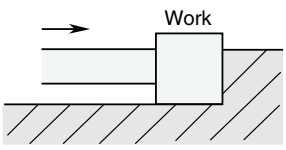
In an application where an object is released continuously at a constant speed and wound up with constant tension, the torque must be doubled and the speed must be halved if the diameter of the winding spool is doubled. Since torque motors provide high torque at low speed, they are suitable for such operations.

Constant Tension Wind Up



●Locked rotor operation is available

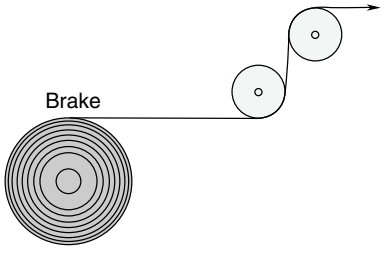
Unlike other standard AC motors, torque motors are designed to provide a stable torque even under stall condition or at very low speed (nearly stalling). They are suitable for pushing applications that require static torque. The motors can operate continuously at 60V. When used at voltages than 60V, the motors are rated for limited duty. The motor has a 5 minute rating at 115V.



Note: When using a motor in locked rotor condition, the output torque becomes very large. Do not exceed the permissible torque of the gearhead.

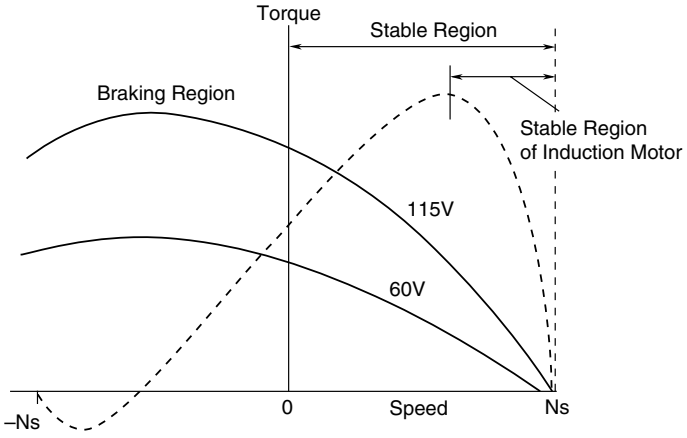
●Used as a brake

By using the motor in the braking region of the speed-torque characteristics, it can be made to serve as a brake. Constant tension operation can be achieved by applying DC voltage.

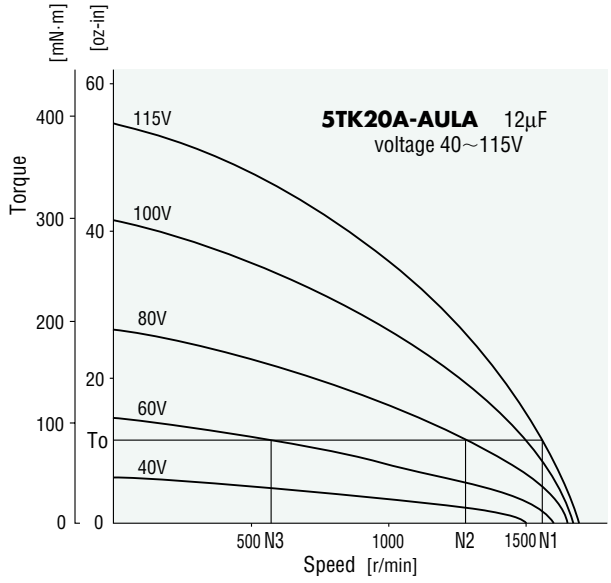


Characteristics of Torque Motors

The speed-torque characteristics of torque motors are different from those of induction motors or reversible motors. As the following graph shows, they have special torque characteristics (torque is highest at zero speed and decreases steadily with increasing speed), so they can provide stable operation through the entire speed range, from starting to no load speed. The torque generated when reversing the motor is a positive torque in the same direction as the rotational magnetic field; this torque is large. When the motor is locked by the load and the motor is rotated opposite the desired direction, this torque acts as a force (braking force) to inhibit the motor from rotating backwards.



The torque generated by the torque motor changes approximately proportionally to the square of the voltage. When the voltage supplied to the motor is changed, speed-torque characteristic curves shift to that of the corresponding voltage. When the voltage is changed to 115, 80 and 60V while the load torque is T_0, the motor rotates at the speeds N_1, N_2 and N_3 respectively. Thus the speed can be changed easily by varying the voltage.



When choosing a torque motor, first determine the required torque and speed. Then select a motor using the speed-torque characteristic curves to determine whether the motor should be operated under continuous duty or limited duty. When used under locked rotor conditions, only the torque factor is considered. The temperature rise of the motor may cause a problem during continuous operation. In this case, choose a motor with an output power large enough for continuous operation and adjust the voltage to control the torque and speed.

Voltage Control of Torque Motors

Phase Control Method Using a Triac

The method most commonly used to control voltage is phase control using a triac. As shown in Fig. 1, by changing the phase angle “alpha” at which the triac switches, the input voltage is controlled as represented by the Phase Angle areas of the graph.

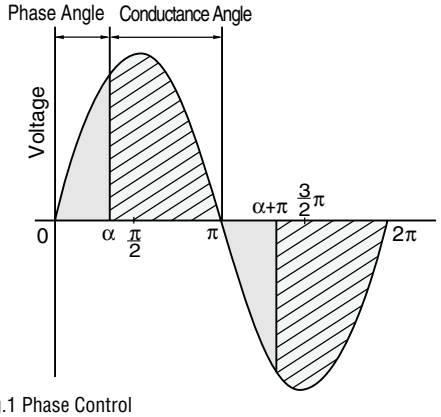


Fig.1 Phase Control

TORQUE MOTORS
Single-Phase
8w • 12w • 23w
Frame Size
2.76"sq.(□70mm), 3.15"sq.(□80mm), 3.54"sq.(□90mm)

GEAR SAFETY STD.

■ Specifications

Model		Rating at Locked Rotor	Voltage	Frequency	Starting Torque		Output Power		At max. output power					Capacitor
									Speed	Torque		Current	Input	
Pinion Shaft Type	Round Shaft Type		V AC	Hz	oz-in	mN·m	HP	W	r/min	oz-in	mN·m	A	W	μF
3TK6GN-AUL	**3TK6A-AULA**	5 minutes	115	60	20.8	150	1/93	8	900	12.1	87	0.62	67	8.0
		Continuous	60		6.2	45	1/300	2.5		3.7	27	0.34	20	
4TK10GN-AUL	**4TK10A-AULA**	5 minutes	115	60	27.1	195	1/62	12	900	18.1	130	0.66	70	8.0
		Continuous	60		6.9	50	1/266	2.8		4.4	31	0.32	19	
5TK20GN-AUL	**5TK20A-AULA**	5 minutes	115	60	48.6	350	1/32	23	900	34.7	250	1.0	110	12.0
		Continuous	60		12.5	90	1/124	6		9.0	65	0.49	29	

●The product contains a built-in thermal protector. If a motor overheats for any reason, the thermal protector is opened and the motor stops. When the motor temperature drops, the thermal protector closes and the motor restarts. Be sure to turn the motor off before inspecting.

■ General Specifications

Item	Specifications
Insulation Resistance	100M ohms or more when 500V DC is applied between the windings and the frame after rated motor operation under normal ambient temperature and humidity.
Dielectric Strength	Sufficient to withstand 1.5kV at 50Hz and 60Hz applied between the windings and the frame after rated motor operation under normal ambient temperature and humidity.
Temperature Rise	135°F (75°C) or less measured by the resistance change method after the temperature of the coil has stabilized under normal operation at the rated voltage and frequency.
Insulation Class	UL•CSA Standard Class A, EN60950 Standard Class E.
Ambient Temperature Range	14°F ~ 104°F (−10°C ~ +40°C)
Ambient Humidity	85% maximum (noncondensing)

■ Permissible Torque When Gearhead Is Attached

Due to the special characteristics, torque motors can be operated over a wide speed range, from locked rotor condition to the maximum speed. The permissible torque when a gearhead and a decimal gearhead are directly connected (T_G) can be calculated according to the following formula using the speed and torque determined from the speed-torque characteristics.

$T_G = T_M \times i \times \eta$
T_M : Rated torque of motor
i : Gear ratio
η : Gearhead efficiency (refer to the table on the right.)

The output torque of the gearmotor must be lower than the maximum permissible torque specified in the graph on page [A-21]. The speed of the gearmotor output shaft (N_G) is calculated as follows:

$$N_G = \frac{N_M}{i}$$

N_M: Rated speed of motor
i : Gear ratio

3GN□KA, 4GN□KA, 5GN□KA

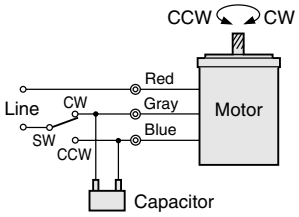
Gear Ratio	Gearhead Efficiency
3, 3.6, 5, 6, 7.5, 9, 12.5, 15, 18	81%
25, 30, 36	73%
50, 60, 75, 90, 100, 120, 150, 180	66%

Right-Angle Gearhead

Model	Gear Ratio	Gearhead Efficiency
4GN□RAA (Solid shaft)	**3.6,6,9**	50% (50%)
	15,18,30,36	60% (54%)
	60,90,120,180	
5GN□RAA (Solid shaft)	**3,3.6,5,6,7.5,9,12.5,15,18,25,30**	68% (60%)
	36,50,60,75,90,100,120,150,180	60% (54%)
4GN□RH (Hollow shaft)	**3.6,6**	40% (40%)
	9	50% (50%)
	15,18,30,36	60% (54%)
	60,90,120,180	
5GN□RH (Hollow shaft)	**3.6,6**	50% (50%)
	9,15,18	68% (60%)
	30,36,60,90,120,180	60% (54%)

●Enter the gear ratio in the box within the model number. The numbers in parenthesis indicate the efficiency at starting condition.
●Gearheads are sold separately.

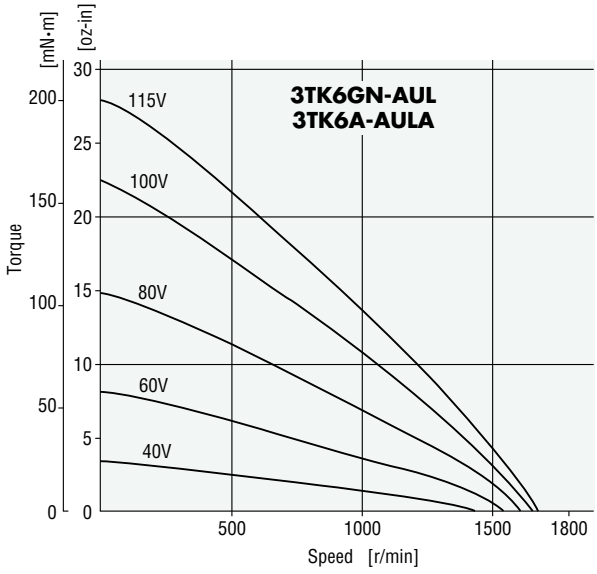
Wiring Diagram

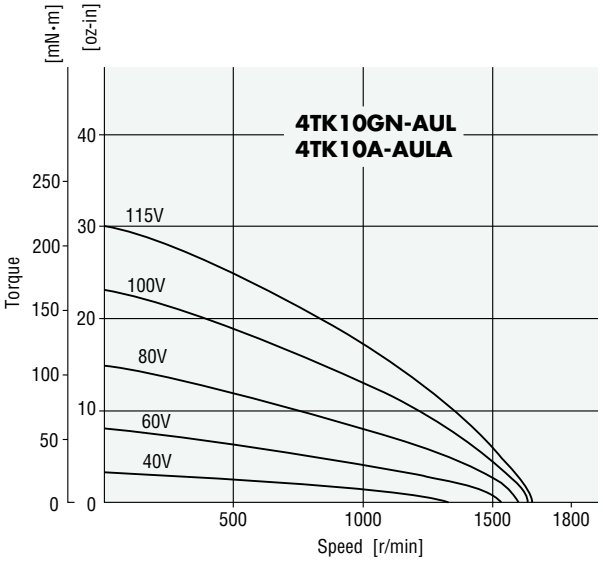


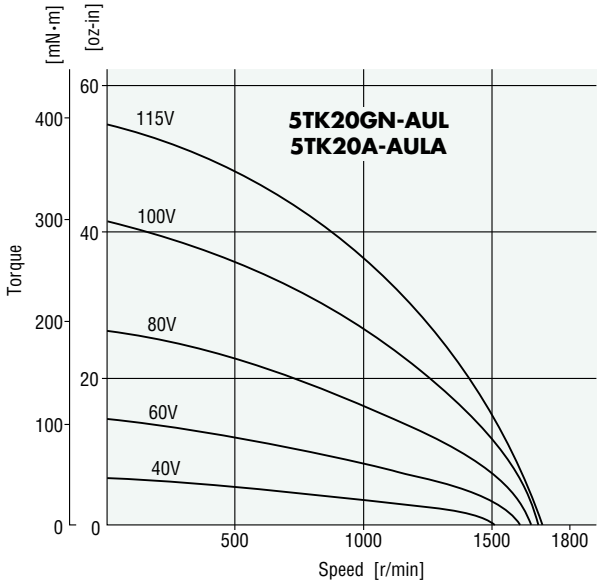
To rotate the motor in a clockwise (CW) direction, flip switch SW to CW.
To rotate it in a counterclockwise (CCW) direction, flip this switch to CCW.

The direction of motor rotation is as viewed from the front shaft end of the motor.

Speed – Torque Characteristics

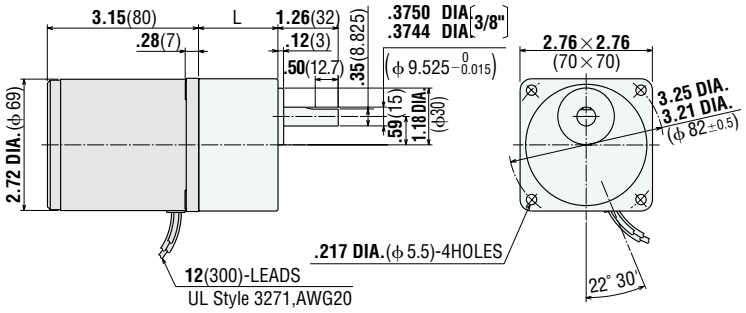






Dimensions Scale 1/4, Unit = **inch** (mm)

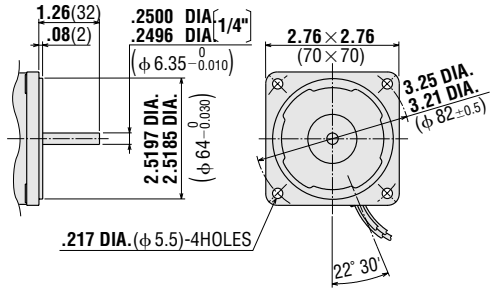
3TK6GN-AUL Weight (Mass): 2.4 lb.(1.1 kg) / **3GN□KA** Weight (Mass): 1.21 lb.(0.55 kg)



L = **1.26** (32) **3GN3KA**~**18KA**

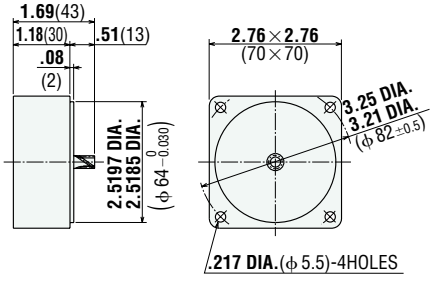
L = **1.65** (42) **3GN25KA**~**180KA**

3TK6A-AULA Round Shaft Type Weight (Mass): 2.4 lb.(1.1 kg)

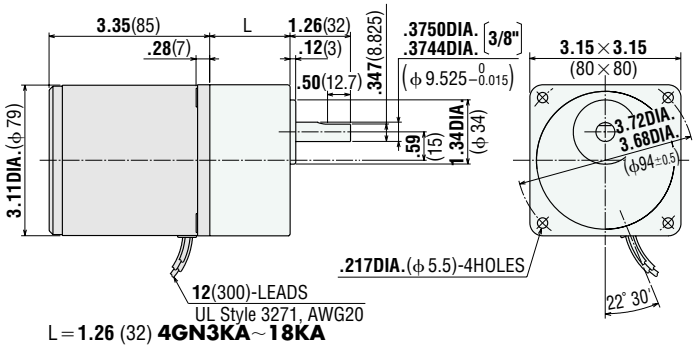


●Decimal Gearhead

3GN10XK Weight (Mass): 0.66 lb.(0.3 kg)



4TK10GN-AUL Weight (Mass): 3.3 lb.(1.5 kg) / **4GN□KA** Weight (Mass): 1.43 lb.(0.65 kg)

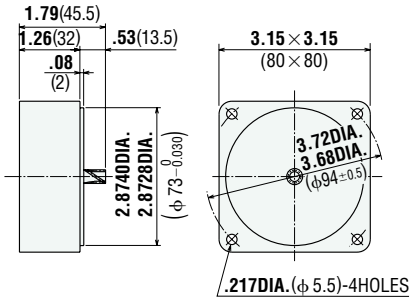


L = **1.26** (32) **4GN3KA**~**18KA**

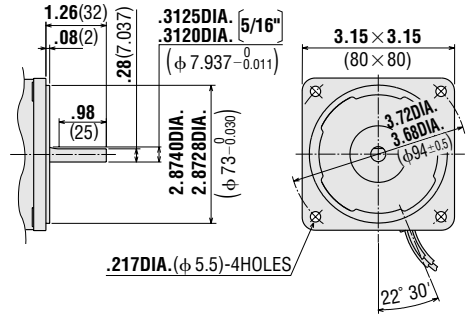
L = **1.67** (42.5) **4GN25KA**~**180KA**

●Decimal Gearhead

4GN10XK Weight (Mass): 0.88 lb.(0.4 kg)

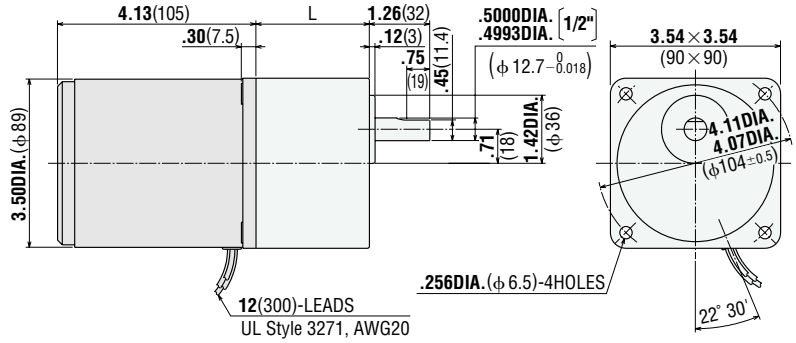


4TK10A-AULA Round Shaft Type Weight (Mass): 3.3 lb.(1.5 kg)



5TK20GN-AUL Weight (Mass): 5.5 lb.(2.5 kg)

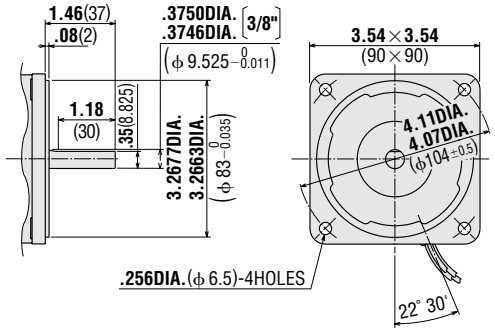
5GN□KA Weight (Mass): 3.31 lb.(1.5 kg)



L=**1.65** (42) **5GN3KA**~**18KA**

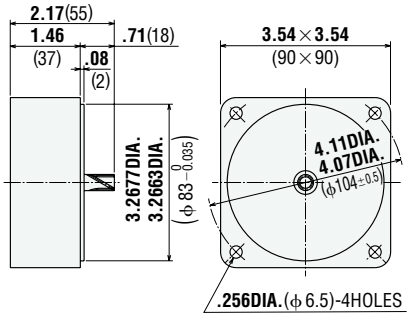
L=**2.36** (60) **5GN25KA**~**180KA**

5TK20A-AULA Round Shaft Type Weight (Mass): 5.5 lb.(2.5 kg)

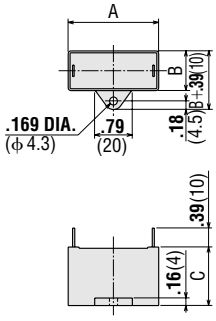


●Decimal Gearhead

5GN10XK Weight (Mass): 1.32 lb.(0.6 kg)



●Capacitor (included with the motor)



Motor Model	Capacitor Model	Dimensions inch (mm) A	B	C	Weight oz (g)
3TK6GN-AUL **3TK6A-AULA**	CH80UL	1.50 (38)	.83 (21)	1.22 (31)	1.23 35
4TK10GN-AUL **4TK10A-AULA**	CH80UL	1.50 (38)	.83 (21)	1.22 (31)	1.23 35
5TK20GN-AUL **5TK20A-AULA**	CH120CUL	2.28 (58)	.83 (21)	1.22 (31)	1.76 50

Capacitor cap is provided with the capacitor.

■ Right-Angle Gearhead

The right-angle gearhead provides an output shaft at a right angle to the motor's output shaft. See page [A-216] for specifications and other information. (Available with **4GN□R□** **5GN□R□** type only)