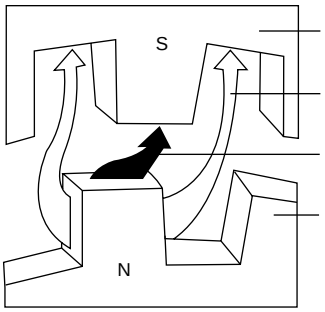
HYBRID STEP MOTOR TECHNOLOGY

SIGMAX® AND STANDARD HYBRID STEP MOTORS

Here's how Sigmax works.

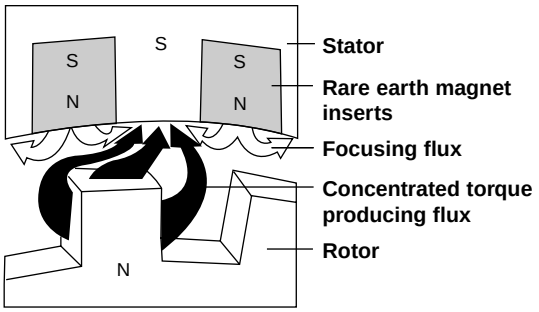
- Stator mounted rare earth magnets concentrate magnetic flux at desired points between the rotor and stator
- Flux focusing action optimizes flux paths
- Produces higher torque and current utilization is better than a comparably sized standard hybrid

STANDARD HYBRID



Typical paths of flux transfer in an energized conventional hybrid step motor. Some flux leakage occurs in normal operation.

SIGMAX® TECHNOLOGY



Patented Sigmax® technology* redirects magnetic flux to inhibit leakage and optimize torque production.

* Sigmax® technology is covered by U.S. patents 4,712,028, 4,713,470, 4,763,034 and 4,827,164.

GENERAL PURPOSE MOTORS

These motors offer torque, speed and acceleration characteristics to fulfill commonly encountered applications. All general purpose motors are available in both standard and Sigmax® configurations.

This category includes:

- M and P Series POWERMAX II ® hybrid motors, the economical and high performance alternative to conventional NEMA 23 step motors
- H and E Series conventional (round frame) hybrid motors in a full range of frame sizes, with a broad selection of windings to duplicate or exceed the performance of most existing step motors

HIGH TORQUE

The POWERPAC N and K Series, in both NEMA 34 and 42 frames, provide an impressive range of high torque output. See the Ratings and Characteristics for the NEMA 34 frame starting on page 15, followed by torque and acceleration (torque to inertia ratio), and torque linearity comparisons. Performance curves start on page 18. NEMA 42 information starts on page 24.

HIGH ACCELERATION

Both the POWERPAC N and K Series have high torque-to-inertia ratios that provide high acceleration rates to move loads fast. The K Series, which incorporates the flux-focusing Sigmax® technology, provides the highest acceleration rates. Specify the K Series for the most rapid load positioning. See the Ratings and Characteristics for the NEMA 34 frame starting on page 15, followed by torque and acceleration (torque-to-inertia ratio), and torque linearity comparisons. Performance curves start on page 19. NEMA 42 information starts on page 24.

SPECIAL PURPOSE MOTORS

Now and then, you'll run into an application with special acceleration requirements. With PacSci special purpose motors, you may not need to order a customized motor or compromise performance.

All are offered in conventional (round frame) configurations:

- E "J" and H "J" Series motors, in NEMA 23 frame sizes, with hollow, low mass rotors for rapid acceleration

Still don't see it here? Just call. Or fax an application data form (pages 8 and 9) to your Pacific Scientific distributor or the factory. We have an extensive customization capability.

APPLICATION ASSISTANCE

HOLDING TORQUE

Holding torque and rated current are leading specifications for selection in the Ratings and Characteristics tables for all motors. Holding torque is often used as a figure of merit when comparing motors. It specifies the maximum external torque that can be applied to a stopped motor with rated current applied without causing the motor to rotate continuously.

Pacific Scientific hybrid step motors are used with a variety of drivers from many different manufacturers. These drivers have an extremely broad range of voltage and current ratings. It is not practical to show individual torque-speed curve performance given the extensive combinations of driver voltages and currents. Instead, holding torque is shown for reference along with rated current.

TORQUE-SPEED CURVES

As applied voltage and/or current to the motor is changed, motor performance is altered. Figures 1 and 2 show typical torque-speed curves using a bipolar chopper driver.

CURRENT CHANGES VS. PERFORMANCE

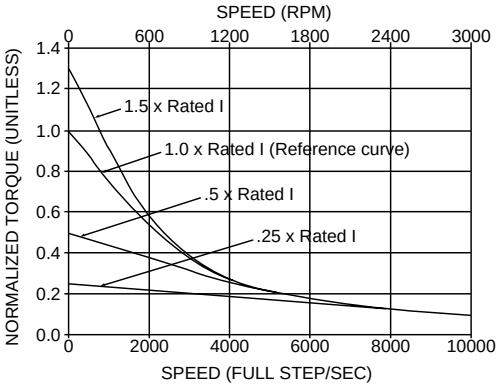


Figure 1

Figure 1 shows the performance of the same motor driven by bipolar chopper drivers with different current ratings. All drivers have the same supply voltage. Note that high speed performance is not appreciably affected by the different current ratings. Low speed running torque, however, varies considerably with changes in the current rating. It is important to understand that when current over the rated current of the motor is applied, the increase in torque will not be proportional to the increased current. Furthermore, applied current levels increasingly higher than rated current will likely result in damage to the motor from demagnetization and/or overheating.

VOLTAGE CHANGES VS. PERFORMANCE

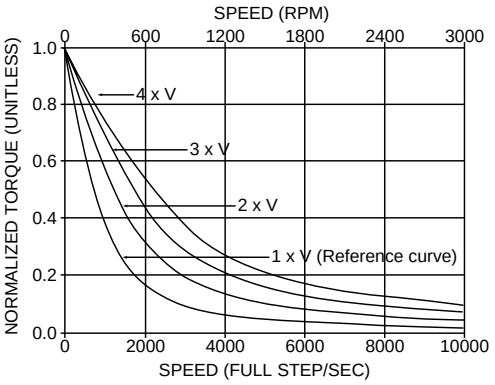


Figure 2

Figure 2 shows the performance of the same motor driven by bipolar chopper drivers with different supply voltage ratings. All drivers have the same current rating. Note that low speed running torque is high and not appreciably affected by supply voltage differences. High speed performance, however, varies considerably with changes in supply voltage. Caution must be exercised when increasing supply voltage. Higher voltages will result in increased motor heating regardless of motor speed.

APPLICATION ENGINEERING

Need help with your motor selection? We make it simple and economical to apply step motors in your designs. Application engineering assistance is only a phone call or FAX away from your Pacific Scientific distributor or the factory. To assist us in providing the optimum motor for your application, please copy and complete the STEP MOTOR APPLICATION DATA form on pages 8 and 9. FAX it to our Application Engineering Department at (815) 226-3148 and we will provide a prompt reply.

Our response includes a comprehensive torque-speed performance curve of the recommended motor at your voltage and current levels.

CUSTOM MOTORS

Even though we offer a broad spectrum of standard motors, we recognize that you might need something special. We routinely design custom windings to provide the application specific characteristics you need. A typical modification such as a special shaft is also a part of this service. Don't hesitate to call us and follow up with the application data form described above.

TECHNICAL OVERVIEW (Con't)

TYPES

POWERPAC K Series	Sigmax® hybrid construction
POWERPAC N Series	Standard hybrid construction
POWERMAX II M Series	Sigmax hybrid construction
POWERMAX II P Series	Standard hybrid construction
General Purpose Conventional hybrid E Series	Sigmax hybrid construction
General Purpose Conventional hybrid H Series	Standard hybrid construction

ROTOR CONSTRUCTION

POWERPAC N and K Series; POWERSYNC AC Synchronous Motors	Laminated
POWERMAX II M and P Series; Conventional E and H Series with "L" rotor designates	Laminated (high speed efficiency)
POWERMAX II M and P Series; Special purpose E and H Series with "J" rotor designates	Low mass/low inertia (fast start/stop, high acceleration)

WINDINGS

H, J, K, L, M and N	Standard winding designations
T type	Maximum torque at low speed
P type	Maximum torque at high speed
A, B, C, D, E, F, G	Additional standard windings

PHASES 2

FULL STEPS PER REVOLUTION 200

FULL STEP ANGLE . . . . . 1.8°

ANGULAR ACCURACY

POWERPAC N Series	±3% of one full step, no load non-cumulative
POWERPAC K Series	±1.5% of one full step, no load non-cumulative
POWERMAX II M and M "J"; E and E "J" Series	±1.5% of one full step, no load, non-cumulative
POWERMAX II P and P "J"; H and H "J", H Series	±3% of one full step, no load, non-cumulative

OPERATING TEMPERATURE . . . . . -20 to 40°C

INSULATION . . . . . NEMA Class B, 130°C

AGENCY APPROVAL . . . . . All NEMA 34 and 42 frame motors are UL recognized; Class B motor insulation (File E103510) Construction (File E61960) CE marked per EN60034-1

INSULATION RESISTANCE . . . . . 100 Megohms @500V dc and 25°C

TECHNICAL OVERVIEW (CON'T)

SEALING . . . . . POWERPAC N and K Series and Nema 34 and 42 with a "C", "L" or "M" designation in the model number have washdown construction in accordance with NEMA MG1-1.26, part E. With the addition of a shaft seal, they meet IEC (International Electrotechnical Commission) IP65 and are suitable for washdown requirements.

ENCODER OPTIONS

POWERPAC . . . . . See page 36
POWERMAX II . . . . . See page 53
Conventional & Special Purpose Hybrids . . . . . See page 79-80
POWERSYNC . . . . . See page 93