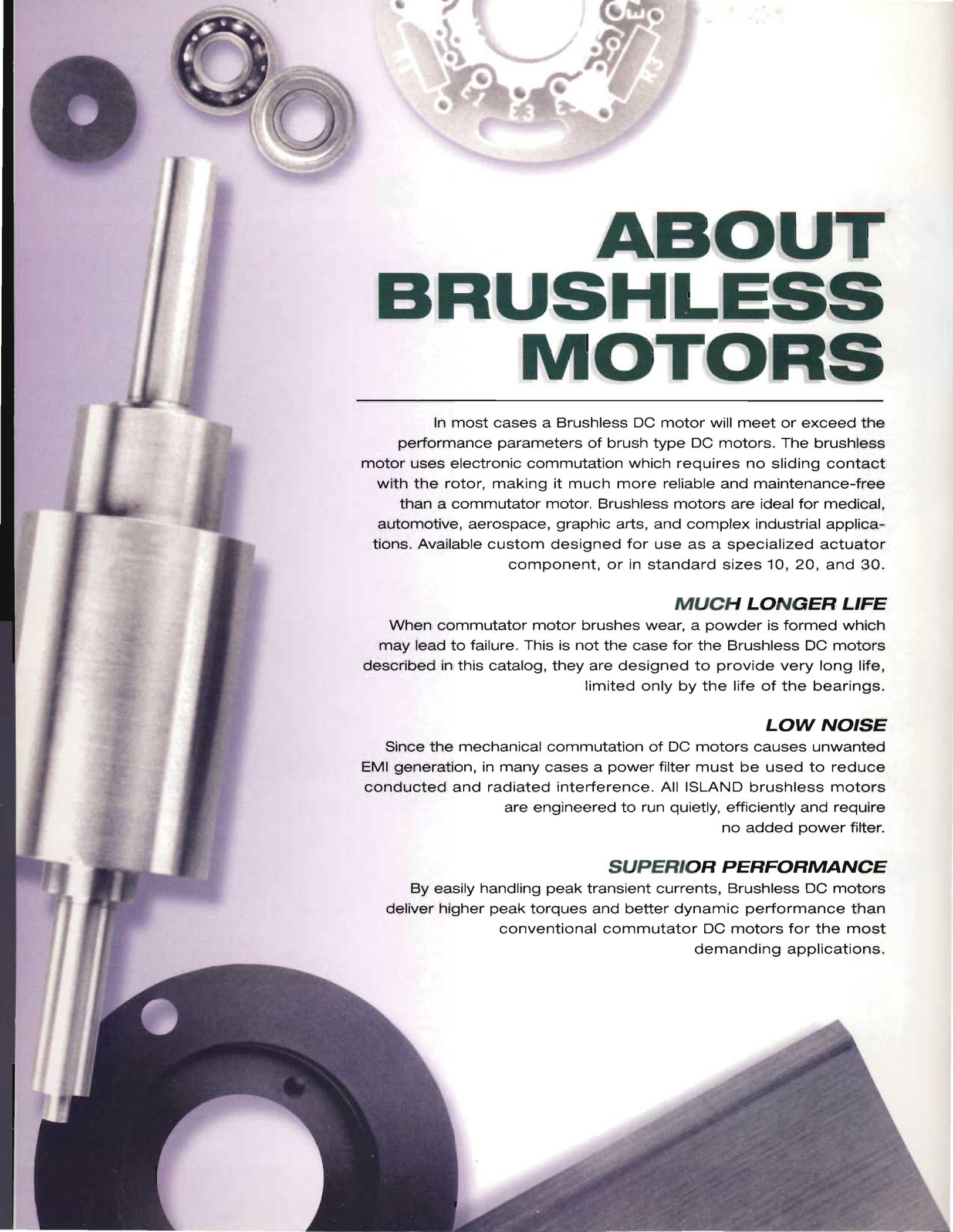


# BRUSHLESS DC MOTORS

MADE TO LAST FOREVER



ISLAND COMPONENTS GROUP, INC.



# ABOUT BRUSHLESS MOTORS

In most cases a Brushless DC motor will meet or exceed the performance parameters of brush type DC motors. The brushless motor uses electronic commutation which requires no sliding contact with the rotor, making it much more reliable and maintenance-free than a commutator motor. Brushless motors are ideal for medical, automotive, aerospace, graphic arts, and complex industrial applications. Available custom designed for use as a specialized actuator component, or in standard sizes 10, 20, and 30.

## ***MUCH LONGER LIFE***

When commutator motor brushes wear, a powder is formed which may lead to failure. This is not the case for the Brushless DC motors described in this catalog, they are designed to provide very long life, limited only by the life of the bearings.

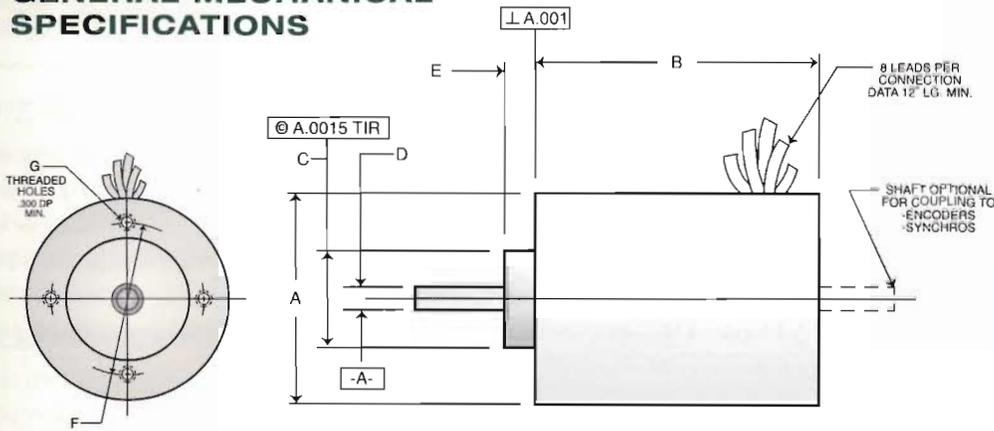
## ***LOW NOISE***

Since the mechanical commutation of DC motors causes unwanted EMI generation, in many cases a power filter must be used to reduce conducted and radiated interference. All ISLAND brushless motors are engineered to run quietly, efficiently and require no added power filter.

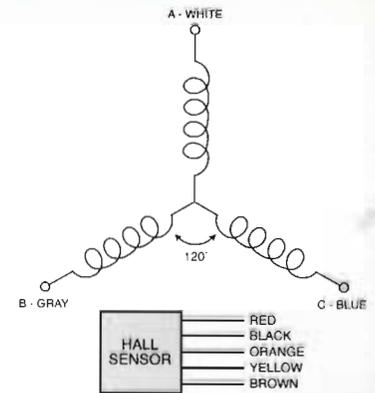
## ***SUPERIOR PERFORMANCE***

By easily handling peak transient currents, Brushless DC motors deliver higher peak torques and better dynamic performance than conventional commutator DC motors for the most demanding applications.

## GENERAL MECHANICAL SPECIFICATIONS



## CONNECTION DATA FOR EXTERNAL CONTROLLERS



# IT'S WHAT'S INSIDE THAT COUNTS.

The geometry of a Brushless DC motor inherently permits more heat dissipation, delivering higher peak torques, with much higher reliability and far less maintenance.

### Cooler Running For Longer Life

The Brushless DC motor combines a wound stator, a permanent magnet rotor and an electronic switching circuit for commutation.

- The wound stator itself, is similar in design to that of a conventional induction motor, and is as simple and reliable. Unlike the brush-type motor that dissipates most of its heat through bearings and brushes, a brushless motor winding is always in excellent thermal contact with its housing, causing a minimal temperature rise during motor operation.

- A Brushless DC motor can be mounted to a chassis, flange, or similar surfaces from which it is very easy to remove heat from the stator. Since thermal limits are determined by the amount of heat removed from the stator, the Brushless DC motor is capable of delivering *much* higher peak torques for longer intervals than a conventional motor, a critical factor in motor selection.

- Though some may think the electronic switching of the Brushless DC motor adds to motor length, its length is usually less than a conventional commutator with brushes.

### Dependable performance means lower costs

- Brushless DC motors are economical where a controller is required. The controller can simultaneously do commutation and control, for lower cost and space savings.

- Controllers may be mounted as integral assemblies with the motor, for convenience in application.

### Less maintenance with fewer shutdowns

- In Brushless DC motor applications for automation and production, the high reliability of electronic commutation and lower temperature rises mean less maintenance and fewer expensive shutdowns.

- By its nature, the Brushless DC motor, using powerful magnets, can use larger and therefore more reliable air gaps.

FRAME SIZE	A	B	C	D	E	F	G
	$\pm.010$	$\pm.020$	$+.000/- .001$	$+.0005/- .0000$	$\pm.005$	$\pm.005$	UNC-2B
IBK-001	1.375	3.300	.6250	.1873	.050	1.125	#6-32
IBH-001	2.100	3.300	1.250	.2498	.050	1.625	#6-32
IBS-001	3.250	4.050	1.750	.2498	.100	2.500	#8-32
IBS-002	3.250	4.050	1.750	.2498	.100	2.500	#8-32

TYPE NUMBER			IBH-001	IBK-001	IBS-001	IBS-002
Units	Symbol	Characteristic				
$\frac{\text{oz-in}}{\text{sec}^2}$	Jm	Rotor Inertia	$2.75 \times 10^{-3}$	$2.29 \times 10^{-4}$	$2.19 \times 10^{-2}$	$2.19 \times 10^{-3}$
$\frac{\text{oz-in}}{\sqrt{\text{watt}}}$	Km	Motor Constant	1.2	2.65	49.4	49.4
oz-in	Tst	Stall Torque	204	30.0	1630	1630
rpm	Nnl	No Load	1909	5730	904	904
vdc	Vdc	Rated Voltage	24	24	24	90
watts	Wst	Stall Power	288	128	1087	1087
amperes	Ist	Stall Current	12	5.33	45.3	12.1
ohms	R	DC Res.	2.0	4.50	0.53	7.45
sec	Tm	Mech. Time Const.	.00270	.00458	.00127	.00127
sec	Te	Elec. Time Const.	0.00020	0.00038	0.00013	0.00013
$\frac{\text{rad}}{\text{sec}^2}$	$\alpha_{st}$	Stall Acc.	74,180	131,000	74,430	74,430
$\frac{\text{oz-in}}{\text{amp}}$	Kt	Torque Constant	17.0	5.63	36.0	134.7
$\frac{\text{volt}}{\text{rad/sec}}$	Ke	Voltage Constant	.120	.040	.254	.951

# RESEARCH BEFORE

## APPLICATION FACTORS

(comparison with induction motors)

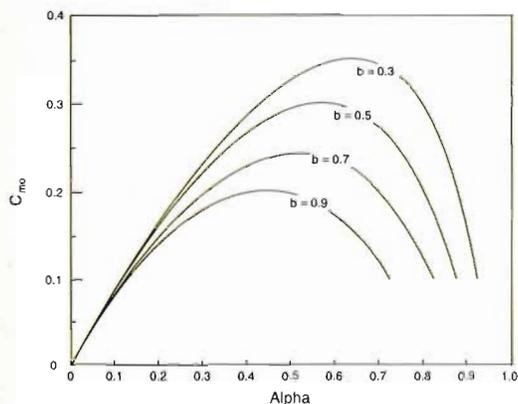
- By its nature, the Brushless DC Motor is often a superior alternative to induction motors. It is inherently the cheapest, most rugged and reliable high-performance motor available.
- Induction motors for other than the simplest applications require more expensive controllers, because they're switching AC rather than simpler DC.
- Modern electronics has improved so much that excellent performance can be obtained from electronically controlled induction motors and Brushless DC Motors.
- Brushless DC Motors develop higher torques and are generally more efficient than induction motors.

Although in specific cases, all applications details must be considered in choosing the best motor type. For example, the nature of available power is often a critical selection factor, e.g. 28VDC battery, vs. 115VAC single phase, vs. 200VAC 3-phase. This relation of motor type and power supply are often critical.

## MOTOR VARIATIONS

Island Components can supply a range of Brushless DC Motors, in addition to those listed here. We can vary performance to accommodate a wide range of:

- available line voltages
- weights from 2 oz. to 2000 oz.
- power outputs (by varying iron stack lengths)
- mechanical interfaces
- ambient temperatures
- rugged environments
- mounting configurations
- cooling means



### Formula for $K_M$ for a Three-Phase Brushless DC Motor

$$K_M = 37.95 \times 10^{-6} K_O B_g L^3 D_o^2 C_{MO} \text{ lb-in.} / \sqrt{W}$$

This formula is for an optimized motor.

$D_o$  = stator lamination diameter (in.)

$L$  = length of stator iron stack (in.)

$B_g$  = airgap flux density (lines/in.2)

$K_O$  = degradation factor for  $K_M$  due to manufacturing limitations

$$C_{MO} = \alpha \sqrt{A_{CU}}$$

$\alpha$  = ratio of rotor outer diameter to  $D_o$

$A_{CU}$  = theoretical copper area, sum of the areas of all lamination slots

Computer-generated universal curve for an eight-pole motor. Similar curves occur for any choice of poles.  $b$  is the ratio of airgap flux density to stator tooth flux density.

These parameters may be optimized for best  $K_M$ , with some computer assistance.

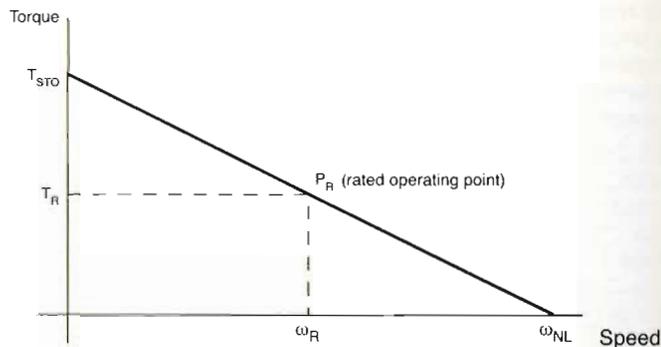
$$K_O = \sqrt{\frac{K_{CU} K_W}{K_{AT} K_{ET}}}$$

$K_{CU}$  = ratio of actual copper area to slot area

$K_W$  = winding factor, product of motor winding pitch and distribution factors

$K_{AT}$  = ratio of copper resistance at operating temperature to resistance at room temperature

$K_{ET}$  = ratio of motor coil length, including end turns, to active coil length, which is twice the stator stack length



### Relationships Among Basic Motor Characteristics

Motor characteristics depend largely on  $K_M \frac{\text{lb-in}}{\sqrt{W}}$

$T_{STO}$  = stall torque with no current limiting

$\omega_{NL}$  = no-load speed, rad/s

$T_R, \omega_R$  = rated parameters at  $P_R$

$D_M = \frac{T_{STO}}{\omega_R} = \text{motor damping}$

$$= \frac{K_M^2}{8.85}$$

$T_M = \text{motor mechanical time constant (s)}$

$$= \frac{J_M}{D_M}$$

$K_T = \text{torque constant (lb-in./A)}$

$K_E = \text{counter EMF constant (Volt/rad-s)}$

$$K_M = \frac{K_T K_E}{\sqrt{R}}$$

$$P_{IN,STALL} = \frac{T_{STO}}{8.85} \times \omega_{NL} = \frac{V_R^2}{R_M} \text{ (stall watts)}$$

$$P_{OUT,MAX} = \frac{1}{4} P_{IN,STALL} \text{ at } \omega = \frac{\omega_{NL}}{2}$$

$$\text{Efficiency (approx. rated)} = \frac{\omega_R}{\omega_{NL}}$$

$$\text{Stall current } I_{STO} = \frac{V_R}{R} \text{ (A)}$$

1. Note how the expressions above are interrelated. Using  $K_M$  and  $J_M$  as key figures of merit is justified.

2. Stall torque, current, and power assume no electronic current limiting. Such limiting may set current at the required value for the rated operating point.

3. For very well designed and manufactured machines, mechanical time constants range from 2 to 5 ms.

# DEVELOPMENT

## PERFORMANCE CHARACTERISTICS

Island Components can work with the customer to define a non-standard motor within application limits, and provide a complete printout of all performance characteristics. This can include special characteristics as required such as: transient peaks, intermittent duty, temperature rise (for specific detailed applications). Our engineers will swiftly compute performance characteristics for all applications.

## ELECTRONICS

Island Components has devised a basic laboratory amplifier/controller to assist in the development of actuation systems. It may be used to configure square wave or sinusoidal motor drives, drivers from analog or digital interfaces, with special networks and filters from easily established insertion points. It is a robust unit, incorporating adjustable current and voltage limiting as well as other features. Island Components can use this to verify total compatibility of the motor with the customer application. We will supply the customer with performance data with regard to parameters of special interest. We will be pleased to quote this amplifier to customers who wish to verify advanced system development.

## STANDARD AMPLIFIER

This is an amplifier designed, developed and packaged by Island Components for use in applying Island Components Brushless DC Motors. It is designed to be a "universal" amplifier, with provision for simple modification by the user to match varied requirements. Gain and phase characteristics, sine and square wave drive, voltage and current limiting, diverse analog and digital inputs, voltage and current driving, and other parameters may be easily modified. When the amplifier has been adjusted for optimum design, system performance may be experimentally verified, and the optimized parameters chosen for production. By interfacing the standard amplifier to sophisticated computers, motor operations can be simulated to collect data about motor performance under all conditions, before manufacturing has begun.

## QUALITY CONTROL

### Assuring Reliability and Dependability

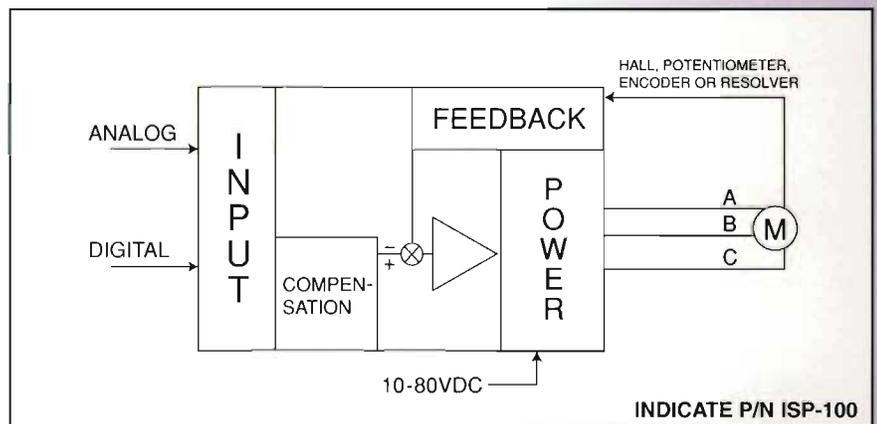
- Island's strict quality control inspection and testing procedures assure that all components and completed products conform to the requirements requested by the customer. Each part must meet the highest standards for safety, workmanship, and functional capabilities before they leave our plant.
- A checklist including stages of inspection, from receipt, to manufacturing, to final shipment, documents product analysis and test reports. This eliminates any substandard qualities or defects that could affect performance and allows corrective action to be taken before you receive any components from Island.
- All products manufactured at Island are made per Military Inspection systems. Island personnel are available to answer any product conformance questions or accuracy verification requests by governmental representatives.
- From time to time, Island gets requests to engineer and manufacture components with "special custom capabilities" that enhance performance beyond Mil spec guidelines or requirements. Custom testing will then be conducted.

## UNIVERSAL MOTOR DRIVE CONFIGURATION

*This Brushless DC motor drive is general purpose and is easily configured to shape it's frequency and dynamic characteristics to deliver required open and closed loop performance.*

## FEATURES

- analog or digital inputs can be accommodated
- Hall effect sensors, encoder, resolver, tachometer, pot feedback, or open loop operation
- current or voltage drive
- six step or sine output
- open or closed loop
- adjustable loop parameters, network, or programmable
- current/voltage limiting available as required



# ELECTROMECHANICAL

## THE ENGINEERS FRIEND FOR SYSTEM INTEGRATION

The packaging of several electro-mechanical components on a common shaft results in increased system accuracy at lower cost. The groupings of components such as magnetic clutches and brakes, spring returns, motors, potentiometers, gearheads, switches, synchros, etc., into a single housing with a common shaft line provides many advantages.

### ADVANTAGES OF IN-LINE ASSEMBLIES

- **LESS SPACE** is required for the combined assemblies, since most gearing associated with coupling between components is eliminated. For example, if a potentiometer is to be mechanically connected to the output shaft of a magnetic clutch, less space will be required by using a common shaft between the components. This feature can be readily applied to many other applications using the many types of available unitized modules.
- **SYSTEM RELIABILITY** depends on the number of mechanical and electrical failures that occur in applications. By using unitized modules, the number of mechanical connections between components is reduced, which in turn reduces failure probability. Greater reliability is achieved.
- **ACCURACIES** and sensitivity are improved with unitized modules because backlash and phasing are less critical. For example, if the output shaft of a magnetic clutch is to be connected to a spring return and single pole commutator switch, the phasing of the switch contacts to the null position of the spring return can be held to closer tolerances if assembled as an integral unit. Also the null position will not be affected by gearing backlash if assembled to a common shaft.
- **LOWER COST** by reducing the number and complexity of parts and the reduction in customer assembly costs combine to make Island Components Group, Inc. packaged systems an economical alternative to individual component procurement and integration.

### IN-LINE ASSEMBLIES CAN CONSIST OF ANY OF THE FOLLOWING:

- CLUTCHES & BRAKES\*
- GEARHEADS\*
- TACHOMETERS\*
- SPLIT FIELD MOTORS\*
- SPRING RETURNS\*
- ENCODERS
- MOTORS (AC)\*
- ELECTRONIC COMMUTATION
- POTENTIOMETERS
- BRUSHLESS DC MOTORS\*
- & MECHANICAL SWITCHES\*
- SYNCHROS

*\*Manufactured by Island Components Group, Inc.*

### AN EXAMPLE OF AN ASSEMBLY

(includes: servo motor, brake, gearhead, clutch, spring return and potentiometer)

- **SERVO MOTOR**  
Island Standard Mark (MK-14)  
400 cycle  
**Function:** Main driver of unitized module  
**Advantages:** Faster Response and Sensitivity-due to elimination of gearing and it's related inertia, backlash & friction
- **STANDARD NON-WIRE WOUND POTENTIOMETER**  
**Function:** Output voltage divider of unitized module  
**Advantages:** Greater accuracy-due to zero backlash coupling
- **GEARHEAD**  
Island Standard size 11 (1000:1)  
**Function:** Steps down RPM of motor and increases output torque  
**Advantages:** Faster Response-due to utilization of brake output shaft pinion as low inertia input pinion
- **NULL TYPE SPRING RETURN MECHANISM**  
Island Standard size 11  
**Function:** Allows potentiometer wiper element to bi-directionally return to a zero or null position  
**Advantages:** Greater accuracy of the zero backlash coupling of both input and output shaft to their respective load
- **DC WAFER BRAKE**  
Island Standard size 11  
**Function:** Brakes rotation of servo motor and gearhead  
**Advantages:** Longer life-from ball bearings due to zero backlash coupling which eliminates inertial shocking of bearing during braking
- **DC WAFER CLUTCH**  
Island Standard size 11  
**Function:** Allows motor, brake and gearhead to override spring return stops, without damage  
**Advantages:** Greater accuracy-full utilization of zero backlash feature of clutch allows closer "nulling" accuracies from spring return mechanism

# ACTUATORS

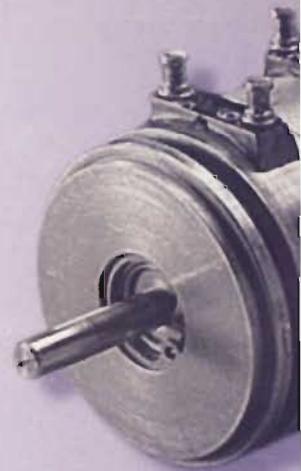
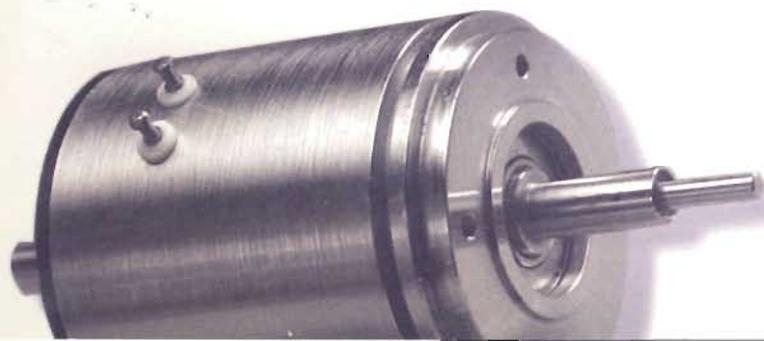
## ***ELECTROMECHANICAL ACTUATORS, SYSTEM INTEGRATION CUSTOM MADE TO YOUR SPECIFICATIONS***

Island Components product line includes both a-c motors, Brushless DC Motors, clutches and brakes, gearheads, synchros and resolvers, applicable electronics, and can (on special request) incorporate encoders. We can make Hall-sensor commutated motors, with square wave characteristics, which is the closest approximation to a commutator d-c motor. Or, using a resolver and our standard amplifier, we can do sinusoidal commutation, which most resembles an optimized synchronous motor, for sinusoidal commutation, which is the quietest, smoothest possible commutation. Our complete product line of components can be combined in practical packages of proven components to match the widest range of requirements.

## ***TECHNICAL SUPPORT BY ISLAND COMPONENTS TO SOLVE APPLICATION PROBLEMS***

- We recognize that each job has it's own special requirements. We are prepared to modify our standard motors to match your most exacting technical requirements. In moderate quantities, and at moderate prices.
- We understand our motors best and are prepared to go further than most manufacturers to make sure that our modifications are exactly suited for your application. We have extensive application experience.
- This includes defining our motor using a complete and accurate model, suitable for computer analysis.
- We are likewise prepared to computer model the motor and our standard controller to achieve the set of combined characteristics most suited to the application.
- We can add networks to our standard controller to match your static and dynamic motor (+) controller (open loop) requirements.
- We can carry the above one step further by working with our customer to define the operating loads and duty cycles, ambient temperatures, using modern design software to model the entire system, closed loop. We can provide assistance in verifying performance and checking suitability for the intended function, thus avoiding misdirected engineering. Our skills at modeling, including the definition of parameters, are critical here.

***ALL COMPONENTS MEET OR EXCEED ALL APPLICABLE INDUSTRIAL  
AND GOVERNMENT REQUIREMENTS AND MIL SPECS.***





#### **MOTORS**

STEPPER MOTORS  
SERVOMOTORS  
MOTOR GENERATORS  
INERTIALLY DAMPED  
HYSTERESIS  
SYNCHRONOUS  
TACHOMETERS  
INTEGRATORS



#### **BRAKES & CLUTCHES**

ELECTROMAGNETIC  
BRAKES  
SPRING BRAKES  
ELECTROMAGNETIC  
CLUTCHES  
SPRING CLUTCHES



#### **GEARHEADS**

PLANETARY  
SPEED REDUCERS  
SPUR GEARHEADS



#### **IN-LINE ASSEMBLIES**

ACTUATORS  
IN-LINE PACKAGES  
STATORS  
ROTOR  
CUSTOM ASSEMBLIES  
SPEED CONTROLS  
SHAFT SPRING  
RETURNS

## **ISLAND COMPONENTS GROUP**

### ***Putting Your Ideas Into Motion***

#### **Engineering & Design Assistance**

In today's modern world, electromechanical components must meet exact specifications. Highly qualified engineers on staff is essential to achieve best project results. At ISLAND, when it comes to providing the expertise to get the job done, we wrote the book. Each engineering application provides us with a new challenge, whether it's enhanced performance, or trouble-shooting an intricate in-line assembly, we're ready. Talk to us about your next project or ideas and we'll get the gears into motion right away.

#### ***Special Applications***

- Gear Ratios
- Bearing & Lubrication
- Temperature Range
- Mechanical Configurations  
(Shaft, Body diameter or Length)
- Reduced Backlash
- Anti-Backlash Systems
- Slip Clutches
- Inline-Assemblies can be Designed  
to Special Requirements
- Parallel plate actuators can be  
supplied for specific applications
- Specialty Motors

#### **Customer Service**

From the moment you call, the friendly professionals at ISLAND are available to work with you.

It is important to us that you are kept informed of each job's status, from the moment you place your order, through manufacturing, to final test and on-time delivery.

Whatever your needs are, you'll receive the courteous service that's grown to be a trademark at ISLAND COMPONENTS GROUP, Inc.



## **ISLAND COMPONENTS GROUP, INC.**

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