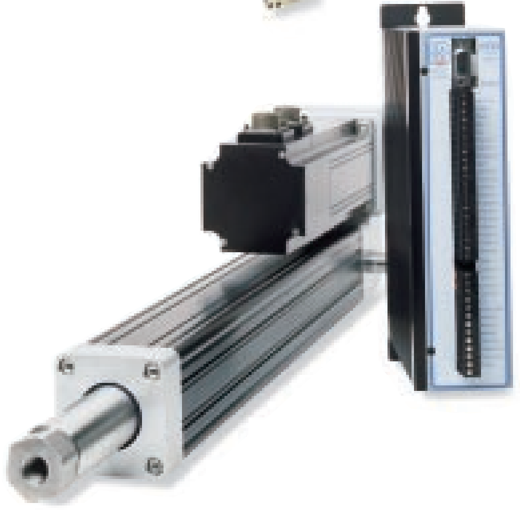
Overview

Brushless Servo Products

IDC has a wide range of brushless servo products to meet your motion control needs. These products are:

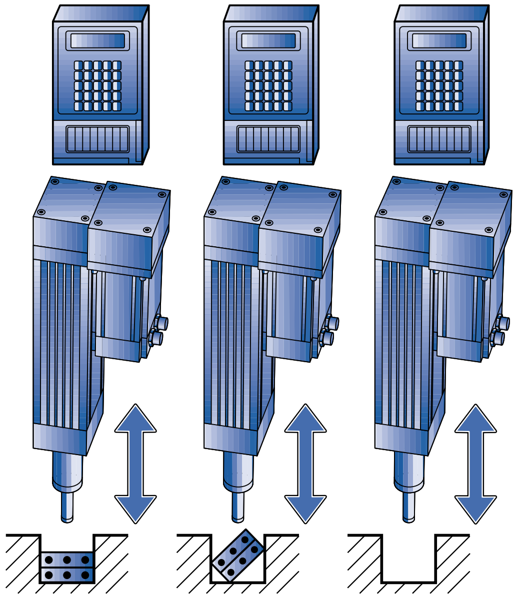
- B8001 digital, brushless servo drive
- B8961, B8962 programmable brushless servo Smart Drives
- 961, 962 stand-alone programmable motion controllers
- 12 brushless motors ranging from 17 frame to 42 frame size
- Brushless gearmotors



Digital Brushless Servo Drives

If your application requires high performance brushless servo drives, consider IDC's B8001. This DSP-based, high bandwidth servo uses an innovative vector control motor commutation scheme that delivers exceptional shaft power and performance. For more information on this technology, see page H-11.

B8001
Operates from 120/240 VAC
5A/10A cont/peak current
Internal power supply
See page H-20



Automated Force Control

Applications such as drilling, spot welding, pressing, clamping, automated fastening and shuttling each have unique requirements for control of torque not addressed by traditional servo products.

These applications require velocity, position and torque control (or force control when used with a linear system), all at the same time. Until IDC Smart Drives were introduced, solutions were often complicated and difficult to integrate.

At IDC, our experience in solving torque control applications has led to an integrated, easy-to-program solution. See application examples on pages H-31 through H-35 for details.

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Overview

Programmable Brushless Servo Smart Drives

IDC's B8961 (single axis) and B8962 (two axis) programmable brushless servo Smart Drives were designed for ease of use, and to minimize system set-up and programming time. When using a B8961/2 you can literally have your system up and running in a matter of minutes! See page H-24 for more information.

Stand-alone Programmable Motion Controllers

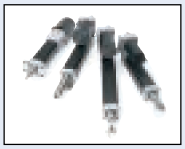
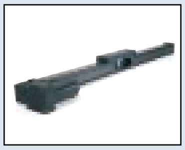
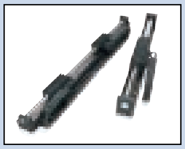
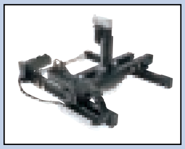
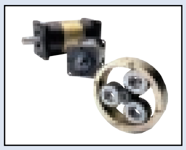
For applications that require a stand-alone motion controller, consider the 961 one axis and 962 two axis indexers.

- Integrated Motion Controller/Power Supply/Operator Interface/and I/O rack provides the user with an industrial motion control solution
- 30 I/O, 8 OPTO I/O slots
- Uses IDC's IDeal™ programming language
- See page H-44 for more information

Brushless Motors and Gearmotors

- Wide range of motor Torque/Speed curves for system optimization
- Both inline and right angle brushless gearmotors available
- IDC brushless gearmotors come in gear ratios from 3:1 to 700:1
- 12 motors from size 17 to 42 frame
- High Speed, Low Torque windings, or High Torque, Low Speed windings
- New BN series motors provide smooth operation and true NEMA dimensions including the shaft diameter
- MS connectors, and 12 ft quick disconnect cables standard on B series motors
- 12 ft. jacketed cables standard on BN series motors
- Optional 24 VDC failsafe integral motor brake on B series motors
- 25, 50, 100 ft cables optional on B series motors
- See page H-47 for more information

Positioning Products to

Product Description			Maximum Speed in/sec [mm/sec] [Note 3]
Electric Cylinder Rod Type		Highest Force (Thrust) Clean, Hydraulic Replacement Compact Cross Section Extends into Work Area	52.5 [1300]
Rodless Screw Drive		High Force (Thrust) High Repeatability Long Travel Load Carrying Capability	40 [1000]
Rodless Belt Drive		Very High Speed Quiet Operation Long Travel Load Carrying Capability	120 [3000]
Linear Servo Module		Highest Speeds Highest Accelerations High Repeatability Low Maintenance, Long Life High Moment Loads	196 [5000]
Cartesian Systems Complete 2 & 3 Axis Assemblies		Fully Engineered Multi-Axis Systems Large Work Area — 60 x 108 inches Multiple & Custom Configurations Long Travel	120 [3000]
Positioning Tables		Smoothest Motion High Precision (Straightness & Flatness) Highest Moment Loads High Accuracy XY, XYZ, and XYθ Configurations	51.3 [1300]
Product Description			**Maximum Speed rev/sec (rev/min)**
Rotary Tables		Accuracy to 3 arc minutes Ratios to 180:1 Low Static Torque Runout to 0.001"	30 [1800] input 0.66 [40] output
Gearmotors Right Angle & Inline		High Value/Low Cost High Input Speeds Ratio to 700:1	108 [6500] input 28 [1650] output

Note 1: Electric Cylinders are designed primarily for thrust applications where loads are supported externally. See engineering section for more details.

Note 2: Thrust ratings are based on mechanical limits rather than motor limits unless indicated.

Note 3: Maximum Speed and Thrust ratings are not necessarily achievable simultaneously.

Complete your System

Repeatability in [mm] [Note 5]	Max. Thrust lbs [N] [Notes 2, 3]	Max. Payload lbs [N]	Max. Travel in [mm]	Section
to 0.0005 [0.013]	5620 [25000]	[Note 1]	60 [1524]	A-1
to 0.0005 [0.013]	to 700 [3110]	300 [1335]	108 [2743]	B-1
to 0.004 [0.1]	300 [1335]	300 [1335]	108 [2734]	B-1
to 0.0003 [0.008] [Note 4]	80 Contin. [358] 281 Peak [1250]	300 [1335]	57.5 [1462]	C-1
[Note 6]	[Note 6]	to 150 [667]	60 x 108 [1524 x 2743]	D-1
to 0.00016 [0.004] bi-directional	to 234 [1041]	to 1482 [6592]	to 60 [1524]	E-1

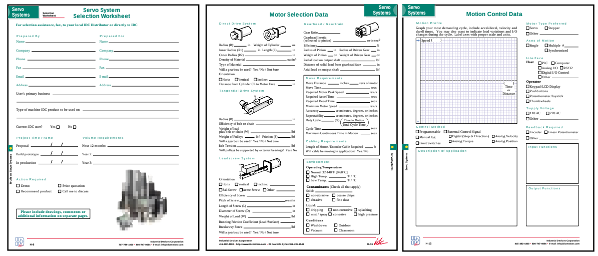
Repeatability	Axial Load lbs (N)	Radial Load lbs (N)	Diameter	Section
0.2 arc minutes	to 214 [952]	to 108 [480]	6 to 12 inches [152 to 304.8 mm]	E-1
7 to 25 arc minutes	to 1260 [5605]	to 1260 [5605]	Frame Size 17, 23, 34, 42	I-1

Note 4: Repeatability is dependent on encoder resolution, load, friction, settling time and gain settings in the servo control.
Note 5: Repeatability is uni-directional unless otherwise specified.
Note 6: Cartesian systems can be configured using a combination of IDC technologies. Repeatability and Max. Thrust are dependent on the technology selected.

Servo System Selection Checklist

The following steps describe the process of selecting a linear motor which matches your application requirements.

☐ **1) Complete the Product Selection Worksheet**
(pages H-8 through H-10)



☐ **2) Peak Speed Requirement (see Engineering Section)**
In order to calculate the peak speed of the motor, your mechanical system must be known, or you must make an assumption as to which mechanical system will meet your application's requirements. Calculate the peak speed required for your motor to complete the desired motion profile. Several motion profiles are covered in the Engineering Section. One commonly chosen motion profile is the triangular profile.

Formula: Triangular Move Profile (peak speed = average speed x 2).

Sample Calculation:

Desired Motion: Move 5 revolutions in 0.2 seconds
Peak Speed Requirement: (5 revolutions ÷ 0.2 seconds) x 2 = 50 revolutions/second

☐ **3) Peak Torque Requirement (see Engineering Section)**
Determine the peak torque requirement for your motor to complete the desired motion profile. Adjust your peak torque requirement by 20% to include a safety factor.

Formula: $\text{Peak Torque} = T_{applied} + T_{gravity} + T_{accel} + T_{friction}$

Sample Calculation:
Peak torque = 10 + 50 + 250 + 20 = 330 oz-in

Sample Calculation:

330 oz-in x 1.2 = 396 oz-in (required for selection of brushless servo motor)

☐ **4) RMS Torque Requirement (see Engineering Section)**
Calculate your application's RMS Torque requirement using the formulas in the Engineering Section. Be sure to adjust your RMS Torque requirement by 20% to include a safety factor.

Sample Calculation:
RMS Torque = 120 oz-in

120 oz-in x 1.2 = 144 oz-in (required for selection of brushless servo motor)

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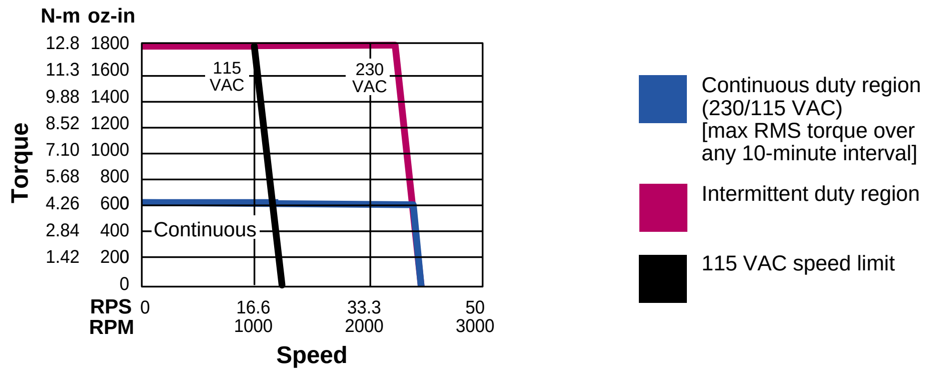
☐ **5) Select Speed-Thrust Curve**

Search through the motor performance curves on pages H-49 through H-60 to find a brushless servo motor which meets your application's torque and speed requirements.

B33 Motor Torque/Speed Curve



☐ **6) Decide which IDC servo control system is most appropriate for your application.**

IDC offers brushless servo drives, programmable brushless servo indexer/drive systems, and motion controllers.

- B8001 Digital Servo Drive—see page H-20
- B8961 One-Axis Servo Indexer/Drive—see page H-24
- B8962 Two-Axis Servo Indexer/Drive—see page H-24
- 961 One-Axis Standalone Indexer—see page H-44
- 962 Two-Axis Standalone Indexer—see page H-44

☐ **7) Decide if a gearmotor is appropriate.**

A gearmotor may be more appropriate for your application than simply a motor-only solution. The information needed to make this determination can be found by reviewing:

- Motor Specifications, pages H-49 through H-60
- Gearhead Specifications, page I-1
- Gearmotor How-to-Order, page I-1
- Motor How-to-Order, page H-48

☐ **8) Proceed to Motor and Control *How-to-Order* Pages**

You have now selected the IDC servo motor and control system most appropriate for your application. Proceed to the Motor *How-to-Order* page (H-48) and the *How-to-Order* page for the IDC control system you selected.

Servo System Selection Worksheet

For selection assistance, fax, to your local IDC Distributor or directly to IDC

Prepared By

Name ______________________

Company ______________________

Phone ______________________

Fax ______________________

Email ______________________

Address ______________________

Prepared For

Name ______________________

Company ______________________

Phone ______________________

Fax ______________________

E-mail ______________________

Address ______________________

User's primary business ______________________

____

Type of machine IDC product to be used on ______________________

____

Current IDC user? Yes ☐ No ☐

Project Time Frame

Proposal ______ / ______ / ______

Build prototype ______ / ______ / ______

In production ______ / ______ / ______

Volume Requirements

Next 12 months: ______________________

Year 2: ______________________

Year 3: ______________________

Action Required

☐ Demo

☐ Price quotation

☐ Recommend product

☐ Call me to discuss

Please include drawings, comments or additional information on separate pages.

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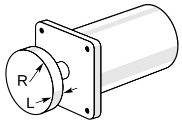
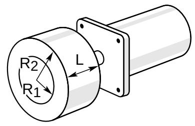
Motor Selection Data

Direct Drive System





Radius (R):________ in Weight of Cylinder ______ oz

Inner Radius (R1) ________ in Length (L)__________ in

Outer Radius (R2) ______________________________ in

Density of Material ___________________________ oz /in^3

Type of Material __________________________________

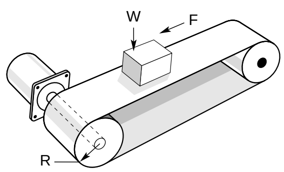
Will a gearbox be used? Yes / No / Not Sure

Orientation

☐ Horiz ☐ Vertical ☐ Incline: _______________

Distance from Cylinder CL to Motor Face ________ in

Tangential Drive System



Radius (R) _____________________________________ in

Efficiency of belt or chain ________________________

Weight of load
plus belt or chain (W) ___________________________ lbf

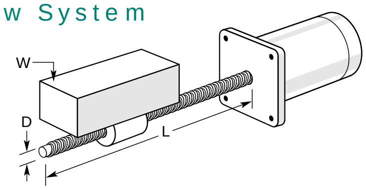
Weight of Pulleys ______ lbf Friction (F)________ lbf

Will a gearbox be used? Yes / No / Not Sure

Belt Tension ___________________________________ lbf

Will pulleys be supported by external bearings? Yes / No

Leadscrew System



Orientation

☐ Horiz ☐ Vertical ☐ Incline: _______________

☐ Ball Screw ☐ Acme Screw ☐ Other __________

Efficiency of Screw ______________________________

Pitch of Screw _____________________________revs / in

Length of Screw (L) ____________________________ in

Diameter of Screw (D) __________________________ in

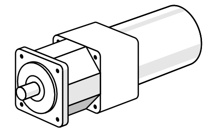
Weight of Load (W) _____________________________ lbf

Running Friction Coefficient (Load/Surface) _________

Breakaway Force _______________________________lbf

Will a gearbox be used? Yes / No / Not Sure

Gearhead / Geartrain



Gear Ratio ______________

Gearhead Inertia
(reflected to pinion) _____________________ oz-in-sec^2

Efficiency ______________________________________ %

Radius of Pinion ____ in Radius of Driven Gear ____ in

Weight of Pinion ____ oz Weight of Driven Gear ____ oz

Radial load on output shaft _______________________ lbf

Distance of radial load from gearhead face _________ in

Axial load on output shaft ________________________ lbf

Move Requirements

Move Distance ________ inches ______ revs of motor

Move Time ____________________________________ secs

Required Motor Peak Speed ________________ rev/s

Required Accel Time ________________________ secs

Required Decel Time ________________________ secs

Minimum Motor Speed _______________________ rev/s

Accuracy __________ arcminutes, degrees, or inches

Repeatability_______ arcminutes, degrees, or inches

Duty Cycle ________ (%) $\left(\frac{\text{Time in Motion}}{\text{Total Cycle Time}}\right)$

Cycle Time ____________________________________ secs

Maximum Continuous Time in Motion ______ secs

Cabling Requirements

Length of Motor / Encoder Cable Required _____ ft

Will cable be moving in application? Yes / No

Environment

Operating Temperature

☐ Normal 32-140°F [0-60°C]

☐ High Temp. ____________ °F / °C

☐ Low Temp. ____________ °F / °C

Contaminants (Check all that apply)

Solid: ______________________

☐ non-abrasive ☐ coarse chips

☐ abrasive ☐ fine dust

Liquid: _____________________

☐ dripping ☐ non-corrosive ☐ splashing

☐ mist / spray ☐ corrosive ☐ high pressure

Conditions

☐ Washdown ☐ Outdoor

☐ Vacuum ☐ Cleanroom

Motion Control Data

Motion Profile

Graph your most demanding cycle, include accel/decel, velocity and dwell times. You may also want to indicate load variations and I/O changes during the cycle. Label axes with proper scale and units.

+ Speed (   )

(   ) Time or Distance

–

Motor Type Preferred

☐ Servo ☐ Stepper

☐ Other ____________

Axes of Motion

☐ Single ☐ Multiple # ________

☐ Synchronized

Interface

Host

☐ PLC ☐ Computer

☐ Analog I/O ☐ RS232

☐ Digital I/O Control

☐ Other ____________

Operator

☐ Keypad/LCD Display

☐ Pushbuttons

☐ Potentiometer/Joystick

☐ Thumbwheels

Supply Voltage

☐ 110 AC ☐ 220 AC

☐ Other ____________

Control Method

☐ Programmable ☐ External Control Signal

☐ Manual Jog ☐ Digital (Step & Direction) ☐ Analog Velocity

☐ Limit Switches ☐ Analog Torque ☐ Analog Position

Feedback Required

☐ Encoder ☐ Linear Potentiometer

☐ Other ____________

Description of Application

Input Functions

Output Functions

Operation

Why IDC's Brushless Servo Drives deliver superior servo performance

In 1995, IDC introduced its B8000 Series of brushless servo products. They came in several configurations and offered many unique and desirable features, at a remarkably low price. Originally attracted by features and pricing, customers have discovered something else—that IDC's B8000 Series products deliver unprecedented servo performance. In fact, it has been those customers most interested in getting the highest possible throughput from their equipment who have become IDC's strongest advocates. Several have commented, "never before have we been able to get this kind of performance out of our machine."

This is the "Inside Story" of IDC's unique, DSP driven, sinewave/vector commutated, positioning servos. This is why our B Series performs far superior to hall effect commutated six step drives, and meaningfully superior to the sinusoidal servos which until now have been considered the "state-of-the-art." We acknowledge that the answer is a little complicated and that our explanation may err on the side of oversimplification. But, hopefully, the following pages will provide some useful insights into the improvements our customers are experiencing.

The information provided here applies to all of our B8000 Series brushless servo controls. The B8000 series uses the same digital control architecture, advanced servo algorithms and power amplifier design—the B8001 digital servo drive, the B8501 analog position controller, and the B8961 (single axis) and B8962 (two axis) programmable smart drives.

Operation

The two functions most critical to any servo's performance are the servo algorithm calculations and the execution of these calculations, through dynamic control of the motor's torque. The foundation of IDC's competitive advantage is a proprietary DSP ASIC that controls these drive functions.

Advanced Servo Algorithms

To calculate servo control parameters, the B8000 DSP uses a "Proportional-Integral-Embedded Velocity (PIV)" servo compensator algorithm with acceleration, and velocity feedforward. This PIV algorithm is computationally intensive, but it is superior to other algorithms (such as PID), both in performance and ease of tuning. Its use is made practical by dedicating the horsepower of one DSP to every motor. IDC Servos attain further performance advantages through the use of fuzzy logic technology within its proprietary integrator, and Anti-hunt™ routines.

Vector Torque Control

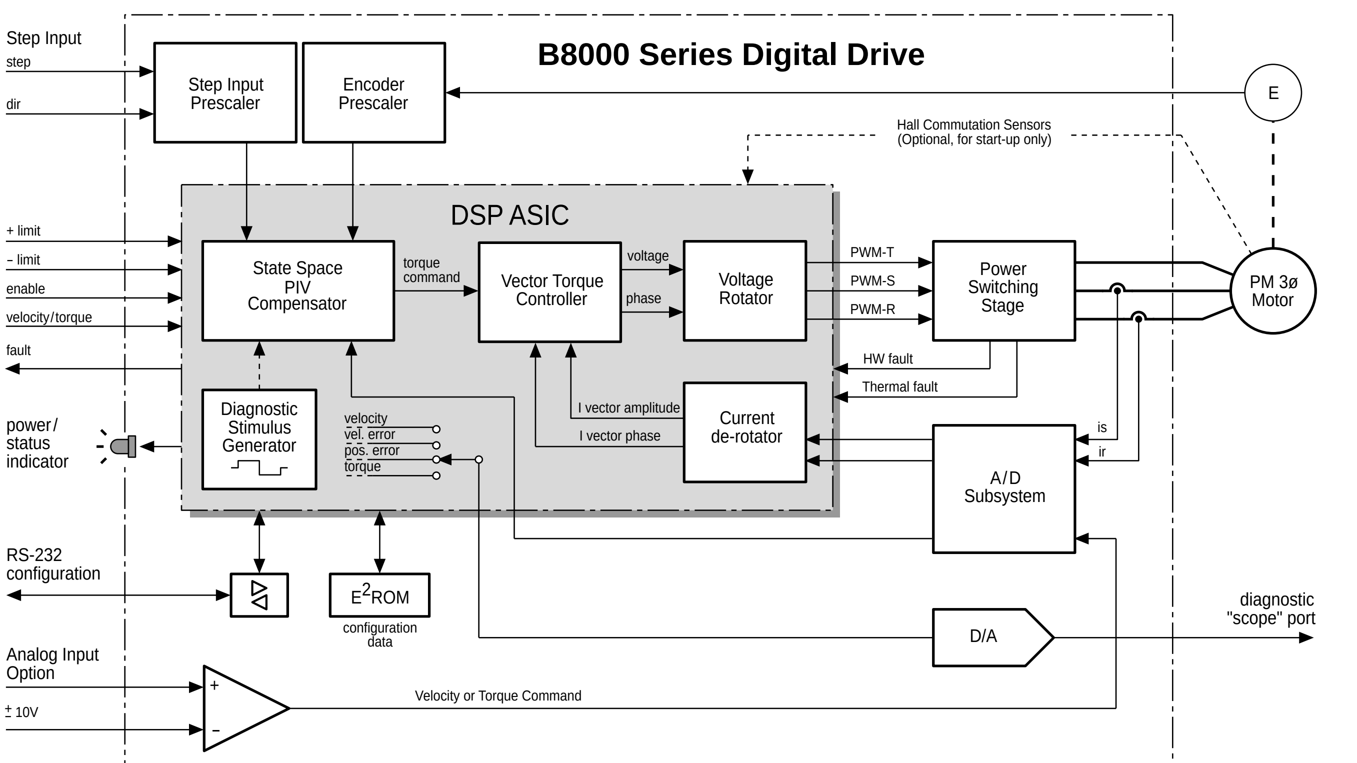
The DSP's other main function, critical to effective servo performance, is dynamic control of motor torque. The IDC Servos continuously determine the amplitude and angle of the magnetic field necessary within the motor to produce the calculated instantaneous torque. The 3-phase voltage needed to produce this magnetic field vector is also calculated, phase adjusted for motor speed and load, and synchronously applied to the motor windings. This allows nearly perfect execution of the servo algorithm's commands, and results in tight servo control, and maximum motor efficiency.

Unique Architecture

IDC's unique servo architecture is a framework for tightly synchronizing the calculated commands with their subsequent execution. Any delay or timing uncertainty within any part of the total servo cycle – from reading the feedback to outputting the correct torque for that moment in time – wreaks havok on servo performance. The sum of these delays and uncertainties is called Total Servo Phase Delay.

As mentioned before, one DSP is dedicated to every motor. Via digital step and direction inputs, it controls all the servo loops, including position. This architecture enables precise loop synchronization thus minimizing timing uncertainties. Furthermore, the most critical servo loop – the torque loop – is continually auto-calibrated and completely digital, thus virtually eliminating control defects caused by sensor drift, and analog phase delay. With this attention toward minimizing cycle delays and uncertainties, we have achieved a total servo phase delay of less than 100 microseconds!

The following pages show you how this fusion of innovative ideas and technology within IDC's servos give you benefits, and performance unmatched by servos twice the price.



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The Most Important Performance Specification

It may be interesting to hear about advanced algorithms and torque control techniques, but these things are only important to you to the extent that they give you bottom-line performance advantages. Much of servo advertising is focused on the individual elements that contribute to performance—raw processor speeds, DAC bits, and update rates—but these elements are only parts of a bigger picture; they mean little by themselves.

Servo bandwidth—the range of input frequencies a servo can follow (within a specified degree of error)—is the fundamental performance specification. Most elements of servo performance are directly related to servo bandwidth:

- Move time—acceleration and velocity for a given tracking accuracy
- Settling time
- Disturbance rejection ("stiffness")
- Smoothness of motion (rejection of velocity disturbances)

The Weak Links

Everyone knows that a chain is only as strong as its weakest link. This is as true with servos as with anything else. We carefully analyzed the factors that limit servo bandwidth, and found that in most servos the strongest links have been given all the attention, while the weak links have been neglected. The raw processor speed, number of DAC bits and update rate are not typically the weak links in any competitive system.

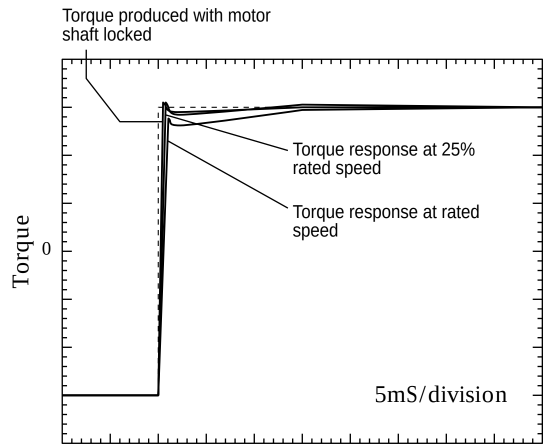
We discovered two major weak links related to system bandwidth—specifications that nobody talks about. One is the speed with which the correct torque can be produced once the desired amount has been calculated, and commanded. This is called "torque response time." The other is "total servo phase delay."

All Torque is not Created Equal

Torque response time is similar to the more commonly specified current loop bandwidth except that it considers commutation effects that govern the actual torque response at the motor shaft. Current loop bandwidth alone is an incomplete measurement. Any delay in the response between the commanded torque, and its execution at the motor shaft, will result in greatly compromised system performance.

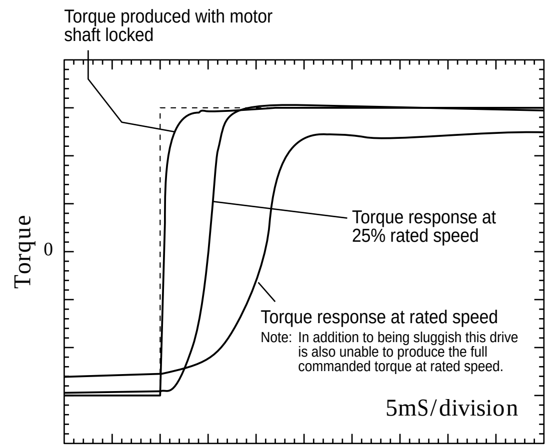
The B8000's torque response time is shown below in comparison to an above-average, competitive servo. While the B8000 has a noticeable advantage even at zero speed, you can see that its real superiority is its near-zero response time at rated speed. This is the condition under which supplying the correct instantaneous torque has the most impact on performance—tracking accuracy, settling time, disturbance rejection, smoothness and efficiency.

B8000 Series indirect torque vector controller test



The B8000's torque response is extremely fast and virtually constant regardless of motor speed. The desired instantaneous torque can be delivered immediately upon demand.

Competitive "digital" sine wave drive with analog current loops



Even a "high-tech" sinewave drive has difficulty producing torque as quickly as necessary for optimal performance, especially when running at speed.

Operation

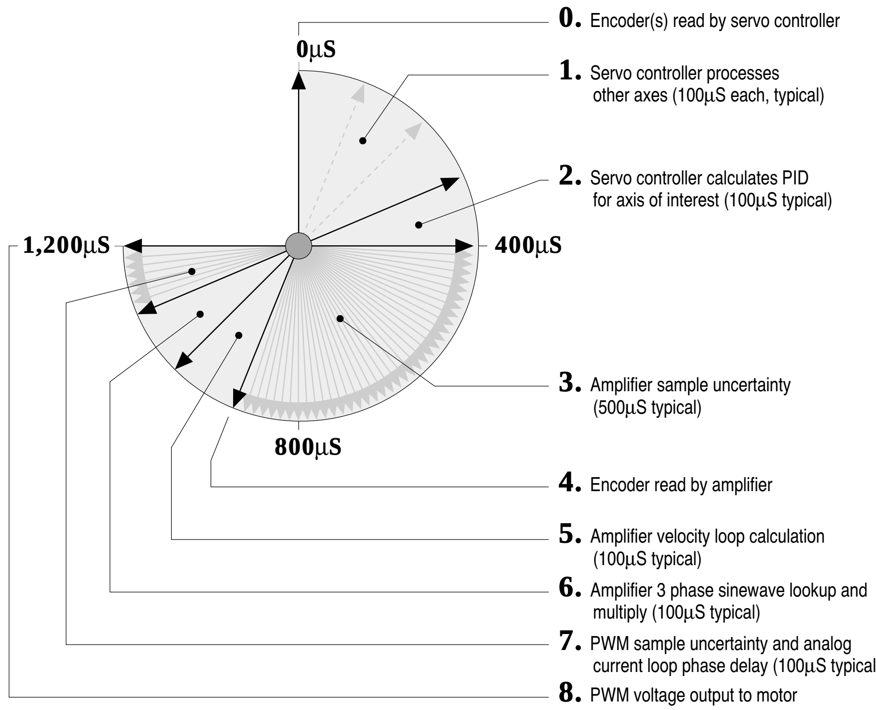
Total Servo Phase Delay

You have seen how quickly and accurately the B8000 produces torque after it calculates the required amount—this is the torque response time. Now let's examine the total servo phase delay—the total time from the moment the position feedback is read to the time that torque begins to be updated.

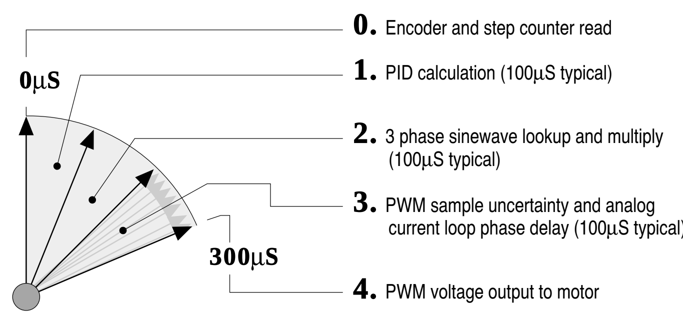
Total Servo Phase Delay (TSPD) is not only dependent upon the time it takes for each individual step in the servo process to be completed, but it is also influenced by the degree of synchronization of these steps. If elements of the system operate asynchronously, as is the case with the traditional servo architecture (where one or more servo loops are closed by the controller, and the remainder by the amplifier), this lack of synchronization will cause uncertainties which, on average, will drastically increase the TSPD.

We chose a step and direction input architecture not only for noise immunity, or as a convenience for upgrading from stepper motor systems, but because this allowed us to close all the servo loops with one processor. This eliminated all of the delays and uncertainties associated with the asynchronism of the traditional architecture. This is a big advantage of any skillfully implemented step and direction servo.

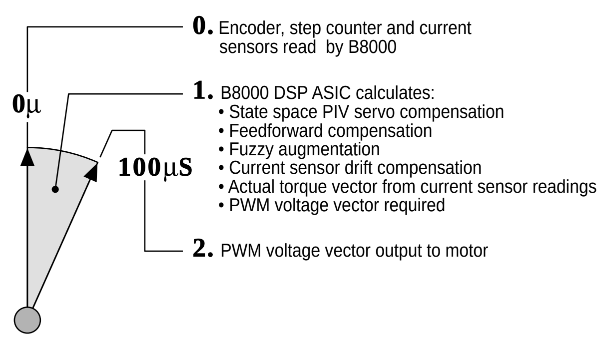
We went several steps further to reduce TSPD. We dedicated a DSP to each motor, designed a true digital torque controller, and developed proprietary algorithms optimized specifically for reducing TSPD. The result of these efforts can be seen in the figures to the right. Low TSPD, combined with improved torque response time, strengthens the weak links found in other servos and results in state-of-the-art servo bandwidth.



The traditional servo architecture – position controller with separate velocity/torque amplifier – has many delays and uncertainties because of asynchronism between controller and amp, and because one processor controls multiple axes.



A well-designed step and direction sinewave drive eliminates many of problems associated with the traditional architecture, but still has delays due to sinewave lookup and current loop phase delay.



IDC Servos minimize total servo phase delay. Combined with rapid torque response, this results in superior servo performance.

An Illustrative Analogy

To more clearly illustrate how torque response time and total servo phase delay affect bottom-line performance, the following analogy may be helpful.

Imagine you're being driven in a car where the front wheels don't turn until some extended time after the driver starts turning the steering wheel. In our analogy, this time delay represents torque response time. You can easily see that the worse this delay is, the harder it would be to negotiate even the slightest curve in the road. If the delay is significant, it wouldn't matter how good of a driver you had (i.e.: how good of a servo "algorithm" he has in his brain), he would not be able to stay on the road.

The difficulties presented to your driver by this slow response time would obviously become more pronounced as you asked your driver to drive faster. To keep our analogy accurate, however, driving faster would not only make the delay more treacherous, it would also increase the amount of the delay, thus compounding the problem. (See the torque response time curves on page H-13.)

Your driver's reflexes, decisiveness and concentration are analogous to the elements of total servo phase delay. If your driver is talking on the cellular phone, adjusting the radio, and reading a map while he's trying to drive (i.e.: he's "controlling other axes"), you can bet he'd have a problem under anything but the easiest driving conditions.

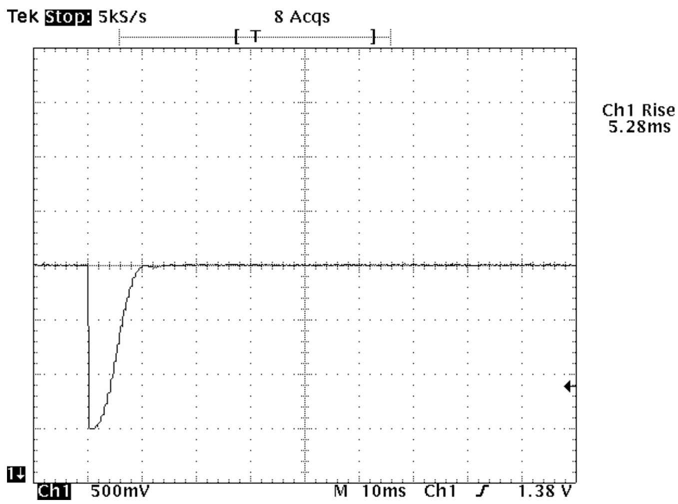
On top of this, if the link between his brain and his muscles has become somewhat unsynchronized because he's had a few drinks, you'll really have a mess.

Overall, the link between command and execution is not only delayed, but also unsynchronized, and further impaired by a controller that's overburdened. All of this combines to greatly impede effective servo control. To complete our driving analogy, the impediments discussed above would have many negative consequences: your tracking accuracy would be poor, your car would be swayed by outside disturbances (wind, potholes, etc.), you would have a tendency to oscillate all over the road, the ride would be far from smooth, and your driver would get very tired and need to rest often from being so inefficient.

If conditions are perfect, the road is perfectly smooth, and you're not in a rush, your ride in this car may be acceptable. If, however, you tell the driver to rush you to the airport and you drive along a less than perfect road with luggage strapped to the roof of your car, there's a good chance that you'll miss your plane.

Analogously, a motion application with a light inertial load, superior mechanics, slow accelerations and low velocities will be adequately controlled by most respectable servo systems. On the other hand, if you need to make fast point-to-point moves, use coordinated axes, require above average accuracy or smoothness, want to use a smaller motor or have an inertial load larger than that of the motor, then you will greatly benefit from a servo system with high bandwidth, fast torque response, and low total servo phase delay.

Benefits of IDC Servo's high bandwidth



This is an oscilloscope print of tracking error (position error) versus time with a B8000 System. The horizontal center line represents zero error and each division above and below center represents 30° of error. The downward vertical spike is a forced, instantaneous position disturbance of 90°. The system completely corrects this large, step-function error within 10 milliseconds!

Current Control is not Torque Control

Earlier, we discussed torque response time, a key specification regarding motor torque that is not generally discussed by servo manufacturers. Now let's illuminate a well known torque specification – the torque-speed curve – what it tells you and doesn't tell you.

The torque-speed curve in a servo's specifications is typically only estimated by manufacturers. The torque is measured with the shaft locked (i.e.: at zero speed), and then other end of the curve, the maximum no-load speed, is also measured. Using these two data points and a ruler, the torque-speed curve is constructed from a theoretical formula.

Unfortunately, the formula does not account for several losses that occur in drives that use standard current loop technology (analog or digital). These losses are caused by dynamic misalignments of the magnetic field within the motor's stator with respect to the magnetic field of the rotor. This misalignment is a result of the limitations inherent in the technology used to control the current in the stator windings.

To understand these limitations, first realize that all control of a brushless servo motor ultimately depends on two things: 1) properly rotating the magnetic field of the stator to cause rotation of the magnetic rotor, and 2) controlling the strength of the magnetic field of the stator so as to regulate the torque generated by the rotor. To precisely control all aspects of the stator's magnetic field, the alternating currents flowing through the stator's phases must be accurately controlled, both in phase (with respect to the rotor) and in amplitude.

Sinusoidal (AC) Servos—State-of-the-Art?

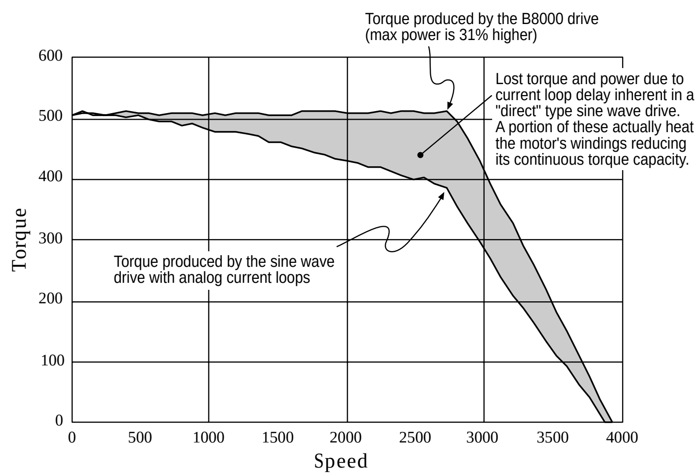
With a traditional sinusoidal (AC) servo drive, the current in each winding phase is actively servo-controlled. In other words, there is a current loop for each phase that compares actual current to the desired current and makes corrections as needed. As the motor goes faster (i.e.: the stator field spins faster), the alternating phase currents need to change more rapidly. There is an inherent problem, however. A finite time delay exists in all traditional current loops which causes a phase error which, in turn, causes a magnetic field misalignment. To make fast point-to-point moves, the phase currents need to change fast and the misalignment becomes a problem.

Some AC servo designs attempt to remedy this problem with a phase advance scheme, but alas, the solution is not so simple. The amount of phase advance is highly dependent upon speed, inertia, friction, and torque direction relative to motor direction. The most sophisticated phase advance scheme available cannot handle all these variables.

The effect of the misalignment is that the torque calculated by the main servo algorithm as necessary to achieve the desired velocity, and position is not produced. Under steady-state velocity and load conditions, the result of this progressive misalignment with respect to speed is a large "droop" in the torque-speed curve, as shown below.

As everyone knows, energy can be neither created nor destroyed, so what happens to the current that goes into the motor but doesn't come out as torque?

B8000 indirect vector torque control vs a competitive, sine wave drive with analog current loops (direct phase current control)



Here, as in the torque response time curves, it can be seen that basic sinewave servo drives are no longer state-of-the-art.

The misdirected current that causes misalignment and reduces torque, converts to heat in the motor windings, thus reducing the motor's continuous torque capability.

More important than the steady-state torque disadvantages are the dynamic performance implications. Compounding the torque response delay discussed earlier, the magnetic field misalignment effectively lowers the main servo algorithm's gains, further reducing the position/velocity bandwidth. This retards dynamic response and increases tracking errors.

New! Vector Torque Control

In contrast to simple current control, our proprietary torque vector controller does not use a separate servo loop for each phase. Instead, it "de-rotates" the measured phase currents – in other words, converts them into one vector value (amplitude and phase)—and calculates the actual magnetic field vector. This vector, which is independent of motor speed and load, is then servo-controlled to remain in precise alignment with the magnetic field of the rotor. Therefore, the true torque can be accurately determined and accurately produced. Consequently, the torque command from the higher-level servo calculations is executed quickly and accurately for excellent servo performance.

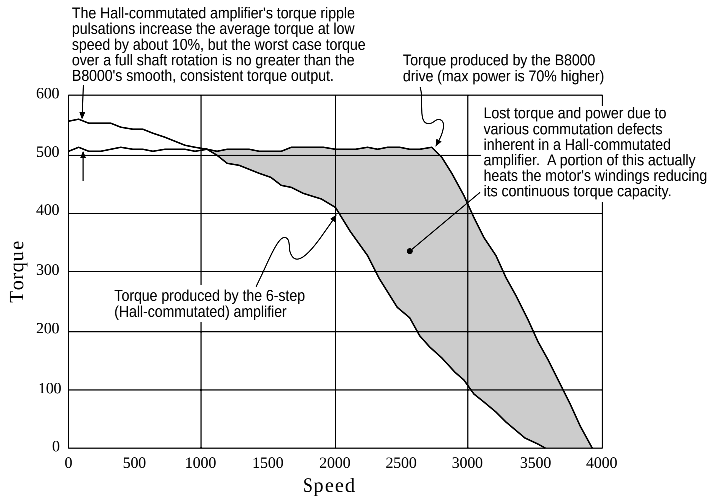
The exact control of the magnetic field also results in a flatter and broader torque-speed curve compared to other servos driving the same motor, and the measured curve looks very much like the theoretical curve. Peak power and efficiency are greatly improved because the losses within the motor are actively minimized. Furthermore, less wasted current means less heat, so you can use a smaller motor for any given application—reducing costs, machine size and power requirements.

Additionally, what's not evident from the torque-speed curve, is that by accurately controlling the magnetic field of the stator, torque ripple is virtually eliminated, as is its associated vibration. This gives you ultra-smooth motor rotation.

How the Simple Hall-Commutated Servo Compares

Comparing IDC Servos with a 6-step (Hall-effect sensor commutated) brushless drive is even more dramatic. In a 6-step drive, the current in each phase is not monitored. Only the total bus current amplitude is measured. This total is directed into the appropriate windings with a crude resolution of 60 electrical degrees by switching the phase voltages on and off as determined by the Hall-effect sensors that monitor the relative position of the rotor. The drive does not know the phase relationship between the individual winding currents – which is critical for orienting the stator's magnetic field – nor can it accurately produce the desired phase currents calculated by the servo algorithm because of its poor switching resolution. These factors lead to inefficient and sub-optimal control. The magnetic field of the stator can end up virtually anywhere, particularly at higher speeds and with loads that have inertias larger than that of the motor. Additionally, the steady-state torque droop of this common type of drive scheme is significantly worse than the sinusoidal drive discussed earlier. This can be seen in the torque-speed curve below.

B8000 indirect vector torque control vs a competitive, 6-step (Hall-commutated) amplifier



Notice that by simultaneously extending both torque and speed, the B8000 produces a 70% advantage in peak power.

Operation

Superior Servo Performance Powered By Proprietary DSP ASIC Technology

Advanced Servo Algorithms

Position and velocity input, based on digital "step and direction" signals, are compared to high-resolution encoder feedback and fed into advanced control algorithms powered by one dedicated DSP per axis.

Servo compensator incorporates Proportional-Integral control with an embedded Velocity loop (PIV), plus velocity and acceleration feedforward, and proprietary algorithm enhancements based on fuzzy logic technology.

Vector Torque Control

The instantaneous magnetic field vector in a brushless motor stator is calculated based upon measurements of current from continually auto-calibrated sensors and compared with the magnetic field necessary to produce the desired instantaneous torque. A voltage vector, adjusted in phase to compensate for motor speed and load, is calculated and output to a "voltage rotator" to send PWM output to the motor.

Accurate Servo Calculation

Fast, precise calculation of instantaneous torque required to achieve desired position and velocity.

Fast Torque Response

Fast, precise and efficient execution of calculated instantaneous torque requirement.

Tight Synchronization

100 microseconds elapsed time for receipt of feedback and output of phase-adjusted, torque-producing voltage at the motor.

Benefit: Superior Servo Performance

- Fast moves—quick acceleration and high velocity
- Excellent tracking accuracy
- Rapid settling time
- Smooth and quiet movement, free from torque ripple
- High servo gain without jitter or "hunting"
- More continuous and peak power from the same size motor
- Higher stiffness and excellent disturbance rejection
- Consistently high performance over a wide range of conditions

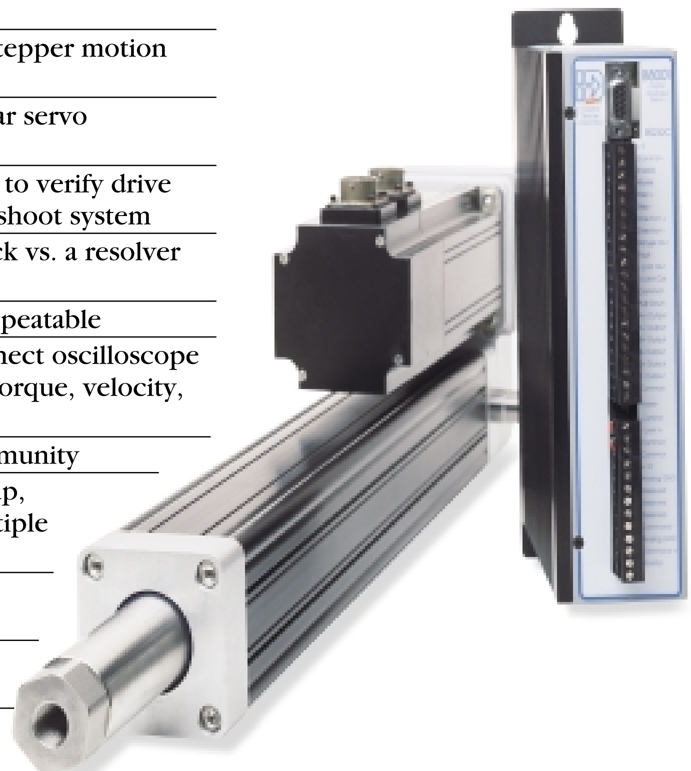
Overview

The B8001 Drive is a DSP-based brushless servo amplifier, designed to drive brushless or brushed DC servo motors. Both Step & Direction, and ±10V velocity or torque command signals are accepted, insuring wide compatibility with available motion controllers.

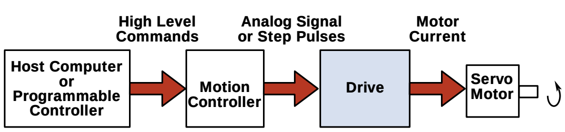
Configuration/Tuning

B8001 Drive/Actuator Systems are pre-tuned to our motors and actuators. Where fine-tuning is required, our IDCMotion™ Servo Tuner software includes a tuning utility to tune from your PC. Since there are no DIP switches, jumpers or potentiometers to adjust, tuning is quick and efficient. To set up repeat systems, simply download the data stored on disk from the previous tuning session.

Features	Benefits
• CE, UL certified	Meets CE and UL standards
• Extremely efficient electrical design	1.5/3 kWatt drive. Compact 2.5" x 9" foot print, 5.75" deep
• State-space, vector drive technology	Better speed-torque than sinusoidal drives
• 120/240 VAC single phase input	Convenient power
• STEP & DIR inputs, and position servo loop	Compatible with stepper motion controllers
• ±10V velocity or torque command input	Works with popular servo controllers
• Diagostic LED	Convenient means to verify drive status, and troubleshoot system
• Commutates motors via encoder feedback	Less costly feedback vs. a resolver based system
• DSP, all digital design	Robust, reliable, repeatable
• Configurable analog diagnostic output	Quick tuning: connect oscilloscope to show ACTUAL torque, velocity, position response
• Optically isolated I/O	Excellent noise immunity
• RS-232C configurable, through friendly MS-Windows software	Simple system setup, especially for multiple systems
• 2MHz encoder input pulse rate (post quadrature)	High speed, high accuracy
• 300Hz velocity bandwidth	Fantastic response & performance
• 10kHz sample rate Vector Control	Smooth motion at all speeds
• 2kHz position servo sample rate	Fast settling time
• Removable screw terminals. Second connections for limits and encoder to controller	Clean, easy wiring to and from drive
• Built-in and external regenetative energy capacity	Protects system, allows greater inertial loads



Compatible Mechanics:
EC2-B, EC3-B, EC4-B, EC5-B, N2-B, NV-BN
R2A-BN, R3-B, R4-B, LM, LD
Positioning Tables



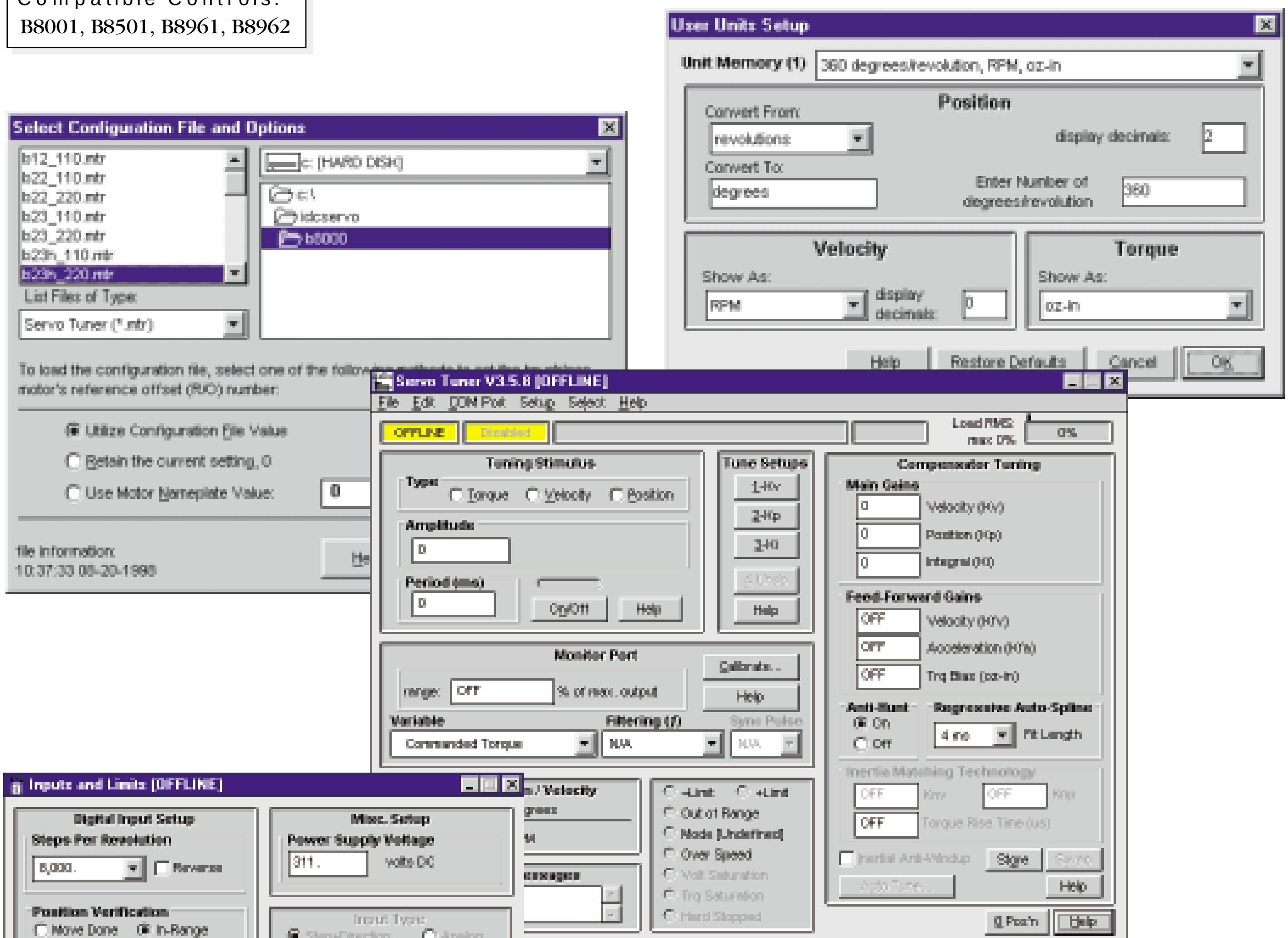
Operation

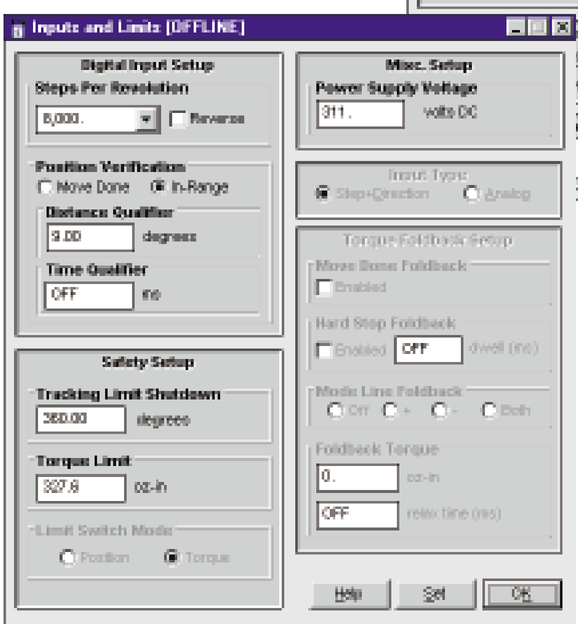
IDCMotion™ Tuning Utility

Drive configuration and trouble shooting are facilitated with the tuning utility included in our IDCMotion™ Servo Tuner software. This Windows based program provides a clear, intuitive interface, with context sensitive on-line help available every step of the way.

Compatible Controls:
B8001, B8501, B8961, B8962

In many applications, tuning of the servo loop will not be necessary, since the default tuning parameters are adequate. Repeat systems can be tuned to the same specs by downloading the tuning data file from the previous system. When manual tuning is desired, the software greatly simplifies the procedure.





Things You Can Do:

- Save a complete configuration to a file.
- Load entire configuration to a system.
- Define motor specs.
- Define drive specs.
- Define controller interface.
- Configure analog monitor output for actual velocity, commanded velocity, velocity error, position error, analog torque command, actual torque, or phase current.

Specifications

Power Input

90-240VAC, single phase, 50/60 Hz, 1150VA @ 115 VAC max, 2300VA @ 230 VAC max

Motor Output

Current Capability	5A continuous, 10A peak
Protection	Protected against phase-to-phase shorts and shorts to ground. Fused.
Power Dump Capacity	See page H-40 for details.

Encoder Input

Type	Differential quadrature incremental encoder, with or without index
Maximum Rate	2MHz (post-quadrature)
Power	+5V @ 200 mA power encoder

Diagnostic Output

Format	0 to 5V analog signal (centered at 2.5V)
Variables	Configurable as actual, and commanded velocity; position error; velocity error; actual, and commanded torque – programmable scaling

Serial Interface

Data Format	RS-232C, half-duplex, no parity, 8 data bits, one stop bit, no handshaking, 9600 baud (fixed)

Commutation

Vector Error	0.1% or less
Calculation Rate	10 kHz

Environmental

Temperature	Thermal shutdown occurs if heatsink temperature exceeds 55°C (131°F). Heatsink temperature is a function of motor current, motor regen, and ambient temperature.
Humidity	0% to 90% non-condensing

Analog Command Input (Velocity or Torque)

Format	±10V differntial signals
Impedance	Greater than 10K
Scale	Digitally programmable via configuration ports in velocity mode. Fixed at 10% of output capability per volt in torque mode.

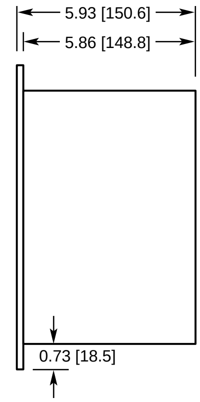
Step & Direction Input

Format	Opto-coupler diodes with 330 series resistance, intended to be driven by a 5V digital signal pulled up to +5V
Max. Rate	1.25MHz
Resolution	Any even number from 200 to 65,534 steps per revolution.

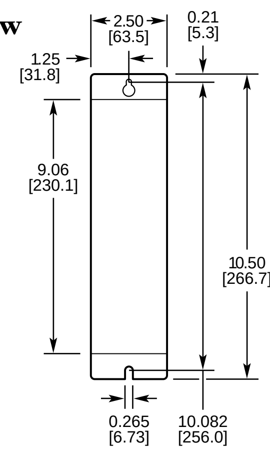
Mounting Dimensions in [mm]

B8001

Side View



Front View



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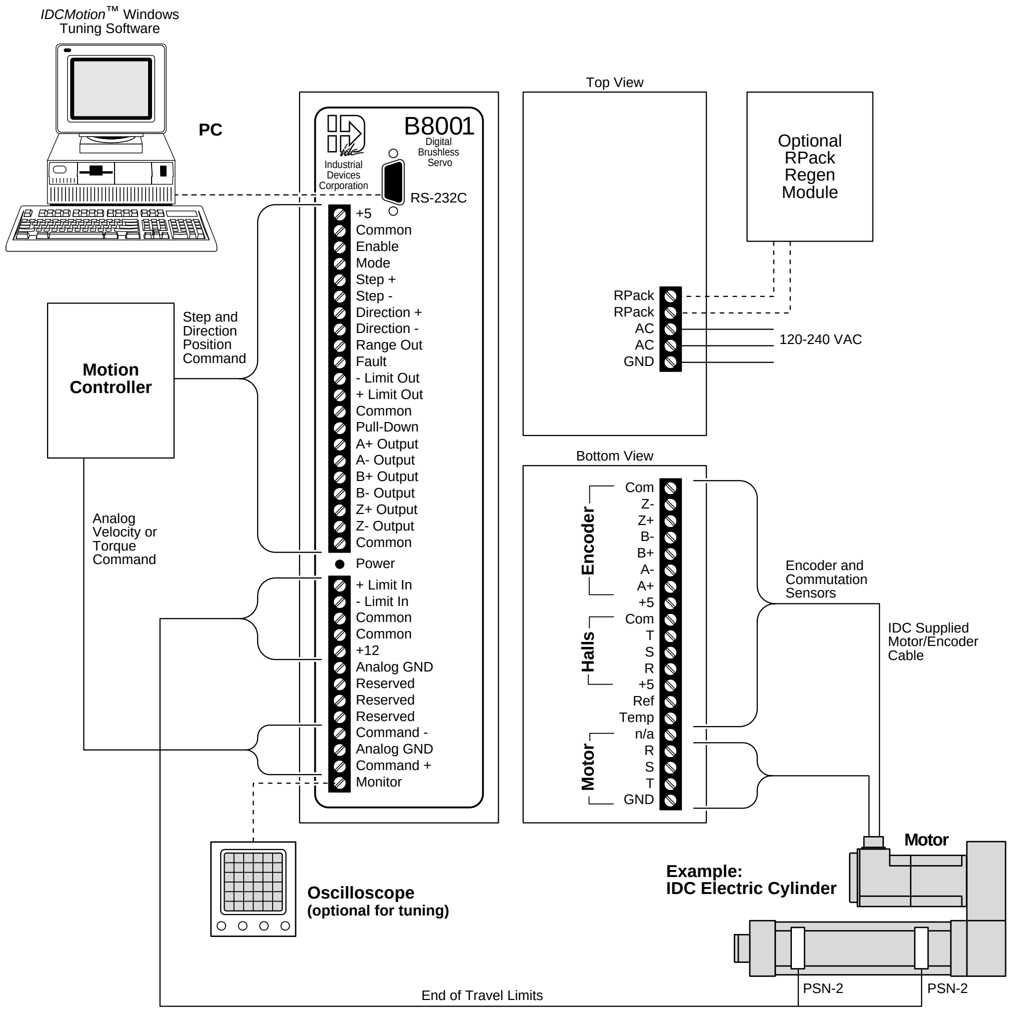
Operation

System Configuration



How To Order

Model	Description	Options	Description
B8001	1 Axis Servo Drive	-LMTR	For operation of a B8001 with an IDC Linear Motor
Accessories		-FK1	115 VAC Fankit (p. H-39)
RPACK-1, 115 VAC RPACK-2, 230 VAC	External regenerative power dissipation module. Only for exceptionally large inertial and/or vertical loads with ballscrew actuators. See page H-40.	-FK2	230 VAC Fan kit (p. H-39)
Limit Switches, NPN	Mounted on IDC mechanics to provide end of travel limit sensing.		

To confirm your selection, review the checklist on page H-8.

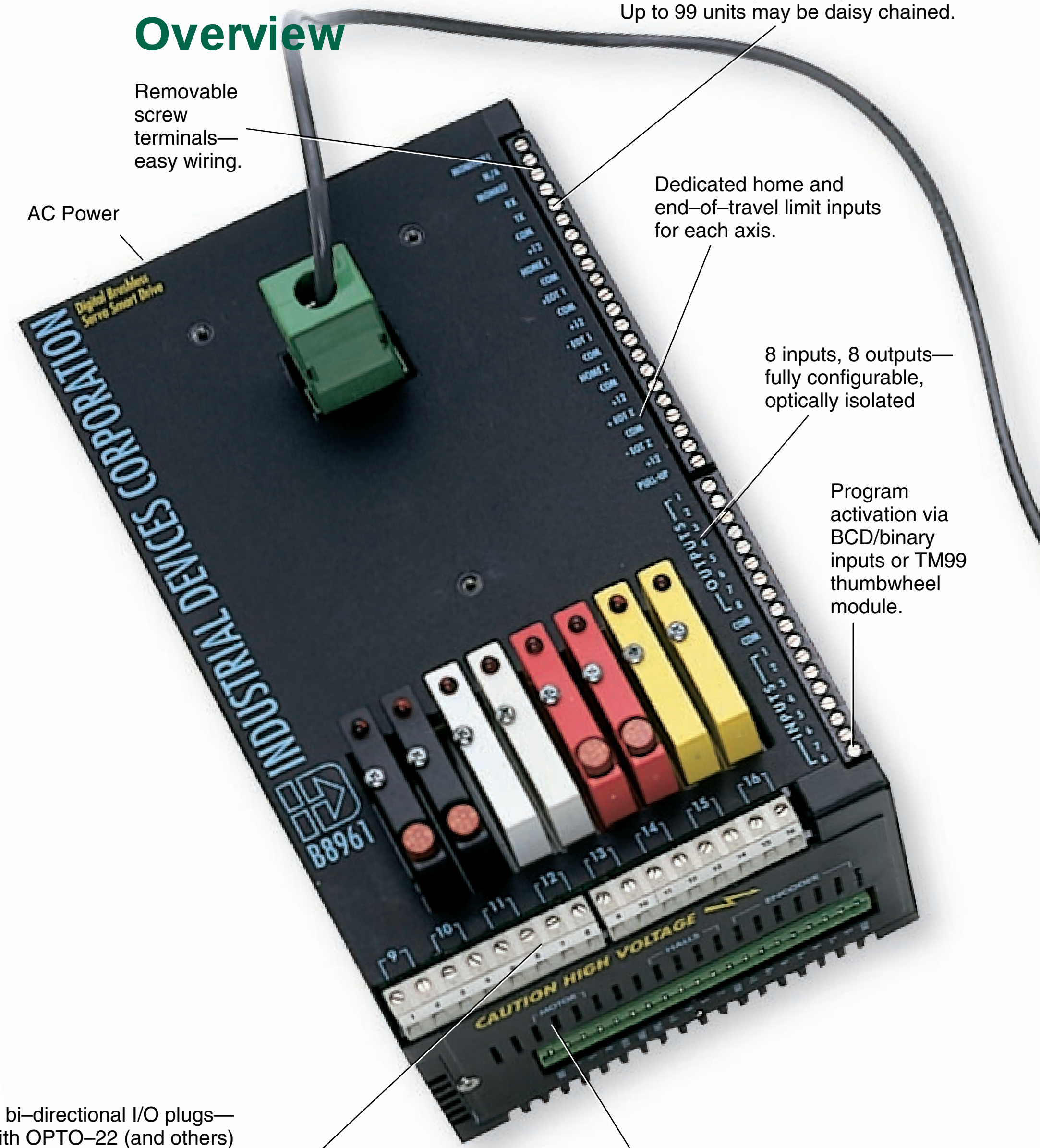
Overview

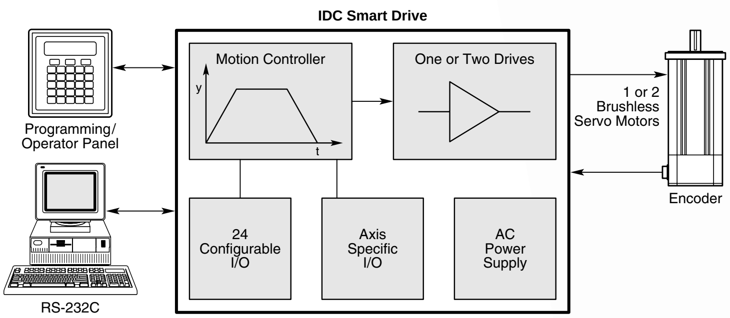
IDC's Programmable Smart Drive Positioning Controls offer tremendous application flexibility. They provide exceptional value and performance relative to similar competitive integrated control solutions.

A single compact package combines a one- or two-axis motion controller, drive(s), OPTO modules, an AC input power supply plus an optional, detachable front panel. Our Smart Drive Systems feature the same outstanding dynamic performance as our stepper and brushless drives.

Our powerful and intuitive IDeal™ programming language will dramatically reduce the time it takes to get your machine running. 6K bytes user memory is available for up to 199 motion programs (30K optional). Our IDCMotion™ Application Development Software is included to program from your PC.

These controls are designed, built, tested and supported by IDC—a complete motion control solution from one reliable source.





Brushless Servo Systems

Overview

Menu–driven setup, help, diagnostic display modes—simplifies setup and troubleshooting.

Easy to read, 2–line, 40–character, back lit display.

Standard panel sealed to IP65 (NEMA 4)—washdown environment.

User scaling of position, velocity and acceleration—to the units you prefer.

Simple panel mounting—drill and punch only, supplied with 6 ft conductor shielded cord.

Operator can run part programs by name.

Easy to hold. Also attaches directly to control.

Commands listed on keys—user friendly.

Large, scratch–proof keys have excellent audible and tactile feedback.

certified

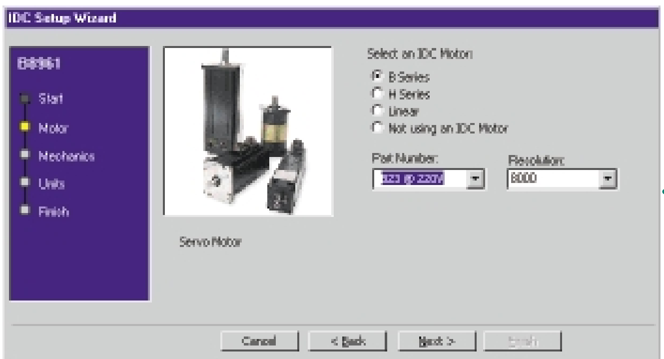
Models	B8961 & B8962
Motor Type	Brushless Servo
Number of Axes	1 & 2
Compatible Mechanics	NV-BN, N2-B, EC2-B, EC3-B, EC4-B, EC5-B, R2A-BN, R3-B, R4-B, LD, LM, Tables
Shaft Power Continuous/Peak	100/1900 Watts
AC Power	120/240 VAC
Control Method	PIVF Feedforward Servo
Other Features	DSP-based, State Space Vector Control, High Bandwidth Digital Servo, Sophisticated, Simultaneous Torque/Velocity/Position Control, Registration, Linear Interpolation, Go Immediate Mode, Optional Analog I/O

Operation

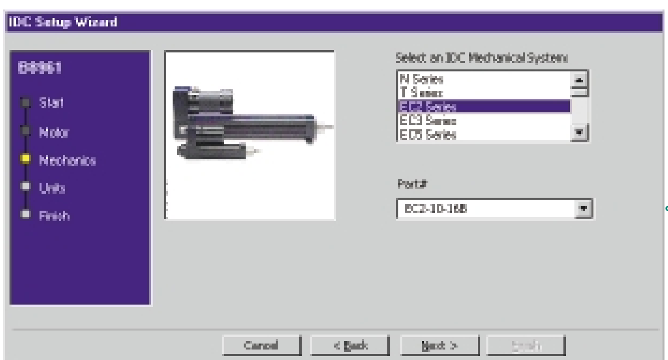
IDC Setup Wizard Makes Application Configuration Easy!

What you can do:

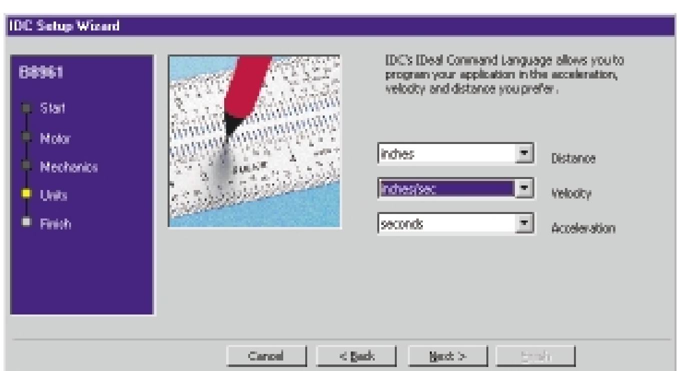
Select a Product



Pick a Motor



Select your Mechanics



Select your Units

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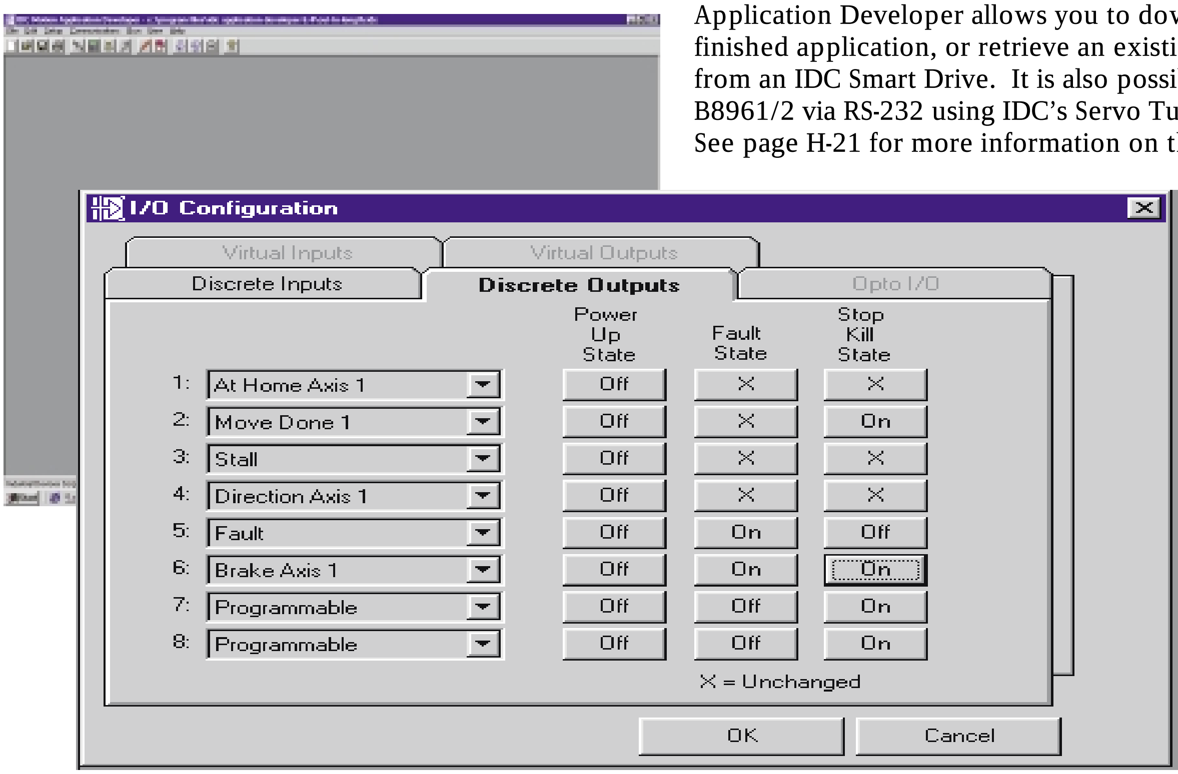
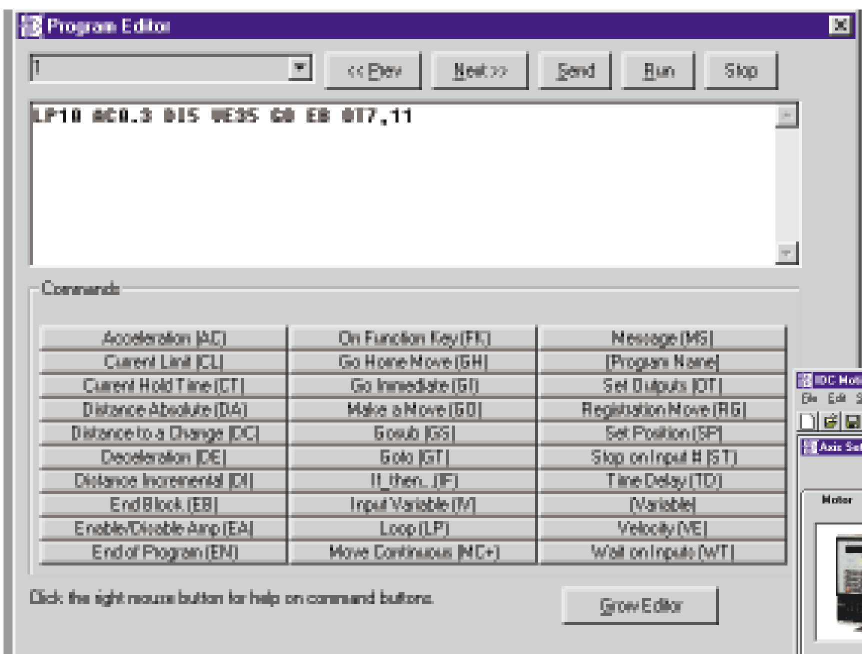
Application Developer

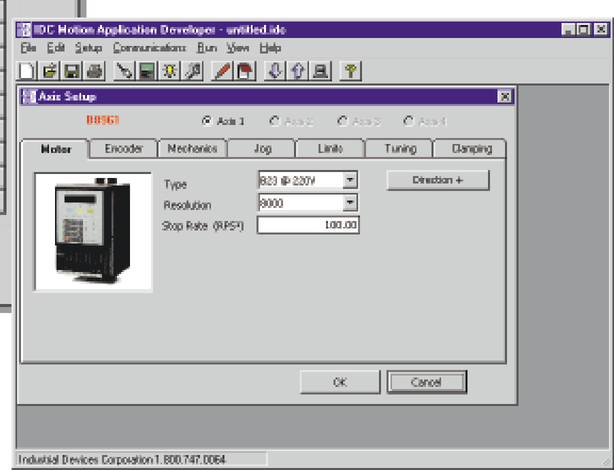
For those who prefer RS-232C communications, IDC provides Application Developer, a Windows-based application development tool. It helps you quickly setup your system, and create programs using your PC. Using Application Developer allows you to download a finished application, or retrieve an existing program from an IDC Smart Drive. It is also possible to tune your B8961/2 via RS-232 using IDC's Servo Tuner program. See page H-21 for more information on the tuning utility.





What You Can Do

- Create programs
- Access examples
- Setup each axis
- Configure I/O
- Specify an environment
- Upload and download
- Emulate a terminal



Compatible Controls:
B8961, B8962, 961, 962, S6961, S6962, SmartStep

IDeal™ Command Language

The B8961 and B8962 Servo Smart Drives are sophisticated, fully featured controls, which are quickly and easily programmed with the intuitive IDeal™ programming language. Here is a partial list of the IDeal command language:

Motion Commands

AC	Acceleration
CL	Current Limit
CT	Current Time Out
DA	Distance Absolute
DC	Distance to Change
DE	Deceleration
DI	Distance Incremental
GH	Go Home
GI	Go Immediate
GO	Start Move
GP	Go Point (Linear Interpolation)
MC	Move Continuous
RG	Registration
TF	Torque Fall Time
TM	Torque Mode
TQ	Torque Output Level
TR	Torque Rise Time
VE	Velocity

Program Flow Commands

BR	Break
EB	End Block
EN	End Routine
FK	Function Key
GS	Go to Subroutine
GT	Go to Program
IF	If Conditional
LP	Loop
LU	Loop Until
LW	Loop While
ST#	Stop on Command
TD	Time Delay
WT	Wait

I/O & Display Commands

IV	Input Variable
OT	Outputs On/Off
MS	Message to Keypad
“ ”	Message out Serial Port

Misscellaneous Commands

{}	Comments
EA	Enable Amplifier
SP	Set Position
SQ	Square Root
ST	Stop Move on Input

Serial Immediate Commands

CB	Clear Buffer
K	Kill
S	Stop
IS	Input Status
OS	Output Status
PAC	Tell Commanded Position
PAE	Tell Encoder Position
RS	Reset
SA	Axis Status
SD	Drive Status
SS	System Status
SW	Firmware Version
UN	Unit Number

Serial Supervisory Commands

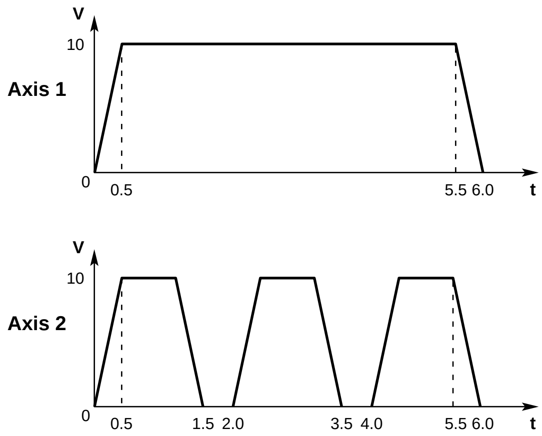
AA	Auto Address
DP	Delete Program
DR	Download Programs to RAM
EC	Enable Terminal Echo
EP	End Program
EX	End Load All
LA	Load All
LS	List Programs
OC	Original Configuration
PR	Define Program
PW	Password
RN	Run Program
UA	Upload All
UL	Upload Programs

Servo Setup Commands

AH	Anti Hunt
AM	Maximum Acceleration
AW	Anti-Inertial Wind-up
BV	Break Velocity
CU	Current Units
ER	Encoder Resolution
FA	Feed Forward Accel
FE	Following Error
FV	Feed Forward Velocity
IR	In Range
KI	Integral Gain
KP	Position Gain
KV	Velocity Gain
MV	Max Velocity

Programming Example, Go Immediate Mode
IDC Solution: B8962

A customer requires a very long move on axis 1, while simultaneously making 3 short moves on axis 2 with time delays of 0.5 seconds between the moves. The time delay of 0.5 seconds between axis 2 moves is important to the overall machine process. Solving this application successfully requires executing operations while both axes are moving such as: asserting outputs, checking status of inputs, doing math, and sending ASCII text out of the RS-232 port.




```
(VAR1)=10                   {Intialize Variable}
LP                          {Beginning of Loop Block}
    DI55,10                 {Define Two Axis Move}
    VE10,10
    AC.5,.5
    GI                      {Start Go Immediate Move Both Axes}
    MS1,“”                  {Clear Screen}
    MS1,(AI9)               {Write Analog Input 9 to the Screen While Moving}
    WT,#2                   {Wait for Axis 2 to Stop Moving}
    TD.5                    {Time Delay of 0.5 seconds}
    DI,10                   {Define Axis 2 Move of 10 units}
    GI                      {Start Axis 2 Go Immediate Move}
    IF8,1                   {If Input 8 is on}
        OT10,1              {Turn on Output 10}
        TD.1                {Time Delay of 0.1 seconds}
        OT10,0              {Turn off Output 10}
    EB                      {End of If Block}
    WT,#2                   {Wait for Axis 2 to Stop Moving}
    TD.5                    {Time Delay of 0.5 seconds}
    DI,10
    GI                      {Start Axis 2 Go Immediate Move}
    (DIST)=(VAR1)*1000      {Do Variable Math while Moving}
    (TERM)=(DIST)           {Send Value of DIST Variable out of Serial Port}
    WT#1,#2                 {Wait for Axis 1 and 2 to Stop Moving}
    OT1,1                   {Turn On Output 1}
    DA0,0
    GO                      {Move Both Axes Back to Starting Position}
EB                          {End of Loop Block, Restart Loop}
EN                          {End Program}
```

Programming Examples

A customer wants to use the control's analog I/O capabilities to create conditional branching based on the input values. Note: Only the "analog inputs" may be configured to read analog information (see example command statements with the use of conditional statements, variables and math).

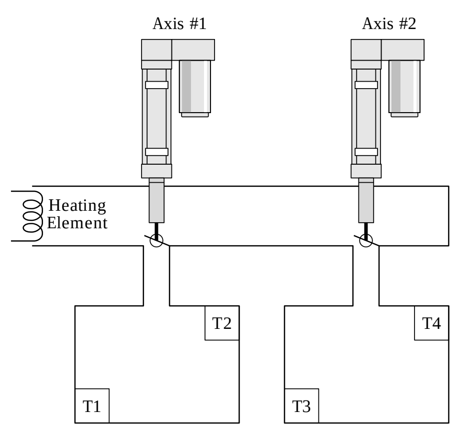
(TEMP)=(AI9)	Reads temperature on analog input #9
(TEMP)=(AI9)*1.2	Temperature is scaled by factor of 1.2
IF(AI1Ø)<200 GO EB	If analog input 10<200, execute the move (Go)
IF(TEMP)>50 OT1 EB	If temperature variable>50 turn on Output 1
IF(PARTS)=25 GS20 EB	If PARTS variable=25 Gosub to Program 20
WT(A1Ø)<200 GO	Wait for analog input 2<200 before moving

Example showing math, display, outputs and variables:

(PIECES)=10	Assigns 10 to a variable called PIECES
(SPEED)=(AI14)*(VEL SCALE)	Speed = analog input #14 times a scaler
MS21, "Enter Length:" IV32,(LENGTH)	Prompts user to input feed length
VE(SPEED)	Sets velocity to the value in the variable
MS1,(POS1)	Displays current position on screen
(TEMPERATURE)=(AI16)	Reads temperature in from analog input #16
(AO13)=256	Sets the analog output to 6.25% of full scale

A customer wishes to control the temperature in two test chambers using a single 120 VAC filament and two thermocouples (T1 and T2) in each room. At "home" position the valves/gates are open (actuators at retracted position).

[CHAMBER]	Name chamber program, CHAMBER
OT13,1	Activate discrete output #13 on the OPTO module (controls filament)
AC.5,.5	Set acceleration on both axis @ .5 sec
VE10,10	Set velocity on both axis to 10
GH5,5	Home both axis
LP	Start continuous loop
(T1)=(AI9)	Reads temperature on analog input #1
(T2)=(AI10)	Reads temperature on analog input #2
(T3)=(AI11)	Reads temperature on analog input #3
(T4)=(AI12)	Reads temperature on analog input #4
IF(T1)<170 GT[CHAMBER] EB	Re-start CHAMBER program
(SUM1)=(T1)+(T2)	SUM1 = the sum of T1 and T2 readings
(AVE1)=(SUM1)/2	Average the temperature in chamber 1
(SUM2)=(T3)+(T4)	SUM2 = the sum of T3 and T4 readings
(AVE2)=(SUM2)/2	Average the temperature in chamber 2
IF(AVE1)>180	Evaluates if average temperature is >180
DA3.5 GO EB	Move axis #1 to close valve
IF(AVE1)<170	Evaluates if average temperature is <170
DA0 GO EB	Move axis #1 to absolute zero to open valve
IF(AVE2)>75	Evaluates if average temperature is >75
DA,3.5 GO EB	Move axis #2 to close valve
IF(AVE2)<70	Evaluates if average temperature is <70
DA,0 GO EB	Move axis #2 to absolute zero to open valve
IF6,1 GT[SHUTDOWN] EB	If input 6 is active go to SHUTDOWN routine
EB	End loop
EN	End program



[SHUTDOWN]

OT13,0	Turn off heating element
GH5,5	Open both valves (home)
EN	End program

This same programming example applies to all of our IDeal™ programmable controls.

Automated Force Control

One control, one actuator, is all you need.

Easy-to-Use Controls

The ability to alter program flow based on torque or force limits opens the door to a world of new application solutions. IDC has integrated this feature with its Smart control products without losing their easy-to-use reputation. The following pages clearly illustrate some of the many possibilities and benefits of this capability.

Applications such as drilling, spot welding, pressing, clamping, automated fastening and shuttling each have unique requirements for control of torque not addressed by traditional servo products.

These applications require velocity, position and torque control (or force control when used with a linear system), *all at the same time.* Until IDC Smart Drives were introduced, solutions were often complicated and difficult to integrate.

At IDC, our experience solving torque control applications has led to an integrated, easy-to-program solution. The following pages describe several of these applications and give examples.

Electric Cylinders, Rodless Actuators

IDC electric cylinders and rodless actuators provide quick and easy mechanical solutions to force control applications.

We offer the widest variety of sizes, styles, lengths and mounting options. Our actuators control forces well over a ton.

If we do not have exactly what you need, we can customize a solution to fit your mechanical specifications.

Force Control: Pressing

Typical Applications

- Pressing bearings
  - Ball bearings onto shafts
  - Sleeve bearings into housings
- Inserting pems
- Snapping together plastic parts

Specific Application Needs

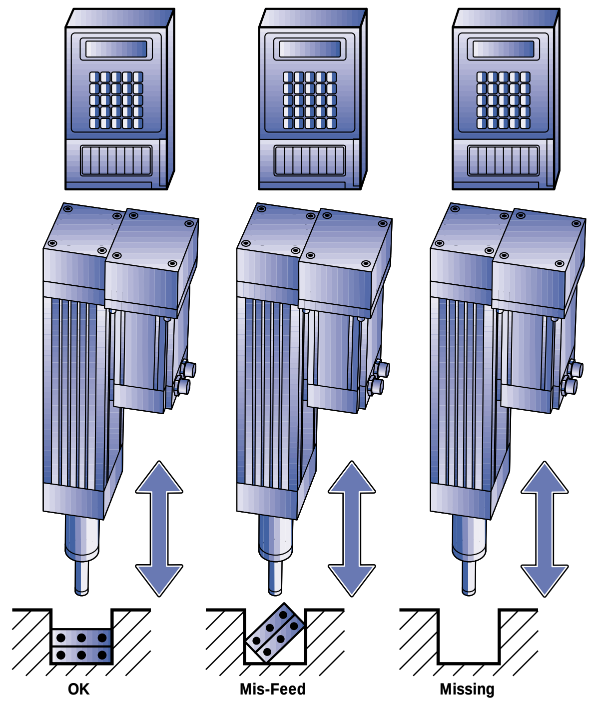
- Precise and repeatable force control.
- Detect if bearing is missing, pressed correctly, or cockeyed.
- Programmable force.
- Protect mechanics.
- Ability to press until an input is made, distance is reached, or time delay is achieved.
- Ability to fire an output to a PLC when the specified current is reached.

IDC Solutions

Our B8961/2 Smart Drives provide consistent control of pressing applications. Bearings are pressed with precisely the force you desire.

By determining how a pressing move ends, our control simplifies your machine solution by detecting when a bearing is not pressed correctly.

This error detection and handling allows you to program solutions to these events, such as reloading a bearing if it was missing or alerting an operator if the bearing goes in cockeyed.



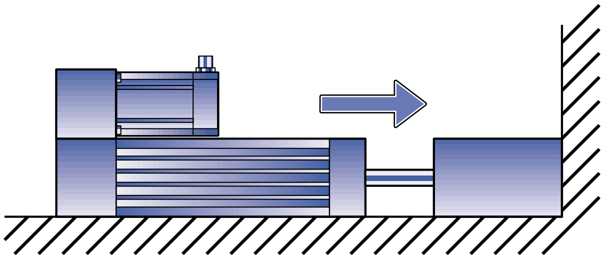
Example Program

[Press]	Name subroutine
(OK)=2 (Missing)=0 (Cockeyed)=1	Define Variable
AC.1	Accelerate in 0.1 sec
VE3	Approach at 3"/sec
CL30	Press at 30% of force
CT1	Press for 1 second
DI5	Stop if not pressed by 5"
GO	Begin the pressing move
IF(CLSTAT1)=(OK) GT[Press] EB	If the press was normal, press another.
IF(CLSTAT1)=(Missing) GT[Reload] EB	If we detect a missing part, reload a bearing
IF(CLSTAT1)=(Cockeyed) GT[Alert] EB	If the bearing goes in wrong, alert the operator

Force Control: Clamping

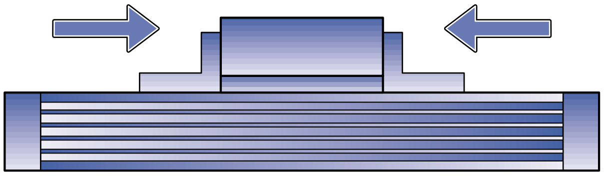
Typical Applications

- Holding part for machining or processing
- Flexible tooling or fixturing
- Shuttling part held with constant force
- Holding parts for cutting or sawing



Specific Application Needs

- Precise and repeatable force control.
- Ability to clamp until a specific event occurs (input, built-in timer, distance is reached, etc.)
- Ability to indicate when object is held (fire an output to a PLC).
- Safety parameters preventing "run-away" due to broken or missing part.
- Ability to "Shuttle" a part while being held with a constant force.



IDC Solutions

Our B8961/2 Smart Drives provide consistent force control in clamping applications.

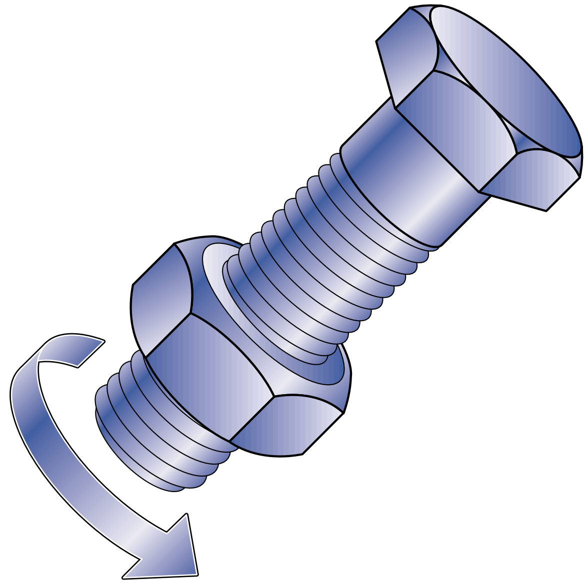
Typical IDC clamping solutions involve only one axis. The object is usually held between a solid structure and an IDC actuator. When the specified clamping force is reached, an output from the IDC Smart Drive (At Current Limit output) can signal the PLC that the part clamped. This allows the clamping operation to be easily synchronized with other machine processes.

IDC also offers some extremely unique clamping solutions using a special rodless actuator. A specially threaded, right hand/left hand lead screw in one of our rodless actuators moves two carriages in and out together in exact mechanical synchronization to clamp parts from both sides.

Example Program

[Clamp]	Name subroutine
AC.3	Accelerate in 0.3 sec
VE3	Set max speed to 3"/sec
ST6,1	Stop clamp if input 6 goes on. A PLC reads the At Current Limit output from the B8961 and stops the clamping move after machining operation is complete
CL70	Clamp at 70% of force
DI4.7	Stop if not clamped by 4.7"
GO	Begin the clamping move

Torque Control: Automated Fastening



Typical Applications
- Driving Screws
- Screwing lids on jars
- Programmable digital torque wrench

Specific Application Needs
- Repeatable and precise torque.
- Non-drifting torque setting.
- Ability to tighten a nut onto a screw, or thread a screw through a nut, until a specific torque is reached.
- Programmable torque setting.
- Eliminate re-calibrating torque wrenches.
- Increased productivity.

IDC Solutions
Nut-running and screw driving applications require fast moves that stop and reverse direction as soon as a specified torque is reached.

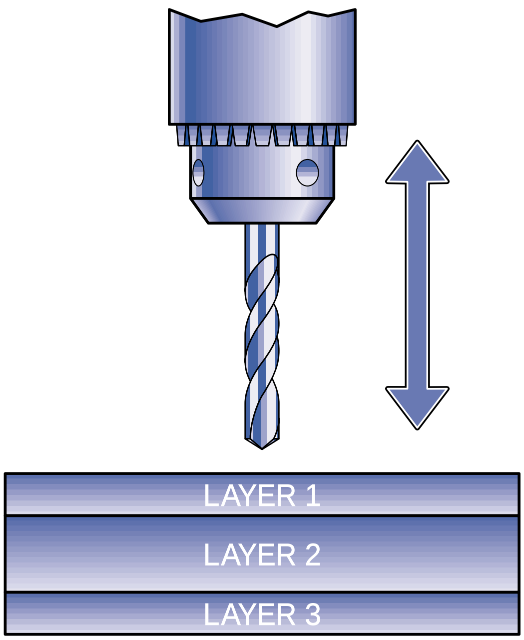
Our B8961/2 Smart Drives provide consistent control of these applications by monitoring the applied torque as a move is made. Programmable torque settings eliminate costly changeover times between setup of different parts.

Our Smart Drive's digital electronics eliminate the need to re-calibrate torque-wrenches that drift over time. Repeatable and precise torque can be set easily.

Example Program

[Running]	Name subroutine
AC.1	Accelerate in 0.1 sec
VE40	Set max speed to 40 rps
CL63	Once 63% of torque is applied
CT.03	Hold for 30 msec and end move
DI5	Set max distance to 5 revs
GO	Begin the move
VE60 DA0 GO	Back out to zero quickly after 63% torque has been applied for 30 ms

Force Control: Drilling



Typical Applications

- Printed Circuit Boards
- Machining Metal
- Wood Working

Specific Application Needs

- Precise speed control
- Indication of worn drill bits.
- Ability to detect “knots” in wood or other materials, preventing broken bits.
- Ability to drill through layered material with different maximum forces and speeds allowed for different layers.
- Rapid approaches to material with constant feed speeds.
- Improved precision of drill holes through preventative maintenance.

IDC Solutions

Our B8961/2 Smart Drives provide consistent control of feed speeds and maximum forces during drilling.

Worn drill bits or knots, if drilling wood, are detected when the control sees the force necessary to feed your drill bit rise above proper levels. When this occurs the control can stop the feed, and indicate to the operator that the drill bit should be changed. The feed force and speed can even be changed at specific positions during the move. This is useful when drilling through different materials of different thicknesses.

Example Program

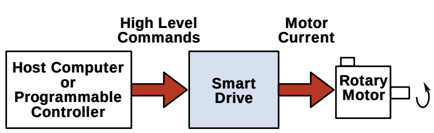
[Drill]	Name subroutine
(Worn)=2	Define variable
AC.1	Accelerate in 0.1 sec
VE5	Set initial speed at 5"/sec
DA1.35	Set drill distance
CL51	Set max force to 51%
CT.1	Stop drilling if max force is exceeded for 0.1 seconds, indicating tool wear or “knot” hit.
DC.7	At layer 2 (0.7 inches)
VE1	Slow down feed of drill bit to 1"/sec
DC1	At layer 3 (1")
VE3	Speed up feed to 3"/sec
GO	Begin the drilling operations
IF(CLSTAT)=(Worn)	If the move ended due to a worn bit,
GT[Change bit] EB	Change the drill bit.
DA0 GO	Return to zero position

Overview

IDC's B8961 (1–axis) and B8962 (2–axes) Brushless Servo Smart Drives are user friendly systems that offer you many compelling features and benefits. Consider these systems when your motion control application requires:

- A well integrated motion controller, digital servo drive, operator interface, power supply, 30 I/O, and built in Opto I/O rack
- CE cULus compliant
- A sophisticated servo controller capable of controlling position, velocity, and force/torque simultaneously. This capability makes the B8961/2 an ideal solution for clamping, pressing, drilling, and automated fastening applications
- A simple Machine Controller
- Interrupts
- Configurable I/O
- Linear Interpolation, and Registration
- Coordinated motion between two axis
- Go Immediate Mode. This mode of operation allows the controller to multitask between motion control and I/O operations. Immediate Mode also allows each axis to move completely independently of the other axis
- 1–99 axes of immediate control via host RS-232C communication
- Optional analog I/O for:
  - Reading an analog input proportional to temperature, distance, pressure, or force
  - Setting an analog output to control position of another axis of motion (for use with a D2500, H3501/4501, or B8501 analog position controls)

Compatible Actuators:
EC2-B, EC3-B, EC4-B, EC5-B, N2-B, NV-BN, R2A-BN, R3-B, R4-B, LM, LD Positioning Tables



Optional Keypad

- Both a programming and a operator interface
- Menu-driven setup, tuning, Help Function, Diagnostic Screens, Trace Mode-easy set up, troubleshooting and program debugging
- Easy to read 40 character display
- Keypad is protected to Nema 4 (IP65) when panel mounted

Drive Performance

- The B8961 and B8962 features the same outstanding dynamic performance and reliability as our DSP based B8001 digital brushless servo drive, described on page H-11

Motion Control

- 6K memory for up to 199 user programs (30K, 400 programs optional)
- User scaling of position, velocity, and acceleration
- Descriptive variables, math and conditional branching
- High Speed interrupt driven inputs–registration
- B8962–linear interpolated vector moves
- IDCMotion™ Windows Application Developer software included. See page H-26.

Opto Compatible I/O

- Accepts OPTO–22 (G4) digital modules and Grayhill (G5) analog and temperature modules
- 100% solid state, opto–isolation to 4000 volts
- 8 positions, all bidirectional
- Specify (intermix) Opto I/O modules: for AC, DC, analog, and temperature signals

Specifications

Common Specifications

Input Power — 90-240 VAC single phase, 50/60 Hz. 1150 VA Max @115 VAC, 2300 VA max @230 VAC. (B8962: X 2).

Motor Output

Current Capability	5A continuous, 10A peak
Protection	Protected against phase-to-phase shorts and shorts to ground. Fused.
Power Dump Capacity	See page H-40 for details.

Encoder Input

Type	Differential quadrature incremental encoder, with or without index
Maximum Rate	2MHz (post-quadratune)
Power	+5V @ 200 mA power encoder

Diagnostic Output

Format	0 to 5V analog signal (centered at 2.5V)
Variables	Configurable as actual, and commanded velocity; position error; velocity error; actual, and commanded torque—programmable scaling

Serial Interface — RS-232C, 3 wire implementation (Tx, Rx, & Com), 9600 Baud, 8 data bits, 1 stop bit, no parity.

Environmental

Operating Temperature	Shutdown occurs if heat-sink exceeds 55°C (131°). This temperature is a function of motor current, regen and ambient temperature. Some applications may require FK fan kit. See page H-39.
Humidity	0% to 90% non-condensing

Additional B8961 & B8962 Specifications

Motion

Position Range	±0-2,147,483,647 steps. Absolute and incremental.
Acceleration Range	0.01 to 999.99 rev/sec/sec
System Resolution	8,000 counts per revolution (IDC supplied motors)

OPTO-compatible I/O — 8 Positions support OPTO-22 (G4) digital, Grayhill (G5) analog and temperature modules

Analog Opto Module	
Resolution	12 bits
Bandwidth	62.5 Hz

Inputs

8 programmable, Limits, Home	Optically isolated, 24 VDC compatible (via pull up terminal—disconnect jumper to 12 VDC), 12 mA sinking current required.
Incremental Encoder	Optically isolated, differential 5 VDC, 2 MHz max (post-quadrature). 5VDC, 200mA power available.

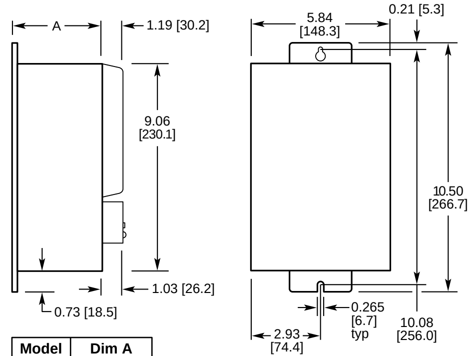
Outputs

8 Programmable	Open collector, sink current 100 mA max. Total of 350 mA for all I/O.

Mounting Dimensions

(B8961 and B8962)

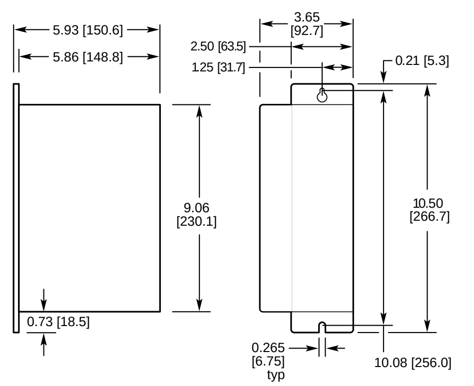
Minimum Depth Mounting in [mm]



Model	Dim A
B8961	3.73 [95.7]
B8962	6.79 [172.5]

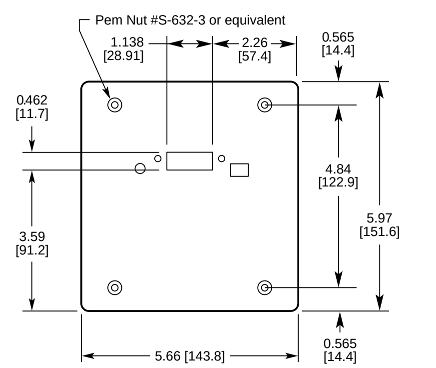
Minimum Width Mounting in [mm]

(B8961 only, front panel and opto modules removed)



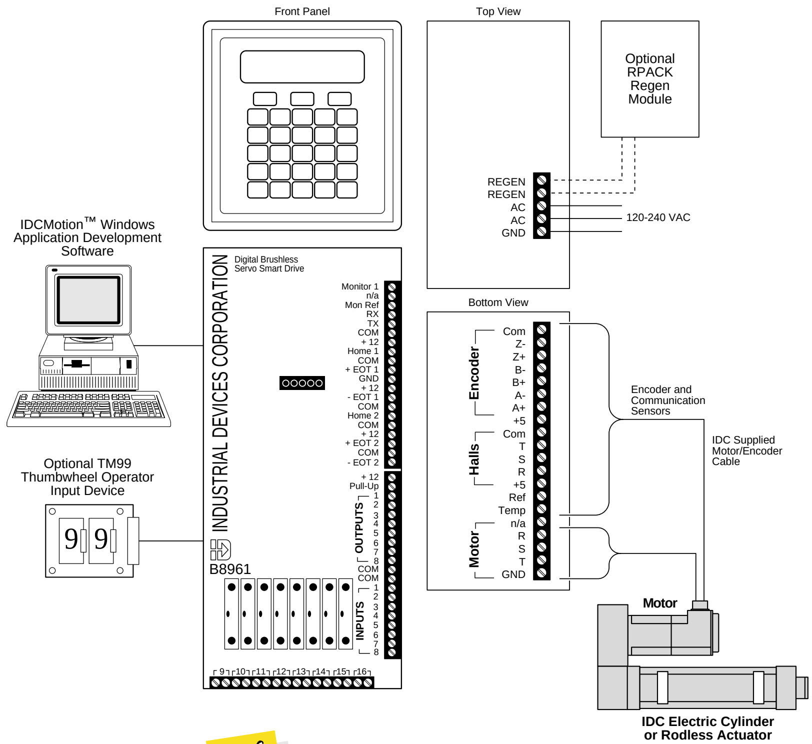
Remote Mounting

Front Panel (rear view) in [mm]



Brushless Servo Systems

Operation



How To Order

Model	Description	Code I/O Module Description		Option	Description
		Position 1 2 3 4 5 6 7 8			
B8961	1-axis unit, with FP220 front panel	A	DC/AC In, 10-32 VDC, 12-32 VAC	-LMTR	For operation with an IDC Linear Motor
B8962	2-axis unit, with FP220 front panel	B	DC In, TTL	-FK1	Fan Kit, 115 VAC See page H-39.
B8961NP	1-axis unit, no front panel	C	DC In, 35-60 VDC	-FK2	Fan Kit, 230 VAC See page H-39.
B8962NP	2-axis unit, no front panel	D	AC In, 90-140 VAC	-30K	30K user program memory
		E	AC In, 180-240 VAC		
		F	DC Out, 5-60 VDC, 3 Amps		
		G	AC Out, 12-140 VAC, 3 Amps		
		H	AC Out, 24-280 VAC, 3 Amps		
		I	Input test switch		
		J	Analog In, 0-10 VDC		
		K	Analog In, 4-20 mA		
		L	Analog Out, 0-10 VDC		
		M	Analog Out, 4-20 mA		
		N	J Thermocouple In, 0-700°C		
		O	K Thermocouple In, -100-924°C		
		P	RTD In, 100 Ohm		
		X	Empty		

Accessories

RPACK-1, 115 VAC Operation	External regenerative power dissipation module. See page H-40.
RPACK-2, 230 VAC Operation	External regenerative power dissipation module. See page H-40.
FP220	Operator interface, front panel. See page H-41.
TM99	Thumbwheel input module. See page H-42.

To confirm your selection, review the checklist on page H-6.

Specifications

IDC controls are designed for convection cooling. The shape and size of our heatsinks are the result of thermal analysis and experimentation.

All of our controls have built-in temperature protection. Thermal sensors inside the B8000 controls will activate at a conservative heatsink temperature of 55°C. Thus, IDC controls will not be damaged when overtemperature conditions occur.

A number of factors affect the internal temperature of a control and whether or not it needs additional cooling:

- Ambient temperature
- Air flow
- Duty cycle
- Power delivered (the RMS current output)
- Number of axes per control
- Regenerative energy returned from the load
- Bus voltage (B Series)

Adequate ventilation in the enclosure does a lot to cool our controls. Most often, a single fan in your enclosure or panel will circulate enough air.

When is a Fan Kit Needed?

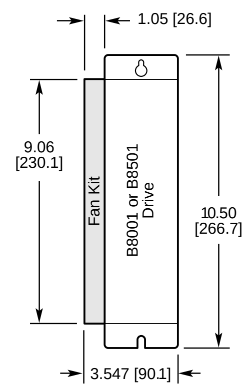
Here are a few general guidelines to indicate when a fan kit may be necessary for your high performance application.

B Series Controls:

- With high regenerative loads that do not require an RPACK. See page H-40.
- Vertical, high friction, or clamping applications

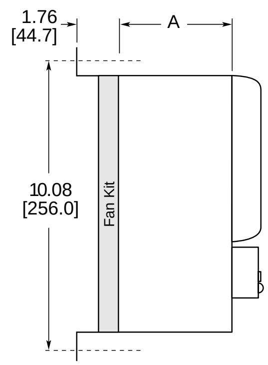
Dimensions in [mm]

Front View (B8001, B8501)



Side View (B8961, B8962)

See page H-37 for complete mounting dimensions for the B8961/2



Model	A
B8961	3.73 [94.7]
B8962	6.79 [179.5]

How To Order

Model	Description
FANKIT-1	120 VAC Fan Kit
FANKIT-2	230 VAC Fan Kit

The Fan Kit is available as an option on the controls listed above by adding an -FK1 or -FK2 suffix to the control model number.

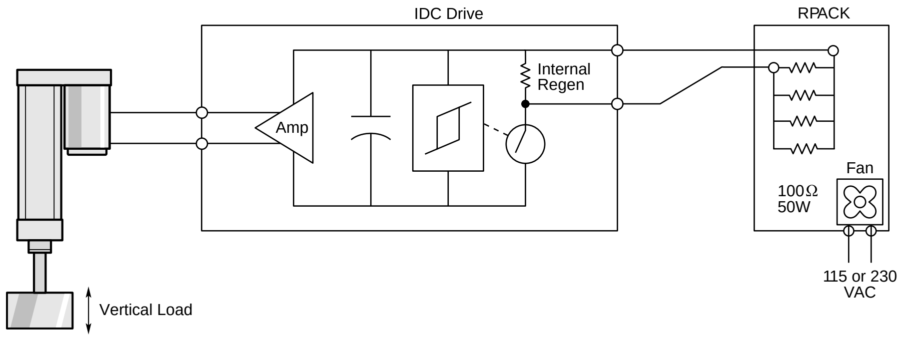
If you are in doubt as to whether a fan kit will be needed for your application, simply leave sufficient panel space for the control with fan kit and test the control without a fan. If your control requires forced air cooling, the fan kit can be purchased separately and easily retrofitted in the field.

Specifications

When a large inertial load is decelerated or a vertical load is lowered, the mechanical energy that is not dissipated as heat in the actuator or drive is “regenerated” by the motor and transferred back into the drive’s power supply. This causes the drive's power supply voltage to increase. Without circuit protection, this voltage increase can damage a drive. Without a means of dissapating this energy, such applications cannot be solved.

All IDC servo drives are fully protected against excessive regenerative energy. First, they are overvoltage and short circuit protected. Second, they are capable of dissipating regenerative energy both internally, and in extreme cases, externally using our model RPACK-1 or RPACK-2. Our drive’s LEDs will even indicate when excessive regenerative energy is present in your application.

An RPACK allows you to make more aggressive moves in high inertia, low friction applications. Each RPACK provides connections for hook-up to either servo or stepper drives for a total dissipation of 240W continuous and 1000W peak (for 3 seconds).

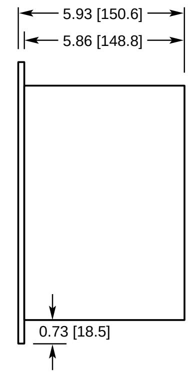


Regen Capacity (watts or joules)

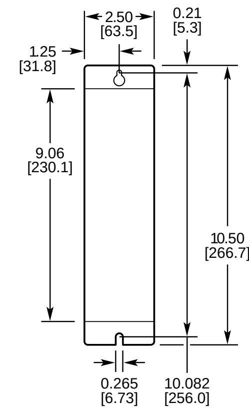
Regen Capacity (watts or joules)	B8000 Series
Internal without fan	Total energy storage capacity (max)
Continuous	70 joules (1 axis)
Peak (3 sec)	140 joules (2 axis)
Internal with fan	
Continuous	70 joules (1 axis)
Peak (3 sec	140 joules (2 axis
RPACK (additional)	
Continuous	240 watts
Peak (3 sec)	1,000 watts
When to use an RPACK-1 or RPACK-2	If drive faults due to overvoltage If load is vertical with ballscrew If decelerating large inertial loads

Dimensions in [mm]

Side View



Front View



How To Order

Model	Description
RPACK-1	115 VAC Operation
RPACK-2	230 VAC Operation

Specifications

All of IDC's programmable Smart Drives and stand-alone motion controllers, which use the IDeal™ programming language, can be programmed and operated from the FP220 removable front panel (keypad). The FP220 makes a great operator-machine interface, as it provides the user with many features and benefits. Some of the features of the FP220 are:

- Remote mountable
- Menu-driven set up and Help
- NEMA 4 (IP65) standard
- Scratch-proof, large keys
- Easy to read, backlit 2 line, 40 character display
- Displays current position and I/O status
- Great for machine diagnostics and troubleshooting
- See page H-37 for mounting information.

Keypad Menus and Functions

RUN

- PROGRAM: Run programs by *name* or number.
- JOG: Jog at low or high speeds using submenu and arrow keys
- TRACE: De-bug tool. Runs a program one command at a time.

EDIT

- PROGRAM: Edit programs. Most commands are listed on the keypad.
- SETUP: Define system environment and operating limits.
- LIST: Directory of stored programs, memory usage and available space.
- TEACH: Teach positions

HELP

- At Main Menu: Provides help on the function of each key.
- At Menu: Provides help on how to move about menus.
- At Submenus: Explains setup choices and how to select an option.
- In Editor: Command descriptions, with syntax.

COPY

- PROGRAM: Copies programs within a control.

DEL

- PROGRAM: Deletes a program.

SETUP:

- Motor: Select motor model
- Mechanics: Scale acceleration, velocity, distance, coordinate system and gear ratio.
- I/O: Set up I/O and OPTO module functions.
- Jog: Set Jog acceleration, velocities, and allow Jog access from run menu.
- Home: Set type of home switch and offset position.
- Prog: Select program to run on power up and how to scan program select inputs.
- Enc: Select open/closed loop mode, encoder resolution and following error
- RS-232C: Set RS-232C parameters.
- Misc: Set useful tools like display mode, stop-rate and faults and shutdown polarity.

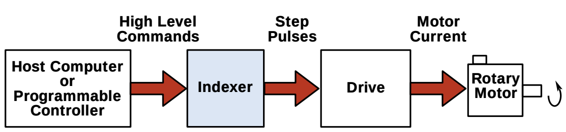
How To Order

Model	Description
FP220	Removable front panel; comes with 6-ft* communications cable
	* Longer cables are available.

Overview

IDC's 961 (single axis) and 962 (two axis) indexers output step and direction or CW/CCW control signals to one or more drives. The 961 and 962 use IDC's IDeal™ command language, insuring a user-friendly programming environment. These indexers can be used with any stepper drive or any digital servo drive that accepts an industry standard step and direction control signal (either differential or single ended). Consider the 961/2 for your motion control application when you require:

- A mix of servo and stepper drives. The 962 is an ideal solution when your application requires coordinated motion between two axis: one of which requires a high power brushless servo, and the other requires a low power stepper.
- Multiple drives to be run from one command signal. This is very useful when an application calls for multiple drive/motor systems to always do identical moves.
- The motion controller to be separate from the drive for E-Stop reasons. Using a 961/2 with a separate drive allows power to be cut from the drive without cutting power to the motion controller.
- A non-IDC drive/motor system, but would like to implement a user friendly motion controller.



Drive Compatibility

The 961 and 962 easily interface to a wide variety of step motor, and digital servo, drives which accept industry standard step and direction control signals. The 961/2 accept incremental encoder feedback, providing closed loop, and stall detect features. The frequency range of the 961/2's step output signal allows you to control drives ranging from the simplest full–step step motor drive to high speed digital brushless servo drives.

Opto–Compatible I/O

- Accepts Opto-22 (G4) digital modules and Grayhill (G5) analog and temperature modules.
- 100% solid state, opto–isolation to 4000 volts
- 8 positions, all bidirectional
- Specify (intermix) factory installed AC, DC, and analog I/O modules

Optional Keypad

- Both a programming and operator interface
- Menu–driven setup, help functions, diagnostic screens, and trace mode to facilitate easy setup, programming and troubleshooting
- Easy to read, backlit 40 character display
- Commands listed on keys for easy reference
- Attaches to the control or mounts remotely
- Keypad is NEMA 4 (IP65) when panel mounted

Motion Control

- 6k of memory for up to 199 user programs (30k, 400 programs optional)
- Up to 2 axis of incremental encoder feedback
- User scaling of position, velocity, and acceleration
- Variable math and conditional branching
- IDCMotion™ Windows Application Developer software included
- 50K resolution

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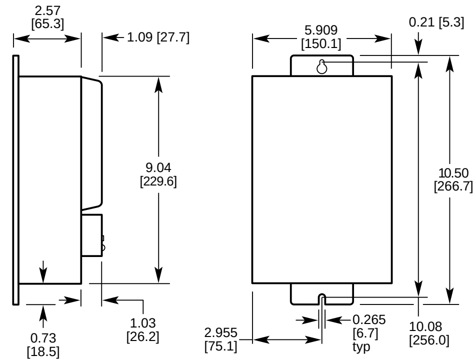
Specifications

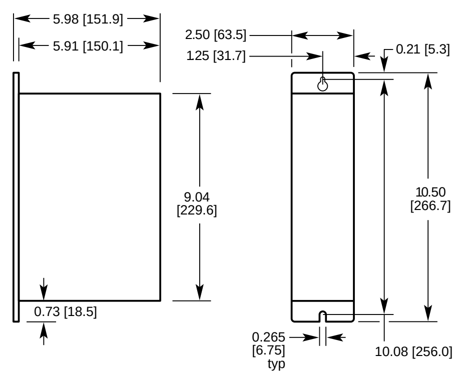
Input Power	120 VAC single phase, 50/60 Hz 2.0 Amps max.
Serial Interface	RS-232C, 3 wire implementation (Tx, Rx and Gnd), 9600 Baud, 8 data bits, 1 stop bit, no parity.
Environmental	
Ambient Temperature	0–50°C.
Humdity	0% to 90% non-condensing.
Drive Signals	
Step, Direction & Shutdown Outputs	Optically isolated. Low signal <0.8 VDC, high signal >3.5 VDC, ±60 mA. Active high. Step pulse width is 0.8 to 10msec (depending on drive resolution setting).
Drive Fault Input	Optically isolated, TTL level, internal 1.0k pull-up to +5 VDC.
Position Range	±0-2,147,483,647 steps. Absolute and incremental
Velocity Range	1 to 1,250,000 steps/sec
Acceleration Range	1 to 20,000,000 steps/sec²
OPTO-compatible I/O	8 Positions support OPTO-22 (G4) digital, and Grayhill (G5) analog and temperature modules (see ordering information).
Inputs	
8 Programmable, Limits, Home	24 VDC max, Optically isolated, can be pulled up to internal isolated 12VDC supply. 12 mA current required.
Incremental Encoder	Optically isolated, differential 5VDC, 2 MHz max (post-quadrature). 5VDC, 200mA power available total.
Outputs	
8 Programmable	Open collector, sink current 100 mA max
Programming	IDeal™ programming language. Program from the front panel, or via your PC using our Windows-compatible IDCMotion™ Application Developer software (included).

Minimum Depth Mounting Dimensions in [mm]

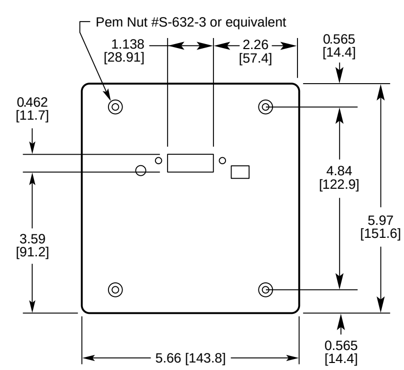


Minimum Width Mounting Dimensions in [mm]

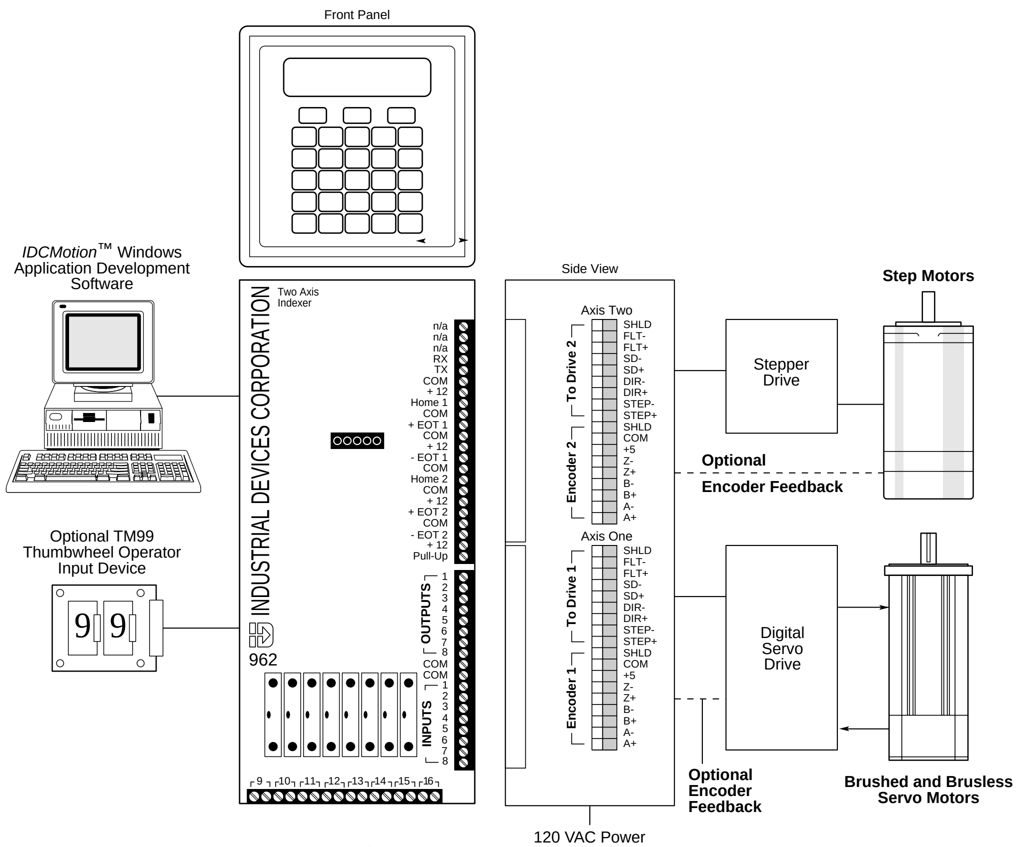
Front panel and opto modules removed.



Remote Mounting Front Panel (rear view) in [mm]



Operation



How To Order

Model	Description
961	1-axis unit, with front panel
962	2-axis unit, with front panel
961NP	1-axis unit, no front panel
962NP	2-axis unit, no front panel

Code Position: 1 2 3 4 5 6 7 8

Code	I/O Module Description
A	DC/AC In, 10-32 VDC, 12-32 VAC
B	DC In, TTL
C	DC In, 35-60 VDC
D	AC In, 90-140 VAC
E	AC In, 180-240 VAC
F	DC Out, 5-60 VDC, 3 Amps
G	AC Out, 12-140 VAC, 3 Amps
H	AC Out, 24-280 VAC, 3 Amps
I	Input test switch
J	Analog In, 0-10 VDC
K	Analog In, 4-20 mA
L	Analog Out, 0-10 VDC
M	Analog Out, 4-20 mA
N	J Thermocouple In, 0-700°C
O	K Thermocouple In, -100-924°C
P	RTD In, 100 Ohm
X	Empty

Option	Description
-30K	30K user program memory

Accessories

TM99	Thumbwheel input module. See page H-42.

To confirm your selection, review the checklist on page H-6.

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Overview

B Series Features

- 17, 23, 34 and 42 frame brushless servo motors
- Optimized for use with IDC's B8000 servo controls
- High Torque-to-inertia ratio for quick acceleration
- Rugged MS-style connectors, 12-ft quick-disconnect cables included

BN Series Features

- 23 and 34 frame brushless servo motors
- True NEMA dimensions (including motor shafts)
- Smooth operation/low cogging
- 12-ft jacketed cables included

Brushless Motor Comparison

	Continuous Stall Torque oz-in [N-m]	Peak Torque oz-in [N-m]	Max Speed @ 115 VAC rps [rpm]	Max Speed @ 230 VAC rps [rpm]	For Complete Motor Specs, see:
B12	24 [0.17]	63 [0.44]	100 [6000]	NA	H-53
B23	160 [1.13]	580 [4.09]	63 [3780]	100 [6000]	H-54
B23H	160 [1.13]	480 [3.39]	76 [4560]	100 [6000]	H-55
B32	493 [3.48]	853 [6.02]	37 [2220]	74 [4440]	H-56
B33	624 [4.41]	1792 [12.65]	20 [1200]	41 [2460]	H-57
B40	488 [3.45]	1328 [9.38]	27 [1620]	55 [3300]	H-58
B41	930 [6.57]	1616 [11.41]	20 [1200]	39 [2340]	H-59
B42	1328 [9.38]	4032 [28.47]	9 [540]	18 [1080]	H-60
BN21	22 [0.15]	70 [0.49]	100 [6000]	N/A	H-49
BN23	51 [0.36]	170 [1.2]	100 [6000]	N/A	H-50
BN31	108 [0.76]	320 [2.26]	79 [4750]	N/A	H-51
BN32	191 [1.35]	560 [3.96]	61 [3700]	N/A	H-52

How To Order

Motor Models	Description
B12	B12 motor w/ 12-ft quick-disconnect cable
B23	B23 motor w/ 12-ft quick-disconnect cable
B23H	B23H motor w/ 12-ft quick-disconnect cable
B32	B32 motor w/ 12-ft quick-disconnect cable
B33	B33 motor w/ 12-ft quick-disconnect cable
B40	B40 motor w/ 12-ft quick-disconnect cable
B41	B41 motor w/ 12-ft quick-disconnect cable
B42	B42 motor w/ 12-ft quick-disconnect cable

Options	Description
-B	24 VDC motor brake
-C25	25-foot cable
-C50	50-foot cable
-C100	100-foot cable

Motor Models	Description
BN21	BN21 motor with 12-foot jacketed cable
BN23	BN23 motor with 12-foot jacketed cable
BN31	BN31 motor with 12-foot jacketed cable
BN32	BN32 motor with 12-foot jacketed cable

Note: Currently, no options are available for the BN motors.

To confirm your selection, review the checklist on page H-6.

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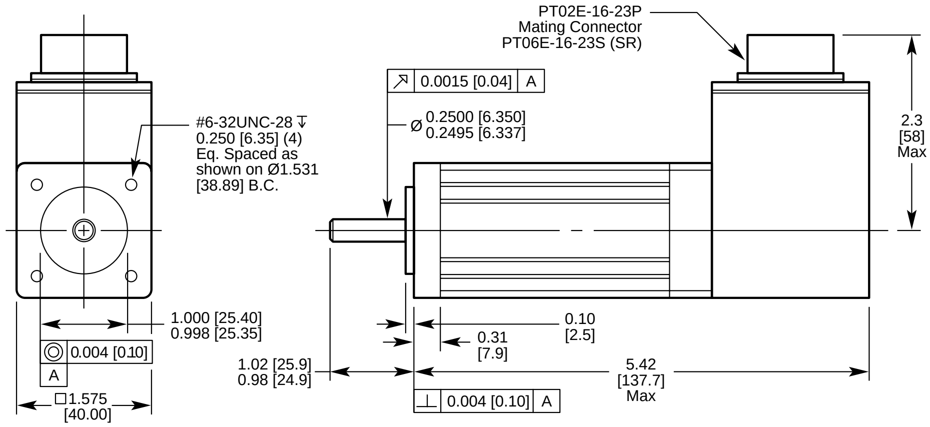
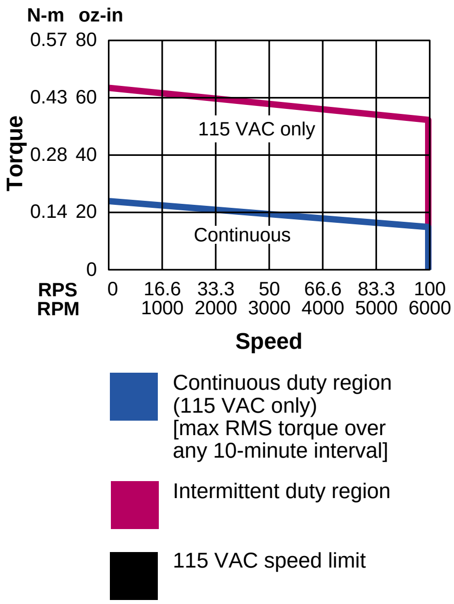
- For operation over 6000 rpm, consult IDC Applications Engineering.
- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin, and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 1.0 in [25 mm] to motor length.





System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	24 [0.169]
Peak oz-in [N-m]	63 [0.445]
Peak Shaft Power @ 115 VAC HP [W]	0.42 [313]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	23.7 [0.167]
Back EMF, $V_{p\text{-}p}$/kRPM*	17.5

* ±10% tolerance

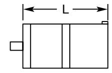
Motor Data

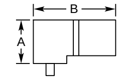
Rotor Inertia oz-in-sec^2 [kg-m]^2	0.000576 [4.07 x 10^{-6}]
Weight lb [kg]	1.51 [0.68]
Axial Shaft Loading lb [kg]	5 [2.27]
Radial shaft loading lb [kg] @ 1 in [25 mm]	10 [4.54]
Incremental encoder	1000 line, 4000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

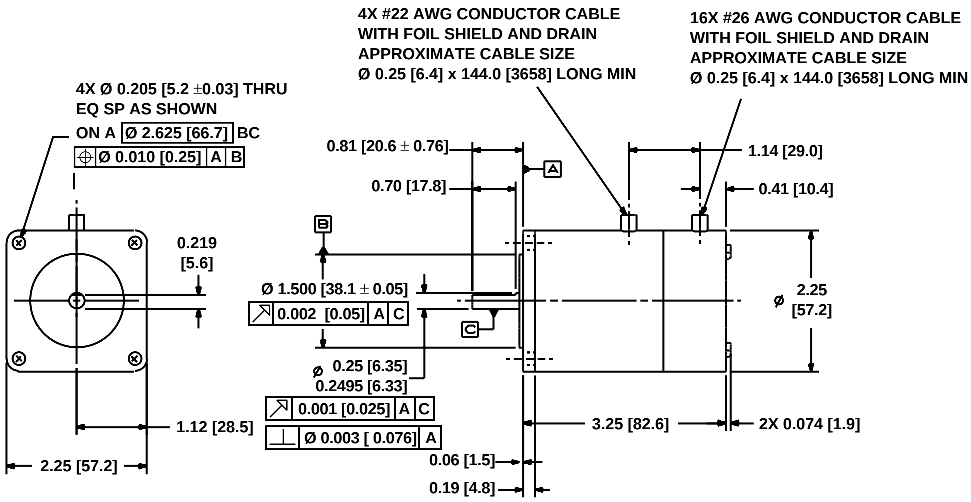
Performance Planetary Gearmotors

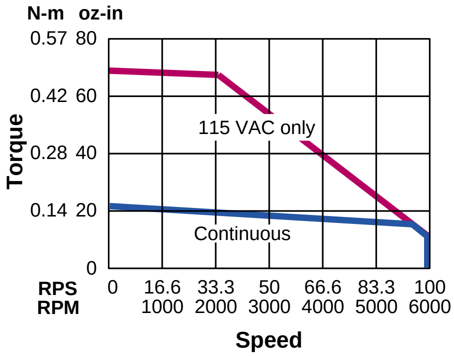
In-line 

Right-angle 

Gear Ratio in [mm]	L	A x B
3 to 10	8.05 [204.5]	2.79 x 10.39 [70.9 x 263.9]
16 to 100	8.58 [217.9]	2.79 x 10.93 [70.9 x 277.6]
160 to 700	9.19 [233.4]	Above 100:1, not available

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin, and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.





Continuous duty region (115 VAC only) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	22 [0.15]
Peak oz-in [N-m]	70 [0.49]
Peak Shaft Power @ 230 VAC HP [W]	0.17 [126]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	27.3 [0.193]
Back EMF, V_{p-p}/kRPM*	20.2

* ±10% tolerance

Motor Data

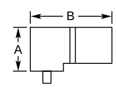
Rotor Inertia oz-in-sec^2 [kg-m]^2	0.00286 [2.03 x 10^{-5}]
Weight lb [kg]	1.3 [0.6]
Axial Shaft Loading lb [kg]	25 [111]
Radial shaft loading lb [kg] @ 0.5 in [12.7 mm]	5.6 [25]
Incremental encoder	1000 line, 4000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

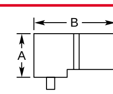
In-line **Right-angle**



Gear Ratio in [mm]	L	A x B
3 to 10	6.01 [152.7]	3.61 x 9.74 [91.7 x 247.4]
16 to 100	6.84 [173.7]	3.61 x 10.57 [91.7 x 268.5]
160 to 700	7.63 [193.8]	Above 100:1, not available

Value Planetary Gearmotors

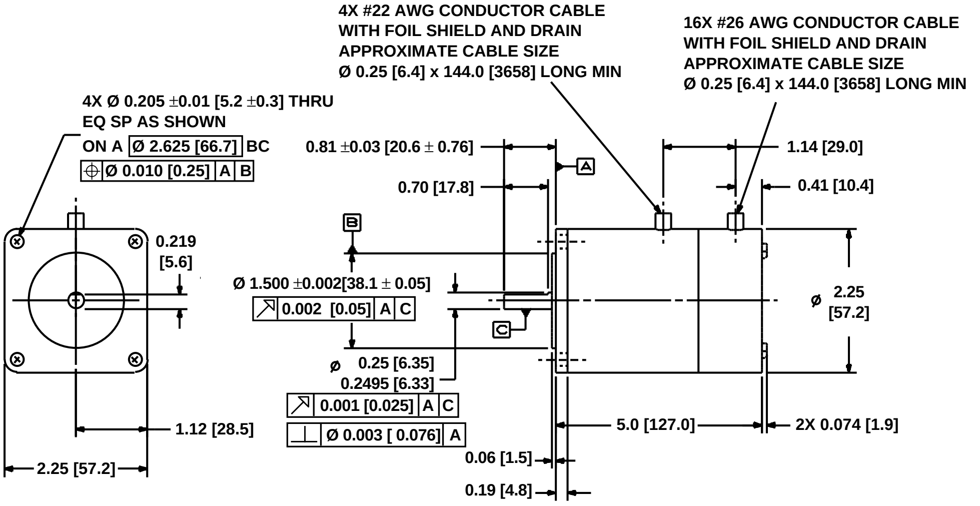
In-line **Right-angle**

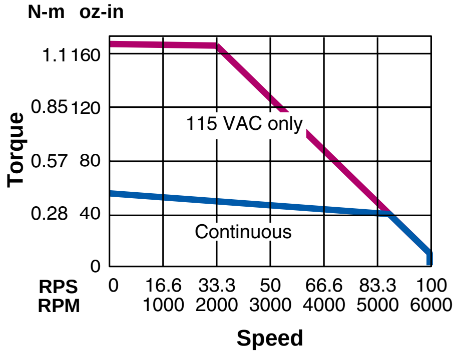


Gear Ratio in [mm]	L	A x B
3 to 10	6.36 [161.5]	3.61 x 10.03 [91.7 x 254.8]
16 to 100	7.27 [184.7]	3.61 x 10.93 [91.7 x 277.6]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.





Continuous duty region (115 VAC only) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	51 [0.36]
Peak oz-in [N-m]	170 [1.2]
Peak Shaft Power @ 230 VAC HP [W]	0.41 [306]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	32.6 [0.23]
Back EMF, V_{p-p}/kRPM*	24.1

* ±10% tolerance

Motor Data

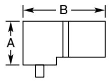
Rotor Inertia oz-in-sec² [kg-m]²	0.00715 [5.06 x 10^{-5}]
Weight lb [kg]	2.9 [1.3]
Axial Shaft Loading lb [kg]	25 [111]
Radial shaft loading lb [kg] @ 0.5 in [12.7 mm]	5.6 [25]
Incremental encoder	1000 line, 4000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

In-line

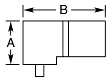


Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	7.76 [197.1]	3.61 x 11.49 [91.7 x 291.8]
16 to 100	8.59 [218.2]	3.61 x 12.32 [91.7 x 312.9]
160 to 700	9.38 [238.3]	Above 100:1, not available

Value Planetary Gearmotors

In-line



Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	8.11 [206]	3.61 x 11.78 [91.7 x 299.2]
16 to 100	9.02 [229.1]	3.61 x 12.68 [91.7 x 322.1]

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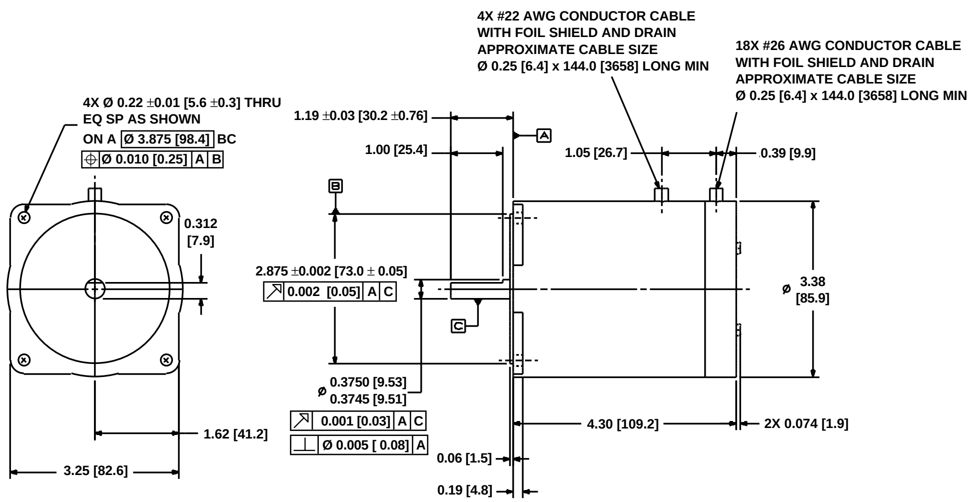
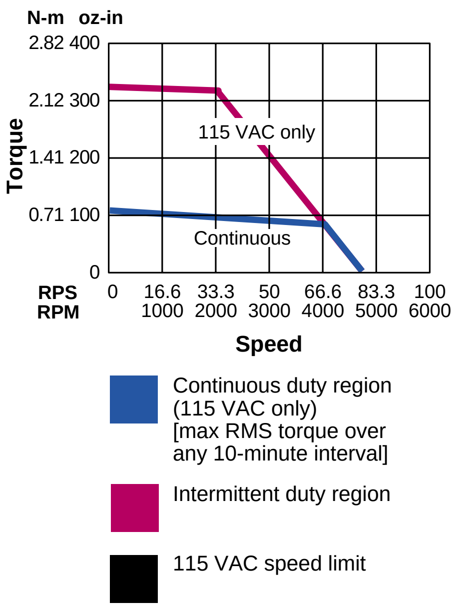
- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin, and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.





System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	108 [0.76]
Peak oz-in [N-m]	320 [2.26]
Peak Shaft Power @ 230 VAC HP [W]	0.66 [490]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	41.8 [0.295]
Back EMF, V_{p-p}/kRPM*	30.9

* ±10% tolerance

Motor Data

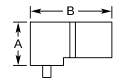
Rotor Inertia oz-in-sec² [kg-m]²	0.0139 [9.84 x 10⁻⁵]
Weight lb [kg]	4.4 [2]
Axial Shaft Loading lb [kg]	50 [222]
Radial shaft loading lb [kg] @ 0.5 in [12.7 mm]	14.5 [64.4]
Incremental encoder	1000 line, 4000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

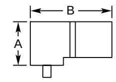
In-line | Right-angle



Gear Ratio in [mm]	L	A x B
3 to 10	8.49 [215.7]	5.20 x 13.46 [132.1 x 341.9]
16 to 100	9.61 [244.2]	5.20 x 14.59 [132.1 x 370.6]
160 to 700	10.84 [275.3]	Above 100:1, not available

Value Planetary Gearmotors

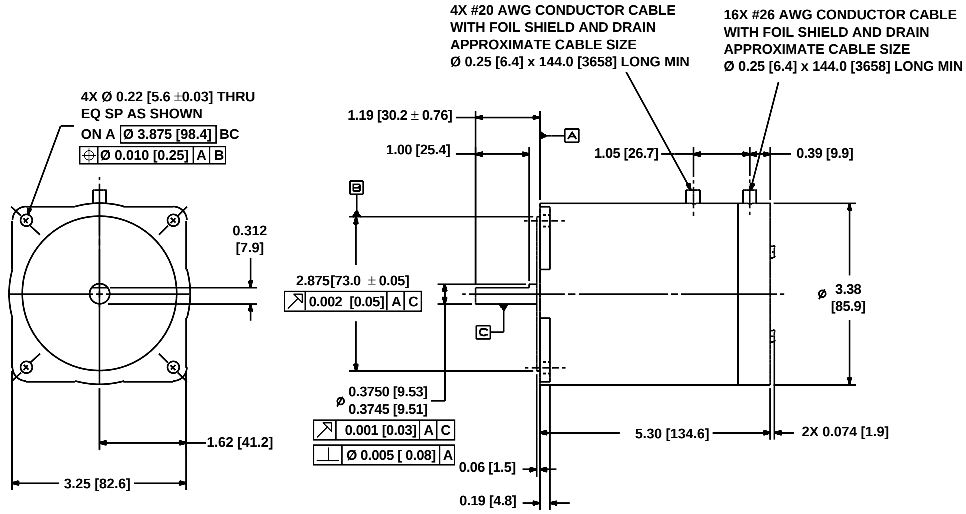
In-line | Right-angle

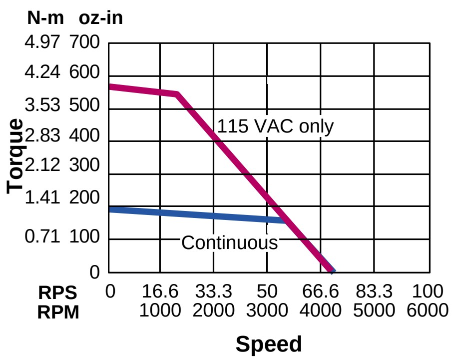


Gear Ratio in [mm]	L	A x B
3 to 10	8.86 [225.1]	5.20 x 13.83 [132.1 x 351.3]
16 to 100	10.12 [257.1]	5.20 x 15.10 [132.1 x 383.5]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.





Continuous duty region (115 VAC only) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	191 [1.35]
Peak oz-in [N-m]	560 [3.96]
Peak Shaft Power @ 230 VAC HP [W]	0.89 [665]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	54.9 [0.388]
Back EMF, V_{p-p}/kRPM*	40.6

* ±10% tolerance

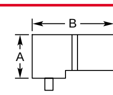
Motor Data

Rotor Inertia oz-in-sec² [kg-m]²	0.0193 [1.37 x 10^{-4}]
Weight lb [kg]	6 [2.8]
Axial Shaft Loading lb [kg]	50 [222]
Radial shaft loading lb [kg] @ 0.5 in [12.7 mm]	14.5 [64.4]
Incremental encoder	1000 line, 4000 counts/rev

Applying Gearmotors*

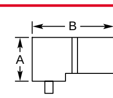
- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors



Gear Ratio in [mm]	In-line L	Right-angle A x B
3 to 10	9.49 [241.1]	5.20 x 14.46 [132.1 x 367.3]
16 to 100	10.61 [269.5]	5.20 x 15.59 [132.1 x 396.0]
160 to 700	11.84 [300.7]	Above 100:1, not available

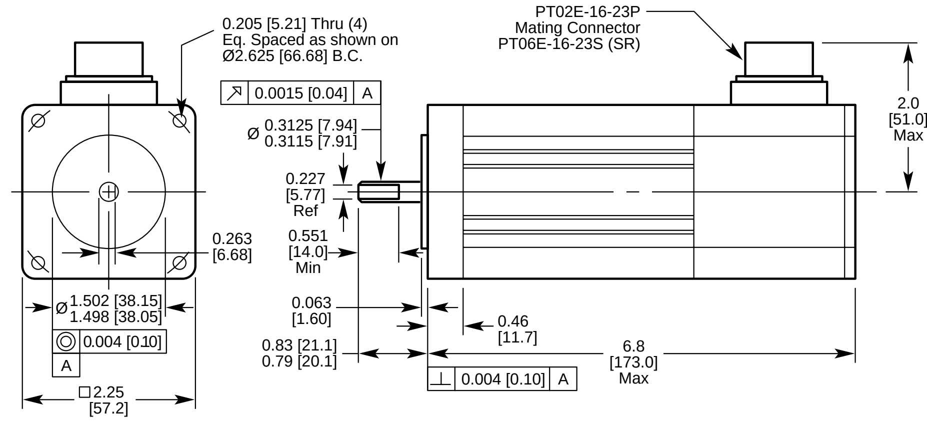
Value Planetary Gearmotors

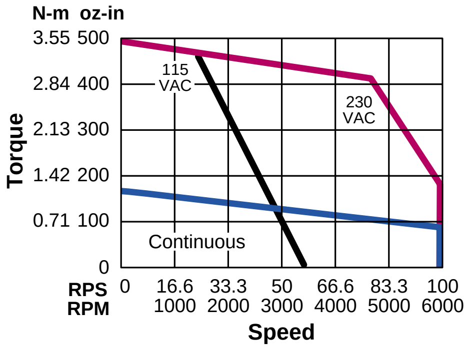


Gear Ratio in [mm]	In-line L	Right-angle A x B
3 to 10	9.86 [250.4]	5.20 x 14.83 [132.1 x 376.7]
16 to 100	11.12 [282.4]	5.20 x 16.10 [132.1 x 408.9]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 1.2 in [31 mm] to motor length





- Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]
- Intermittent duty region
- 115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	160 [1.13]
Peak oz-in [N-m]	500 [3.53]
Peak Shaft Power @ 230 VAC HP [W]	1.8 [1345]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	58 [0.409]
Back EMF, $V_{p\text{-}p}$/kRPM*	42.9

* ±10% tolerance

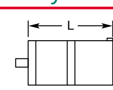
Motor Data

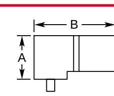
Rotor Inertia oz-in-sec² [kg-m]²	0.0025 [1.8 x 10⁻⁵]
Weight lb [kg]	4.0 [1.8]
Axial Shaft Loading lb [kg]	15 [6.8]
Radial shaft loading lb [kg] @ 1 in [25 mm]	20 [9.1]
Incremental encoder	2000 line, 8000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

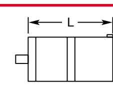
Performance Planetary Gearmotors

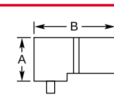
In-line


Right-angle


Gear Ratio in [mm]	L	A x B
3 to 10	9.56 [242.8]	3.61 x 13.29 [91.7 x 337.6]
16 to 100	10.39 [263.9]	3.61 x 14.12 [91.7 x 358.6]
160 to 700	11.18 [284.0]	Above 100:1, not available

Value Planetary Gearmotors

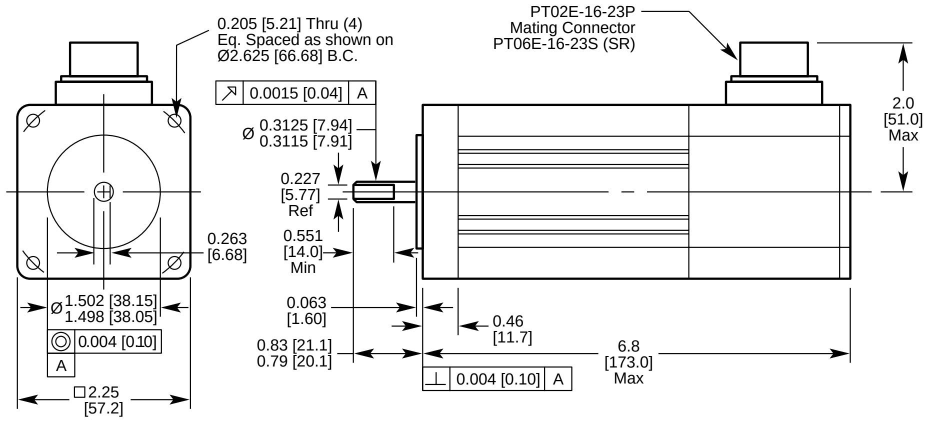
In-line


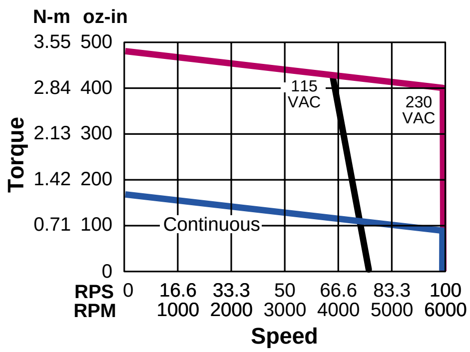
Right-angle


Gear Ratio in [mm]	L	A x B
3 to 10	9.91 [251.7]	3.61 x 13.58 [91.7 x 344.9]
16 to 100	10.82 [274.8]	3.61 x 14.48 [91.7 x 367.8]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 1.2 in [31 mm] to motor length





Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	160 [1.13]
Peak oz-in [N-m]	480 [3.39]
Peak Shaft Power @ 230 VAC HP [W]	1.9 [1420]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	48 [0.339]
Back EMF, $V_{p\text{-}p}$/kRPM*	35.5

* ±10% tolerance

Motor Data

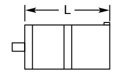
Rotor Inertia oz-in-sec^2 [kg-m]^2	0.0025 [1.8 x 10^{-5}]
Weight lb [kg]	4.0 [1.8]
Axial Shaft Loading lb [kg]	15 [6.8]
Radial shaft loading lb [kg] @ 1 in [25 mm]	20 [9.1]
Incremental encoder	2000 line, 8000 counts/rev

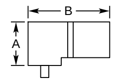
Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

In-line



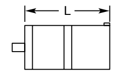


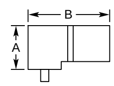
Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	9.56 [242.8]	3.61 x 13.29 [91.7 x 337.6]
16 to 100	10.39 [263.9]	3.61 x 14.12 [91.7 x 358.6]
160 to 700	11.18 [284.0]	Above 100:1, not available

Value Planetary Gearmotors

In-line





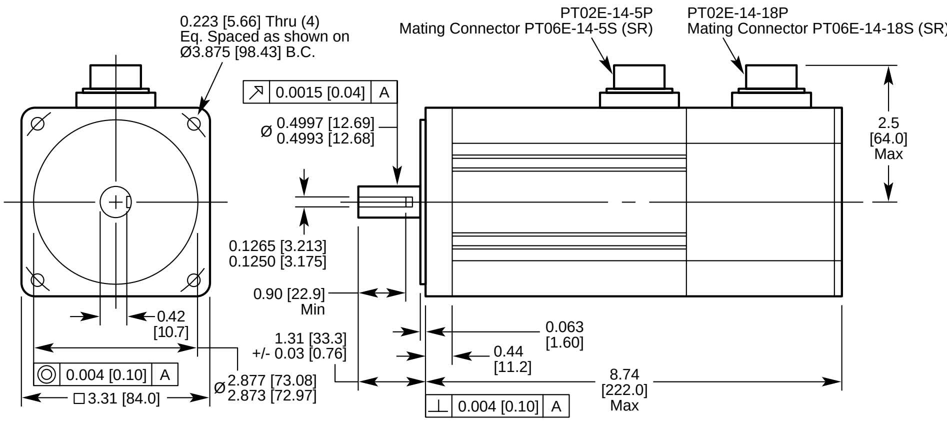
Right-angle

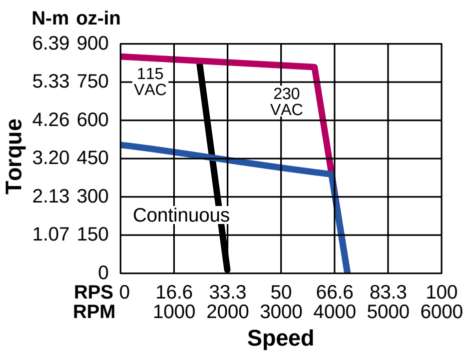
Gear Ratio in [mm]	L	A x B
3 to 10	9.91 [251.7]	3.61 x 13.58 [91.7 x 344.9]
16 to 100	10.82 [274.8]	3.61 x 14.48 [91.7 x 367.8]

Industrial Devices Corporation
707-789-1000 • http://www.idcmotion.com • 24 hour info by fax 916-431-6548

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 1.5 in [38 mm] to motor length





Continuous duty region (230/115 VAC only) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	493 [3.48]
Peak oz-in [N-m]	853 [6.02]
Peak Shaft Power @ 230 VAC HP [W]	2.9 [2208]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	98.5 [0.695]
Back EMF, KV V_{p-p}/kRPM*	72.8

* ±10% tolerance

Motor Data

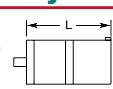
Rotor Inertia oz-in-sec² [kg-m]²	0.016 [1.14 x 10⁻⁴]
Weight lb [kg]	12.0 [5.4]
Axial Shaft Loading lb [kg]	25 [11.3]
Radial shaft loading lb [kg] @ 1 in [25 mm]	40 [18.1]
Incremental encoder	2000 line, 8000 counts/rev

Applying Gearmotors*

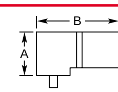
- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

In-line



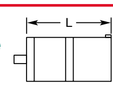
Right-angle



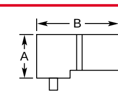
Gear Ratio in [mm]	L	A x B
3 to 10	12.93 [328.4]	5.20 x 17.90 [132.1 x 454.7]
16 to 100	14.05 [356.9]	5.20 x 19.03 [132.1 x 483.4]
160 to 700	15.28 [388.1]	Above 100:1, not available

Value Planetary Gearmotors

In-line

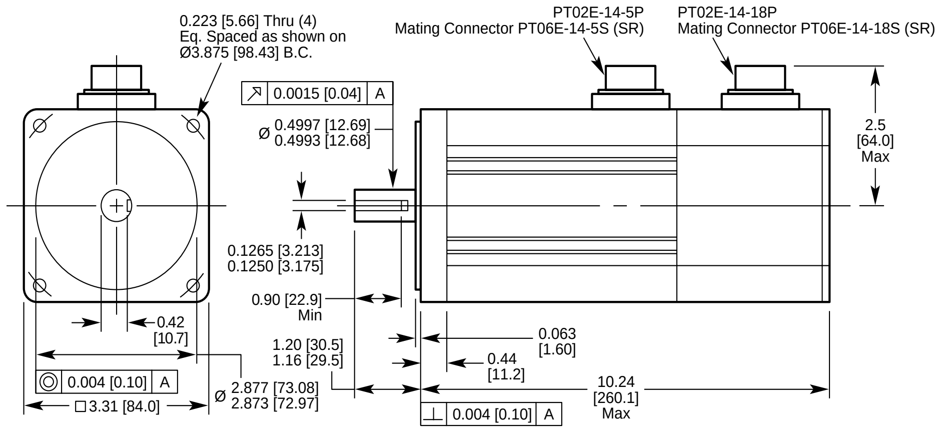


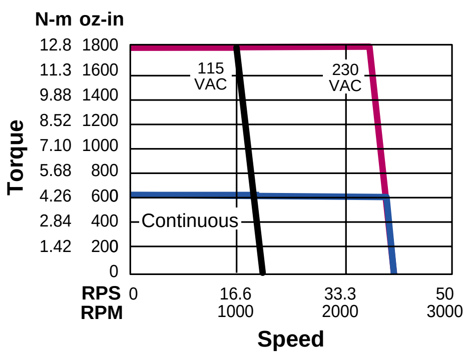
Right-angle



Gear Ratio in [mm]	L	A x B
3 to 10	13.3 [337.8]	5.20 x 18.27 [132.1 x 464.1]
16 to 100	14.56 [369.8]	5.20 x 19.54 [132.1 x 496.3]

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 1.5 in [38 mm] to motor length





Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	624 [4.40]
Peak oz-in [N-m]	1792[12.65]
Peak Shaft Power @ 230 VAC HP [W]	3.0 [2220]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	179.2 [1.265]
Back EMF, KV $V_{p\text{-}p}$/kRPM*	132.5

* ±10% tolerance

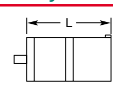
Motor Data

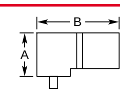
Rotor Inertia oz-in-sec² [kg-m]²	0.023 [1.60 x 10⁻⁴]
Weight lb [kg]	14.6 [6.6]
Axial Shaft Loading lb [kg]	25 [11.3]
Radial shaft loading lb [kg] @ 1 in [25 mm]	40 [18.1]
Incremental encoder	2000 line, 8000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

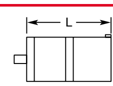
In-line 

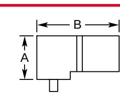


Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	14.43 [366.5]	5.20 x 19.40 [132.1 x 492.8]
16 to 100	15.55 [395.0]	5.20 x 20.53 [132.1 x 521.5]
160 to 700	16.78 [426.2]	Above 100:1, not available

Value Planetary Gearmotors

In-line 

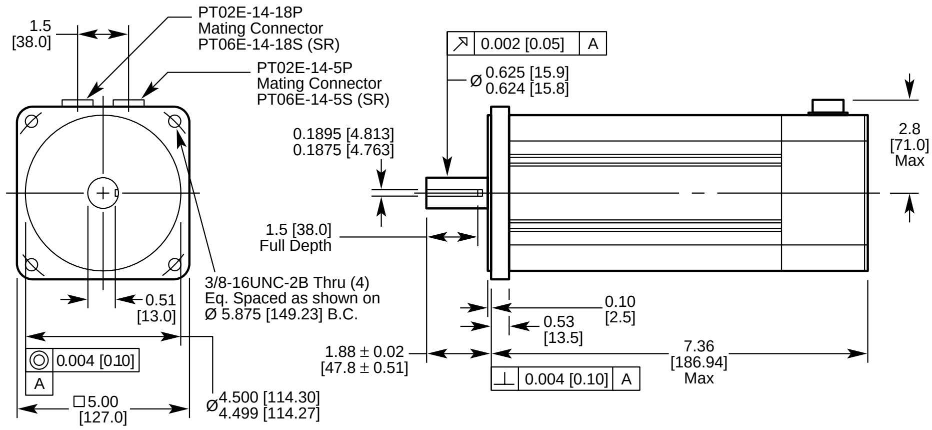


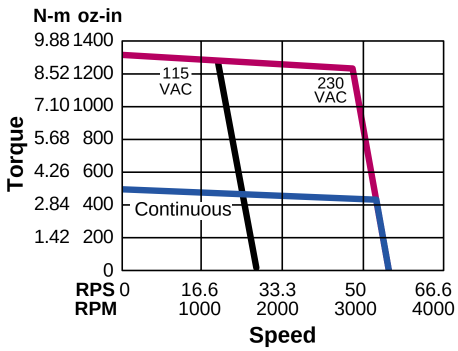
Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	14.8 [375.9]	5.20 x 19.77 [132.1 x 502.2]
16 to 100	16.06 [407.9]	5.20 x 21.0 [132.1 x 534.4]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 2.0 in [51 mm] to motor length





Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	488 [3.45]
Peak oz-in [N-m]	1328 [9.38]
Peak Shaft Power @ 230 VAC HP [W]	2.6 [1970]
Torque Sensitivity	
$K_{T(p-p)}$ oz-in/A [N-m/A]*	132.8 [0.938]
Back EMF, KV V_{p-p}/kRPM*	98.2

* ±10% tolerance

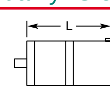
Motor Data

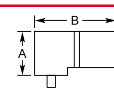
Rotor Inertia oz-in-sec^2 [kg-m]^2	0.024 [1.69 x 10^{-4}]
Weight lb [kg]	12.6 [5.7]
Axial Shaft Loading lb [kg]	50 [22.7]
Radial shaft loading lb [kg] @ 1 in [25 mm]	100 [45.4]
Incremental encoder	2000 line, 8000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

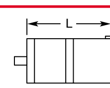
Performance Planetary Gearmotors

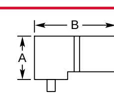
In-line 

Right-angle 

Gear Ratio in [mm]	L	A x B
3 to 10	12.52 [318.0]	5.95 x 18.75 [151.1 x 476.3]
16 to 100	14.15 [359.4]	5.95 x 20.38 [151.1 x 517.7]
160 to 700	15.30 [388.6]	Above 100:1, not available

Value Planetary Gearmotors

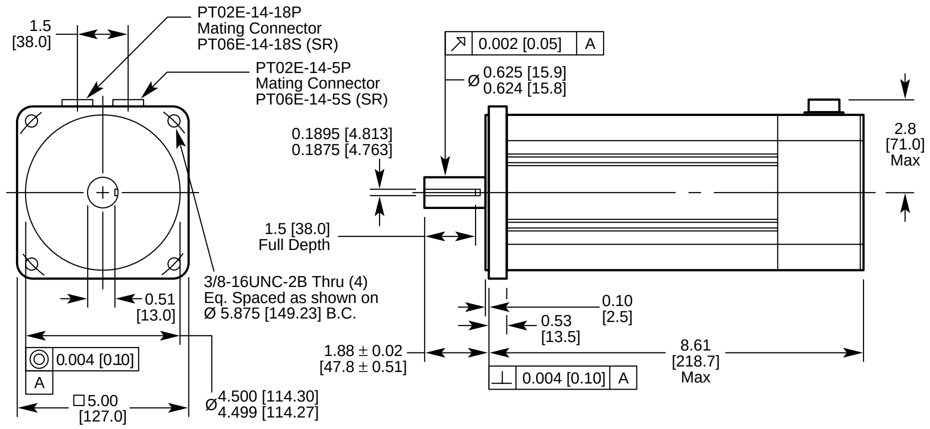
In-line 

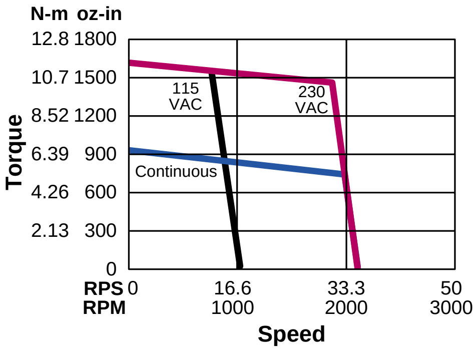
Right-angle 

Gear Ratio in [mm]	L	A x B
3 to 10	12.56 [319.0]	5.95 x 19.21 [151.1 x 487.9]
16 to 100	14.16 [359.7]	5.95 x 20.81 [151.1 x 528.6]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 2.0 in [51 mm] to motor length





Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	930 [6.57]
Peak oz-in [N-m]	1616 [11.41]
Peak Shaft Power @ 230 VAC HP [W]	2.8 [2079]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	186.5 [1.32]
Back EMF, KV $V_{p\text{-}p}$/kRPM*	137.9

* ±10% tolerance

Motor Data

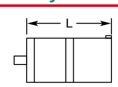
Rotor Inertia oz-in-sec^2 [kg-m]^2	0.0425 [3.0 x 10^{-4}]
Weight lb [kg]	20.0 [9.1]
Axial Shaft Loading lb [kg]	50 [55.7]
Radial shaft loading lb [kg] @ 1 in [25 mm]	100 [45.4]
Incremental encoder	2000 line, 8000 counts/rev

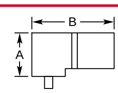
Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

In-line



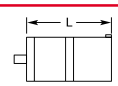


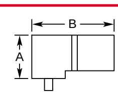
Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	13.77 [349.8]	5.95 x 20.00 [151.1 x 508.0]
16 to 100	15.4 [391.2]	5.95 x 21.63 [151.1 x 549.4]
160 to 700	16.55 [420.4]	Above 100:1, not available

Value Planetary Gearmotors

In-line



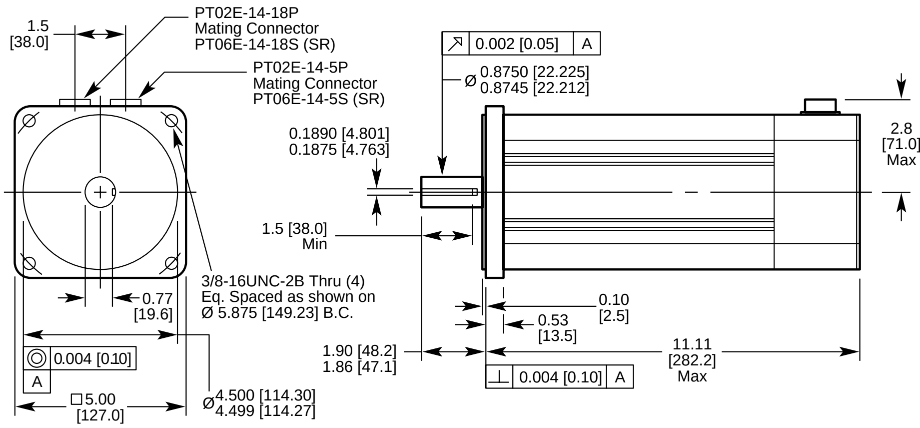


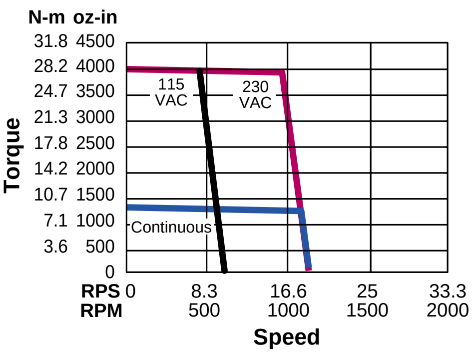
Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	13.81 [350.8]	5.95 x 20.46 [151.1 x 519.7]
16 to 100	15.41 [391.4]	5.95 x 22.06 [151.1 x 560.3]

Performance

- Performance using B8000 Series controls
- IDC recommends at least a 10% torque safety margin and taking winding tolerances into account when applying servo motors.
- See How to Order on page H-48.
- Brake option adds 2.0 in [51 mm] to motor length





Continuous duty region (230/115 VAC) [max RMS torque over any 10-minute interval]

Intermittent duty region

115 VAC speed limit

System Ratings with B8000 Controls

Torque	
Continuous Stall Torque oz-in [N-m]	1328 [9.38]
Peak oz-in [N-m]	4032 [28.47]
Peak Shaft Power @ 230 VAC HP [W]	3.2 [2382]
Torque Sensitivity	
$K_{T(p\text{-}p)}$ oz-in/A [N-m/A]*	403.2 [2.847]
Back EMF, KV $V_{p\text{-}p}$/kRPM*	298.0

* ±10% tolerance

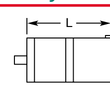
Motor Data

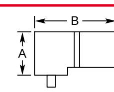
Rotor Inertia oz-in-sec² [kg-m]²	0.082 [5.8 x 10^{-4}]
Weight lb [kg]	28.6 [13.0]
Axial Shaft Loading lb [kg]	50 [22.7]
Radial shaft loading lb [kg] @ 1 in [25 mm]	100 [45.4]
Incremental encoder	2000 line, 8000 counts/rev

Applying Gearmotors*

- See page I-1 for IDC gearmotor information
- See page I-1 for how to determine gearmotor performance
- The servo drive should be current limited if the continuous or intermittent torque of the motor exceeds the gearhead torque ratings.

Performance Planetary Gearmotors

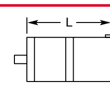
In-line 

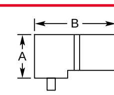


Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	16.27 [413.3]	5.95 x 22.50 [151.1 x 571.5]
16 to 100	17.90 [454.7]	5.95 x 24.13 [151.1 x 612.9]
160 to 700	19.05 [483.9]	Above 100:1, not available

Value Planetary Gearmotors

In-line 



Right-angle

Gear Ratio in [mm]	L	A x B
3 to 10	16.31 [414.3]	5.95 x 22.96 [151.1 x 583.2]
16 to 100	17.91 [454.9]	5.95 x 24.56 [151.1 x 623.8]

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