

# ELECTRICAL PRODUCTS



**AC & DC  
Adjustable  
Speed Controls  
and Motors**

 **Boston**  
Gear

## OUR QUALITY POLICY

DRIVEN BY THE VOICE OF THE CUSTOMER AND TOTAL ASSOCIATE INVOLVEMENT, BOSTON GEAR WILL STRIVE, THROUGH CONTINUOUS IMPROVEMENT, TO PROVIDE PRODUCTS AND SERVICES THAT MEET OR EXCEED CUSTOMER EXPECTATIONS.

### [www.bostongear.com](http://www.bostongear.com)

Boston Gear's new, easy to navigate web site offers a variety of tools designed to simplify the selection and ordering process. Powered by advanced Internet XML technology, [www.bostongear.com](http://www.bostongear.com) offers 24 hour access to the industry's premier source for power transmission information:

- **BostSpec2 – Boston Gear's award winning open and enclosed gearing configurator. Based upon your applications requirements, select from over 84,000 parts, view specifications, even download CAD drawings**
- **Products – get the most current product information, features, benefits, or application data**
- **Literature – all of Boston Gear's catalogs, brochures, specification sheets, and installation manuals are available for immediate down loading**
- **Distributor Locator – find your local stocking Boston Gear distributor**

Whether you're looking to design a worm gear speed reducer to fit your application, get information on Boston Gear's newest products, or receive the latest news about the company, [www.bostongear.com](http://www.bostongear.com) is your answer.

## The Second Century of Service

Started in 1877 as a machine shop making gear cutting machines, Boston Gear has led the growth of the power transmission industry for more than a century. In its early years, Boston Gear introduced the concepts of gear standardization and stock gears – innovations of enormous benefit to power transmission system designers, specifiers and users.

Boston Gear was the early pioneer in enclosed drives, a category it still dominates with dependable, high performance products like Worm, Helical and Bevel Gear Drives.

Today, Boston Gear provides the widest range of integrated motion control products from one source. The convenience of this single-source capability is yours when you deal with Boston Gear.

## Engineering Services

The Boston Gear Engineering Group can satisfy your technical needs through skillful application of standard products or development of custom designs. Creating specials is an important aspect of customer service. It is supported by R & D personnel who use microprocessor-controlled equipment to collect and monitor data on materials and product performance.

Computer-Aided-Design (CAD) systems help Boston Gear engineers create new approaches to broad industrial challenges or specific customer needs. Computer simulation and testing at critical stages ensure that their designs are practical

## Manufacturing Excellence

Boston Gear manufactures more than 50,000 products in-house at our facility in Charlotte, North Carolina. Production is efficiently organized into manufacturing cells under group technology. For example, turning and grinding are combined under the control of a single operator in each cell. This approach encourages a sense of responsibility and pride of workmanship, to gain consistently high-quality output.

Computerized production control provides close supervision over scheduling and resource planning, coupled with the flexibility to fit your requirements smoothly into the master schedule. Other dedicated computer controls within the production department govern the ordering and delivery functions to keep operations lean and efficient.



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Electrical Products Catalog

# RATIO TROL SYSTEMS

## RATIO TROL PRODUCTS ADD SOPHISTICATED CONTROL TO MOTION

Boston Gear, the reliable source for motion control products for over 100 years, has added electronic brains to its mechanical brawn. New Ratiotrol microprocessor-based AC and DC controllers bring operating intelligence to our high-performance speed reducers, gears, motors, bearings, shaft accessories, clutches and brakes. Your advantage is more capable and adaptable motion control systems when you utilize the coordinated components available from Boston Gear.

## ELECTRONIC DRIVES AND CONTROLLERS

From fractional horsepower AC & DC controllers to powerful three-phase AC inverters, Boston Gear serves a broad spectrum of control needs for adjustable speed AC and DC drives. In manufacturing and assembly operations, Ratiotrol controllers adapt easily to new factory automation projects or system upgrades. For material handling systems and conveyors, food processing equipment, extruders and mixers, they give you a low-cost route to the infinitely adjustable speeds needed to match a production line or process flow. Many can be field or factory-modified for specialized performance and operating convenience.

## CUSTOM/FACTORY MODIFICATIONS

Many Boston Gear Ratiotrol series accept pre-engineered options to meet unusual environmental conditions or to offer specialized performance and operating convenience. Simple plug-in modules and Boston Gear Field Kits make it easy to accomplish many modifications in the field; other options are factory installed and tested before delivery. Modifications can range from simple product adaptations for OEM applications to complex integrated installations controlling multiple drives in automated process lines.



## FIELD SUPPORT

The specialists at Boston Gear distributors are ready to help you meet all your motion control needs. For in-depth technical assistance, they can turn to the Boston Gear field application engineering force. Our field engineers have daily exposure to the specialized needs of many industries. They work cooperatively with our distributors to solve customer problems, design new systems and upgrade existing systems with added capabilities.

## APPLICATION ASSISTANCE

Multi-level assistance is available from the network of Boston Gear full-line distributors, backed by Boston Gear's own dedicated field specialists, electrical product specialists and factory application engineers. All are available to analyze applications and help you specify the product combination that will perform your work with efficiency and economy.

## TECHNICAL ASSISTANCE

Besides assisting with application review and product selection, all of the people in the Boston Gear distributor, field and factory organizations can help resolve problems by offering technical assistance. They are trained and prepared to troubleshoot unexpected process difficulties, or to provide functional analysis and repair of the controller/motor drive system.

## AVAILABILITY

Boston Gear service has many facets and they all involve the coast-to-coast Boston Gear distributor organization. The distributors' own product knowledge is supplemented by our field and factory experts; their local product inventories are backed by national and regional warehouse stocks. On-line computer links give distributors instant access to Boston Gear headquarters for order entry, inventory checks, price information, etc.



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# PRODUCT SELECTION/REFERENCE GUIDE

## *DC Controllers, Single Phase, Nonregenerative*

|  |  |                       |  |                        |   |  |  |
|--|--|-----------------------|--|------------------------|---|--|--|
| Ratiopax<br>Pages 9-10                                     |   | DCX<br>Pages 11-15    |  | BETA II<br>Pages 16-20 |  |  |  |
| BETAprime<br>Pages 21-25                                   |   | VEplus<br>Pages 26-30 |   |                        |   |  |  |
| <h2><i>DC Controllers, Single-Phase, Regenerative</i></h2> |  |                       |  |                        |   |  |  |
| RBA/VEA-RG<br>Pages 31-37                                  |  |                       |  |                        |   |  |  |

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# PRODUCT SELECTION/REFERENCE GUIDE

## Accessories

Remote Stations



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Tachometer Generator



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Magnetic Pick-up



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Analog Meter



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Digital Meter



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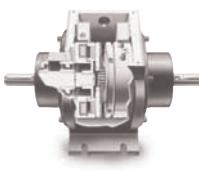
## Clutches and Brakes

DC C-Face



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DC Foot Mounted



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DC Shaft Mounted



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AC C-Face



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AC C-Face Washdown



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AC Motor Brake Kit



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## DC Motors

Permanent Magnet



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Permanent Magnet-Washdown



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Shunt Wound



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## AC Motors

Open Driproof



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Totally Enclosed



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Washdown



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Brake Motors



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Rigid Base



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Inverter Duty



Pages 108-109

# RATIO TROL SYSTEMS

## System Selection

The proper selection of a Ratiotrol system is based on first determining the load torque, second, the horsepower of the motor and last, the type and configuration of the controller to power the selected motor. Sizing an adjustable speed drive generally is no different than selecting a motor and reducer for a constant speed application. Maximum RPM and maximum torque are used in all calculations involving constant torque applications, which are the most common. Our standard Ratiotrol systems are constant torque drives and therefore, selection is straight forward.

Constant horsepower applications, typically winders or machine tools, require the use of the maximum load torque (usually at the minimum speed) in selecting a suitable drive. If the required constant HP value is known, the required system HP is equal to the required speed range ratio multiplied by the constant HP figure.

NOTE: Auxiliary drives beyond the reducer output shaft can reduce the cost of a system significantly since a chain or gear drive multiplies the torque delivered by the reducer, thereby reducing the load required to be driven by the reducer. For instance, if a 3:1 ratio chain drive can be incorporated in a drive train, the driven load (torque) can be divided by 3 and the load speed multiplied by 3 before selecting a suitable motor and reducer combination.

### SELECTION PROCEDURE:

- 1) Select a reducer as you would for a constant speed application and size the motor/controller package to provide the HP indicated by the reducer's input HP rating.  
Note: When using compound worm gear reducers with ratios greater than 200:1, use a motor with twice the HP shown for that reducer. This technique will provide sufficient starting torque at low motor speeds to overcome the near-static friction conditions present in the output bearings and gearing of the reducer.
- 2) The motor selected in Step 1 determines the "System HP" to use when you progress to the Ratiotrol System Selection Guides.
- 3) From the Selection Guide, proceed to the appropriate AC or DC Controller section to determine the complete motor and controller catalog numbers, options and any desired accessories.

| SINGLE PHASE DC CONTROLLER SELECTION GUIDE |                    |                 |     |         |           |        |              |        |               |        |
|--|--------------------|-----------------|-----|---------|-----------|--------|--------------|--------|---------------|--------|
| System HP                                  | Line Voltage (VAC) | Nonregenerative |     |         |           |        | Regenerative |        | Motor Series* |        |
|  |                    | Ratiopax        | DCX | BETA II | BETApplus | VEplus | RBA-RG       | VEA-RG | PM            | Shunt  |
| 1/12                                       | 115                | •               | •   |         |           |        |              |        | BPM/PM908T    | —      |
| 1/6  | 115                | •               | •   | •       | •         | •      | •            | •      | PM916         | V91600 |
| 1/4  | 115                | •               | •   | •       | •         | •      | •            | •      | PM925         | V92500 |
| 1/3  | 115                | •               | •   | •       | •         | •      | •            | •      | PM933         | V93300 |
| 1/2  | 115                | •               | •   | •       | •         | •      | •            | •      | PM950         | V95000 |
|  | 230                | •               | •   | •       | •         | •      | •            | •      | PM1850        | —      |
| 3/4  | 115                |                 | •   | •       | •         | •      | •            | •      | PM975         | V97500 |
|  | 230                | •               | •   | •       | •         | •      | •            | •      | PM1875        | V18750 |
| 1  | 115                |                 | •   | •       | •         | •      | •            | •      | PM9100        | V91000 |
|  | 230                | •               | •   | •       | •         | •      | •            | •      | PM18100       | V18100 |
| 1-1/2                                      | 230                |                 | •   | •       | •         | •      | •            | •      | PM18150       | V18150 |
| 2  | 230                |                 | •   | •       | •         | •      | •            | •      | PM18200       | V18200 |
| 3  | 230                |                 | •   | •       | •         | •      | •            | •      | PM18300       | 18300  |
| 5  | 230                |                 |     |         |           | •      |              | •      | PM18500       | 18500  |

\*Basic DC Motor Catalog number, refer to Pages 86-87 for complete motor selection.

# RATIO TROL SYSTEMS

*Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative*



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# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

## Specification Chart

The purpose of this chart is to provide a general feature comparison of the Boston Gear controllers. When selecting, refer to the specific catalog selection for complete information.

| SINGLE PHASE NONREGENERATIVE DC MOTOR CONTROLLER SPECIFICATIONS |  |            |            |                           |            |                           |            |                           |                    |                           |                    |                           |                    |
|---|--|------------|------------|---------------------------|------------|---------------------------|------------|---------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------|
| Features  |  | Ratiopax   |            | DCX                       |            | DCXplus                   |            | BETA II                   |                    | BETAPlus                  |                    | VEplus                    |                    |
| AC Line   | Voltage<br>50/60 Hz  | 115        | 230        | 115                       | 230        | 115                       | 230        | 115                       | 230                | 115                       | 230                | 115                       | 230                |
| Range   | Maximum Horsepower   | 1/2        | 1          | 1                         | 3          | 1/2                       | 1          | 1                         | 3                  | 1                         | 3                  | 1                         | 5                  |
| Output  | Armature Voltage (0 to)<br>Field Voltage   | 90<br>50   | 180<br>100 | 90<br>100                 | 180<br>200 | 90<br>100                 | 180<br>200 | 90<br>50/<br>100          | 180<br>100/<br>200 | 90<br>50/<br>100          | 180<br>100/<br>200 | 90<br>50/<br>100          | 180<br>100/<br>200 |
| AC Line<br>Protection   | Fuse<br>Circuit Breaker  | S          |            | O                         |            | S                         |            | S                         |                    | S                         |                    | S<br>O                    |                    |
| Functions   | Jog<br>Preset Speeds<br>Armature Contactor<br>Unidirectional W/ D.B.<br>Reversing W/DB<br>Reversing, Switch<br>Constant Torque Operation | S<br>S     |            | O<br>O                    |            | S<br>S                    |            | S<br>S                    |                    | S<br>S                    |                    | S<br>S<br>S               |                    |
| Enclosure   | Angle Bracket Chassis<br>Open Chassis<br>NEMA 1<br>NEMA 3<br>NEMA 4<br>NEMA 12   | S          |            | S                         |            | S                         |            | S<br>S                    |                    | S                         |                    | S                         |                    |
| Adjustments   | Acceleration (Seconds)<br>Deceleration (Seconds)<br>IR Compensation (%)<br>Maximum Speed (%)<br>Minimum Speed (%)<br>Current Limit (%)   | 75-100     |            | 0.8-10<br>0.8-10<br>0-100 |            | 0.8-10<br>0.8-10<br>0-100 |            | 0.2-40<br>0.2-40<br>0-100 |                    | 0.2-30<br>0.2-30<br>0-100 |                    | 0.2-30<br>0.2-30<br>0-100 |                    |
|   | Trim Pot Adjustments<br>Resistance Wire<br>Reconnectable Jumpers<br>Dip Switches   | S          |            | S                         |            | S                         |            | S<br>S                    |                    | S                         |                    | S<br>S                    |                    |
| Isolated Regulator  |  | O          |            |                           |            | S                         |            | S                         |                    | S                         |                    | S                         |                    |
| Load Monitor  |  |            |            |                           |            |                           |            | S                         |                    | S                         |                    | S                         |                    |
| Speed<br>Regulation   | Standard IR Feedback<br>Percentage<br>Speed Range<br>Tachometer Feedback<br>Percentage<br>Speed Range                                    | 5%<br>20:1 |            | 2%<br>30:1                |            | 2%<br>30:1                |            | 2%<br>50:1                |                    | 2%<br>50:1                |                    | 2%<br>50:1                |                    |
| Input   | Analog   | S          |            | 1%<br>100:1<br>S          |            | 1%<br>100:1<br>S          |            | 0.5%<br>200:1<br>S        |                    | 0.5%<br>200:1<br>S        |                    | 0.5%<br>200:1<br>S        |                    |
| Tachometer<br>Feedback  | Unidirectional<br>Bidirectional  |            |            | S                         |            | S                         |            | S<br>O                    |                    | S<br>O                    |                    | S<br>O                    |                    |
| Modifiable<br>Features  | DC Tachometer Feedback<br>AC Line Starting<br>Torque Regulator<br>External DC Signal Follower<br>Limit Switch Reversing                  |            |            | S                         |            | S                         |            | S<br>S                    |                    | S<br>S                    |                    | S<br>S<br>S               |                    |
| Options   | Field Installed<br>Factory Installed   |            |            | O<br>O                    |            |                           |            | O                         |                    | O                         |                    | O<br>O                    |                    |
| UL/cUL  |  | S          |            | S                         |            | S                         |            | S                         |                    | S                         |                    | S                         |                    |
| Pages   |  | 9-10       |            | 11-15                     |            | 11-15                     |            | 16-20                     |                    | 21-25                     |                    | 26-30                     |                    |

S-Standard   O-Optional

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# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

**RATIO PAX Series**

1/12-1 Horsepower



Ratiopax Controllers are economical, **non-modifiable**, general purpose controllers featuring static conversion of AC line power to regulated DC for nonregenerative, adjustable speed armature control of shunt-wound and permanent-magnet DC motors. Their lightweight and compact design makes these units an ideal choice for a broad range of industrial applications.

Motors suitable for application with these controllers are listed in the DC motor section.

### DESIGN FEATURES AND FUNCTIONS

- Enclosure** – All models are furnished in a rugged die cast enclosure. Complete control assembly is attached to the front cover which can be removed from the enclosure by removing four (4) screws.
- Operator Controls** – Mounted on the front cover. Included is a calibrated SPEED control potentiometer and a RUN-STOP toggle switch. A Forward-Stop-Reverse maintained switch is standard on the RP1R & RP2R. This switch includes a no pass through center detent which provides anti-plug protection.
- AC Line Protection** – AC line fuse provides instantaneous protection from peak loads and fault currents. The fuse is front panel mounted, and can be replaced without removing the cover.
- Voltage Transient Protection** – Suppression network to minimize the effect of high voltage or high frequency spikes.
- Full-Wave Power Conversion** – 2 SCRs 2 diodes and a free-wheeling diode provide optimum form factor for best motor performance and longevity. NEMA Code K Converter.
- Reference Circuit** – 24 VDC regulated to provide stable performance with changes in line voltage.
- Maximum Speed Adjustment** – Adjustable from 75 to 100% of motor base speed.
- Trigger Circuit** – Fast rise, hard firing type to minimize di/dt degradation of SCRs.
- Counter EMF Voltage Feedback with IR Compensation** – Non-adjustable, factory set.
- Quality Features** – FR4 glass printed circuit card • Rugged construction • Conservatively rated components selected for long service life.

### RATINGS

- Service factor** .....1.0
- Duty** ..... Continuous
- Overload Capacity** .....150% for 1 minute
- Run Speed Potentiometer** .....100K Ohms, 2W
- Reference Power Supply** ..... 24 VDC
- AC Line Fuse, Interrupting Capacity** ..... 5000 Amps
- RP1, RP1R Controllers** .....115 VAC, 50 or 60 Hz, Single Phase
- RP2, RP2R Controllers** ..... 230 VAC, 50 or 60 Hz, Single Phase

### PERFORMANCE CHARACTERISTICS

- Controlled Speed Range** – Zero to motor base speed. Speed range with respect to specified regulation is shown below.
- Speed Regulation** – Regulation percentages listed are of motor base speed under steady-state conditions. Normal operation will result in performance equal to or better than specifications.

| Regulation Method                              | SPEED REGULATION CHARACTERISTICS |                 |                   |                           |             |
|--|----------------------------------|-----------------|-------------------|---------------------------|-------------|
|  | Variables                        | Load Change 95% | Line Voltage ±10% | Field Heating Cold/Normal | Temp. ±10°C |
| Standard Voltage Feedback with IR Compensation | 5%                               | ±1%             | 5–12%             | ±2%                       | 20:1        |

- Efficiency** (rated speed/rated load)  
(a) Controller (SCR regulator) .....98%  
(b) Complete drive (controller and motor, typical) .....85%
- Current Limit** (factory set, nonadjustable).....150% full-load torque (typical)

### OPERATING CONDITIONS

- Line Voltage Variation** .....±10% of rated
- Line Frequency Variation** .....±2 Hz
- Ambient Temperature** .....0°C to 40°C (32°F to 104°F)
- Altitude (standard)**.....3300 feet (1000 meters) maximum

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# RATIOOTROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

RATIOOTROL SYSTEMS  
RATIOOTROL SYSTEMS

## MODEL TYPES

Ratiotrol controllers are offered as four standard models. Models RP1 and RP2, are unidirectional packaged controllers and Models RP1R and RP2R, are reversible controllers with Forward-Stop-Reverse switch. All are furnished in a totally-enclosed, non-ventilated, rugged, die-cast aluminum alloy enclosure with integral operator controls.

### ORDER BY CATALOG NUMBER OR ITEM CODE

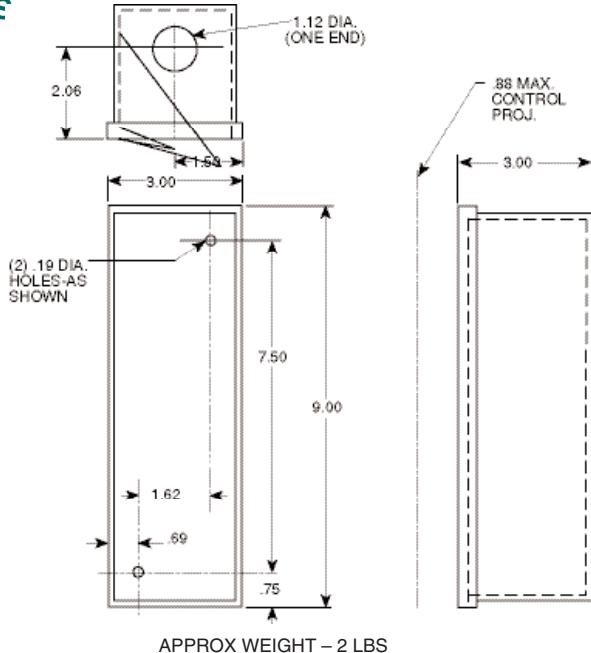
| NEMA 1 ENCLOSED CONTROLLER WITH INTEGRAL OPERATOR CONTROLS |         |                |           |                           |
|--|---------|----------------|-----------|---------------------------|
| Horsepower Range   |         | Catalog Number | Item Code | Function                  |
| 115 VAC  | 230 VAC |                |           |                           |
| 1/6 – 1/2  | —       | RP1            | 63370     | Run/Stop                  |
|  |         | RP1R           | 63372     | Armature Switch Reversing |
| —  | 1/2 – 1 | RP2            | 63371     | Run/Stop                  |
|  |         | RP2R           | 63373     | Armature Switch Reversing |

### TYPICAL APPLICATION DATA

|  |                                 |           | Ratings |       |       |       |       |       |
|--|---------------------------------|-----------|---------|-------|-------|-------|-------|-------|
| Rated Horsepower (HP)                                    |                                 |           | 1/6     | 1/4   | 1/3   | 1/2   | 3/4   | 1     |
| Rated Kilowatts (kW)                                     |                                 |           | 0.124   | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 |
| 1-Phase AC Input (Full-Load)                             | Line Amps                       | 115V Unit | 3.9     | 5.0   | 6.0   | 8.7   | —     | —     |
|  |                                 | 230V Unit | —       | —     | —     | 4.2   | 5.9   | 8.8   |
|  | KVA                             | .48       | .58     | .71   | 1.0   | 1.4   | 2.0   |       |
| DC Output (Full-Load)                                    | Motor Armature Amps             | 90V       | 2.0     | 2.8   | 3.5   | 5.4   | —     | —     |
|  |                                 | 180V      | —       | —     | —     | 2.6   | 3.8   | 5.5   |
|  | Motor <sup>(1)</sup> Field Amps | 50V       | 2.0     | 2.0   | 2.0   | 2.0   | —     | —     |
|  |                                 | 100V      | —       | —     | —     | 2.0   | 2.0   | 2.0   |
| Full-Load Torque (lb-ft) with 1750 RPM Base Speed Motors |                                 |           | 0.5     | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   |

(1) Does not apply to permanent magnet motors.

### DIMENSIONS – ALL MODELS



**BOSTON GEAR®**

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

DCX® Series

DCXplus® Series

1/12-3 Horsepower



Ratiotrol DCX® controllers statically convert single-phase AC line power to regulated DC for nonregenerative adjustable speed armature control of shunt-wound and permanent magnet DC motors. They are ideal for simple MRO modifications of existing drives or for installation in OEM equipment to provide variable speed motor operation with traditional Boston Gear reliability.

These controls feature a number of exclusive advantages. Their built-in adjustment trimpots, for example, offer immediate access to a broad range of horsepower settings.

They completely eliminate the need to stock a variety of components for every horsepower rating.

The dual voltage models can be connected to either 115 VAC or 230 VAC for operation without the use of jumpers or switches.

With a selection of four enclosed models, two panel-front models for installation in OEM control cabinets, and three chassis models with up to 3 horsepower capability and companion optional accessories, Boston Gear has a low-cost controller suitable for virtually any requirement.

Motors suitable for application with these controllers are listed in the DC motor section.

## DESIGN FEATURES AND FUNCTIONS

- DCXplus® Enclosed Models** – These units are furnished in a compact, die cast aluminum, non-ventilated NEMA 1 or NEMA 12 rated enclosure. The complete control assembly is mounted on the front panel which can be removed from the enclosure by removing four (4) screws. The unenclosed panel assembly can be mounted through a cut-out in the user's enclosure.
- DCX® Chassis Models** – The units are furnished as a very compact open chassis consisting of the regulator/power conversion circuit board mounted to a formed aluminum chassis. The DCX202C model may be furnished with a supplemental heatsink (DCX-HTSK or DCX-RHTSK) to improve heat dissipation and thereby extend the horsepower range. Chassis units are dimensionally interchangeable with many competitive units.
- Full-Wave Power Conversion** – NEMA Code K converter configuration formed of discrete devices rated 600 PIV. Converter consists of two (2) SCR's, two diodes and a free wheeling diode which provide optimum form factor for best motor performance and long service. Enclosed models use the control enclosure as an integral heatsink with the power control devices electrically isolated from the enclosure.
- Voltage Transient Protection** – Metal oxide suppressor across the AC line minimizes the effect of high voltage spikes from the AC power source.
- Tachometer Feedback** – All standard units except DCX102C accept a 35, 50 or 100 VDC/1000 RPM feedback signal from a motor mounted DC tachometer generator for improved speed regulation. (Unidirectional units only).
- Horsepower Selection** – Easily calibrated by built-in trimpots to suit individual motor horsepower ratings without special instruments, or plug-in shunts.
- Wiring Terminals** – Enclosed models are provided with barrier terminal strips for all external power and signal wires. Chassis models are provided with male tab wiring connectors. A terminal strip is offered as Options DCX-BTB2 or DCX-BTB3.
- AC Line Fuse** – Enclosed models include an AC line fuse mounted on the circuit board. Chassis units do not include a fuse as standard, but a fuse holder may be provided with Options DCX-BTB2, DCX-BTB3 or DCX-FBK.
- Operator Controls** – All enclosed models include integral operator controls consisting of a speed setting potentiometer and an ON-OFF AC line power switch. Switch is maintained in ON and OFF positions. Reversing models additionally include a 3-position FORWARD-STOP-REVERSE maintained switch. Switch includes a no pass through center detent which provides a delay when changing direction. Chassis units are controlled by external, customer furnished switches, pushbuttons, or control logic. These units include an inhibit circuit for automatic operation by switch, relay or PLC.
- Chassis units are furnished with a speed setting potentiometer and female wiring connectors supplied loose.
- Line Voltage Selection** – Line voltage selection is automatic without the use of jumpers or switches.
- Field Supply** – A full-wave, transient protected motor field supply is provided.
- UL Rating** – The DCX Series units are either UL listed or UL recognized.

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Electrical Products Catalog

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# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

DCX® Series  
DCXplus® Series  
1/12-3 Horsepower

## RATINGS

1. Horsepower... See selection chart Page 6
2. Service Factor ..... 1.0
3. Duty ..... Continuous
4. Operating Voltages

| OPERATING VOLTAGES             |            |       |
|--------------------------------|------------|-------|
| Power Source<br>(Single-Phase) | Output VDC |       |
|                                | Armature   | Field |
| 115V, 50 or 60 Hz              | 0-90       | 100   |
| 230V, 50 or 60 Hz              | 0-180      | 200   |

5. Overload Capacity (armature) ..... 150% for 1 minute
6. Run Speed Potentiometer ..... 5K Ohms, 1/2 W
7. Reference Power Supply ..... 10VDC<sup>(1)</sup>
8. Line Fuse<sup>(2)</sup> ..... Provided by others

- (1) Units are optionally adaptable for use with 4-20mA and 0-10 VDC reference voltages by the use of option DCX-25A
- (2) Line fuse is standard on DCXplus models, optional on all others

## PERFORMANCE CHARACTERISTICS

1. Controlled Speed Range — Zero to motor base speed. Speed range with respect to specified regulation is shown on right.
2. Speed Regulation — Regulation percentages listed are of motor base speed under steady-state conditions. Normal operation will result in performance equal to or better than specifications.

## SPEED REGULATION CHARACTERISTICS

| Regulation<br>Method                                 | Variable              |                          |                              |                | Speed<br>Range |
|--|-----------------------|--------------------------|------------------------------|----------------|----------------|
|  | Load<br>Change<br>95% | Line<br>Voltage<br>± 10% | Field Heating<br>Cold/Normal | Temp.<br>±10°C |                |
| Standard Voltage<br>Feedback with IR<br>Compensation | 2%                    | ± 1%                     | 5-12%                        | ± 2%           | 30:1           |
| Tachometer<br>Feedback <sup>(1)</sup>                | 1%                    | ± 1%                     | 0.2%                         | ±2%            | 100:1          |

(1) Unidirectional models only.

### 3. Efficiency (Rated speed/rated load)

Controller ..... 99%  
Controller and Motor (typical) ..... 85%

## ADJUSTMENTS

1. Current Limit ..... 0-150% full-load torque (typical)
2. Maximum Speed ..... 60-100% of motor base speed
3. Minimum Speed ..... 0-40% of motor base speed
4. IR (load) Compensation ..... 0-100% of rated load
5. Acceleration/Deceleration<sup>(1)</sup> ..... 0.8-10 seconds

NOTE: (1) DCX102C acceleration/deceleration is 1.0 second fixed rate.

## OPERATING CONDITIONS

1. Line Voltage Variation ..... ±10% of rated
2. Line Frequency Variation ..... ±2 Hz
3. Ambient Temperature
 

|          |                             |
|----------|-----------------------------|
| Chassis  | 0°C to 50°C (32°F to 122°F) |
| Enclosed | 0°C to 40°C (32°F to 104°F) |
4. Altitude (Standard).... 3300 Feet (1000 meters) maximum
5. Relative Humidity ..... 95% non-condensing

## TYPICAL APPLICATION DATA

|  |                                       |              | Ratings |       |       |       |       |       |       |       |       |       |
|--|---------------------------------------|--------------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Rated Horsepower (HP)  |                                       |              | 1/12    | 1/6   | 1/4   | 1/3   | 1/2   | 3/4   | 1     | 1-1/2 | 2     | 3     |
| Rated Kilowatts (kW)   |                                       |              | 0.062   | 0.124 | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 | 1.129 | 1.492 | 2.238 |
| 1-Phase<br>AC Input<br>(Full-Load)                             | Line<br>Amps                          | 115V<br>Unit | 2.0     | 3.9   | 5.0   | 6.0   | 8.7   | 12.4  | 15.0  | —     | —     | —     |
|  |                                       | 230V<br>Unit | —       | —     | —     | —     | 4.8   | 5.9   | 8.8   | 12.6  | 15.8  | 24.0  |
|  | KVA                                   |              | .30     | .48   | .58   | .71   | 1.0   | 1.4   | 2.0   | 3.0   | 4.0   | 6.0   |
| DC Output<br>(Full-Load)                                       | Motor<br>Armature<br>Amps             | 90V          | 0.9     | 2.0   | 2.8   | 3.5   | 5.4   | 8.1   | 10.5  | —     | —     | —     |
|  |                                       | 180V         | —       | —     | —     | —     | 2.5   | 3.8   | 5.5   | 8.2   | 11.6  | 16.0  |
|  | Motor <sup>(1)</sup><br>Field<br>Amps | 100V         | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | —     | —     | —     |
|  |                                       | 200V         | —       | —     | —     | —     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |
| Full-Load Torque<br>(lb-ft) with 1750 RPM<br>Base Speed Motors |                                       |              | .25     | 0.5   | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   | 4.5   | 6.0   | 9.0   |

(1) Does not apply to permanent magnet motors.

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# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

DCX® Series  
DCXplus® Series  
1/12-3 Horsepower

## MODEL TYPES

DCX and DCXplus Series controllers are offered as open chassis or enclosed configurations in nine (9) standard models in four (4) functional groups. The DCX® Series chassis units are ideal for the OEM or panel builder who may want to build a custom system by integrating the controller in an enclosure with special logic or auxiliary control devices. The DCXplus® Series enclosed units are offered as complete self-contained functional packages which include power conversion and regulator electronics, AC line protection and integral operator controls.

## DCX® AND DCXplus® SERIES SELECTION CHART

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Horsepower Range <sup>(4)</sup>  |                                   | Catalog Number | Item Code | Function                            |
|--|-----------------------------------|----------------|-----------|-------------------------------------|
| 115 VAC  | 230 VAC                           |                |           |                                     |
| <b>DCX ANGLE BRACKET CHASSIS CONTROLLERS</b>                               |                                   |                |           |                                     |
| 1/12 – 1/2   | —                                 | DCX102C        | 65984     | Run/Stop <sup>(3)(2)</sup>          |
| 1/12 – 1/2<br>1/2 – 1 <sup>(1)</sup>                                       | 1/2 – 1<br>1/2 – 2 <sup>(1)</sup> | DCX202C        | 65985     | Run/Stop <sup>(3)(2)</sup>          |
| 1/12 – 1   | 1/2 – 3                           | DCX302C        | 65986     | Run/Stop <sup>(3)(2)</sup>          |
| <b>DCXplus FRONT PANEL ASSEMBLY WITH INTEGRAL OPERATOR CONTROLS</b>        |                                   |                |           |                                     |
| 1/12 – 1/2   | 1/2 – 1                           | DCX202EP       | 65987     | Run/Stop                            |
|  |                                   | DCX202ERP      | 65991     | Run/Stop, Armature Switch Reversing |
| <b>DCXplus NEMA 1 ENCLOSED CONTROLLER WITH INTEGRAL OPERATOR CONTROLS</b>  |                                   |                |           |                                     |
| 1/12 – 1/2   | 1/2 – 1                           | DCX202E        | 65988     | Run/Stop                            |
|  |                                   | DCX202ER       | 65992     | Run/Stop, Armature Switch Reversing |
| <b>DCXplus NEMA 12 ENCLOSED CONTROLLER WITH INTEGRAL OPERATOR CONTROLS</b> |                                   |                |           |                                     |
| 1/12 – 1/2   | 1/2 – 1                           | DCX202EN12     | 65990     | Run/Stop                            |
|  |                                   | DCX202ERN12    | 65995     | Run/Stop, Armature Switch Reversing |

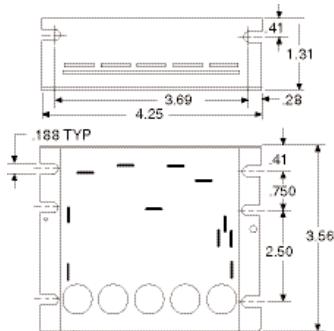
(1) Requires either Option DC-RHTSK for 1 HP on 115 VAC and 2 HP on 230 VAC or Option DCX-HTSK for 3/4 HP on 115 VAC and 1-1/2 HP on 230 VAC.

(2) DC units are furnished with a potentiometer rated 5K ohms, 1/2 watt for separate mounting.

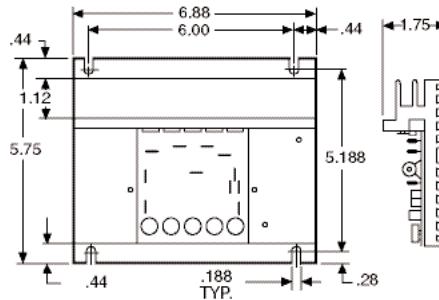
(3) Armature contactor Run-Stop-DB, and contactor reversing and dynamic braking are provided by Options DCX-DA and DCX-RA

(4) Units may be easily recalibrated for any standard rating within the range of the product using trim pots.

## DIMENSIONS - DCX CHASSIS



DCX102C, DCX202C



DCX302C

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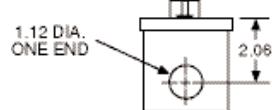
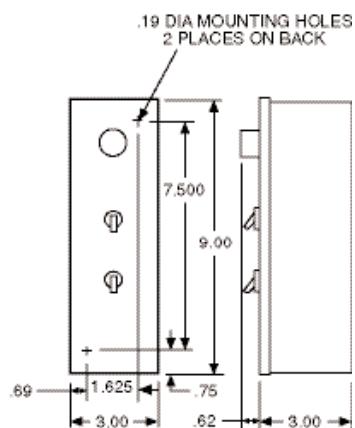
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# RATIO TROL SYSTEMS

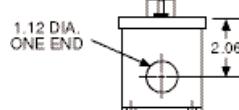
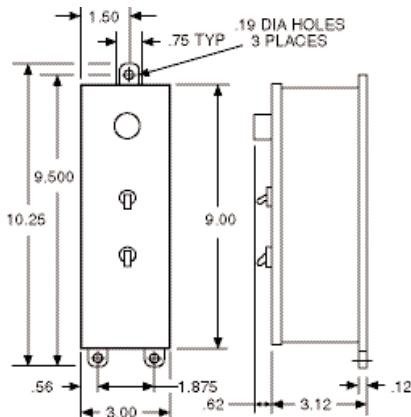
Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

## DIMENSIONS - DCXplus ENCLOSED

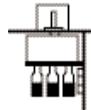
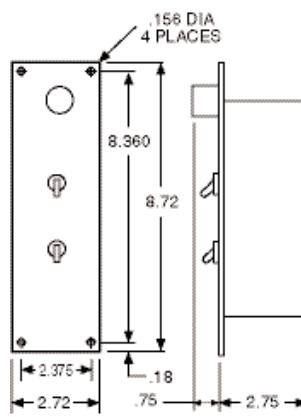
DCX® Series  
DCXplus® Series  
1/12-3 Horsepower



DCXplus NEMA 1



DCXplus NEMA12

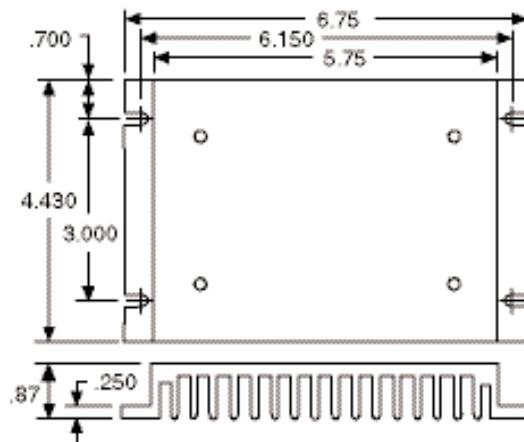


DCXplus Panel-Front

## DIMENSIONS - HEATSINKS



DCX RHTSK

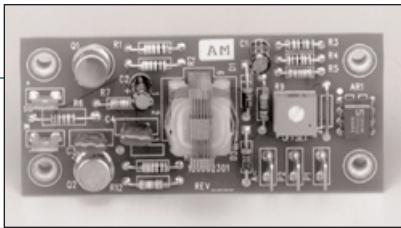


DCX HTSK

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# RATIO TROL SYSTEMS

## OPTIONS FOR DCX SERIES CHASSIS UNITS

| ORDER BY CATALOG NUMBER OR ITEM CODE   |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
|--|---|------------------|---------------|-----------|-----|-----|-----|-----|-------|----|-----------|------|------------------|--|--|--|--|--|--|--|--|--|------|-----|-----|-----|-----|-----|---|-------|---|---|---------|------|-----|-----|-----|-----|----|----|----|---|---|----------|------|---|---|---|---|-----|-----|-----|----|----|-----------|------|----|----|----|----|---|---|---|---|---|--------|------|---|---|---|---|---|---|---|---|---|
| Barrier Terminal Board<br>DCX-BTB-2 (68249)<br>DCX-BTB-3 (68254)   | Kit includes screw terminals for all external wiring, one line fuse holder, and an LED power on indicator in an assembly that plugs piggy-back onto chassis model units. (fuse not included)<br>Total height when assembled to DCX102C or DCX202C is 2.12 inches  | OPTION           | INPUT VOLTAGE | HP RATING |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
|  |   | DCXBTB-2         | 115 VAC       | 1         |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
|  |   | DCXBTB-3         | 115/230 VAC   | 3         |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Contactor, Two-Pole with Dynamic Braking<br>DCX-DA (65996)   | <b>DYNAMIC BRAKING RESISTOR RATINGS</b> <table border="1"> <thead> <tr> <th rowspan="2">COMPONENT</th> <th rowspan="2">UNIT</th> <th colspan="10">RATED HORSEPOWER</th> </tr> <tr> <th>1/12</th> <th>1/6</th> <th>1/4</th> <th>1/3</th> <th>1/2</th> <th>3/4</th> <th>1</th> <th>1-1/2</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>Braking</td> <td>115V</td> <td>250</td> <td>180</td> <td>129</td> <td>103</td> <td>66</td> <td>44</td> <td>34</td> <td>—</td> <td>—</td> </tr> <tr> <td>Torque %</td> <td>230V</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>278</td> <td>190</td> <td>130</td> <td>88</td> <td>62</td> </tr> <tr> <td>Stops Per</td> <td>115V</td> <td>18</td> <td>15</td> <td>12</td> <td>11</td> <td>8</td> <td>6</td> <td>2</td> <td>—</td> <td>—</td> </tr> <tr> <td>Minute</td> <td>230V</td> <td>—</td> <td>—</td> <td>—</td> <td>—</td> <td>8</td> <td>6</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>This option permits motor Start/Stop operation by pushbuttons or external logic in 115 or 230 VAC applications.</p> <p>Dimensions 4.3" x 4.6" x 1.9"</p> |                  |               |           |     |     |     |     |       |    | COMPONENT | UNIT | RATED HORSEPOWER |  |  |  |  |  |  |  |  |  | 1/12 | 1/6 | 1/4 | 1/3 | 1/2 | 3/4 | 1 | 1-1/2 | 2 | 3 | Braking | 115V | 250 | 180 | 129 | 103 | 66 | 44 | 34 | — | — | Torque % | 230V | — | — | — | — | 278 | 190 | 130 | 88 | 62 | Stops Per | 115V | 18 | 15 | 12 | 11 | 8 | 6 | 2 | — | — | Minute | 230V | — | — | — | — | 8 | 6 | 1 | 1 | 1 |
| COMPONENT  | UNIT  | RATED HORSEPOWER |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
|  |   | 1/12             | 1/6           | 1/4       | 1/3 | 1/2 | 3/4 | 1   | 1-1/2 | 2  | 3         |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Braking  | 115V  | 250              | 180           | 129       | 103 | 66  | 44  | 34  | —     | —  |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Torque %   | 230V  | —                | —             | —         | —   | 278 | 190 | 130 | 88    | 62 |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Stops Per  | 115V  | 18               | 15            | 12        | 11  | 8   | 6   | 2   | —     | —  |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Minute   | 230V  | —                | —             | —         | —   | 8   | 6   | 1   | 1     | 1  |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| This option is the same as DCX-DA except two double pole contactors are provided for reversing the DC motor armature rated 1 HP at 90 VDC armature or 3 HP at 180 VDC maximum. Anti-plug protection is provided to prevent armature reversal until a safe minimum speed is attained. The direction of motor rotation is controlled by external RUN/FORWARD-REVERSE pushbuttons, switches or logic. Braking times are same as DCX-DA above. Dimensions 4.3" x 4.6" x 1.9" |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| Kit includes a fuse block, lead wire with spade connectors, and mounting screw. This option provides external line fuse protection for DCX Series chassis controllers (fuse not included).   |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| This option consists of an extruded aluminum heatsink and hardware to mount a Model DCX202C controller. This heatsink is intended for use only with Model DCX202C where its greater heat dissipation permits increasing the units original rated horsepower. Dimensions: 4.44"x6.75"x.88"  |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| This option provides the same function as Option DCX-HTSK except it is a unique space saving radial design and offers a greater horsepower rating. Dimensions: 2"x1.38"x4.25"  |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| This option provides a two (male) into one (female) push-on terminal to facilitate connection of DCX Series units for tachometer feedback and/or inhibit.  |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| This option provides a knob and a dial face graduated 0-100% for use with the potentiometer provided with DCX Series units.  |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |
| <p>This option is intended as a low cost alternative which offers greater accuracy and flexibility. The option is capable of operating from the following isolated or nonisolated signals: 4-20 DC ma, 0-10 VDC. <i>This option includes a scaling potentiometer for offset adjustment.</i> Dimensions 1.5" x 3.38" x .75"</p>    |   |                  |               |           |     |     |     |     |       |    |           |      |                  |  |  |  |  |  |  |  |  |  |      |     |     |     |     |     |   |       |   |   |         |      |     |     |     |     |    |    |    |   |   |          |      |   |   |   |   |     |     |     |    |    |           |      |    |    |    |    |   |   |   |   |   |        |      |   |   |   |   |   |   |   |   |   |

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# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative



### BETA II Series

1/6-3 Horsepower

BETA II series controllers are high quality, economically priced, general purpose controllers that feature static conversion of AC line power to regulated DC for nonregenerative adjustable speed armature control of shunt wound and permanent magnet DC motors. The combination of a rugged compact design, mechanical flexibility, with many standard and field modifiable features, make these units an ideal choice for a broad range of industrial applications.

The BETA II controllers are designed and manufactured to comply with applicable standards established by the National Electric Code and NEMA for industrial motor and control equipment. The units are UL and cUL Listed.

Motors suitable for Application with these controllers are listed in the DC motor section.

### DESIGN FEATURES AND FUNCTIONS

#### 1. Construction

a) **Angle Bracket Chassis** – Circuit board and power devices are mounted to a formed metal bracket which allows a smaller footprint than the conventional basic chassis. The optional contactor assemblies may also be mounted on the same bracket.

b) **Basic Chassis** – Open chassis constructed of a rugged die-cast aluminum alloy with provisions for conduit entry at the top and bottom by two (2) 3/4-14 NPSC tapped holes with knockout plugs. The optional contactor boards may also be mounted in the basic chassis.

c) **Enclosed** – Basic chassis unit with an aluminum die-cast cover added. The cover has a recessed area to guard the local operator control from accidental operation. All units use an oil resistant synthetic gasket to meet the provisions for NEMA 4/12, making them suitable for a wide range of wet and dirty industrial environments. All models with integral operator controls include flexible boots to seal the operator control switches, and a seal for the motor speed potentiometer.

d) **Washdown Duty** – Basic Chassis unit and aluminum die-cast cover painted with a durable white epoxy paint. All units are furnished with stainless steel hardware, oil resistant synthetic gasket and flexible boots for sealing the operator controls to meet the provisions of NEMA 4X.

2. **Full-Wave Conversion** – NEMA Code K converter configuration consisting of two (2) SCRs, two (2) diodes and a free wheeling diode provides optimum form factor for best motor performance and long service. The units have 600 PIV devices. The controller base or metal bracket forms an integral heatsink with the power control devices and is electrically isolated from the rest of the control.

3. **Voltage Transient Protection** – Metal oxide suppresser across the AC line minimizes the effect of high voltage spikes from the AC power source.

4. **AC Line Protection** – AC line fuse provides instantaneous protection from peak loads and fault currents. The AC line fuse and holder are located on the main circuit board of the controller.

5. **Motor Contactor** – Models with a M or U in the catalog number include DC magnetic armature contactors. This provides a positive, two-pole disconnection of the motor armature from the rectified power source. Action of the

contactor is sequenced with the SCR regulator to ensure that the DC power circuit is “phased-off” before the contactor is opened. This results in “dry-switching” for improved contactor life. Anti-plug protection is provided to prevent armature reversal until a safe minimum speed is reached. Two types of contactor assemblies are available; Unidirectional (U suffix) which adds contactors to disconnect the motor armature when the control is stopped and Reversing (M suffix) which adds additional contactors to disconnect and reverse the motor armature when the unit is reversed.

6. **Dynamic Braking** – A standard feature of the controllers when supplied with the motor contactor. Dynamic braking provides exponential rate braking of the DC motor armature. Included is a DB resistor with an anti-plug circuit to prevent restarting the controller until the braking cycle is complete, thereby preventing a potentially damaging electrical surge and mechanical stress.

The DB resistor is rated for stopping a typical load, when the external machine inertia does not exceed that of the motor armature, as shown in the chart below. The DB resistor may be disconnected when braking is not desired.

| Model | Component        | Voltage | Rated Horsepower |     |     |     |     |     |       |     |    |
|-------|------------------|---------|------------------|-----|-----|-----|-----|-----|-------|-----|----|
|       |                  |         | 1/6              | 1/4 | 1/3 | 1/2 | 3/4 | 1   | 1-1/2 | 2   | 3  |
| RBA2  | Braking          | 115V    | 180              | 129 | 103 | 66  | 44  | 34  | —     | —   | —  |
|       | Torque (%)       | 230V    | —                | —   | —   | 278 | 190 | 130 | 88    | 62  | —  |
|       | Stops Per Minute | 115V    | 15               | 12  | 11  | 8   | 6   | 2   | —     | —   | —  |
|       |                  | 230V    | —                | —   | —   | 8   | 6   | 1   | 1     | 1   | —  |
| RBA3  | Braking          | 115V    | 300              | 215 | 170 | 110 | 75  | 60  | —     | —   | —  |
|       | Torque (%)       | 230V    | —                | —   | —   | 400 | 320 | 220 | 145   | 105 | 85 |
|       | Stops Per Minute | 115V    | 9                | 6   | 5   | 5   | 4   | 4   | —     | —   | —  |
|       |                  | 230V    | —                | —   | —   | 5   | 4   | 4   | 3     | 3   | 2  |

7. **Operator Controls** – All enclosed models with integral operator controls include a speed setting potentiometer and a multi-position switch providing RUN-STOP-JOG functions. The switch is maintained in RUN and STOP positions and a spring return to the center stop position from the momentary JOG position. Jog speed is set by the RUN speed potentiometer. The reversing models, when supplied without a contactor assembly, have an armature reversing power switch which is maintained in the FORWARD or REVERSE run positions. This switch

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

### DESIGN FEATURES AND FUNCTIONS (Continued)

includes a no pass through center detent which provides a delay when changing direction for anti-plug protection. Reversing models with a contactor assembly include a momentary contact FORWARD-REVERSE run switch with a spring return to the center position. This switch controls only low control power since armature switching is accomplished by magnetic contactors. The unit is jogged forward or reverse by the momentary FORWARD-REVERSE switch after selecting the JOG position on the RUN-STOP-JOG switch (the JOG position is maintained on this unit).

**8. Control Transformer** – All models include a control transformer which provides internal reference and power supply voltages, and a low voltage source for the magnetic controls, control logic and operator controls.

**9. Counter EMF Voltage Feedback with IR Compensation** – Adjustable to suit individual motor characteristics.

**10. Trigger Circuit** – Fast rise, hard firing to ensure reliable conduction and minimize di/dt degradation of SCRs.

**11. Field Supply** – Transient protected. Selectable for either half-wave or full-wave output. See Table for operating voltages.

**12. Control Relay** – Enables remote control of all models and provides an interlock to prevent a restart after a power outage. This may be defeated when an external customer furnished AC line contactor is used to control the unit.

**13. Customer Use Run Relay Contact** – Form A normally open contact rated five (5) amps at 115 VAC or 30 VDC coordinating with a run command. May be used for external control and indicating devices. May also be applied as a pushbutton seal-in or a drive OK contact.

**14. Hybrid Circuitry** – Miniature components in custom surface mount assemblies improve reliability and make available more features in the smallest possible mechanical configuration.

**15. Selectable Capabilities –**

- a) DC Tachometer Feedback** – Provided is impedance matching, voltage scaling and terminals for accepting a signal from a DC tachometer generator directly coupled to the drive motor armature. The tachometer signal makes the controller directly sensitive to motor speed. This results in an expanded speed range, improved speed regulation with load changes, motor field heating and other operating variables. The controller will automatically transfer to counter EMF voltage feedback to prevent a runaway motor if the tachometer circuit is opened. (A broken tachometer drive coupling will cause the motor to run at maximum speed.) Tachometers producing 7 to 150 VDC at maximum motor speed may be used. *This feature is suitable for use only with unidirectional units using DC tachometers.*
- b) AC Line Starting** – A provision is included to defeat the no-restart-on-power-failure feature to permit run-stop control of unidirectional models by an external AC line contactor. Included is circuitry to assure smooth motor starting.
- c) Torque Regulator** – These units may be easily reconfigured to function as torque regulators. In this mode, the speed setting potentiometer is used to set and regulate the maximum motor armature current over a range of 0 to 150% of rated current. Accordingly motor speed is unregulated and will go to a level of 0 to 100% of rated speed, depending upon the application load torque.

**16. Mechanical Flexibility** – The same basic unit can be used as an open chassis or an enclosed package controller. Enclosed units may be mounted under or through a console surface as shown on page 20. The angle bracket chassis offers the same controller in a smaller footprint and is designed for use in the customer's own panel.

**17. Horsepower and Voltage Calibration** – Units are shipped calibrated for the maximum horsepower rating and 230V operation. They may be easily recalibrated for 115V operation by reconfigurable jumpers and any standard horsepower rating within the design range by clipping shunt wires.

**18. Safety Features** – UL, cUL listed, low voltage operator control. Requires mandatory restart after power interruption, NEMA 4/12.

### RATINGS

#### 1. Horsepower Range:

|          |  |
|----------|--|
| Enclosed | 1/6 thru 1 HP @ 115 VAC<br>1/2 thru 2 HP @ 230 VAC |
| Chassis  | 1/6 thru 1 HP @ 115 VAC<br>1/2 thru 3 HP @ 230 VAC |

#### 2. Operating Voltages

| OPERATING VOLTAGES             |            |                      |                                 |                                |
|--------------------------------|------------|----------------------|---------------------------------|--------------------------------|
| Power Source<br>(Single-Phase) | Output VDC |                      | Control<br>Reference<br>Voltage | Magnetic<br>Control<br>Voltage |
|                                | Armature   | Field <sup>(1)</sup> |                                 |                                |
| 115V, 50 or 60 Hz              | 0-90       | 50/100               | 0-10 VDC<br>4-20 MA             | 24 VDC                         |
| 230V, 50 or 60 Hz              | 0-180      | 100/200              |                                 |                                |

(1) Selectable

BETA II Series

1/6-3 Horsepower

a signal from a DC tachometer generator directly coupled to the drive motor armature. The tachometer signal makes the controller directly sensitive to motor speed. This results in an expanded speed range, improved speed regulation with load changes, motor field heating and other operating variables. The controller will automatically transfer to counter EMF voltage feedback to prevent a runaway motor if the tachometer circuit is opened. (A broken tachometer drive coupling will cause the motor to run at maximum speed.) Tachometers producing 7 to 150 VDC at maximum motor speed may be used. *This feature is suitable for use only with unidirectional units using DC tachometers.*

**b) AC Line Starting** – A provision is included to defeat the no-restart-on-power-failure feature to permit run-stop control of unidirectional models by an external AC line contactor. Included is circuitry to assure smooth motor starting.

**c) Torque Regulator** – These units may be easily reconfigured to function as torque regulators. In this mode, the speed setting potentiometer is used to set and regulate the maximum motor armature current over a range of 0 to 150% of rated current. Accordingly motor speed is unregulated and will go to a level of 0 to 100% of rated speed, depending upon the application load torque.

**16. Mechanical Flexibility** – The same basic unit can be used as an open chassis or an enclosed package controller. Enclosed units may be mounted under or through a console surface as shown on page 20. The angle bracket chassis offers the same controller in a smaller footprint and is designed for use in the customer's own panel.

**17. Horsepower and Voltage Calibration** – Units are shipped calibrated for the maximum horsepower rating and 230V operation. They may be easily recalibrated for 115V operation by reconfigurable jumpers and any standard horsepower rating within the design range by clipping shunt wires.

**18. Safety Features** – UL, cUL listed, low voltage operator control. Requires mandatory restart after power interruption, NEMA 4/12.

3. Service Factor ..... 1.0
4. Duty ..... Continuous
5. Overload Capacity (Armature circuit) . 150% for 1 minute
6. Run Speed Potentiometer ..... 5K ohms, 1/2 W
7. Reference Power Supply ..... 10 VDC
8. AC Line Fuse, Interrupting Capacity ..... 100,000 Amps

### ADJUSTMENTS

Potentiometer adjustments are provided for:

1. Acceleration Time ..... 0.2-40 seconds
2. Deceleration Time ..... 0.2-40 seconds
3. Minimum Speed ..... 0-40% of base speed
4. Maximum Speed ..... 50-100% of base speed
5. IR (Load) Compensation ..... 0-100% of rated load
6. Current Limit ..... 0-150% of full load torque

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

BETA II Series

1/6-3 Horsepower

## PERFORMANCE CHARACTERISTICS

- Controlled Speed Range** — Zero to motor base speed. Speed range with respect to specified regulation is shown below.
- Speed Regulation** — Regulation percentages listed are of motor base speed under steady-state conditions. Normal operation will result in performance equal to or better than specifications.

| SPEED REGULATION CHARACTERISTICS               |                 |                         |                           |                              |             |
|--|-----------------|-------------------------|---------------------------|------------------------------|-------------|
| Regulation Method                              | Variable        |                         |                           |                              | Speed Range |
|  | Load Change 95% | Line Voltage $\pm 10\%$ | Field Heating Cold/Normal | Temp. $\pm 10^\circ\text{C}$ |             |
| Standard Voltage Feedback with IR Compensation | 2%              | $\pm 1\%$               | 5-12%                     | $\pm 2\%$                    | 50:1        |
| Optional Tachometer Feedback <sup>(1)</sup>    | 0.5%            | $\pm 1\%$               | 0.2%                      | $\pm 2\%$                    | 200:1       |

(1) Unidirectional Models Only

- Efficiency** — (rated speed/rated load)
  - Controller (SCR regulator).....99%
  - Complete drive (Controller and motor, typical).....85%

## OPERATING CONDITIONS

- Line Voltage**..... 115/230 VAC, 50/60 Hz, Single Phase
- Line Voltage Variation**.....  $\pm 10\%$  of rated<sup>(1)</sup>
- Line Frequency Variation**.....  $\pm 2$  Hz
- Ambient Temperature**..... Enclosed: 0° to 40° C (32° to 104° F)  
Chassis: 0° to 55° C (32° to 131° F)
- Altitude** ..... 3300 ft. (1000 meters) maximum
- Relative Humidity** ..... 0-95%, noncondensing

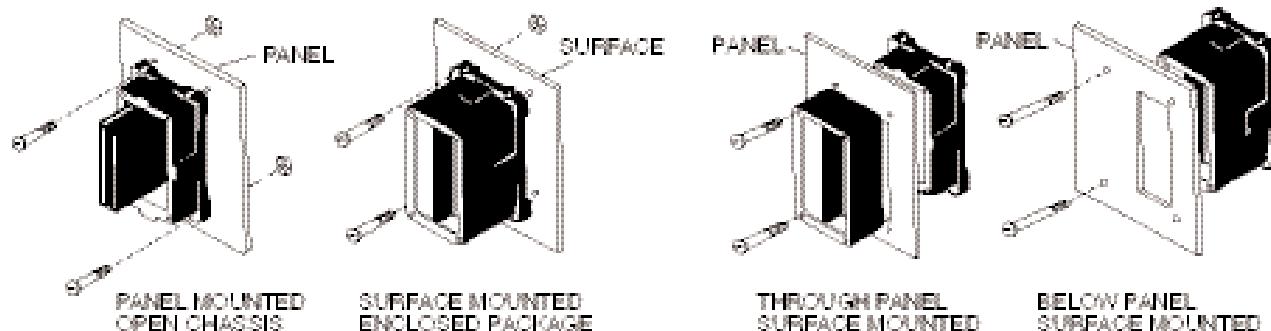
(1) Unit will operate down to -15% of rated voltage although this may prevent rated speed with rated load.

## TYPICAL APPLICATION DATA

| Rated Horsepower (HP)                                     |                     |         | Ratings |       |       |       |       |       |       |       |       |  |
|---|---------------------|---------|---------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Rated Kilowatts (kW)                                      |                     |         | 0.124   | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 | 1.120 | 1.492 | 2.238 |  |
| 1-Phase AC Input (Full-Load)                              | Line Amps           | 115 VAC | 3.9     | 5.0   | 6.0   | 8.7   | 12.4  | 15.8  | —     | —     | —     |  |
|   |                     | 230 VAC | —       | —     | —     | 4.2   | 5.9   | 8.8   | 12.6  | 15.8  | 22.0  |  |
|   | KVA                 |         | 0.48    | 0.58  | 0.71  | 1.00  | 1.40  | 2.00  | 3.00  | 4.00  | 5.00  |  |
| DC Output (Full-Load)                                     | Motor Armature Amps | 90V     | 2.0     | 2.8   | 3.5   | 5.4   | 8.1   | 10.5  | —     | —     | —     |  |
|   |                     | 180V    | —       | —     | —     | 2.7   | 4.0   | 5.5   | 8.2   | 11.6  | 14.4  |  |
|   | (Maximum)           | 50V     | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | —     | —     | —     |  |
|   |                     | 100V    | —       | —     | —     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |  |
|   |                     | 200V    | —       | —     | —     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |  |
| Full-Load Torque (lb-ft) with 1750 RPM Base Speed Motors  |                     |         | 0.5     | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   | 4.5   | 6.0   | 9.0   |  |
| Minimum Transformer KVA for Voltage Matching or Isolation |                     |         | 0.5     | 0.75  | 0.75  | 1.0   | 1.5   | 2.0   | 3.0   | 5.0   | 7.5   |  |

(1) Does not apply to Permanent Magnet Motors

## MOUNTING CONFIGURATIONS



**BOSTON GEAR®**

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative MODEL TYPES

BETA II Series

1/6-3 Horsepower

BETA II controllers are offered in twenty three (23) standard models in six functional groups. The basic chassis models are the nucleus of all the enclosed models; standard covers and contactor assemblies can be added to the basic chassis to make an enclosed controller or the enclosed unit may be ordered complete as shown below.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Horsepower Range <sup>(1)</sup>   |         | Catalog Number | Item Code | Function   |
|---|---------|----------------|-----------|--|
| 115 VAC   | 230 VAC |                |           |  |
| <b>ANGLE BRACKET CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>       |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2C          | 57854     | Run/Stop <sup>(2)</sup>  |
|   |         | RBA2CU         | 57855     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBA2CM         | 57856     | Armature Contactor Forward/Reverse and DB                              |
| <b>BASIC CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>               |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2           | 64801     | Run/Stop <sup>(2)</sup>  |
|   |         | RBA2U          | 57831     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBA2M          | 64821     | Armature Contactor Forward/Reverse and DB                              |
| 1/6 – 1   | 1/2 – 3 | RBA3           | 64865     | Run/Stop <sup>(2)</sup>  |
|   |         | RBA3U          | 57889     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBA3M          | 64873     | Armature Contactor Forward/Reverse and DB                              |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>          |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2B          | 64805     | Run/Stop <sup>(2)</sup>  |
|   |         | RBA2UB         | 57852     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBA2MB         | 64855     | Armature Contactor Forward/Reverse and DB                              |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITH INTEGRAL OPERATOR CONTROLS</b>     |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2S          | 64814     | Run/Stop/Jog <sup>(2) (4)</sup>  |
|   |         | RBA2R          | 64820     | Run/Stop/Jog, Armature Switch Reversing <sup>(3) (4)</sup>             |
|   |         | RBA2US         | 57853     | Run/Stop/Jog, Armature Contactor Run and DB <sup>(4)</sup>             |
|   |         | RBA2MR         | 64863     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(5)</sup> |
| <b>WASHDOWN DUTY ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>      |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2B-WD       | 13048     | Run/Stop <sup>(2)</sup>  |
|   |         | RBA2UB-WD      | 13050     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBA2MB-WD      | 13100     | Armature Contactor Forward/Reverse and DB                              |
| <b>WASHDOWN DUTY ENCLOSED CONTROLLERS WITH INTEGRAL OPERATOR CONTROLS</b> |         |                |           |  |
| 1/6 – 1   | 1/2 – 2 | RBA2S-WD       | 13102     | Run/Stop/Jog <sup>(2) (4)</sup>  |
|   |         | RBA2R-WD       | 13104     | Run/Stop/Jog, Armature Switch Reversing <sup>(3) (4)</sup>             |
|   |         | RBA2US-WD      | 13106     | Run/Stop/Jog, Armature Contactor Run and DB <sup>(4)</sup>             |
|   |         | RBA2MR-WD      | 13108     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(5)</sup> |

\*Refer to Remote Operator Control Stations on Pages 47 and 48.

(1) Units are shipped calibrated for the maximum horsepower ratings shown. Units may be calibrated for other standard ratings by the removal of appropriate resistance wires. Units are connected for 230 VAC and are easily reconnected for 115 VAC input.

(2) Contactorless Run-Stop Operation

(3) Contactorless Reversing Operation

(4) Jog Speed is set by the Run Speed Potentiometer. Maintained in RUN position, JOG position is momentary with a spring return to STOP.

(5) Jog Speed is set by the Run Speed Potentiometer. Maintained JOG position, Forward/Reverse are momentary.

### CONTROLLER WEIGHTS

| Model        | RBA2C | RBA2CU<br>RBA2CM | RBA2<br>RBA3 | RBA2U<br>RBA2M<br>RBA3U<br>RBA3M | RBA2B, RBA2S<br>RBA2R, RBA2BWD<br>RBA2SWD<br>RBA2RWD | RBA2UB, RBA2MB<br>RBA2US, RBA2MR<br>RBA2UB-WD<br>RBA2MB-WD<br>RBA2US-WD<br>RBA2MR-WD |
|--------------|-------|------------------|--------------|----------------------------------|--|--|
| Weight (Lbs) | 2.0   | 2.3              | 3.3          | 3.8                              | 5.5  | 6.1  |

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

BETA II Series  
1/6-3 Horsepower

## ORDER BY CATALOG NUMBER OR ITEM CODE

| REMOTE OPERATOR CONTROL STATIONS BETA II |           |                  |                          |                          |                            |
|--|-----------|------------------|--------------------------|--------------------------|----------------------------|
| Catalog Number                           | Item Code | Control Elements |                          |                          | Use With Controller Models |
|  |           | Pushbuttons      | Switches                 | Pots                     |                            |
| RCS1                                     | 69362     | Run, Stop        | —                        | Motor Speed              | ALL                        |
| RCS3C                                    | 58098     | Run, Stop        | Run/Jog                  | Motor Speed<br>Jog Speed | RBA2U, RBA3U, RBA2UB       |
| RCS3D                                    | 58099     | Run, Stop        | Run/Jog                  | Motor Speed<br>Jog Speed | RBA2, RBA3, RBA2B          |
| RCS6                                     | 60239     | Fwd, Rev, Stop   | —                        | Motor Speed              | RBA2M, RBA3M, RBA2MB       |
| RCS16                                    | 58102     | —                | Run/Stop/Jog             | Motor Speed              | RBA2U, RBA3U, RBA2UB       |
| RCS17                                    | 58103     | —                | Run/Stop/Jog,<br>Fwd/Rev | Motor Speed              | RBA2M, RBA3M, RBA2MB       |

Remote Operator Station dimensions shown on page 48.

## OPTIONS

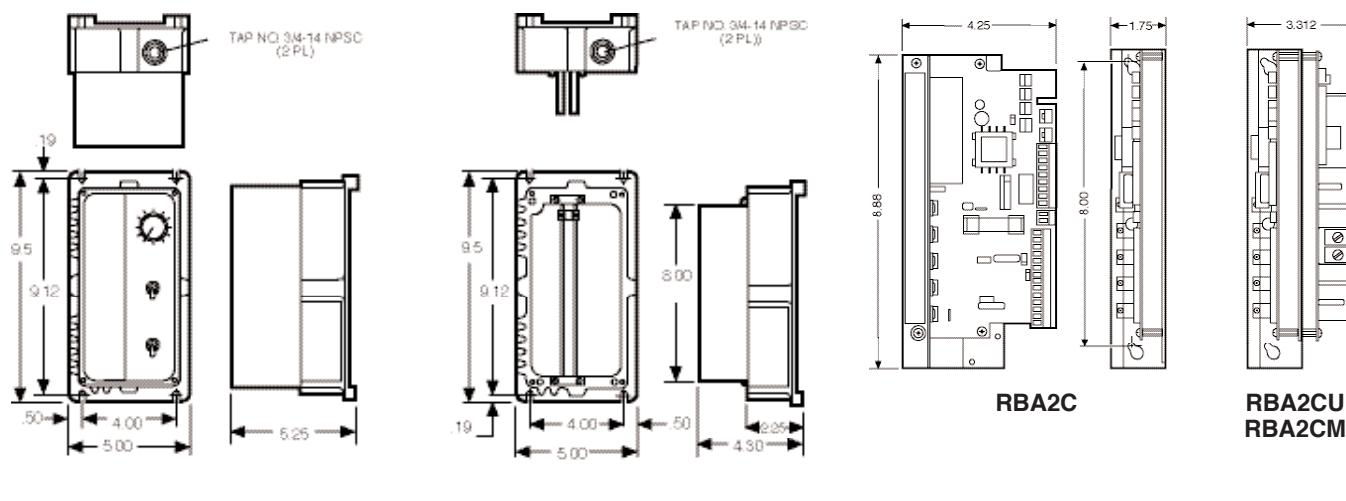
Options and modifications are listed alpha-numerically within each group. Complete option descriptions are listed in the DC option section. To order a controller with the option installed or the modification made, add the option number or letter as a suffix to the controller catalog number, e.g. RBA2B-21. To order a kit for field installation, order by item code.

| Group    | Option  | No.                    | Kit Item Code            | Notes                    |
|----------|---|------------------------|--------------------------|--------------------------|
| Feedback | Torque (Current) Reference<br>DC Tachometer Feedback  | 18E<br>24              | —<br>—                   | (1)<br>(1)               |
| External | Line Starting<br>Motor Speed Potentiometer, One Turn<br>Motor Speed Potentiometer, Ten Turn (Analog)<br>Motor Speed Potentiometer, Ten Turn (Digital) | LS<br>21<br>21A<br>21B | —<br>—<br>60168<br>66103 | (1)<br>(2)<br>(3)<br>(3) |

Notes:

- (1) Modifiable feature of controller
- (2) Unit will not be rated NEMA 4/12 unless factory installed.
- (3) Unit will not be rated NEMA 4/12

## DIMENSIONS



ENCLOSED

CHASSIS

ANGLE BRACKET CHASSIS

**BOSTON GEAR®**

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

BETAprus Series

1/6-3 Horsepower



BETAprus series controllers are high performance, high quality, general purpose units which feature static conversion of AC line power to regulated DC for nonregenerative, adjustable speed armature control of shunt-wound or permanent magnet DC motors. The BETAprus series features an *isolated speed reference circuit* and uses miniature component hybrid assemblies which provide many standard features in a compact package. This series incorporates the use of *DIP switches and reconnectable jumpers* to configure the voltage, horsepower and selectable features of the controller. The combination of a rugged compact design with standard features and field modifications make this controller an ideal choice for a broad range of industrial applications.

These controllers are designed and manufactured to comply with applicable standards established by the National Electric Code and NEMA pertaining to motor and industrial control equipment. The controllers are UL and cUL Listed.

Motors suitable for application with these controllers are listed in the DC motor section.

## DESIGN FEATURES AND FUNCTIONS

### 1. Construction

- a) Angle Bracket Chassis** – Circuit board and power devices are mounted to formed metal bracket which allows a smaller footprint than the conventional basic chassis. The optional contactor assemblies may also be mounted on the same bracket.
- b) Basic Chassis** – Open chassis constructed of a rugged die-cast aluminum alloy with provisions for conduit entry at the top and bottom by two (2) 3/4-14 NPSC tapped holes with knockout plugs. The optional contactor assemblies may also be mounted in the basic chassis.
- c) Enclosed** – Basic chassis unit with an aluminum die-cast cover added. The cover has a recessed area to guard the local operator control from accidental operation. All units use an oil resistant synthetic gasket to meet the provisions for NEMA 4/12, making them suitable for a wide range of wet and dirty environments. All models with integral operator controls include flexible boots to seal the operator control switches, and a seal for the motor speed potentiometer.
- d) Washdown Duty** – Basic chassis unit and aluminum die-cast cover painted with a durable white epoxy paint. All units are furnished with stainless steel hardware, oil resistant synthetic gasket and flexible boots for sealing the operator controls to meet the provisions of NEMA 4X.

### 2. Full-Wave Power Conversion

Full-wave converter configuration consisting of four SCR's and a freewheeling diode provide benefits for optimum motor performance and long service. Power bridge is composed of 600PIV, discrete, encapsulated and electrically isolated devices. The alloy base forms an integral heatsink with the power control devices electrically isolated from the base.

The "full-bridge" configuration offers important benefits over the conventional two SCR semiconverter commonly used. Smoother operation results since two SCR's in series must fire to enable conduction as opposed to one SCR in conventional single-phase converters. This provides broad band immunity to inadvertent SCR firing due to line noise, and contributes to operating safety since the failure of one SCR will not initiate undesired motor rotation when the armature is at rest.

The freewheeling diode improves the form factor which lowers rms currents resulting in reduced motor temperatures by minimizing power dissipation at low speeds. This enhances both motor performance and life.

**3. Voltage Transient Protection** – Metal oxide suppressor across the AC line is combined with RC snubbers across the power bridge to limit potentially damaging high voltage spikes from the AC power source.

**4. AC Line Protection** – A high (100K amp) interrupting capacity AC line fuse provides instantaneous protection from peak loads and fault currents. This fuse holder is mounted on the main circuit board of the controller.

**5. Isolated Regulator** – Internal DC circuits are isolated from the AC power source for operator and equipment safety and for simplified application. The control reference input common may be grounded or connected without additional isolation to other drive units or grounded external signal sources. Isolation eliminates the common condition of line voltage to ground potentials being present on the speed control potentiometer.

#### 6. Feedback Isolation

- (a) Current Feedback – Isolation by optical coupler.
- (b) Voltage Feedback – High impedance circuit (two megohms).

**7. Feedback** – Two selectable modes of analog feedback are provided. See table for speed regulation characteristics.

(a) Armature Feedback – Counter EMF voltage feedback with IR compensation. IR compensation is adjustable to suit individual motor characteristics and optimize speed regulation in this mode.

(b) DC Tachometer Feedback – Provides impedance matching, voltage scaling and terminals for accepting a signal from a DC tachometer generator mechanically coupled to the drive motor armature. This results in expanded speed range, improved speed regulation with load changes and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other operating variables. The controller will automatically transfer to counter EMF voltage feedback to prevent runaway if the tachometer circuit is open. (A broken tachometer drive coupling will cause the motor to run at maximum speed.) Tachometers producing 7 VDC to 150 VDC at maximum motor speed may be used.

*This feature is suitable for use with unidirectional units using DC tachometers.*

# RATIOCONTROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

### DESIGN FEATURES AND FUNCTIONS (Continued)

8. **Control Voltage** – A transformer coupled 24 VDC power supply isolates all magnetic pushbutton control and logic from the AC power source for operator protection.
9. **Field Supply** – Transient protected, half-wave or full-wave. See table for operating voltages.
10. **Contactorless Design** – Unit is designed for reliable solid state, run-stop operation without an armature contactor. Logic includes a provision to prevent an involuntary restart after a power failure. This feature may be defeated when an external customer furnished AC line contactor is used to control the unit.
11. **Motor Contactor** – Models with a M or U in the catalog number include DC magnetic armature contactors. This provides a positive, two-pole disconnection of the motor armature from the rectified power source. Action of the contactor is sequenced with the SCR regulator to ensure that the DC power circuit is “phased-off” before the contactor is opened. This results in “dry-switching” for improved contactor life. Anti-plug protection is provided to prevent armature reversal until a safe minimum speed is reached. Two types of contactor assemblies are available; Unidirectional (U suffix) which adds contactors to disconnect the motor armature when the control is stopped and Reversing (M suffix) which adds additional contactors to disconnect and reverse the motor armature when the unit is reversed.
12. **Dynamic Braking** – Standard feature of models with a motor contactor. Dynamic braking provides exponential rate braking of the DC motor armature. Included is a DB resistor with an anti-plug circuit to prevent restarting the controller until the braking cycle is complete, thereby preventing a potentially damaging electrical surge and mechanical stress. The DB resistor is rated for stopping a typical load, when the external machine inertia does not exceed that of the motor armature, as shown below.

DB RESISTOR RATINGS

| Model | Component        | Voltage | Rated Horsepower |     |     |     |     |     |       |     |    |
|-------|------------------|---------|------------------|-----|-----|-----|-----|-----|-------|-----|----|
|       |                  |         | 1/6              | 1/4 | 1/3 | 1/2 | 3/4 | 1   | 1-1/2 | 2   | 3  |
| RBS2  | Braking          | 115V    | 180              | 129 | 103 | 66  | 44  | 34  | —     | —   | —  |
|       | Torque (%)       | 230V    | —                | —   | —   | 278 | 190 | 130 | 88    | 62  | —  |
|       | Stops Per Minute | 115V    | 15               | 12  | 11  | 8   | 6   | 2   | —     | —   | —  |
|       |                  | 230V    | —                | —   | —   | 8   | 6   | 1   | 1     | 1   | —  |
| RBS3  | Braking          | 115V    | 300              | 215 | 170 | 110 | 75  | 60  | —     | —   | —  |
|       | Torque (%)       | 230V    | —                | —   | —   | 400 | 320 | 220 | 145   | 105 | 85 |
|       | Stops Per Minute | 115V    | 9                | 6   | 5   | 5   | 4   | 4   | —     | —   | —  |
|       |                  | 230V    | —                | —   | —   | 5   | 4   | 4   | 3     | 3   | 2  |

13. **Motor Overload** – A nonadjustable electronic circuit continuously monitors motor armature current and shuts down the drive whenever the load exceeds 120% for 80 seconds.
14. **Operator Controls** – All enclosed models with integral operator controls include a speed setting potentiometer and a multi-position switch providing RUN-STOP-JOG functions. The switch is maintained in RUN and STOP positions and a spring return to the center stop position from the momentary JOG position. Jog speed is set by the RUN speed potentiometer. The reversing models, when supplied without a contactor assembly, have an armature reversing power switch which is maintained in the FORWARD or REVERSE run positions. This switch includes a no pass through center position detent which provides a delay when changing

BETApplus Series

1/6-3 Horsepower

direction. Reversing models with a contactor assembly include a momentary contact FORWARD-REVERSE run switch with a spring return to the center position. This switch controls only low control power since armature switching is accomplished by magnetic contactors. The unit is jogged forward or reverse by the momentary FORWARD-REVERSE switch after selecting the JOG position on the RUN-STOP-JOG switch (the JOG position is maintained on this unit).

15. **Selectable Capabilities** –
  - (a) **DC Tachometer Feedback** – See description under Feedback 7(b).
  - (b) **AC Line Starting** – Provision is included to defeat the no-restart-after-power-failure feature to permit run-stop control of unidirectional models by an external AC line contactor. Included is circuitry to assure smooth starting.
  - (c) **Torque Regulator** – BETApplus units may be easily reconfigured to function as a torque regulator. In this mode the speed setting potentiometer is used to set and regulate the motor maximum armature current over a range of 0–150% of rated. Accordingly, motor speed is unregulated and will go to a level of 0–100% of rated, depending upon the application load torque.
  - (d) **External DC Signal Follower** – These units include isolation and impedance matching circuitry to interface an externally supplied grounded or ungrounded, isolated or non-isolated 0–5 VDC, 0–10 VDC or 4–20 mA DC signal source with the motor controller reference input. This provides a linear transfer of the external signal to motor speed. Typical applications include those where motor speed must be controlled as a function of a process variable such as temperature, weight, flow, pressure, etc. In many applications, the reference signal is obtained from a process instrument controller, or other commercially available transducers with a DC output.
16. **Mechanical Flexibility** – BETApplus units offer outstanding application flexibility. The same basic unit can be used as an open chassis or enclosed package controller.
17. **Horsepower and Voltage Calibration** – Units are shipped calibrated for the maximum horsepower rating and 230V operation. They may be easily recalibrated for any standard horsepower rating within the design range and 115V operation by reconfigurable jumpers.
18. **Customer Use Run Contact** – Form A normally open contact rated five amps at 115 VAC or 30 VDC coordinated with run command may be used for external control and indicating devices.
19. **Visual Status Indicator** – Bicolor LED glows green to show normal operation with the armature current at 100% of rated or less, glows red to show current limit operation.
20. **Control Relay** – Enables remote control of all models and provides an interlock to prevent a restart after a power outage.
21. **Hybrid Circuitry** – Extensive use of surface mount miniature components expands flexibility, enhances reliability, and results in a significant reduction in the size of the controller.
22. **Safety Features** – UL and cUL Listed. Low Voltage Operator Control. Requires reset for restart after power interruption. TENV enclosure. Isolated regulator. High Interrupting Capacity AC Line Fuse.

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

### RATINGS

- 1. Horsepower:**

|          |                         |
|----------|-------------------------|
| Enclosed | 1/6 thru 1 HP @ 115 VAC |
|          | 1/2 thru 2 HP @ 230 VAC |
| Chassis  | 1/6 thru 1 HP @ 115 VAC |
|          | 1/2 thru 3 HP @ 230 VAC |
- 2. Service Factor** ..... 1.0
- 3. Duty** ..... Continuous
- 4. Operating Voltages**

| OPERATING VOLTAGES             |            |                      |  |                                |
|--------------------------------|------------|----------------------|--|--------------------------------|
| Power Source<br>(Single-Phase) | Output VDC |                      | Control<br>Reference<br>Voltage <sup>(2)</sup> | Magnetic<br>Control<br>Voltage |
|                                | Armature   | Field <sup>(1)</sup> |  |                                |
| 115V, 50 or 60 Hz              | 0-90       | 50/100               | 0-5 VDC  | 24 VDC                         |
| 230V, 50 or 60 Hz              | 0-180      | 100/200              | 0-10 VDC<br>4-20 mA                            |                                |

(1) Unidirectional Models Only

(2) Grounded or Ungrounded. Choice of one reference voltage.

- 5. Overload Capacity** (Armature circuit) . 150% for 1 minute
- 6. Run Speed Potentiometer** ..... 5K ohms, 1/2 W
- 7. Reference Power Supply** ..... 10 VDC
- 8. AC Line Fuse, Interrupting Capacity** ..... 100,000 Amps

### ADJUSTMENTS

Potentiometer adjustments are provided for:

- 1. Acceleration Time** ..... 0.2-30 seconds
- 2. Deceleration Time** ..... 0.2-30 seconds
- 3. Minimum Speed** ..... 0-40% of Base Speed
- 4. Maximum Speed** ..... 50-100% of Base Speed
- 5. IR (Load) Compensation** ..... 0-100% of Rated Load
- 6. Torque (Current) Limit** ..... 0-150% of Full Load

### ELECTRICAL DATA

| TYPICAL APPLICATION DATA                                     |  |         |         |       |       |       |       |       |       |  |
|--|--|---------|---------|-------|-------|-------|-------|-------|-------|--|
| Component  |  |         | Ratings |       |       |       |       |       |       |  |
| Rated Horsepower (HP)  |  |         | 1/6     | 1/4   | 1/3   | 1/2   | 3/4   | 1     | 1-1/2 |  |
| Rated Kilowatts (kW)   |  |         | 0.124   | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 | 1.120 |  |
| 1-Phase<br>AC Input<br>(Full-Load)                           | Line<br>Amps                                       | 115 VAC | 3.9     | 5.0   | 6.0   | 8.7   | 12.4  | 15.8  | —     |  |
|  |  | 230 VAC | —       | —     | —     | 4.2   | 5.9   | 8.8   | 12.6  |  |
|  |  | KVA     | 0.48    | 0.58  | 0.71  | 1.00  | 1.40  | 2.00  | 3.00  |  |
| DC Output<br>(Full-Load)                                     | Motor<br>Armature<br>Amps                          | 90V     | 2.0     | 2.8   | 3.5   | 5.4   | 8.1   | 10.5  | —     |  |
|  |  | 180V    | —       | —     | —     | 2.6   | 3.8   | 5.5   | 8.2   |  |
|  | Motor <sup>(1)</sup><br>Field<br>Amps<br>(Maximum) | 50V     | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | —     |  |
|  |  | 100V    | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   |  |
|  |  | 200V    | —       | —     | —     | 1.0   | 1.0   | 1.0   | 1.0   |  |
| Full-Load Torque (lb-ft) with 1750 RPM<br>Base Speed Motors  |  |         | 0.5     | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   | 4.5   |  |
| Minimum Transformer KVA for Voltage<br>Matching or Isolation |  |         | 0.5     | 0.75  | 0.75  | 1.0   | 1.5   | 2.0   | 3.0   |  |

(1) Does not apply to Permanent Magnet Motors

### OPERATING CONDITIONS

- 1. Line Voltage** ..... 115/230 VAC, 50/60 Hz, Single Phase
- 2. Line Voltage Variation** ..... ±10%<sup>(1)</sup>
- 3. Line Frequency Variation** ..... ±2 Hz
- 4. Ambient Temperature** ..... Enclosed: 0° to 40°C (32° to 104°F)  
Chassis: 0° to 55°C (32° to 131°F)
- 5. Altitude** ..... 3300 ft. (1000 meters) maximum
- 6. Relative Humidity** ..... 0-95%, noncondensing

(1) Unit will operate down to -15% of rated voltage, although this may prevent rated speed with rated load.

### PERFORMANCE CHARACTERISTICS

- 1. Controlled Speed Range** — Zero to motor base speed. Speed range with respect to specified regulation is shown below.
- 2. Speed Regulation** — Regulation percentages listed are of motor base speed under steady-state conditions. Normal operation will result in performance equal to or better than specifications.

| Regulation<br>Method                                 | Variable              |                         |                                     |                | Speed<br>Range |
|--|-----------------------|-------------------------|-------------------------------------|----------------|----------------|
|  | Load<br>Change<br>95% | Line<br>Voltage<br>±10% | Field<br>Heating<br>Cold/<br>Normal | Temp.<br>±10°C |                |
| Standard Voltage<br>Feedback with IR<br>Compensation | 2%                    | ±1%                     | 5-12%                               | ±2%            | 50:1           |
| Optional Tachometer<br>Feedback <sup>(1)</sup>       | 0.5%                  | ±1%                     | 0.2%                                | ±2%            | 200:1          |

(1) Unidirectional Models Only

- 3. Efficiency** — (rated speed/rated load)

- Controller (SCR regulator) ..... 98%
- Complete drive (Controller and motor, typical) ..... 85%

**BOSTON GEAR®**

Electrical Products Catalog

23

# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

BETApplus Series  
1/6-3 Horsepower

## MODEL TYPES

BETApplus controllers are offered in twenty-three (23) standard models in six functional groups. The basic chassis models are the nucleus of all the enclosed models; standard covers

can be added to the basic chassis to make an enclosed controller or the enclosed unit may be ordered complete as shown below.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Horsepower Range <sup>(1)</sup>   |         | Catalog Number | Item Code | Function   |
|---|---------|----------------|-----------|--|
| 115 VAC   | 230 VAC |                |           |  |
| <b>ANGLE BRACKET CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>       |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2C          | 57898     | Run/Stop <sup>(2)</sup>  |
|   |         | RBS2CU         | 57899     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBS2CM         | 57903     | Armature Contactor Forward/Reverse and DB                              |
| <b>BASIC CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>               |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2           | 64874     | Run/Stop <sup>(2)</sup>  |
|   |         | RBS2U          | 57894     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBS2M          | 64878     | Armature Contactor Forward/Reverse and DB                              |
| 1/6-1   | 1/2-3   | RBS3           | 64881     | Run/Stop <sup>(2)</sup>  |
|   |         | RBS3U          | 57895     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBS3M          | 64882     | Armature Contactor Forward/Reverse and DB                              |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS</b>           |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2B          | 64875     | Run/Stop <sup>(2)</sup>  |
|   |         | RBS2UB         | 57896     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBS2MB         | 64879     | Armature Contactor Forward/Reverse and DB                              |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITH INTEGRAL OPERATOR CONTROLS</b>     |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2S          | 64876     | Run/Stop/Jog <sup>(2) (4)</sup>  |
|   |         | RBS2R          | 64877     | Run/Stop/Jog, Armature Switch Reversing <sup>(3) (4)</sup>             |
|   |         | RBS2US         | 57897     | Run/Stop/Jog, Armature Contactor Run and DB <sup>(4)</sup>             |
|   |         | RBS2MR         | 64880     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(5)</sup> |
| <b>WASHDOWN DUTY ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>      |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2B-WD       | 13184     | Run/Stop <sup>(2)</sup>  |
|   |         | RBS2UB-WD      | 13280     | Armature Contactor Run/Stop and DB                                     |
|   |         | RBS2MB-WD      | 13324     | Armature Contactor Forward/Reverse and DB                              |
| <b>WASHDOWN DUTY ENCLOSED CONTROLLERS WITH INTEGRAL OPERATOR CONTROLS</b> |         |                |           |  |
| 1/6-1   | 1/2-2   | RBS2S-WD       | 13350     | Run/Stop/Jog <sup>(2) (4)</sup>  |
|   |         | RBS2R-WD       | 13362     | Run/Stop/Jog, Armature Switch Reversing <sup>(3) (4)</sup>             |
|   |         | RBS2US-WD      | 13364     | Run/Stop/Jog, Armature Contactor Run and DB <sup>(4)</sup>             |
|   |         | RBS2MR-WD      | 13378     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(5)</sup> |

\*Refer to Remote Operator Stations, Pages 47 and 48.

(1) Units are shipped calibrated for the maximum horsepower ratings shown. Units may be calibrated for other standard ratings by the changing of a Jumper. Units are connected for 230 VAC and are easily reconnected for 115VAC input.

(2) Contactorless Run-Stop Operation

(3) Contactorless Reversing Operation

(4) Jog Speed is set by the Run Speed Potentiometer. Maintained in RUN position, JOG position is momentary with a spring return to STOP.

(5) Jog Speed is set by the Run Speed Potentiometer. Maintained JOG position, Forward/Reverse are momentary.

## CONTROLLER WEIGHTS

| Model         | RBS2C | RBS2CU<br>RBS2CM | RBS2<br>RBS3 | RBS2U<br>RBS2M<br>RBS3U<br>RBS3M | RBS2B, RBS2S<br>RBS2R, RBS2BWD<br>RBS2SWD<br>RBS2RWD | RBS2UB, RBS2MB<br>RBS2US, RBS2MR<br>RBS2UB-WD<br>RBS2MB-WD<br>RBS2US-WD<br>RBS2MR-WD |
|---------------|-------|------------------|--------------|----------------------------------|--|--|
| Weight (Lbs.) | 2.0   | 2.3              | 3.3          | 3.8                              | 5.5  | 6.1  |

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

BETApplus Series  
1/6-3 Horsepower

## REMOTE STATIONS

ORDER BY CATALOG NUMBER OR ITEM CODE

| REMOTE OPERATOR CONTROL STATIONS BETApplus |           |                  |                               |                          |                            |
|--|-----------|------------------|-------------------------------|--------------------------|----------------------------|
| Catalog Number                             | Item Code | Control Elements |                               |                          | Use With Controller Models |
|  |           | Pushbuttons      | Switches                      | Pots                     |                            |
| RCS1                                       | 69362     | Run, Stop        | —                             | Motor Speed              | ALL                        |
| RCS3C                                      | 58098     | Run, Stop        | Run/Jog                       | Motor Speed<br>Jog Speed | RBS2U, RBS3U, RBS2UB       |
| RCS3D                                      | 58099     | Run, Stop        | Run/Jog                       | Motor Speed<br>Jog Speed | RBS2, RBS3, RBS2B          |
| RCS6                                       | 60239     | Fwd, Rev, Stop   | —                             | Motor Speed              | RBS2M, RBS3M, RBS2MB       |
| RCS16                                      | 58102     | —                | Run/Stop/Jog                  | Motor Speed              | RBS2U, RBS3U, RBS2UB       |
| RCS17                                      | 58103     | —                | Run/Stop/Jog,<br>Fwd/Stop/Rev | Motor Speed              | RBS2M, RBS3M, RBS2MB       |

Remote Operator Station dimensions shown on Page 48.

## OPTIONS

Options are listed alpha-numerically within each group. Complete option descriptions are listed in the DC option section. To order a controller with the option installed or the modification made, add the option number or letter as a suffix to the controller catalog number e.g. RBS2B-21. To order a kit for field installation, order by item code.

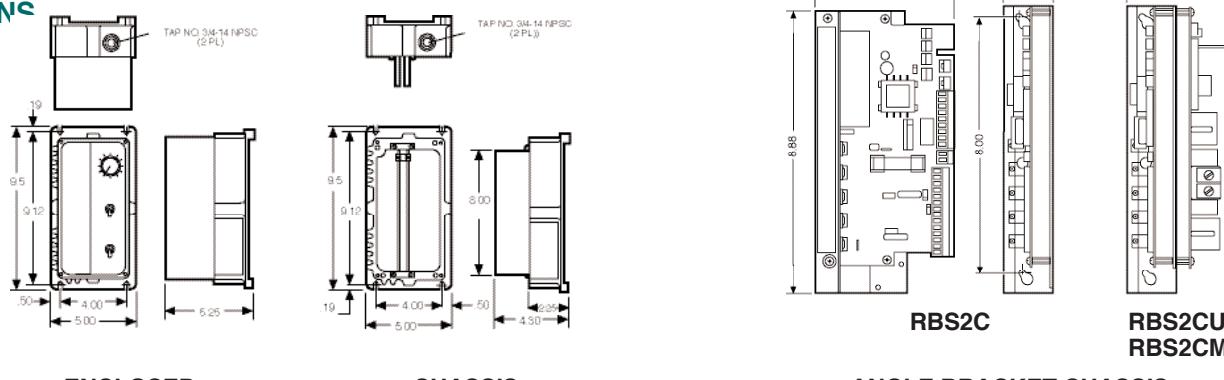
| Group    | Option   | No.                          | Kit Item Code                 | Notes                           |
|----------|--|------------------------------|-------------------------------|---------------------------------|
| Feedback | Torque (Current) Reference<br>DC Tachometer Feedback   | 18E                          | —                             | (1)                             |
|          |  | 24                           | —                             | (1)                             |
| External | Motor Speed Potentiometer, One Turn<br>Motor Speed Potentiometer, TenTurn (Analog)<br>Motor Speed Potentiometer, Ten Turn (Digital)<br>Follower/Manual Mode Selector Switch<br>Line Starting | 21<br>21A<br>21B<br>38<br>LS | —<br>60168<br>66103<br>—<br>— | (2)<br>(3)<br>(3)<br>(2)<br>(1) |

(1) Modifiable Feature of controller

(2) Unit will not be NEMA 4/12 unless factory installed.

(3) Unit will not be rated NEMA 4/12

## DIMENSIONS

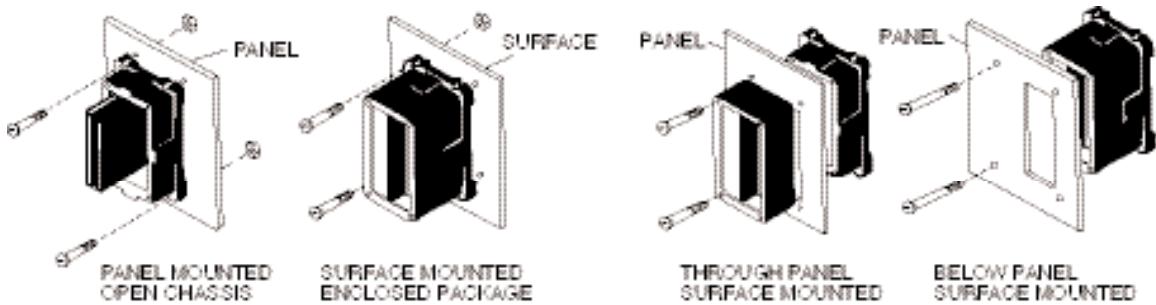


ENCLOSED

CHASSIS

ANGLE BRACKET CHASSIS

## Mounting Configurations



**BOSTON GEAR®**

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

VEplus Series

1/6-5 Horsepower



VEplus series of controllers are a high performance, high quality, general purpose unit which features static conversion of AC line power to regulated DC for nonregenerative, adjustable speed armature control of shunt-wound or permanent magnet DC motors. The VEplus series *features an isolated speed reference circuit* and use miniature component hybrid assemblies which provide an additional number of standard features and field modifications. This series also incorporates the *use of DIP switches and reconnectable jumpers* to configure the voltage, horsepower and selectable features of the controller. Supplied in a larger chassis to *allow the addition of pre-engineered options and extending the horsepower range to 5 HP* make this an ideal choice for your more demanding requirements.

These controllers are designed and manufactured to comply with applicable standards established by the National Electric Code and NEMA pertaining to motor and industrial control equipment. The controllers are UL and cUL Listed.

Motors suitable for application with these controllers are listed in the DC motor section.

### DESIGN FEATURES AND FUNCTIONS

#### 1. Construction

**a) Basic Chassis** – Open chassis constructed of a rugged die-cast aluminum alloy which features a heatsink design consisting of a unique pin configuration with omnidirectional heat dissipation characteristics. This allows the unit to be wall mounted in either a vertical or horizontal position. Conduit entry is provided top and bottom by two (2) 3/4-14 NPSC tapped holes. All open chassis are cooled by natural convection. Additional space is provided in the base for the addition of the optional contactor assemblies and pre-engineered options.

**b) Enclosed** – Basic chassis unit with the addition of a screw fixed cover which is gasketed with an oil resistant synthetic rubber gasket to meet the provisions for NEMA 4/12, making them suitable for a wide range of wet and dirty industrial environments. The covers are molded of high strength Noryl® engineering plastic. The cover is designed to accept either a blank panel or various local control panels. All models with integral operator controls include flexible boots to seal the operator control switches, and a seal for the motor speed potentiometer. 5 HP units require the use of a fan assembly mounted to the bottom of the heatsink.

**2. Full-Wave Power Conversion** – Full-wave converter configuration consisting of four SCR's and a freewheeling diode provide benefits for optimum motor performance and long service. Power bridge is composed of 600PIV, discrete, encapsulated and electrically isolated devices. The alloy base forms an integral heatsink with the power control devices electrically isolated from the base.

The "full-bridge" configuration offers important benefits over the conventional two SCR semiconverter commonly used. Smoother operation results since two SCR's in series must fire to enable conduction as opposed to one SCR in conventional single-phase converters. This provides broad band immunity to inadvertent SCR firing due to line noise, and contributes to operating safety since the failure of one SCR will not initiate undesired motor rotation when the armature is at rest.

The freewheeling diode improves the form factor which lowers rms currents resulting in reduced motor temperatures by minimizing power dissipation at low speeds. This enhances both motor performance and life.

**3. Voltage Transient Protection** – Metal oxide suppressors across the AC line is combined with RC snubbers across the power bridge to limit potentially damaging high voltage spikes from the AC power source.

**4. AC Line Protection** – A high (100K amp) interrupting capacity AC line fuse provides instantaneous protection

from peak loads and fault currents. The fuse holder is mounted on the main circuit board of the controller. The optional circuit breaker (30) is a two-pole, molded case, magnetic trip circuit breaker which provides a means of manually disconnecting the AC power to the controller and motor and automatic, instantaneous trip protection from a peak load.

**5. Isolated Regulator** – Internal DC circuits are isolated from the AC power source for operator and equipment safety and for simplified application. The control reference input common may be grounded or connected without additional isolation to other drive units or grounded external signal sources. Isolation eliminates the common condition of line voltage to ground potentials being present on the speed control potentiometer.

#### 6. Feedback Isolation –

- Current Feedback – Isolation by optical coupler.
- Voltage Feedback – High impedance circuit (two megohms).

**7. Feedback** – Two selectable modes of analog feedback are provided. See Table for speed regulation characteristics.

**a) Armature Feedback** – Counter EMF voltage feedback with IR compensation. IR compensation is adjustable to suit individual motor characteristics and optimize speed regulation in this mode.

**b) DC Tachometer Feedback** – Provides impedance matching, voltage scaling and terminals for accepting a signal from a DC tachometer generator mechanically coupled to the drive motor armature. This results in expanded speed range, improved speed regulation with load changes and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other operating variables. The controller will automatically transfer to counter EMF voltage feedback to prevent run away if the tachometer circuit is open. (A broken Tachometer drive coupling will cause the motor to run at maximum speed). Tachometers producing 7 VDC to 150 VDC at maximum motor speed may be used.

*This feature is suitable for use with unidirectional units using DC tachometers.*

**8. Control Voltage** – A transformer coupled 24 VDC power supply isolates all magnetic pushbutton control and logic from the AC power source for operator protection.

**9. Field Supply** – Transient protected, half-wave or full-wave. See Table for output voltages.

**10. Contactorless Design** – Unit is designed for reliable solid state, run-stop operation without an armature contactor.

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

VEplus Series

1/6-5 Horsepower

### DESIGN FEATURES AND FUNCTIONS (Continued)

Logic includes a provision to prevent an involuntary restart after a power failure. This feature may be defeated when an external customer furnished AC line contactor is used to control the unit.

11. **Motor Contactor** – Models with M or U in the catalog number include DC magnetic armature contactors. This provides a positive, two-pole disconnection of the motor armature from the rectified power source. Action of the contactor is sequenced with the SCR regulator to ensure that the DC power circuit is “phased-off” before the contactor is opened. This results in “dry-switching” for improved contactor life. Anti-plug protection is provided to prevent armature reversal until a safe minimum speed is reached. Two types of contactor assemblies are available; Unidirectional (U suffix) which adds contactors to disconnect the motor armature when the control is stopped and Reversing (M suffix) which adds additional contactors to disconnect and reverse the motor armature when the unit is reversed.
12. **Dynamic Braking** – Standard feature of models with a motor contactor. Dynamic braking provides exponential rate braking of the DC motor armature. Included is a DB resistor with an anti-plug circuit to prevent restarting the controller until the braking cycle is complete, thereby preventing a potentially damaging electrical surge and mechanical stress. The DB resistor is rated for stopping a typical load, when the external machine inertia does not exceed that of the motor armature, as shown below.

#### DB RESISTOR RATINGS

| Model | Component        | Voltage | Rated Horsepower |     |     |     |     |     |       |     |     |     |
|-------|------------------|---------|------------------|-----|-----|-----|-----|-----|-------|-----|-----|-----|
|       |                  |         | 1/6              | 1/4 | 1/3 | 1/2 | 3/4 | 1   | 1-1/2 | 2   | 3   | 5   |
| VES3  | Braking          | 115V    | 300              | 215 | 170 | 110 | 75  | 60  | —     | —   | —   | —   |
|       | Torque (%)       | 230V    | —                | —   | —   | 400 | 320 | 220 | 145   | 105 | 85  | —   |
|       | Stops Per Minute | 115V    | 9                | 6   | 5   | 5   | 4   | 4   | —     | —   | —   | —   |
|       |                  | 230V    | —                | —   | —   | 5   | 4   | 4   | 3     | 3   | 2   | —   |
| VES5  | Braking          | 115V    | 1000             | 960 | 660 | 460 | 320 | 220 | 150   | 100 | —   | —   |
|       | Torque (%)       | 230V    | —                | —   | —   | 920 | 640 | 440 | 300   | 200 | 160 | 100 |
|       | Stops Per Minute | 115V    | 15               | 12  | 11  | 8   | 6   | 4   | 3     | 3   | —   | —   |
|       |                  | 230V    | —                | —   | —   | 8   | 6   | 4   | 3     | 3   | 2   | 2   |

13. **Motor Overload** – A nonadjustable electronic circuit continuously monitors motor armature current and shuts down the drive whenever the load exceeds 120% for 80 seconds.
14. **Operator Controls** – All enclosed models with integral operator controls include a speed setting potentiometer and a multi-position switch providing RUN-STOP-JOG functions. The switch is maintained in RUN and STOP positions and a spring return to the center stop position from the momentary JOG position. Jog speed is set by the RUN speed potentiometer. Reversing models with a contactor assembly include a momentary contact FORWARD-REVERSE run switch with a spring return to the center position. This switch controls only low control power since armature switching is accomplished by magnetic contactors. The unit is jogged forward or reverse by the momentary FORWARD-REVERSE switch after selecting the JOG position on the RUN-STOP-JOG switch (the JOG position is maintained on this unit).

#### 15. Selectable Capabilities –

- (a) DC Tachometer Feedback – See description under Feedback 7(b)
- (b) AC Line Starting – Provision is included to defeat the no-restart-after-power-failure feature to permit run-stop control of unidirectional models by an external AC line contactor. Included is circuitry to assure smooth starting.
- (c) Torque Regulator – VEplus units may be easily reconfigured to function as a torque regulator. In this mode the speed setting potentiometer is used to set and regulate the motor maximum armature current over a range of 0–150% of rated. Accordingly, motor speed is unregulated and will go to a level of 0–100% of rated, depending upon the application load torque.
- (d) External DC Signal Follower – These units include isolation and impedance matching circuitry to interface an externally supplied grounded or ungrounded, isolated or non-isolated 0–5 VDC, 0–10 VDC or 4–20 mA DC signal source with the motor controller reference input. This provides a linear transfer of the external signal to motor speed. Typical applications include those where motor speed must be controlled as a function of a process variable such as temperature, weight, flow, pressure, etc. In many applications, the reference signal is obtained from a process instrument controller, or other commercially available transducers with a DC output.

#### 16. Mechanical Flexibility – VEplus series units offer outstanding application flexibility. The same basic unit can be used as an open chassis or enclosed package controller.

#### 17. Horsepower and Voltage Calibration – Units are shipped calibrated for the maximum horsepower rating and 230V operation. They may be easily recalibrated for any standard horsepower rating within the design range and 115V operation by reconfigurable jumpers.

#### 18. Customer Use Run Contact – Form A normally open contact rated five amps at 115 VAC or 30 VDC coordinated with run command may be used for external control and indicating devices.

#### 19. Visual Status Indicator – Bicolor LED glows green to show normal operation with the armature current at 100% of rated or less, glows red to show current limit operation.

#### 20. Control Relay – Enables remote control of all models and provides an interlock to prevent a restart after a power outage.

#### 21. Hybrid Circuitry – Extensive use of surface mount miniature components expands flexibility, enhances reliability, and results in a significant reduction in the size of controllers over competitive models.

#### 22. Safety Features – UL and cUL Listed. Low Voltage Operator Control. Requires reset for restart after power interruption. TENV enclosure. Isolated regulator. High Interrupting Capacity AC Line Fuse.

#### 23. Quality Features – FR4 glass circuit cards. Rugged die-cast aluminum alloy chassis base. High strength Noryl® covers. Conservatively rated components selected for long service life.

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# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

VEplus Series  
1/6-5 Horsepower

## RATINGS

- Horsepower:**  
Enclosed or Chassis ..... 1/6 thru 1 HP @ 115 VAC  
..... 1/2 thru 5 HP @ 230 VAC
- Service Factor** ..... 1.0
- Duty** ..... Continuous
- Operating Voltages**

| OPERATING VOLTAGES             |            |                      |  |                                |
|--------------------------------|------------|----------------------|--|--------------------------------|
| Power Source<br>(single-phase) | Output VDC |                      | Control<br>Reference<br>Voltage <sup>(2)</sup> | Magnetic<br>Control<br>Voltage |
|                                | Armature   | Field <sup>(1)</sup> |  |                                |
| 115V, 50 or 60 Hz              | 0-90       | 50/100               | 0-5 VDC<br>0-10 VDC<br>4-20 mA                 | 24 VDC                         |
| 230V, 50 or 60 Hz              | 0-180      | 100/200              |  |                                |

(1) Selectable

(2) Grounded or Ungrounded, choice of one Reference Voltage

- Overload Capacity** (Armature circuit) . 150% for 1 minute
- Run Speed Potentiometer** ..... 5K ohms, 1/2 W
- Reference Power Supply** ..... 10 VDC
- AC Line Fuse, Interrupting Capacity** ..... 100,000 Amps

## ADJUSTMENTS

Potentiometer adjustments are provided for:

- Acceleration Time** ..... 0.2-30 seconds
- Deceleration Time** ..... 0.2-30 seconds
- Minimum Speed** ..... 0-40% of base speed
- Maximum Speed** ..... 50-100% of base speed
- IR (Load) Compensation** ..... 0-100% of rated load
- Torque (Current) Limit** ..... 0-150% of full load

## PERFORMANCE CHARACTERISTICS

- Controlled Speed Range** — Zero to motor base speed. Speed range with respect to specified regulation is shown below.
- Speed Regulation** — Regulation percentages listed are of motor base speed under steady-state conditions. Normal operation will result in performance equal to or better than specifications.

| Regulation<br>Method                                 | SPEED REGULATION CHARACTERISTICS |                       |                         |                                     | Speed<br>Range |
|--|----------------------------------|-----------------------|-------------------------|-------------------------------------|----------------|
|  | Variable                         | Load<br>Change<br>95% | Line<br>Voltage<br>±10% | Field<br>Heating<br>Cold/<br>Normal |                |
| Standard Voltage<br>Feedback with IR<br>Compensation | 2%                               | ±1%                   | 5-12%                   | ±2%                                 | 50:1           |
| Optional Tachometer<br>Feedback <sup>(1)</sup>       | 0.5%                             | ±1%                   | 0.2%                    | ±2%                                 | 200:1          |

(1) Unidirectional Models Only

### 3. Efficiency (rated speed/rated load)

- Controller (SCR regulator).....98%
- Complete drive (Controller and motor, typical).....85%

## OPERATING CONDITIONS

- Line Voltage<sup>(1)</sup>** ..... 115/230 VAC, 50/60 Hz, Single Phase
- Line Voltage Variation** ..... ±10%
- Line Frequency Variation** ..... ±2 Hz
- Ambient Temperature** ..... 0° to 40°C (32° to 104°F)  
..... Chassis: 0° to 55°C (32° to 131°F)
- Altitude** ..... 3300 ft. (1000 meters) maximum
- Relative Humidity** ..... 0-95%, noncondensing

(1) Unit will operate down to -15% of rated voltage, although this may prevent rated speed with rated load.

| TYPICAL APPLICATION DATA  |  |            |         |       |       |       |       |       |       |       |       |       |
|---|--|------------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|   |  |            | Ratings |       |       |       |       |       |       |       |       |       |
| Rated Horsepower (HP)   |  |            | 1/6     | 1/4   | 1/3   | 1/2   | 3/4   | 1     | 1-1/2 | 2     | 3     | 5     |
| Rated Kilowatts (kW)  |  |            | 0.124   | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 | 1.120 | 1.492 | 2.238 | 3.730 |
| 1-Phase<br>AC Input<br>(Full-Load)                              | Line<br>Amps                                       | 115<br>VAC | 3.9     | 5.0   | 6.0   | 8.7   | 12.4  | 15.8  | —     | —     | —     | —     |
|   |  | 230<br>VAC | —       | —     | —     | 4.2   | 5.9   | 8.8   | 12.6  | 15.8  | 22.0  | 32.0  |
|   |  | KVA        | 0.48    | 0.58  | 0.71  | 1.00  | 1.40  | 2.00  | 3.00  | 4.00  | 5.00  | 8.00  |
| DC Output<br>(Full-Load)  | Motor<br>Armature<br>Amps                          | 90V        | 2.0     | 2.8   | 3.5   | 5.4   | 8.1   | 10.5  | —     | —     | —     | —     |
|   |  | 180V       | —       | —     | —     | 2.6   | 3.8   | 5.5   | 8.2   | 11.6  | 15.1  | 25.0  |
|   | Motor <sup>(1)</sup><br>Field<br>Amps<br>(Maximum) | 50V        | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | —     | —     | —     | —     |
|   |  | 100V       | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.5   | 2.0   |
|   |  | 200V       | —       | —     | —     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.5   | 2.0   |
| Full-Load Torque<br>(lb-ft) with 1750 RPM<br>Base Speed Motors  |  |            | 0.5     | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   | 4.5   | 6.0   | 9.0   | 15.0  |
| Minimum Transformer<br>KVA for Voltage<br>Matching or Isolation |  |            | 0.5     | 0.75  | 0.75  | 1.0   | 1.5   | 2.0   | 3.0   | 5.0   | 7.5   | 10.0  |

(1) Does not apply to Permanent Magnet Motors

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed DC Motor Controllers, Nonregenerative

VEplus Series

1/6-5 Horsepower

### MODEL TYPES

VEplus controllers are offered in eighteen (18) standard models in three functional groups. The basic chassis models are the nucleus of all the enclosed models.

Standard covers can be added to the basic chassis to make an enclosed controller (a fan assembly must also be added to the VES5 models) or the enclosed model may be ordered complete as shown below.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Horsepower Range <sup>(1)</sup>                           |         | Catalog Number | Item Code | Functions  |
|---|---------|----------------|-----------|--|
| 115 VAC   | 230 VAC |                |           |  |
| BASIC CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*      |         |                |           |  |
| 1/6-1   | 1/2-3   | VES3           | 64883     | Run/Stop <sup>(2)</sup>  |
|   |         | VES3U          | 57904     | Armature Contactor Run/Stop and DB                                     |
|   |         | VES3M          | 64884     | Armature Contactor Forward/Reverse and DB                              |
| 1/6-1   | 1/2-5   | VES5           | 64890     | Run/Stop <sup>(2)</sup>  |
|   |         | VES5U          | 57909     | Armature Contactor Run/Stop and DB                                     |
|   |         | VES5M          | 64891     | Armature Contactor Forward/Reverse and DB                              |
| NEMA 4/12 ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS* |         |                |           |  |
| 1/6-1   | 1/2-3   | VES3B          | 64885     | Run/Stop <sup>(2)</sup>  |
|   |         | VES3UB         | 57910     | Armature Contactor Run/Stop and DB                                     |
|   |         | VES3MB         | 64887     | Armature Contactor Forward/Reverse and DB                              |
| 1/6-1   | 1/2-5   | VES5B          | 64892     | Run/Stop <sup>(2)</sup>  |
|   |         | VES5UB         | 57926     | Armature Contactor Run/Stop and DB                                     |
|   |         | VES5MB         | 64894     | Armature Contactor Forward/Reverse and DB                              |
| NEMA 4/12 CONTROLLERS WITH INTEGRAL OPERATOR CONTROLS     |         |                |           |  |
| 1/6-1   | 1/2-3   | VES3S          | 64886     | Run/Stop/Jog <sup>(2) (3)</sup>  |
|   |         | VES3US         | 57930     | Run/Stop/Jog, Armature Contactor Run and DB <sup>(3)</sup>             |
|   |         | VES3MR         | 64889     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(4)</sup> |
| 1/6-1   | 1/2-5   | VES5S          | 64893     | Run/Stop/Jog <sup>(2) (3)</sup>  |
|   |         | VES5US         | 57935     | Run/Stop/Jog, Armature Contactor Run/Stop and DB <sup>(3)</sup>        |
|   |         | VES5MR         | 64896     | Run/Stop/Jog, Armature Contactor Forward/Reverse and DB <sup>(4)</sup> |

(1) Units are shipped calibrated for the maximum HP ratings shown. Units may be calibrated for other standard HP ratings by changing the position of a jumper. Units are connected for 230VAC and are easily reconnected for 115VAC input.

(2) Contactorless Run-Stop operation.

(3) JOG speed is set by the RUN-SPEED potentiometer. Maintained in RUN position, JOG position is momentary with a spring return to STOP.

(4) JOG speed is set by the RUN SPEED potentiometer. Maintained in JOG position. FORWARD/REVERSE are momentary.

\*Refer to Remote Operator Station, Pages 47 and 48.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| REMOTE OPERATOR CONTROL STATIONS VEplus |           |                  |                               |                          |                             |
|---|-----------|------------------|-------------------------------|--------------------------|-----------------------------|
| Catalog Number                          | Item Code | Control Elements |                               |                          | Use With Controller Models  |
|   |           | Pushbuttons      | Switches                      | Pots                     |                             |
| RCS1                                    | 69362     | Run, Stop        | —                             | Motor Speed              | ALL                         |
| RCS3C                                   | 58098     | Run, Stop        | Run/Jog                       | Motor Speed<br>Jog Speed | VES3UB<br>VES5UB            |
| RCS3D                                   | 58099     | Run, Stop        | Run/Jog                       | Motor Speed<br>Jog Speed | VES3, VES5,<br>VES3B, VES5B |
| RCS6                                    | 60239     | Fwd, Rev, Stop   | —                             | Motor Speed              | VES3MB<br>VES5MB            |
| RCS16                                   | 58102     | —                | Run/Stop/Jog                  | Motor Speed              | VES3UB<br>VES5UB            |
| RCS17                                   | 58103     | —                | Run/Stop/Jog,<br>Fwd/Stop/Rev | Motor Speed              | VES3MB<br>VES5MB            |

Remote Operator Station dimensions shown on Page 48.

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# RATIO TROL SYSTEMS

Single-Phase Adjustable Speed  
DC Motor Controllers, Nonregenerative

VEplus Series  
1/6-5 Horsepower

## OPTIONS

Options and modifications are listed alpha-numerically within each group. Complete option descriptions are listed in the DC option section.

To order a controller with the options installed, add the option number or letter as a suffix to the controller catalog number, e.g. VES3MR-IAB-25A, VES5MB-21A, etc. To order a kit for field installation, order by item code.

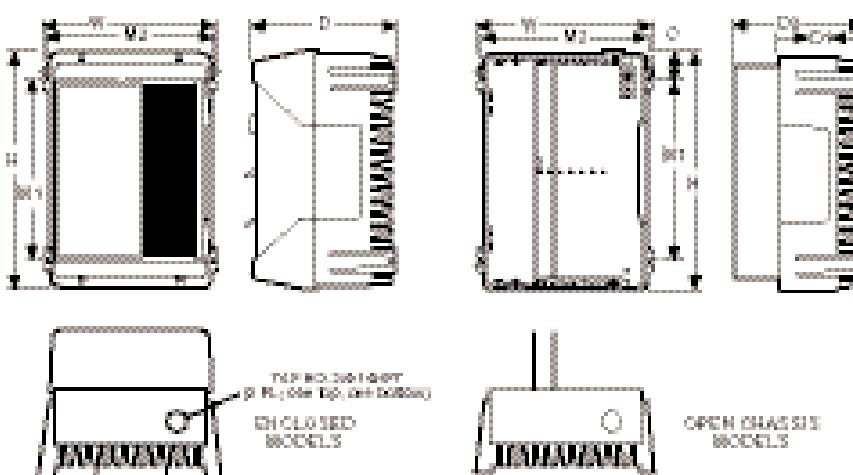
A large number of options, or certain combinations of options may require a larger enclosure or an additional enclosure.

| Group                                 | Option  | No.  | Kit Item Code   | Notes  |
|---------------------------------------|---|--|---|--|
| Power                                 | Circuit Breaker (Two-Pole)  | 30   | 58091   |  |
| Input Signal (plug in) <sup>(2)</sup> | Follower, Master Override<br>Follower, AC or DC Tachometer Generator<br>Follower, Digital Pulse Generator<br>Follower, External DC Signal<br>Follower, AC Current Transducer<br>Follower, MIRC<br>Precision Reference | 14<br>22A<br>22B<br>25A<br>25C<br>35<br>47 | 60170<br>60163<br>60270<br>60165<br>—<br>60173<br>50390 | (1, 2)<br>(1, 2)<br>(1, 2)<br>(1, 2)<br>(1, 2)<br>(1, 2)<br>(1, 2) |
| Feedback (plug-in) <sup>(2)</sup>     | Torque Taper<br>Torque (Current) Limit Control<br>Torque (Current) Reference<br>DC Tachometer Feedback<br>Feedback, AC or DC Tachometer Generator<br>Feedback, Digital Pulse Generator                                | 18A<br>18B<br>18E<br>24<br>24A<br>24B      | 60164<br>60164<br>—<br>—<br>60162<br>60269              | (1, 2)<br>(1, 2)<br>(6)<br>(6)<br>(1, 2)<br>(1, 2)                 |
| Input and Feedback                    | Centerwind Torque Control<br>Constant Velocity Winder   | 36A<br>36B                                 | 60175<br>61285  | (1, 2, 3)<br>(1, 2, 3)   |
| Interfaces                            | Interface Adapter Board   | IAB  | 64907   |  |
| External                              | Line Starting<br>Motor Speed Potentiometer, Ten Turn (Analog)<br>Motor Speed Potentiometer, Ten Turn (Digital)<br>Follower/Manual Mode Selector Switch  | LS<br>21A<br>21B<br>38                     | —<br>60168<br>66103<br>—                                | (6)<br>(5)<br>(5)<br>(4)   |
| Enclosure                             | Hinge, Enclosure Cover  | 50   | 67539   |  |

Notes: (1) Option IAB (64907) required to use these options  
(2) Only one plug-in option in a group is possible  
(3) Not to be combined with options from other groups

(4) Will not be NEMA 4/12 unless factory installed  
(5) Unit will not be rated NEMA 4/12  
(6) Modifiable feature of controller

## DIMENSIONS



| Enclosed | H    | W   | D   | D1  | D2  | M1  | M2  | C   | Weight (lbs.) |          |
|----------|------|-----|-----|-----|-----|-----|-----|-----|---------------|----------|
|          |      |     |     |     |     |     |     |     | Chassis       | Enclosed |
| VES3     | 12.1 | 9.0 | 7.3 | 4.1 | 5.6 | 9.3 | 8.6 | 1.3 | 9.0           |          |

NOTE: VES5 enclosed models are supplied with a fan assembly.

**BOSTON GEAR®**

# RATIO TROL SYSTEMS

*Single-Phase Adjustable Speed  
Regenerative DC Motor Controllers*



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# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

## Specification Chart

The purpose of this chart is to provide a general feature comparison of the Boston Gear controllers. When selecting refer to the specific catalog selection for complete information.

| REGENERATIVE DC MOTOR CONTROLLER SPECIFICATIONS |  |   |                       |
|---|--|---|-----------------------|
| Features  |  | RBA-RG/VEA-RG                             |                       |
| AC Line (50/60 Hz)                              | Single-Phase Voltage<br>Three-Phase Voltage  | 115<br>—                                  | 230<br>—              |
| Range   | Maximum Horsepower   | 1   | 5                     |
| Output  | Armature Voltage<br>Field Voltage  | 90<br>50/100                              | 180<br>100/200        |
| AC Line Protection                              | Fuse<br>Circuit Breaker  | S<br>S                                    | S<br>O                |
| Enclosure                                       | Open Chassis<br>Angle Bracket Chassis<br>NEMA 1<br>NEMA 4<br>NEMA 12   | S<br>S<br>S<br>S<br>S                     | S<br>S<br>S<br>S<br>S |
| Adjustments                                     | Acceleration (Seconds)<br>Deceleration (Seconds)<br>IR Compensation (%)<br>Maximum Speed (%)<br>Current Limit (%)<br>Gain<br>Phase Shift | 0.2-30<br>0.2-30<br>10<br>50-10<br>10-150 |                       |
| Horsepower/<br>Voltage<br>Calibration           | Trim Pot Adjustments<br>Resistance Wire<br>Plug In Jumpers<br>Switch   | S<br>S                                    |                       |
| Isolated Regulator                              |  | O   |                       |
| Speed Regulation                                | Standard IR Feedback<br>Percentage<br>Speed Range<br>Tachometer Feedback<br>Percentage<br>Speed Range                                    | 2%<br>50:1<br>0.5%<br>200:1               |                       |
| Input   | Analog<br>Digital  | S   |                       |
| Tachometer Feedback                             | Bidirectional  | S   |                       |
| Options   | Field Installed<br>Factory Installed   | O   |                       |
| UL/cUL  |  | S   |                       |
| Pages   |  | 33-37                                     |                       |
| S-Standard      O-Optional                      |  |   |                       |

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

RBA-RG/VEA-RG Series

1/6-5 Horsepower



Boston Gear RBA-RG/VEA-RG regenerative controllers, are economical, general purpose units. The units feature static conversion of AC line power to regulated direct current adjustable speed, four-quadrant armature control of shunt-wound or permanent magnet DC motors. The compact dimensions and design features of the units make this series of controllers an ideal choice for numerous industrial applications which require controllable bidirectional speed and torque for overhauling loads, contactorless reversing and static braking.

RBA-RG & VEA-RG units are identical in standard features and functions and differ only in mechanical configuration and horsepower range. RBA-RG Series units are smaller, are limited to three horsepower maximum and will accept a limited number of options. VEA-RG Series units are physically larger permitting ratings through five horsepower and provide greater available space to facilitate mounting a wide range of optional features. Accordingly, RBA-RG Series units are preferred in space intensive applications where the standard features and functions are adequate for the application. The RBA-RG Series is available as standard in open and enclosed configurations along with the angle bracket chassis style. The VEA-RG Series is available as standard in the open and enclosed configuration.

RBA-RG/VEA-RG controllers are designed and manufactured to comply with applicable standards established by the National Electrical Code and NEMA for industrial motor and control equipment. The units are UL and cUL Listed.

### DESIGN FEATURES AND FUNCTIONS

**1. Construction** – The die-cast aluminum alloy base assembly forms the basic RBA-RG Series open chassis (excluding RBA2C-RG units) which includes regulator electronics, AC line fuse, power conversion and protective circuitry as a totally functional, self-contained unit. The entire back surface of the VEA-RG Series base is a unique, pin configuration heatsink with omni-directional heat dissipation characteristics. This allows vertical or horizontal wall mounting as best suits the available space. All open models are cooled by natural convection. Conduit entry is provided in the base by two 3/4-14 NPT tapped holes, one each on the top and bottom.

Enclosed models consist of the basic chassis with the addition of a screw fixed cover which is gasketed with an oil resistant synthetic rubber gasket to exclude contaminants. Basic enclosed units are TENV, NEMA 4 and 12. All models with integral operator controls also include flexible boots to seal the operator control switches and a seal for the motor speed potentiometer.

*RBA3-RG Models, when rated three (3) horsepower as an enclosed unit, requires the use of a stand off kit (Option SK). This is included when an enclosed controller is ordered.*

*VEA5-RG Models, when rated five (5) horsepower as an enclosed unit, requires the addition of Option VFKT cooling fan assembly. This is included when an enclosed controller is ordered.*

VEA-RG Series unit covers are molded of high strength Noryl® engineering plastic. An aperture in the cover permits mounting a blank panel for remote control models or various standard or optional local operator control panels. *Where a hinged cover is desired, Option 50 provides a kit permitting easy field installation.*

RBA-RG Series unit covers are die-cast aluminum alloy. Various cover models are provided. Blank face models include no operator control elements, as they are intended for remote control operation. The local control model provides a motor speed potentiometer and Run/Stop Jog toggle switch.

RBA2C-RG Models are offered only in a special space saving chassis configuration, formed of aluminum into a Right Angle chassis design, which requires only two (2) mounting screws.

**2. Full-Wave Power Conversion** – Dual full-wave converter configuration, consists of eight (8) SCRs connected in back to back bridges of four (4) SCRs each. The SCR's are rated 600 PIV minimum.

**3. Voltage Transient Protection** – Metal oxide suppressor with RC snubbers across the AC line input and a second RC snubber across the DC output.

**4. AC Line Protection** – A 100,000 ampere interrupting capacity AC line fuse provides instantaneous protection from peak loads and fault currents. This line fuse is located inside the controller. A molded-case magnetic-trip circuit breaker (Option 30) is available for VEA-RG Model controllers, which provides a manual disconnection to the controller, and also provides automatic instantaneous trip protection from a peak load.

**5. AC Line Power** – Controllers are reconnectable for 115 or 230 VAC, single-phase, 50 or 60 Hertz.

**6. Safety Features** – UL listed and cUL. Requires mandatory restart after power interruption.

**7. AC Line Starting** – Provision is included to defeat the mandatory restart after power interruption to permit run-stop control of the units by an external AC line contactor.

**8. Deadband Selection** – This will help to eliminate "creeping" motor speed with zero speed reference signal. It gives a non-adjustable ±2% deadband around zero speed.

**9. Field Supply** – Transient protected, full-wave and half-wave field supply.

**10. Operator Controls** – Units with a "S" suffix in the catalog number (example: RBA2S-RG) contain a motor speed potentiometer and a Run-Stop-Jog switch. The speed potentiometer is reconnectable for unidirectional or bidirectional operation.

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

### DESIGN FEATURES AND FUNCTIONS (Continued)

11. **Static Reversing** – Solid state, electronic reversal of the motor armature. No reversing contacts to burn, arc or wear.
12. **Static Braking** – Provides smooth regeneration braking of the DC drive motor. Braking is effective whenever the manual speed control potentiometer is reset to command a reduction in speed or change in the direction of motor rotation.
13. **DC Tachometer Feedback** – Unit includes terminals to accept a 5.5 to 100VDC/1000 RPM (1750 RPM maximum) signal from a motor mounted DC tachometer generator for improved speed regulation.
14. **External Current (Torque) Control** – Terminals are provided for external forward and reverse current limit (torque) control.
15. **Diagnostic LED** – A dual color LED, green for power on, red for current limit is provided.
16. **Customer Use Run Contacts** – Form A normally open contact rated five (5) amps at 115 VAC or 30 VDC coordinated with run command may be used for external control and indicating devices. May be applied as pushbutton seal-in or a drive "RUN" contact.
17. **Hybrid Circuitry** – Miniature components in a custom surface mount assembly, improve reliability and make possible more features in the smallest possible mechanical configuration.
18. **Option Connectors** – These connectors are provided for options that fit in a space provided inside the controller.
19. **Dynamic Braking** – Standard feature of model numbers with a "U" suffix. Dynamic braking provides exponential rate braking of the DC motor armature. Included is a Dynamic Braking resistor with an anti-plug circuit to prevent restarting the controller until the braking cycle is complete, thereby preventing a potentially damaging contact arcing. The Dynamic Braking resistor is rated for stopping a typical load, when the external machine inertia does not exceed that of the motor armature, as shown in table.
20. **Control Voltage** – A transformer coupled 24 VDC power supply provides non-isolated control power for all magnetic control logic and operator controls.
21. **DIP Switch Settings** – An 8-position DIP Switch is used to program the controller for various applications and operations.
22. **Motor Contactor** – Controller model numbers with a "U" suffix, e.g., RBA2U-RG, VEA5US-RG, have a DC magnetic armature contactor, which disconnects both motor armature leads from the controller. An antiplug circuit ensures that the contactor does not make or break DC from the SCR bridge.

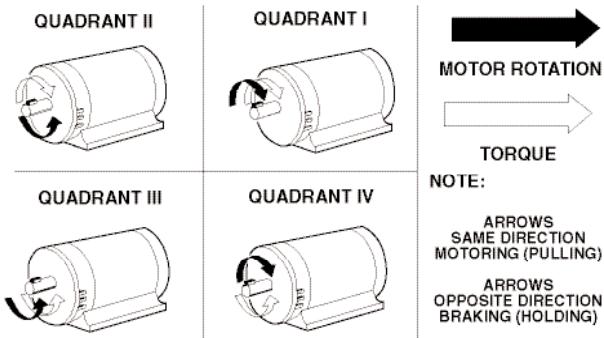
| DYNAMIC BRAKING CHARACTERISTICS (1) (2) |         |               |                  |     |     |     |     |     |       |     |
|---|---------|---------------|------------------|-----|-----|-----|-----|-----|-------|-----|
| Component                               | Model   | Rated Voltage | Rated Horsepower |     |     |     |     |     |       |     |
|   |         |               | 1/6              | 1/4 | 1/3 | 1/2 | 3/4 | 1   | 1 1/2 | 2   |
| Braking Torque (%)                      | RBA2-RG | 115V          | 180              | 129 | 103 | 66  | 44  | 34  | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | 400 | 278 | 200 | 138 | 93    | 66  |
|   | RBA3-RG | 115V          | 300              | 214 | 171 | 111 | 74  | 57  | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | N/A | 462 | 316 | 218 | 146   | 103 |
|   | VEA5-RG | 115V          | 600              | 429 | 343 | 222 | 148 | 114 | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | N/A | 923 | 632 | 436 | 293   | 207 |
| Stops Per Minute                        | RBA2-RG | 115V          | 15               | 12  | 11  | 8   | 6   | 2   | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | 12  | 8   | 6   | 2   | 1     | N/A |
|   | RBA3-RG | 115V          | 9                | 6   | 5   | 5   | 4   | 4   | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | N/A | 5   | 4   | 4   | 3     | 2   |
|   | VEA5-RG | 115V          | 15               | 12  | 10  | 10  | 7   | 7   | N/A   | N/A |
|   |         | 230V          | N/A              | N/A | N/A | 10  | 7   | 7   | 5     | 3   |

Notes: (1) Ratings shown for units with contactor board (Model number contains "U" suffix, ex RBA3U-RG).

(2) High inertia loads may extend braking time and cause the wattage rating of the dynamic braking resistors to be exceeded.

### RBA-RG/VEA-RG Series

1/6-5 Horsepower



### PRINCIPLES OF OPERATION

Regenerative adjustable speed drives, also known as four-quadrant drives, are capable of controlling not only the speed and direction of motor rotation, but also the direction of motor torque. This is illustrated to the right.

The term regenerative describes the ability of the drive under braking conditions to convert the mechanical energy of the motor and connected load into electrical energy which is returned (or regenerated) to the AC power source.

When the drive is operating in Quadrants I and III, both motor rotation and torque are in the same direction and it functions as a conventional nonregenerative unit. The unique characteristics of a regenerative drive are apparent in Quadrants II and IV. In these quadrants the motor torque opposes the direction of motor rotation which provides a controlled braking or retarding force. A high performance regenerative drive, such as the RBA-RG/VEA-RG Series, is able to switch rapidly from motoring to braking modes while simultaneously controlling the direction of motor rotation.

### RATINGS

1. **Horsepower Range** ..... 1/6-5 HP
2. **Power Source** ..... 115 or 230 VAC, Single-Phase, 50 or 60 Hz
3. **Operating Voltages**

| OPERATING VOLTAGES             |            |         |                           |                          |
|--------------------------------|------------|---------|---------------------------|--------------------------|
| Power Source<br>(Single-Phase) | Output VDC |         | Control Reference Voltage | Magnetic Control Voltage |
|                                | Armature   | Field   |                           |                          |
| 115V, 50 or 60 Hz              | 0-90       | 50/100  | 0 to ±10 VDC              | 24 VDC                   |
| 230V, 50 or 60 Hz              | 0-180      | 100/200 |                           |                          |

4. **Service Factor** ..... 1.0
5. **Duty** ..... Continuous
6. **Overload Capacity (Armature Circuit)** ..... 150% for 1 Minute
7. **Line Fuse Interrupting Capacity (Non-Isolated)** ..... 100,000 Amps
8. **Reference Power Supply (Non-Isolated)** ..... ±10VDC
9. **Run Speed Potentiometer** ..... 10K ohms, 1/2 W
10. **Current/Torque Reference Potentiometer** ..... 10K ohms, 1/2 W

# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

RBA-RG/VEA-RG Series

1/6-5 Horsepower

### ADJUSTMENTS

Potentiometer adjustments are provided for:

- Current Limit**.....10-150% Full-Load Torque (Independent forward and reverse circuits)
- Maximum Speed**.....50-100% of Motor Base Speed
- IR (Load) Compensation**.....10% Boost
- Acceleration**.....0.2 to 30 Seconds
- Deceleration**.....0.2 to 30 Seconds
- Deadband (Yes or No Adjustment)**.....0 or  $\pm 2\%$
- Jog Speed**.....0 to 100% of Motor Base Speed

### OPERATING CONDITIONS

- Line Voltage Variation**..... $\pm 10\%$  of rated
- Line Frequency Variation**..... $\pm 2$  Hz
- Ambient Temperature (1)**.....0°C to 40°C (32°F to 104°F)
- Altitude (Standard)**.....1000 meters (3300 feet) Maximum
- Relative Humidity**.....95% Noncondensing

(1) 0°C to 55°C (32°F to 131°F) maximum in enclosed areas where chassis models are mounted.

### PERFORMANCE CHARACTERISTICS

- Controlled Speed Range** – Zero to motor base speed. Speed range with respect to specified regulation is listed in Table. See page I2 for continuous duty application limitations of DC motors.
- Speed Regulation** – Regulation percentages shown in Table below are of motor base speed under steady-state conditions.
- Efficiency** (Rated speed/Rated load)
  - Controller SCR regulator .....98%
  - Complete drive with motor (typical) .....85%
- Current Ripple Frequency** .....120 Hz (60 Hz line)  
100 Hz (50 Hz line)
- Controller Bandwidth (Speed of Response)** .....5 Hz

| SPEED REGULATION CHARACTERISTICS               |                 |                         |                           |                              |             |
|--|-----------------|-------------------------|---------------------------|------------------------------|-------------|
| Regulation Method                              | Variable        |                         |                           |                              | Speed Range |
|  | Load Change 95% | Line Voltage $\pm 10\%$ | Field Heating Cold/Normal | Temp. $\pm 10^\circ\text{C}$ |             |
| Standard Voltage Feedback with IR Compensation | 2%              | $\pm 1\%$               | 5-12%                     | $\pm 2\%$                    | 50:1        |
| Tachometer Feedback with 5 PY DC Tach Feedback | 0.5%            | $\pm 1\%$               | 0.2%                      | $\pm 2\%$                    | 200:1       |

| TYPICAL APPLICATION DATA                                  |                     |           |         |       |       |       |       |       |       |       |       |       |  |
|---|---------------------|-----------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Component   |                     |           | Ratings |       |       |       |       |       |       |       |       |       |  |
| Rated Horsepower (HP)                                     |                     |           | 1/6     | 1/4   | 1/3   | 1/2   | 3/4   | 1     | 1-1/2 | 2     | 3     | 5     |  |
| Rated Kilowatts (kW)                                      |                     |           | 0.124   | 0.187 | 0.249 | 0.373 | 0.560 | 0.746 | 1.120 | 1.492 | 2.238 | 3.730 |  |
| 1-Phase AC Input (Full-Load)                              | Line Amps           | 115V Unit | 3.9     | 5.0   | 6.0   | 8.7   | 12.4  | 15.8  | —     | —     | —     | —     |  |
|   |                     | 230V Unit | —       | —     | —     | 4.2   | 5.9   | 8.8   | 12.6  | 15.8  | 22.0  | 32.0  |  |
|   | KVA                 |           | 0.48    | 0.58  | 0.71  | 1.00  | 1.40  | 2.00  | 3.00  | 4.00  | 5.00  | 8.00  |  |
| DC Output (Full-Load)                                     | Motor Armature Amps | 90V       | 2.0     | 2.8   | 3.5   | 5.4   | 8.1   | 10.5  | —     | —     | —     | —     |  |
|   |                     | 180V      | —       | —     | —     | 2.6   | 3.8   | 5.5   | 8.2   | 11.6  | 15.1  | 25.0  |  |
|   | Motor Field Amps    | RBA-RG    | 1.0     | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | —     |  |
|   |                     | VEA-RG    | 2.0     | 2.0   | 2.0   | 2.0   | 2.0   | 2.0   | 2.0   | 2.0   | 2.0   | 2.0   |  |
| Full Load Torque (lb-ft) with 1750 RPM Base Speed Motors  |                     |           | 0.5     | 0.75  | 1.0   | 1.5   | 2.2   | 3.0   | 4.5   | 6.0   | 9.0   | 15.0  |  |
| Minimum Transformer KVA for Voltage Matching or Isolation |                     |           | 0.5     | 0.75  | 0.75  | 1.0   | 1.5   | 2.0   | 3.0   | 5.0   | 7.5   | 10.0  |  |

**BOSTON GEAR®**

Electrical Products Catalog

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# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

**RBA-RG/VEA-RG Series**

**1/6-5 Horsepower**

### MODEL TYPES

RBA-RG/VEA-RG controllers are offered in eighteen (18) standard models in four (4) functional groups. The basic chassis models are the nucleus of all the enclosed models; standard covers and contactor assemblies can be added to the basic chassis to make an enclosed controller or the enclosed unit may be ordered complete as shown below.

#### ORDER BY CATALOG NUMBER OR ITEM CODE

| Horsepower Range <sup>(1)</sup>                                  |         | Catalog Number | Item Code | Function  |
|--|---------|----------------|-----------|---|
| 115 VAC  | 230 VAC |                |           |   |
| <b>ANGLE BRACKET CHASSIS UNITS WITHOUT OPERATOR CONTROLS*</b>    |         |                |           |   |
| 1/6-1  | 1/2-2   | RBA2C-RG       | 68402     | Run/Stop(4)                                     |
|  |         | RBA2CU-RG      | 68411     | Bidirectional with Armature Contactor and DB    |
| <b>BASIC CHASSIS CONTROLLERS WITHOUT OPERATOR CONTROLS*</b>      |         |                |           |   |
| 1/6-1  | 1/2-2   | RBA2-RG        | 68385     | Run/Stop(4)                                     |
|  |         | RBA2U-RG       | 68388     | Bidirectional with Armature Contactor and DB    |
| 1/6-1  | 1/2-3   | RBA3-RG        | 68397     | Run/Stop(4)                                     |
|  |         | RBA3U-RG       | 68400     | Bidirectional with Armature Contactor and DB    |
| 1/6-1  | 1/2-5   | VEA5-RG        | 68440     | Run/Stop(4)                                     |
|  |         | VEA5U-RG       | 68441     | Bidirectional with Armature Contactor and DB    |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITHOUT OPERATOR CONTROLS*</b> |         |                |           |   |
| 1/6-1  | 1/2-2   | RBA2B-RG       | 68392     | Run/Stop(4)                                     |
|  |         | RBA2UB-RG      | 68394     | Bidirectional with Armature Contactor and DB    |
| 1/6-1  | 1/2-3   | RBA3B-RG       | 68419     | Run/Stop(2)(4)                                  |
| 1/6-1  | 1/2-5   | VEA5B-RG       | 68442     | Run/Stop(3)(4)                                  |
|  |         | VEA5UB-RG      | 68443     | Bidirectional with Armature Contactor and DB(3) |
| <b>NEMA 4/12 ENCLOSED CONTROLLERS WITH OPERATOR CONTROLS*</b>    |         |                |           |   |
| 1/6-1  | 1/2-2   | RBA2S-RG       | 68395     | Run/Stop/Jog(4)(5)                              |
|  |         | RBA2US-RG      | 68396     | Bidirectional with Armature Contactor and DB    |
| 1/6-1  | 1/2-3   | RBA3S-RG       | 68424     | Run/Stop/Jog(2)(4)(5)                           |
| 1/6-1  | 1/2-5   | VEA5S-RG       | 68444     | Run/Stop/Jog(3)(4)(5)                           |
|  |         | VEA5US-RG      | 68445     | Bidirectional with Armature Contactor and DB    |

\*Refer to Remote Operator Stations on Pages 47 and 48

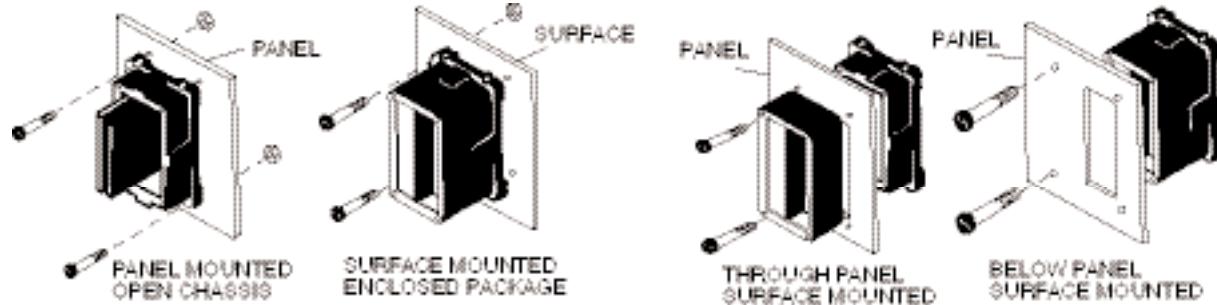
(1) Units are shipped calibrated for the maximum horsepower ratings shown. Units may be calibrated for other standard ratings by the removal of jumpers. Units are connected for 230 VAC and are easily reconnected for 115 VAC input.

(2) Includes option SK, Spacer Kit, as standard.

(3) Includes option VFKT, Cooling Fan, as standard.

(4) Contactorless Run-Stop Operation.

(5) Jog Speed is set by the Run Speed potentiometer, maintained in the Run position, Jog position is momentary with a spring return to Stop.



*RBA-RG Series Mounting Configurations*

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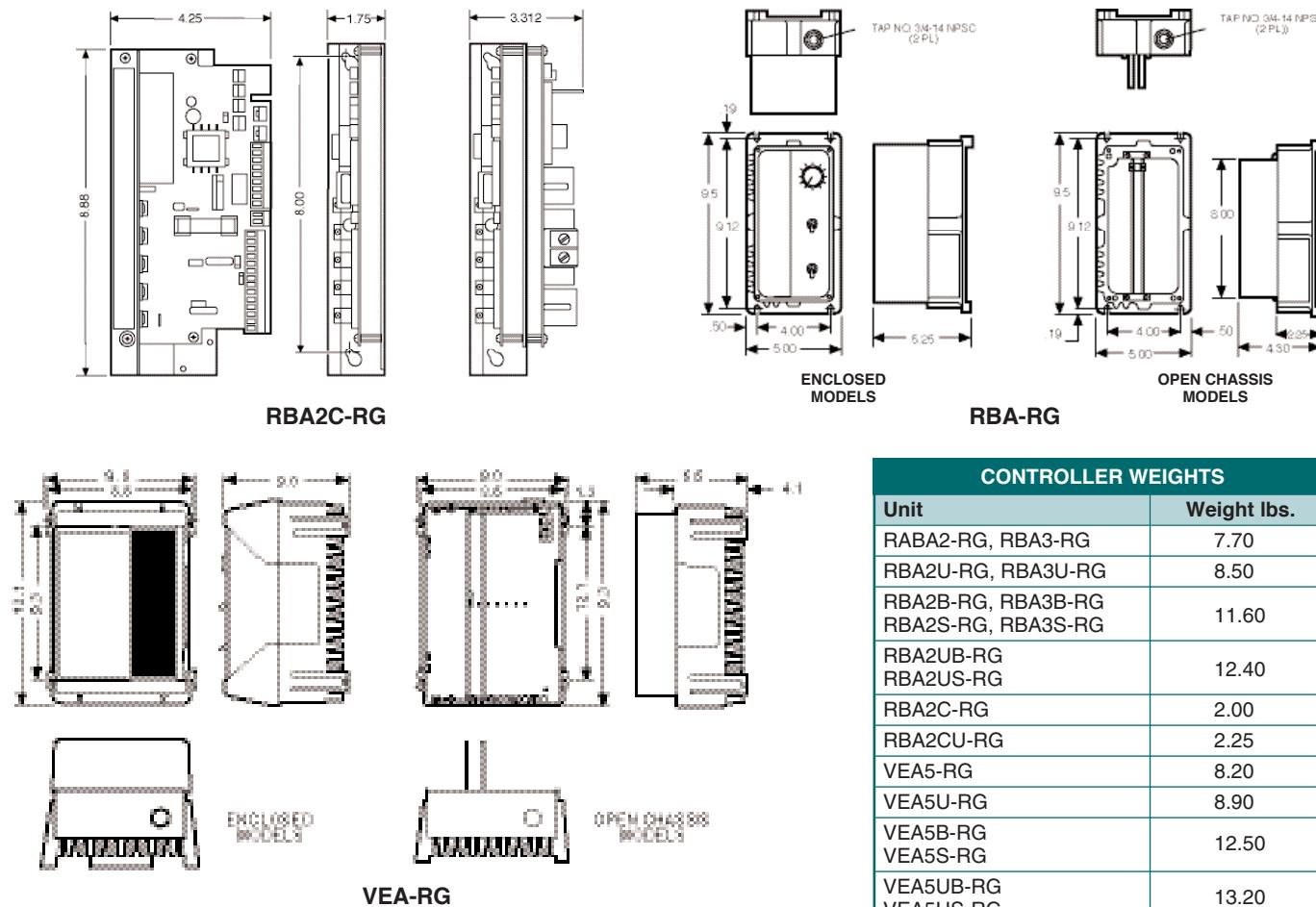
# RATIO TROL SYSTEMS

## Single-Phase Adjustable Speed Regenerative DC Motor Controllers

RBA-RG/VEA-RG Series

1/6-5 Horsepower

### DIMENSIONS



RBA-RG

### CONTROLLER WEIGHTS

| Unit               | Weight lbs. |
|--------------------|-------------|
| RABA2-RG, RBA3-RG  | 7.70        |
| RBA2U-RG, RBA3U-RG | 8.50        |
| RBA2B-RG, RBA3B-RG |             |
| RBA2S-RG, RBA3S-RG | 11.60       |
| RBA2UB-RG          |             |
| RBA2US-RG          | 12.40       |
| RBA2C-RG           | 2.00        |
| RBA2CU-RG          | 2.25        |
| VEA5-RG            | 8.20        |
| VEA5U-RG           | 8.90        |
| VEA5B-RG           |             |
| VEA5S-RG           | 12.50       |
| VEA5UB-RG          |             |
| VEA5US-RG          | 13.20       |

### OPTIONS

The versatility of the RBA-RG/VEA-RG Series controllers for various applications can be extended by selecting one (1) or more of the listed options. Most can be easily added in the field via simplified instructions provided. The table below lists the options in functional groups along with information on allowable combinations and installation complexity.

#### Allowable Option Combinations

| Remarks  | Option   | Catalog Number | Kit Number | Notes |
|--|--|----------------|------------|-------|
| <b>Enclosure Options</b> —Choice of any or all within this group. May be combined with options from any other group. | Hinge kit to allow the cover to swing open             | 50             | 67539      |       |
|  | Spacer kit for RBA3B-RG, RBA3S-RG enclosed controllers | SK             | 68416      |       |
| <b>Power Options</b>   | Circuit Breaker—Two Pole (VEA-RG only)                 | 30             | 68456      |       |
| <b>Accel/Decel Option</b>  | Four-Quadrant Acceleration/Deceleration                | 17             | 68457      |       |
| <b>Circuit Board Options</b> —Choice of one within this group  | Torque Taper   | 18             | 68458      | (1)   |
|  | Pulse Tachometer Feedback/Follower                     | 24B            | 68462      | (1)   |
|  | Isolated Input   | 25             | 68478      |       |
|  | Limit Switch Reversing                                 | RI             | 68461      | (1)   |
| <b>External Options</b> —Choice of any or all within this group  | Motor Speed Potentiometer, One-Turn                    | 21             | —          | (2)   |
|  | Motor Speed Potentiometer, Ten-Turn With Analog Dial   | 21A            | 66929      | (2)   |
|  | Option Guide Card Kit                                  | MK             | 68476      | (1)   |
|  | Option/Contactor Mounting Kit for RBA2C-RG             | SKO            | 64101      |       |

(1) Option MK is a pre-requisite to enable the use of options in the VEA-RG Series.

(2) Will not be NEMA 4/12 unless factory installed.

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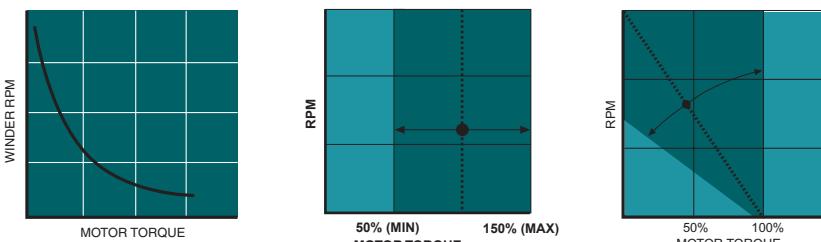
# RATIO TROL SYSTEMS

## Options and Modifications for DC Controllers

| Option No. | Description   | For Use with Series            |
|------------|---|--------------------------------|
| CL         | <b>MAGNETIC CONTROL INTERFACE (115V)</b><br>The standard magnetic control run logic excitation is 24 VDC, obtained from a self-contained power supply in the VEplus controllers. This option provides a means of interfacing a controller with pushbuttons or external logic powered by a 115 or 230 VAC excitation source. The interface circuit includes three control relays with 115 VAC coils for use in both unidirectional and reversing applications.   | VEplus                         |
| IAB        | <b>INTERFACE, SIGNAL OPTIONS</b><br>Series VEplus units incorporate as standard many of the functions that were formerly offered as extra cost options on the products they replace. However, some special applications may still require the use of signal options. Option IAB enables the use of these options by providing a power supply, mounting area and an electrical connector to interface and mate with these options. This option mounts within the VEplus chassis.<br><br>Space limitations prevent mounting this option within the BETA units and therefore it may be mounted externally with brackets provided in a kit.   | BETA II<br>BETApplus<br>VEplus |
| LS         | <b>LINE STARTING</b><br>A modification which will defeat the internal "anti-restart" feature of the controller. An external AC line contactor may then be used to start and stop controller   | BETA II<br>BETApplus<br>VEplus |
| MK         | <b>OPTION CARD GUIDE KIT</b><br>This option is required when mounting the option cards in the enclosure or if the option cards are mounted external.  | VEA-RG                         |
| RI         | <b>LIMIT SWITCH REVERSING</b><br>This option board allows interfacing the controller with a variety of external devices, such as limit switches, push buttons and potentiometers. There are two (2) speed potentiometers on this board, one (1) for forward speed and one (1) for reverse speed. These internal potentiometers can be switched out if external potentiometers are required. In addition, this board will allow a controlled stop feature with an adjustable speed dropout.  | VEA-RG<br>RBA-RG               |
| SK         | <b>SPACER KIT FOR 3 HP RBA-RG ENCLOSED CONTROLLER</b><br>This spacer kit is required for mounting controllers when they are to be used for their maximum 3 HP rating.   | RBA-RG                         |
| SKO        | <b>OPTION MOUNTING KIT</b><br>This kit contains standoffs for mounting an optional contactor or option board onto an Angle Bracket chassis.   | RBA-RG                         |
| 14         | <b>MASTER OVERRIDE (FOLLOWER, EXTERNAL AC SIGNAL)</b><br>Provides necessary impedance matching, isolation, signal conversion and filtering as required to adjust the speed of the drive (or drives) from an external AC signal source. Option 14 permits full range speed control from an external 0 to 115 VAC adjustable signal source manually controlled by a potentiometer, variable autotransformer or some other suitable means.<br>This option is required for each controller which is to be controlled by the external AC signal.<br>Included in this option are minimum and maximum speed adjustments, with the normal drive run speed potentiometer functioning as a ratio setting when following the external AC signal. This option is useful for multiple section machines where a definite speed relationship must be maintained between sections, while the entire machine is varied over a specified speed range by a common manual speed control device.<br>This option consists of a small plug-in circuit board which inserts into the input connector of the control board.<br><i>The option does not include the external AC signal source.</i><br>Master Override Station Cat. No. 62317 provides the required master signal and also includes master run-stop pushbuttons. (Option 14A)<br>If the controls are to be started with individual pushbutton stations, Master Station Cat. No. 62311 may be used to provide master speed control only. (Option 14B) | VEplus                         |
| 17         | <b>FOUR-QUADRANT ACCELERATION/DECELERATION</b><br>This option board has four (4) adjustment potentiometers consisting of a forward acceleration potentiometer, a forward deceleration potentiometer, a reverse acceleration potentiometer and a reverse deceleration potentiometer. The potentiometers have an adjustment range of .3 to 30 seconds. Also, the board has a bypass mode to disable the four (4) potentiometers on the option board and switch to the two (2) potentiometers (acceleration and deceleration) on the control board.<br>This option board mounts on the control board and does not take up the option slot in the casting base.   | VEA-RG<br>RBA-RG               |

# RATIO TROL SYSTEMS

## Options and Modifications for DC Controllers

| Option No. | Description   | For Use with Series |
|------------|---|---------------------|
| 18         | <p><b>TORQUE TAPER</b></p> <p>This option consists of a plug-in circuit board. This board provides an inverse-linear speed-torque relationship when operating in the braking (regenerative) mode, and provides constant torque in the motoring mode of operation. Motoring torque and braking torque are individually adjustable as well as forward and reverse torque taper. Applications include the following:</p> <ol style="list-style-type: none"> <li>1. Winders where the material being wound travels at a constant speed during winder roll buildup.</li> <li>2. Unwinders, since this option provides relatively constant holdback tension (<math>\pm 20\%</math>) from full roll to empty roll.</li> </ol>  | VEA-RG<br>RBA-RG    |
| 18A        | <p><b>TORQUE TAPER</b></p> <p>Center driven winders ideally require a reciprocal speed torque relationship (constant horsepower) to maintain constant tension throughout the range of material build-up. Acceptable performance can be economically achieved for many applications with an inverse-linear speed-torque relationship provided by this option. Tension control accuracy of approximately 20% can normally be maintained from empty to full roll at a given machine speed.</p> <p><i>This option consists of a plug-in circuit board which replaces the FEEDBACK board in the control and a torque potentiometer for installation in the operator's panel. Independent potentiometers are provided for:</i></p> <p><b>TORQUE ADJUST</b>—Establishes maximum low speed torque. The TORQUE ADJUST in combination with the SLOPE ADJUST establishes the torque available at any point throughout the operating speed range</p> <p><b>SLOPE ADJUST</b>—Establishes the rate of torque increase with decreasing speed, throughout the operating range. Adjustable from 0 to 100% torque at maximum motor speed with minimum effect on low speed torque. The SLOPE ADJUST potentiometer is mounted within the controller on the option circuit board.</p> <p><b>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportion to motor speed. Web break or other process material detectors are recommended to prevent a dangerous overspeed should the process material break.</b></p> <p><i>Option 18A normally provides acceptable performance in applications where the material being wound travels at a constant speed during winder roll buildup. If the process is such that the speed of the material being wound varies during winder roll buildup or if more accurate tension control is desired, see Option 36A.</i></p> <p><i>This Option Kit is also used for constant torque applications where conventional operation of the current limit is required and remote mounting of the torque (current) potentiometer is desired. When used in this manner, the Slope adjustment is set for a vertical cutoff of motor (maximum setting) torque (current). See Option 18B.</i></p>  <p><b>FIGURE A.</b><br/>"Ideal" Constant HP curve for a winder application</p> <p><b>FIGURE B.</b><br/>Torque Adjust with slope adjust at maximum</p> <p><b>FIGURE C.</b><br/>Slope Adjust with torque adjust at 100% torque setting</p> | VEplus              |
| 18B        | <p><b>TORQUE (CURRENT) LIMIT CONTROL</b></p> <p>Provides the ability to adjust the drive current limit setting and thus the motor torque over a range of 50-150% by a remote mounted TORQUE ADJUST potentiometer. (See Option 18A).</p>   | VEplus              |
| 18C        | <p><b>FOLLOWER, CURRENT REGULATOR</b></p> <p>Provides a means of controlling motor armature current and torque by a manually adjusted potentiometer or an external DC voltage reference signal. The circuit includes internal isolation permitting direct connection to a grounded signal source. Since torque is directly controlled independent of motor speed, provision is included for limiting maximum motor speed.</p> <p>Multiple motor applications typically involve master speed regulated drive which establishes the speed of the system and one (1) or more current regulated follower drive units. The follower units obtain their current reference signal from the master controller. Typical applications include:</p> <ol style="list-style-type: none"> <li>a. Load sharing between two (2) or more drive units with their motors mechanically coupled.</li> <li>b. Load sharing between two (2) or more drive units coupled by the process material itself such as steel bar stock being pulled by multiple drive units through separately powered sections of a machine.</li> </ol>   | VEplus              |

**BOSTON GEAR®**

# RATIOCONTROL SYSTEMS

## Options and Modifications for DC Controllers

| Option No. | Description   | For Use with Series            |
|------------|---|--------------------------------|
| 18C        | <p><b>FOLLOWER, CURRENT REGULATOR (LESS ADJUSTMENTS) (Continued)</b></p> <p>c. Tension control of a web of process material being transferred between sections of a multiple section machine.</p> <p><b>APPLICATION INFORMATION</b></p> <ol style="list-style-type: none"> <li><b>1. Current response time</b><br/>Zero to full-load current.....150 Milliseconds</li> <li><b>2. Output current control</b><br/>Range .....10:1</li> <li><b>3. Signal input required for maximum current output</b><br/>Range 1 .....3.35 to 36.5 VDC<br/>Range 2 .....0.34 to 3.7 VDC<br/>Range 3 .....0.04 to 0.44 VDC</li> <li><b>4. Transfer linearity</b><br/>Input signal to output current.....1%</li> </ol> <p><i>This option consists of a plug-in circuit board which inserts into both input and feedback connectors of the control board. Included are separate adjustments for:</i></p> <p><b>Maximum Speed</b> .....0-Motor Base Speed<br/> <b>Maximum Current</b> .....0-150% of rated<sup>(1)</sup><br/> <b>Input Scaling</b> .....Adjustable to match the input signal (0.04 to 36.5 VDC) for maximum current output.<br/> <b>Current offset</b> .....Adjustable for zero current output with minimum signal input.</p> <p>(1) 0-75% of rated achieved by adjustment of the unit current limit.</p>  | VEplus                         |
| 18E        | <p><b>TORQUE (CURRENT) REFERENCE</b></p> <p>A modification that will allow the controller to function as a torque regulator. This modification allows the use of an external potentiometer to set maximum motor torque (0-150% of rated).</p>   | BETA II<br>BETApplus<br>VEplus |
| 21         | <p><b>POTENTIOMETER, SINGLE TURN MOTOR SPEED</b></p> <p>Provides a single turn, 2W potentiometer, knob and analog dial plate.<br/>Not intended for bidirectional operation via speed potentiometer.</p>   | ALL                            |
| 21A        | <p><b>POTENTIOMETER, TEN-TURN MOTOR SPEED (ANALOG)</b></p> <p>Provides a Ten-Turn, 2W potentiometer, knob and analog dial.<br/>Not intended for bi-directional operation via speed potentiometer.</p>   | ALL                            |
| 21B        | <p><b>POTENTIOMETER, TEN-TURN MOTOR SPEED (DIGITAL)</b></p> <p>Provides a Ten Turn, 1/2W Potentiometer with digital dial and knob.<br/>Not intended for bi-directional operation via speed potentiometer.</p>   | ALL                            |
| 22A        | <p><b>FOLLOWER, AC OR DC TACHOMETER GENERATOR</b></p> <p>Intended for automatic control systems where it is necessary for the drive to follow the speed of a preceding drive unit or rotating machine coupled to an AC or DC tachometer generator. The tachometer voltage signal provides the speed reference for the "follower" drive.</p> <p>Option 22A is not recommended for use where multiple drive controllers are required to operate from a common signal source, unless the controllers are isolated. A more economical approach if the controllers are not isolated would be the use of the MIRC master isolated reference controller which is intended for use with multiple drive controllers. See Option 35.</p> <p>Adjustments are provided to adapt the unit to a wide range of system requirements. Included are independent adjustments for:</p> <p>TACH SCALING – Adjustable to interface the tachometer generated voltage with the required controller reference voltage when the FOLLOWER RATIO potentiometer is set on maximum. If a plus ratio is required (i.e.: the follower drive is at full speed when the master drive is at half speed) set the FOLLOWER RATIO potentiometer at its midpoint and adjust TACH SCALING for the required controller reference voltage and then adjust the FOLLOWER RATIO potentiometer toward 100.</p> <p>FOLLOWER RATIO – Adjustable to permit tracking the tachometer signal voltage at a plus or minus ratio.</p> <p>The FOLLOWER RATIO potentiometer is mounted in the operator control panel.</p> <p>MINIMUM SPEED (Additive) – Adjustable to permit tracking the tachometer signal at a fixed offset voltage.</p> <p>MINIMUM SPEED ADDITIVE potentiometer is mounted on the Option 22A circuit board.</p> | VEplus                         |

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| Option No. | Description   | For Use with Series            |
|------------|---|--------------------------------|
| 22A        | <p><b>FOLLOWER, AC OR DC TACHOMETER GENERATOR (Continued)</b></p> <p>MINIMUM SPEED (Override)—Adjustable by the MOTOR SPEED potentiometer to establish a minimum drive speed independent of tachometer signal voltage. The MOTOR SPEED potentiometer is also used as a manual speed setting control when no tachometer signal is present. The MOTOR SPEED potentiometer is mounted in the operator control station.</p> <p>A MANUAL/FOLLOWER selector switch is therefore unnecessary for most applications and is not included with this option. See Option 38 when a switch is desired. The MOTOR SPEED potentiometer is mounted in the operator control station.</p> <p><i>Option 22A consists of a small plug-in circuit board which inserts into the input connector of the Control Circuit Board and a FOLLOWER RATIO potentiometer for separate mounting.</i></p> <p><i>This option does not include the tachometer generator which must provide 30 volts at base speed and not to exceed 180 volts at maximum speed.</i></p> <div> </div> <div> <p><b>FIGURE A. TACH SCALING AND FOLLOWER RATIO</b></p> </div> <div> </div> <div> <p><b>FIGURE B. MINIMUM SPEED ADDITIVE</b></p> </div> <div> </div> <div> <p><b>FIGURE C. MINIMUM SPEED OVERRIDE</b></p> </div>  | VEplus                         |
| 22B        | <p><b>FOLLOWER, DIGITAL PULSE GENERATOR</b></p> <p>This option provides signal conditioning and isolation for accepting a signal from a magnetic pulse pick-up mechanically coupled to a preceding drive motor, rotating machinery or various static pulse generators permitting the drive to follow at an adjustable ratio.</p> <p><i>This option consists of:</i></p> <ol style="list-style-type: none"> <li><i>Digital to analog conversion circuit board which inserts into the INPUT connector of the control circuit board.</i></li> <li><i>A signal conditioning circuit board which is mounted in the base of the controller or remotely mounted.</i></li> <li><i>MANUAL/FOLLOWER selector switch for separate mounting.</i></li> <li><i>Interconnection wire harness.</i></li> </ol> <p>Two (2) modes of operation are provided: Manual and Follower, as selected by the MANUAL/FOLLOWER switch. In the Manual mode, the MOTOR SPEED potentiometer controls motor speed. In the Follower mode, the motor follows the digital pulse signal, and the MOTOR SPEED potentiometer functions as the follower ratio adjust potentiometer.</p> <p>The signal conditioner circuit board accepts the output of any one of the following devices:</p> <ol style="list-style-type: none"> <li>1. Magnetic pulse pick-up capable of providing 450 pulses/second at motor base speed and not exceeding a maximum of 2500 pulses/second at motor base speed. Recommended input: <ul style="list-style-type: none"> <li>100 tooth gear on a 1150 RPM motor.</li> <li>60 tooth gear on a 1750 RPM motor.</li> <li>30 tooth gear on a 2400 RPM motor.</li> </ul> </li> <li>2. Pulse generator (TTL) with a 0 to +5V output, capable of providing a minimum of 450 pulses/second at motor base speed and not exceeding a maximum of 2500 pulses/second at motor base speed.</li> <li>3. Pulse generator with an open collector output, capable of conducting 2 milliamperes at 24 VDC.</li> </ol> <p>This option does not include the magnetic pick-up assembly, pulse gear or other signal source, or the motor speed potentiometer.</p> | VEplus                         |
| 24         | <p><b>TACHOMETER FEEDBACK</b></p> <p>An internal modification which provides impedance matching from a DC tachometer generator which is directly coupled to the motor armature. This option improves speed regulation with respect to changes in load, line voltage, ambient temperature and motor field heating. The tachometer generator must be capable of providing 5 to 120 VDC/1000 RPM. The tachometer generator is not part of this option.</p>   | BETA II<br>BETApplus<br>VEplus |
| 24A        | <p><b>FEEDBACK, TACHOMETER AC OR DC</b></p> <p>Provides impedance matching and terminals for accepting a signal from a 2-phase AC or DC tachometer generator, mechanically coupled to the drive motor armature. The tachometer signal defeats the IR compensation circuitry in the</p>  | VEplus                         |

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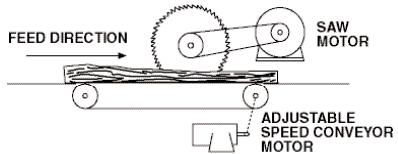
| Option No.                 | Description  | For Use with Series        |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
|----------------------------|--|----------------------------|-------------------------------|-----|----|------|----|------|----|------|---|-----|----|------|----|------|----|-------|---|--------|
| 24A                        | <p><b>FEEDBACK, TACHOMETER AC OR DC (Continued)</b></p> <p>drive controller making the unit directly sensitive to motor speed. This results in expanded speed range, improved speed regulation with load changes and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other operating variables. The controller will automatically switch to armature feedback if the tachometer signal is lost.</p> <p>Tachometer generator must provide 30 to 180 volts at maximum motor speed. A MAXIMUM SPEED TACHOMETER potentiometer is provided to scale the tachometer signal.</p> <p><i>Option 24A consists of a small plug-in circuit board which inserts into the FEEDBACK connector on the control circuit board, replacing the armature feedback circuit board. Option 24A does not include the tachometer generator.</i></p> <p><i>Caution: Do not use a single-phase AC Tachometer.</i></p>  | VEplus                     |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 24B                        | <p><b>FEEDBACK, DIGITAL PULSE GENERATOR</b></p> <p>Provides signal conditioning and isolation for accepting a signal from a magnetic pulse pick-up mechanically coupled to the drive motor armature. The magnetic pulse pickup must provide a minimum of 450 pulses per second at motor speed (60 tooth gear on a 1750 RPM motor). The pulse pick-up signal defeats the IR compensation circuitry in the drive controller, making the unit directly sensitive to motor speed. Speed range is limited to 35:1.</p> <p>The option results in improved speed regulation with load changes (equal to DC tachometer feedback) and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other variables.</p> <p><i>Option 24B consists of:</i></p> <p><i>a. Digital to analog conversion circuit board which inserts into the FEEDBACK connector of the control circuit board.</i></p> <p><i>b. A signal conditioner circuit board which is mounted on the base of the controller or remotely mounted.</i></p> <p><i>This option does not include the pulse pick-up assembly.</i></p>   | VEplus                     |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 24B                        | <p><b>PULSE TACHOMETER FEEDBACK/FOLLOWER</b></p> <p>This option is interfaces the controller to a pulse train for speed reference or as a feedback signal. It allows the use of a 60 tooth gear for either speed reference or feedback. It is capable of providing digital pulse tach reference an/or feedback functions. The sensor can be a magnetic pickup (2 wire), proximity sensor (3 wire), AC tachometer generator (18 cycles/revolution), two-phase AC tachometer generator, or digital tachometer generator or encoder (240 pulses/revolution) Note: two-phase AC tachometer generator can be used for follower or feedback applications, but not both.</p>  | VEA-RG<br>RBA-RG           |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 25                         | <p><b>ISOLATED INPUT AND FOLLOWER</b></p> <p>This option board isolates the motor speed potentiometer from the non-isolated controller for operator and equipment safety. Also, it will allow the controller to follow a 4-20 DCMA current signal and a wide range of DC voltage signals (<math>\pm 0.05</math> to <math>\pm 500</math> VDC). This makes the option ideal for following signal transducers, motor shunts, DC tachometer generators and the armature voltage from DC motors.</p>  | VEA-RG<br>RBA-RG           |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 25A                        | <p><b>FOLLOWER, DC PROCESS</b></p> <p>Provides necessary impedance matching circuitry to interface a customer supplied DC signal source with the drive controller reference input. Typical applications are those where motor speed must be controlled as a function of a process variable such as temperature, weight, flow, pressure, etc.</p> <p>In many applications, the reference signal is obtained from a process instrument controller or other commercially available transducer with a DC milliampere output. Devices of this type normally provide signal levels compatible with requirements listed in the table:</p> <table border="1"> <thead> <tr> <th>DC Input Signal Range (ma)</th><th>Option Input Impedance (Ohms)</th></tr> </thead> <tbody> <tr> <td>0-5</td><td>80</td></tr> <tr> <td>0-10</td><td>40</td></tr> <tr> <td>0-25</td><td>16</td></tr> <tr> <td>0-50</td><td>8</td></tr> <tr> <td>1-5</td><td>80</td></tr> <tr> <td>2-10</td><td>40</td></tr> <tr> <td>4-20</td><td>16</td></tr> <tr> <td>10-50</td><td>8</td></tr> </tbody> </table> <p>Included are suitable adjustments for linear transfer of instrument output current to motor speed. The adjustments will normally be set so minimum transducer signal results in minimum or zero motor speed and maximum signal produces maximum motor speed. Also provided is an adjustment to extend or compress the transducer signal output so a 5:1 transducer output signal range, for example, could provide a 10:1 or 20:1 drive speed range. Included are individual potentiometer adjustments for:</p> <p>MINIMUM SPEED (Override) – Adjustable by the MOTOR SPEED potentiometer to establish a minimum drive speed independent of the external reference signal. The MOTOR SPEED potentiometer is also used as a manual speed setting control when no external reference signal is present.</p> | DC Input Signal Range (ma) | Option Input Impedance (Ohms) | 0-5 | 80 | 0-10 | 40 | 0-25 | 16 | 0-50 | 8 | 1-5 | 80 | 2-10 | 40 | 4-20 | 16 | 10-50 | 8 | VEplus |
| DC Input Signal Range (ma) | Option Input Impedance (Ohms)  |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 0-5                        | 80   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 0-10                       | 40   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 0-25                       | 16   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 0-50                       | 8  |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 1-5                        | 80   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 2-10                       | 40   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 4-20                       | 16   |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |
| 10-50                      | 8  |                            |                               |     |    |      |    |      |    |      |   |     |    |      |    |      |    |       |   |        |

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## Options and Modifications for DC Controllers

| Option No. | Description   | For Use with Series |
|------------|---|---------------------|
| 25A        | <p><b>FOLLOWER, DC PROCESS (Continued)</b></p> <p>A MANUAL/FOLLOWER selector switch is therefore unnecessary for most applications and is not included with this option. See Option 38 when a switch is required. The MOTOR SPEED potentiometer is mounted in the operator control station.</p> <p>IMPEDANCE MATCH - Provides a means of matching the impedance of the signal source and also functions as GAIN adjustment.</p> <p>OFFSET - Trims minimum input signal.</p> <p>IMPEDANCE MATCH and OFFSET potentiometers are mounted on the Option Circuit Board</p> <div> </div> <div style="text-align: center;">FIGURE A</div> <div> </div> <div style="text-align: center;">FIGURE B</div> <p><i>Option consists of a small plug-in circuit board which inserts into the INPUT connector of the control circuit board. Option does not include the external signal source, Motor Speed potentiometer or optional Manual Follower selector switch.</i></p>   | VEplus              |
| 25C        | <p><b>FOLLOWER, AC CURRENT TRANSDUCER</b></p> <p>Intended for automatic control systems where it is necessary for the drive to follow an AC signal proportional to the load current of a constant speed, AC induction motor. Typical examples are conveying systems where the material feed rate has a direct influence over the loading of the AC motor, i.e.: the carriage or conveyor feeding logs to a saw powered by an AC motor. Since the thickness and density of the wood is not uniform this option permits automatic adjustment of conveyor speed to the highest feed rate which will not overload the saw motor.</p> <p><b>In order that a proper current transformer may be supplied it is necessary that nameplate data such as horsepower, voltage, load current, etc. be provided from the AC motor.</b></p> <p>AUTO/MANUAL SELECTOR SWITCH (1)–Selects the operation function. When the switch is in AUTO position, the drive functions as an AC current follower unit. When the switch is in MANUAL position the drive functions as an adjustable speed unit. When the AUTO function is selected, the separately furnished Motor Speed potentiometer provides speed adjustment of the DC motor at a ratio from 0 to 100% of the AC input signal. When the MANUAL function is selected, the Motor Speed potentiometer provides normal manual speed adjustment of the DC motor.</p> <p>DIRECT/INVERT SLIDE SWITCH (2)–Selects the operation mode. When the switch is in DIR position, the speed of the DC drive motor varies directly proportional to the load current drawn by the AC motor. When the switch is in INVT position the speed of the DC drive motor varies inversely proportional to the AC motor load current, i.e., when the load of the AC motor increases causing it to draw more current, the DC motor speed decreases.</p> <p>BIAS (2)–Set the maximum DC motor speed for the INVERT mode of operation.</p> <p>CURRENT SCALING (2)–Matches the range of the AC input signal to the input signal range requirements of the controller.</p> <p>INTEGRATION RATE (2)–Sets the response rate of the system when the AUTO function is selected.</p> <p>MINIMUM SPEED (2)–Sets minimum speed independently of the input control signal.</p> <p>PROPORTIONAL GAIN (2)–Sets the gain of Circuit Board when the AUTO function is selected.</p> <p><i>This option consists of:</i></p> <ol style="list-style-type: none"> <li><i>Toroidal current transformer for separate mounting by the user for sensing AC motor load current.</i></li> <li><i>A small plug-in circuit board which inserts into the input connector of the control circuit board.</i></li> <li><i>AUTO/MANUAL selector switch for mounting remotely.</i></li> </ol> | VEplus              |



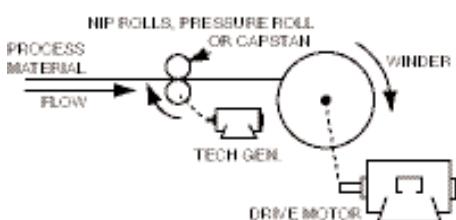
# RATIOCONTROL SYSTEMS

## Options and Modifications for DC Controllers

| Option No. | Description  | For Use with Series |
|------------|--|---------------------|
| 25C        | <p><b>FOLLOWER, AC CURRENT TRANSDUCER (Continued)</b></p> <p><b>NOTES:</b></p> <p>(1) Mounted in operator control station.</p> <p>(2) Located on circuit board.</p> <p><i>This illustration shows an application which requires an inverse relationship between AC motor load current and the follower drive motor speed. This option may also be programmed for a direct relationship where the follower drive would increase in speed with increasing AC motor load current.</i></p>   | VEplus              |
| 30         | <p><b>AC LINE CIRCUIT BREAKER, TWO POLE</b></p> <p>Provides a two-pole, magnetic only, fast trip circuit breaker as a means of manually disconnecting controller from the AC line. The high interrupting capacity fuse in the basic unit is retained as primary short circuit protection.</p>  | VEA-RG              |
| 34         | <p><b>MASTER ISOLATED REFERENCE CONTROLLER</b></p> <p>This is a master system housed in a VEL/H size cabinet including a circuit breaker for use as an on-off switch, a run-stop control relay, operator's controls consisting of run and stop pushbuttons and a master speed pot. Input voltage may be 115 or 230 VAC, 60/50 Hz. The control provides an adjustable frequency signal for each control in the system with a suitable follower board (see below). The master control also accepts input options and thus can provide system acceleration-deceleration, external signal, etc. Order Cat. No. 60174.</p>  | VEplus              |
| 35         | <p><b>FOLLOWER, MASTER ISOLATED REFERENCE CONTROLLER (MIRC)</b></p> <p>Provides an input circuit board to interface a controller with speed reference signals transmitted by the Model MIRC master controller. The receiver circuit board includes necessary isolation, impedance matching and frequency to analog conversion.</p> <p>This option is required for each controller whenever one or more is to be controlled by the MIRC. Option 35 includes adjustments for maximum ratio, minimum speed and offset as well as the separately furnished MOTOR SPEED potentiometer.</p> <p>The MIRC is a versatile master controller suggested for use whenever isolation is required between a controller and a grounded external signal source and/or signal isolation is required between multiple controllers which must track a common speed reference signal.</p> <p>All adjustments excepting the MOTOR SPEED potentiometer are mounted on the option circuit board. The MOTOR SPEED potentiometer functions as a manual speed setting device with the MASTER/LOCAL selector switch in the LOCAL position. In the MASTER position the potentiometer provides a ratio or draw adjustment.</p> <p>See Option 34 for additional information on the MIRC Master Controller.</p> <p><i>Option 35 consists of a small plug-in circuit board which inserts into a prewired connector provided for this purpose and a MASTER/LOCAL selector switch.</i></p> <p><i>The MIRC follower option will control motor speed for unidirectional operation only.</i></p> <p><i>This option does not include the MIRC Master Controller or the MOTOR SPEED potentiometer. See Option 34.</i></p>   | VEplus              |
| 36A        | <p><b>CENTERWIND TORQUE CONTROL</b></p> <p>This option offers a more sophisticated solution to controlling the tension of center driven winders than Torque Taper Options 18 &amp; 18A. Tension control is more accurate since this option produces a reciprocal speed-torque relationship which closely matches the ideal constant horsepower curve required to maintain constant tension. Option 36A has provisions to accept a signal proportional to web speed from either a tachometer generator driven from the production machine feeding the winder or a potentiometer ganged to the production machine speed control. Tension control accuracy of better than 20% can normally be maintained from empty to full roll, and the control automatically compensates for changes in production machine speed.</p> <p><i>This option consists of a plug-in circuit board which inserts into both the INPUT and the FEEDBACK connectors of the control board, and a TORQUE ADJUST potentiometer pre-wired for installation in the operator control panel. Included are independent potentiometer adjustments for:</i></p> <p>TORQUE ADJUST – Sets the desired tension in the material being wound. This potentiometer is mounted in the operator control panel.</p> <p>TACH SCALING (1) – Scales the production machine tachometer signal voltage to the control requirements.</p> <p>MAX TORQUE EMPTY ROLL (1) – Establishes the torque required to maintain proper tension at high winder speed.</p> <p>MAX TORQUE FULL ROLL (1) – Establishes the torque required to maintain proper tension at low winder speed.</p> <p>TORQUE BOOST TIME (1) – Establishes the time that additional torque is supplied to accelerate the winder when the production machine speed is increased.</p> | VEplus              |

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| Option No.  | Description   | For Use with Series          |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
|---|---|------------------------------|------------------------|----------------------------------|--------------------------|---|--|-----------------------------------|------------|------------------------|---------------------------|------------------------|---|---------------------------------------|-----------|--------|
| 36A   | <p><b>CENTERWIND TORQUE CONTROL (Continued)</b></p> <p>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportion to motor speed. Also, web break or other process material detectors are suggested to prevent a dangerous overspeed should the process material break.</p> <p>An AC or DC tachometer generator with a minimum output of 30 volts at base speed and not exceeding 180 volts at maximum production machine speed or a 5K ohm potentiometer ganged to the production machine speed control is required, but not furnished as part of this option</p> <p>(1) These potentiometers are mounted on the option circuit board.</p>   | VEplus                       |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 36B   | <p><b>CONSTANT VELOCITY WINDER</b></p> <p>This option provides an economical but accurate method of automatically controlling the tension of process material in strip, web, wire or cable form as wound by a center driven winder.</p> <p>The option requires the use of a DC tachometer generator coupled to the process material by nip rolls, a pressure roller or capstan in a manner that will provide a continuous feedback of the velocity of the process material.</p> <p>A manually set MOTOR SPEED potentiometer establishes the desired line speed of the process material. As material builds up on the winder core, the diameter increases which would tend to increase the line speed of the material. This will produce a higher voltage output from the tachometer generator which will cause the drive motor and winder to slow down to maintain a constant velocity and uniform winder tension.</p> <p>Should a break occur in the process material, this option will automatically transfer to an adjustable minimum take up speed to minimize damage to the product and winder machinery.</p> <p><b>RATINGS</b></p> <table> <tr> <td>1. Regulation Accuracy .....</td> <td>2% of motor base speed</td> </tr> <tr> <td>2. Maximum Line Speed Range.....</td> <td><u>30</u><br/>Build Ratio</td> </tr> <tr> <td colspan="2">Example: a 3:1 build ratio (3 ft. dia. full roll, 1 ft. dia. empty roll) = 10:1 line speed range.</td> </tr> <tr> <td>3. MOTOR SPEED potentiometer.....</td> <td>5,000 ohms</td> </tr> </table> <p><i>This option consists of a plug-in circuit board which inserts into both the INPUT and the FEEDBACK connectors of the control board. Included are independent potentiometer adjustments for:</i></p> <p><b>ADJUSTMENTS</b></p> <table> <tr> <td>1. Take-Up Speed .....</td> <td>0 to 50% of maximum speed</td> </tr> <tr> <td>2. Maximum Speed .....</td> <td>Sets maximum range of MOTOR SPEED potentiometer</td> </tr> <tr> <td>3. Acceleration (Response Time) .....</td> <td>1-60 sec.</td> </tr> </table> <p><b>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportion to motor speed.</b></p> <p>A DC Tachometer Generator with a minimum output of 1.0 volt at base speed and not to exceed 120 volts at maximum production machine speed and a 5K MOTOR SPEED potentiometer are required but not furnished as part of this option.</p>  | 1. Regulation Accuracy ..... | 2% of motor base speed | 2. Maximum Line Speed Range..... | <u>30</u><br>Build Ratio | Example: a 3:1 build ratio (3 ft. dia. full roll, 1 ft. dia. empty roll) = 10:1 line speed range. |  | 3. MOTOR SPEED potentiometer..... | 5,000 ohms | 1. Take-Up Speed ..... | 0 to 50% of maximum speed | 2. Maximum Speed ..... | Sets maximum range of MOTOR SPEED potentiometer | 3. Acceleration (Response Time) ..... | 1-60 sec. | VEplus |
| 1. Regulation Accuracy .....  | 2% of motor base speed  |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 2. Maximum Line Speed Range.....  | <u>30</u><br>Build Ratio  |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| Example: a 3:1 build ratio (3 ft. dia. full roll, 1 ft. dia. empty roll) = 10:1 line speed range. |   |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 3. MOTOR SPEED potentiometer.....   | 5,000 ohms  |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 1. Take-Up Speed .....  | 0 to 50% of maximum speed   |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 2. Maximum Speed .....  | Sets maximum range of MOTOR SPEED potentiometer   |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 3. Acceleration (Response Time) .....   | 1-60 sec.   |                              |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |
| 38  | <p><b>MANUAL/FOLLOWER MODE SELECT (TOGGLE SWITCH)</b></p> <p>This option is intended as a companion to Option 22, Option 25A and Option 25B.</p> <p>Option 22, 25A and 25B do not include a selector switch and rely upon a zero speed setting of the MOTOR SPEED potentiometer to transfer to full automatic control by the external signal.</p> <p>Option 38 when used with these options, allows manual switch selection of either the MOTOR SPEED potentiometer or automatic control by the external signal.</p> <p><i>Option 38 includes a switch with a MANUAL/FOLLOWER legend plate for installation in the operator control panel.</i></p>  | ALL                          |                        |                                  |                          |   |  |                                   |            |                        |                           |                        |   |                                       |           |        |

**BOSTON GEAR®**

Electrical Products Catalog

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# RATIO TROL SYSTEMS

## Options and Modifications for DC Controllers

| Option No. | Description  | For Use with Series |
|------------|--|---------------------|
| 47         | <b>REFERENCE, PRECISION</b><br><br>This option provides a high stability, precision reference circuit that replaces the function of the standard internal reference circuit in the drive controller. This circuit offers important benefits for critical applications where sensitivity to operating variables such as load changes, temperature, line voltage variations, etc. must be held to an absolute minimum. This option may be used in combination with Option 24A, Feedback, Tachometer AC or DC.<br><br><i>This option consists of a small plug-in circuit board which replaces the standard input board.</i> | VEplus              |
| 50         | <b>HINGE, ENCLOSURE COVER</b><br><br>Enclosed models include a screw fixed, gasketed cover which is removable for increased accessibility during installation, troubleshooting or repair. When desired the cover may also be provided with optional hinges making servicing more convenient.<br><br><i>This option may be provided factory installed or a kit is offered for simple field installation.</i>  | VEplus<br>VEA-RG    |
|            |  |                     |

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# ACCESSORIES

Boston Gear offers a complete range of accessories for use with our AC and DC Ratiotrol controllers. All components have been selected for their compatibility to the systems.

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## REMOTE CONTROL STATIONS

The remote control stations shown on these pages may be used with one or more controller. The listings indicate control functions, components and the controllers with which each remote control station may be used. Dimensions are shown for NEMA 1 enclosures. Consult factory for dimensions on other NEMA enclosures. NEMA definitions are on Page 127.

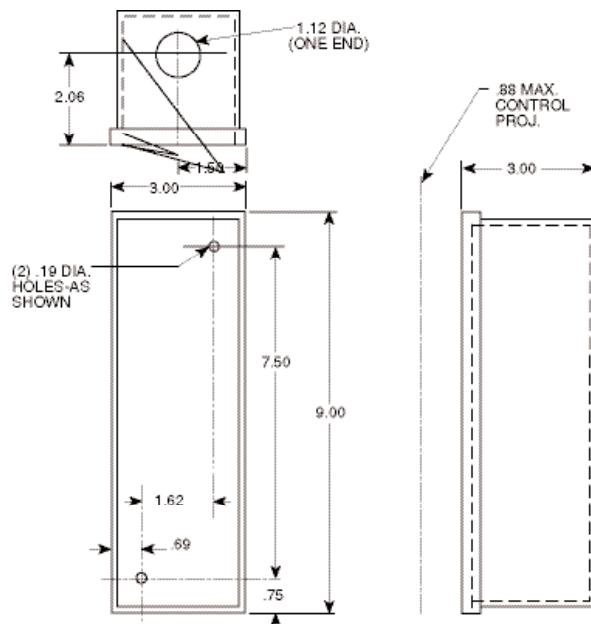
### ORDER BY CATALOG NUMBER OR ITEM CODE

| Control Elements |          |                          | Use With<br>Controller<br>Models   | Remote Station    |              |
|------------------|----------|--------------------------|------------------------------------|-------------------|--------------|
| Pushbuttons      | Switches | Pots                     |                                    | Catalog<br>Number | Item<br>Code |
| Run, Stop        | —        | Motor Speed<br>Jog Speed | RBA, RBS,<br>VES                   | RCS1              | 69362        |
| Run, Stop        | Run/Jog  | Motor Speed              | RBA(U,UB), RBS(U,UB), VES(U,UB)    | RCS3C             | 58098        |
| Run, Stop        | Run/Jog  | Motor Speed<br>Jog Speed | RBA, RBS, VES                      | RCS3D             | 58099        |
| Fwd, Rev, Stop   | —        | Motor Speed              | RBA(M,MB), RBS(M,MB),<br>VES(M,MB) | RCS6              | 60239        |

(CONTINUED)

# ACCESSORIES

## REMOTE CONTROL STATIONS (Continued)



### ORDER BY CATALOG NUMBER OR ITEM CODE

| Control Elements |               |             | Use With<br>Controller<br>Models   | Remote Station    |              |
|------------------|---------------|-------------|------------------------------------|-------------------|--------------|
| Pushbuttons      | Switches      | Pots        |                                    | Catalog<br>Number | Item<br>Code |
| —                | Run/Stop/Jog  | Motor Speed | RBA(U,UB),<br>RBS(U,UB), VES(U,UB) | RCS16             | 58102        |
| —                | Run/Stop/Jog, | Motor Speed | RBA(M,MB),                         | RCS17             | 58103        |

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# ACCESSORIES

## *DC Tachometer Generator*



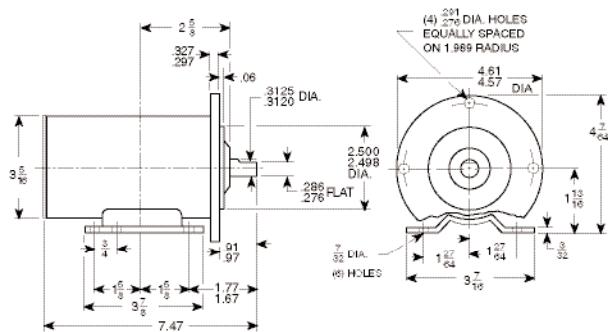
Tachometer Generators are used to sense (monitor) motor shaft speed and to supply a voltage signal to a meter for speed indication, to another control to set its speed (follower or "Slave") or to signal speed changes to the control associated with the motor (tachometer feedback).

Boston Gear offers three models to allow a variety of applications, flange mounted to adapt to rear of motors (with adapters), foot mounted for belt driven applications and one unit which can be both foot or flange mounted.

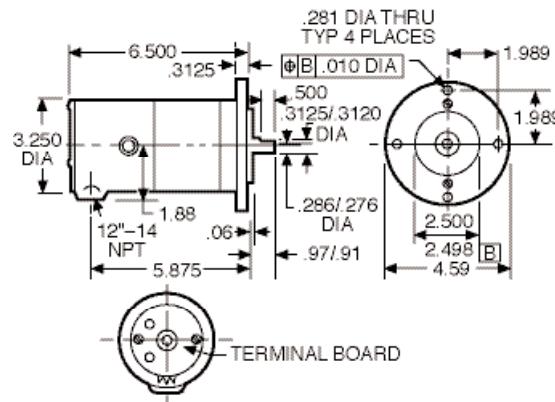
## ORDER BY CATALOG NUMBER OR ITEM CODE

| Output per 1000 RPM | Mounting    | Catalog Number | Item Code | Driving Torque (oz. in.) | Max RPM | Inertia (lb. in <sup>2</sup> ) | Ripple % |
|---------------------|-------------|----------------|-----------|--------------------------|---------|--------------------------------|----------|
| 50 VDC              | Foot/flange | TG-3           | 38614     | 1.5                      | 5000    | 1.4                            | 1.5      |
| 50 VDC              | Flange      | TG3C-P         | 19170     | 1.5                      | 5000    | 1.4                            | .5       |
| 50 VDC              | Foot        | TG3F-P         | 19171     | 1.5                      | 5000    | 1.4                            | .5       |

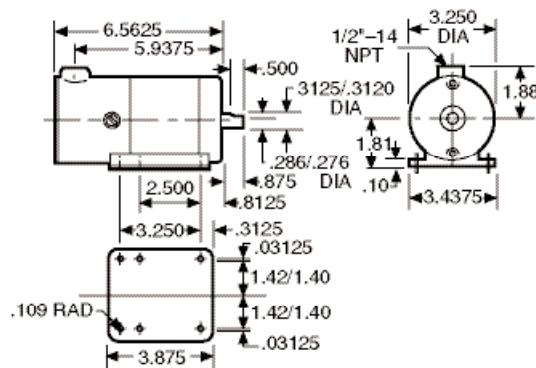
## DIMENSIONS



TG3



TG3C-P



**TG3F-P**

## ADAPTERS

Flange mounted generator can be mounted on certain motors capable of supporting its size and weight as shown below:

**ORDER BY CATALOG NUMBER OR ITEM CODE**

| For Use With<br>Motors | Adapter Required |           |
|------------------------|------------------|-----------|
|                        | Catalog Number   | Item Code |
| 18300ATF-B             | TGAB3*           | 66795     |

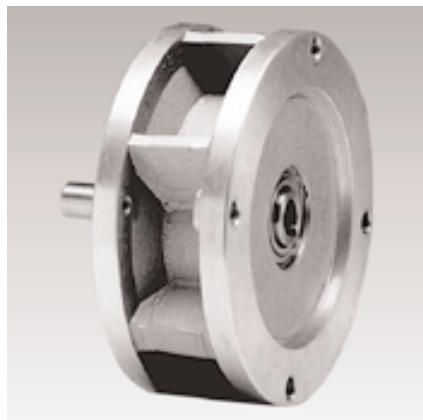
\*Requires coupling BG11-3-5-5 Coupling

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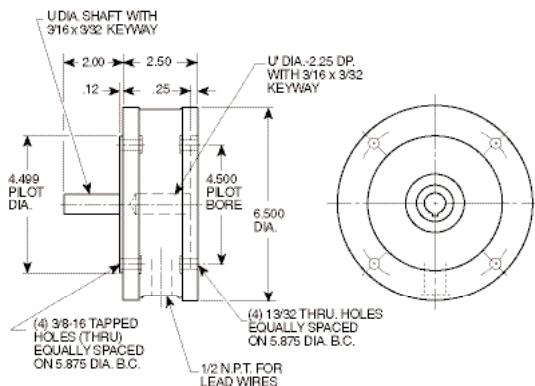
# ACCESSORIES

## AC Tachometer Generator, Double C-Face

TG50A Series



These self-contained AC voltage generators produce a 2 phase linear output voltage proportional to speed. There are two gray leads (1st phase) and two black leads (2nd phase) in each generator. The generator output voltage, of 50 VAC/1000 RPM, can be used with a meter for speed indication or in a Tachometer follower or Tachometer feedback system. These generators will fit any standard NEMA 56C, 180C or 140TC frame motor. To prevent excessive loading, external connections to the generator should not total less than 25K ohms. This unit is designed for use between a C-Face motor and a flanged reducer, it is not intended for overhung loads on output shaft.

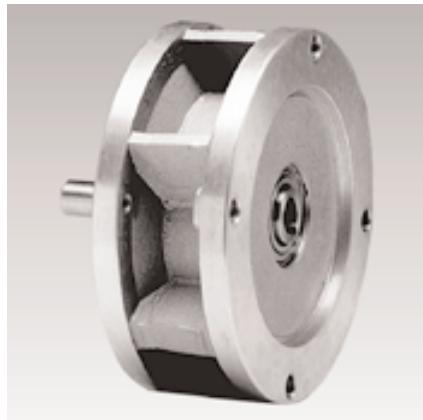


### ORDER BY CATALOG NUMBER OR ITEM CODE

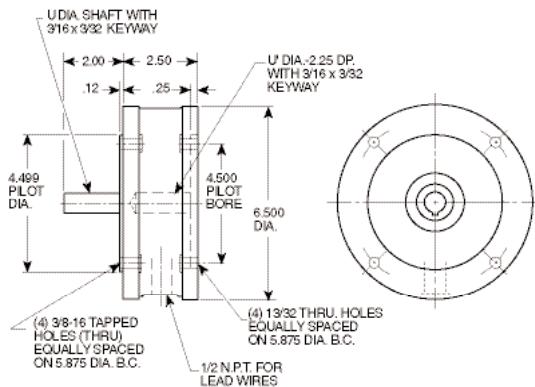
| Voltage Output/ 1000 RPM | Max. Speed RPM | Catalog Number | Item Code | NEMA C-Face | Bore Code | Temperature Constant (Per Degree F) | U Output Dia. | U' Input Dia. | Approx. Weight (Lbs.) |
|--------------------------|----------------|----------------|-----------|-------------|-----------|-------------------------------------|---------------|---------------|-----------------------|
| 50 VAC                   | 6000           | TG50A56C       | 60153     | 56C         | B5        | .04 Volt                            | .6245/.6250   | .6257/.6252   | 7                     |
| 50 VAC                   | 6000           | TG50A140TC     | 60154     | 180C-140TC  | B7        | .04 Volt                            | .8745/.8750   | .8757/.8752   | 7                     |

## DC Tachometer Generator, Double C-Face

TG35D Series



These self-contained DC voltage generators produce a linear output voltage proportional to speed. The generator output voltage of 35 VDC/1000 RPM can be used with a meter for speed indication or in a Tachometer follower or Tachometer feedback system. These generators will fit any standard NEMA 56C, 180C or 140TC frame motor. To prevent excessive loading, external connections to the generator should not total less than 50K ohms. Not for use with regenerative controllers. This unit is designed for use between a C-Face motor and a flanged reducer, it is not intended for overhung loads on output shaft.



### ORDER BY CATALOG NUMBER OR ITEM CODE

| Voltage Output/ 1000 RPM | Max. Speed RPM | Catalog Number | Item Code | NEMA C-Face | Bore Code | Temperature Constant (Per Degree F) | U Output Dia. | U' Input Dia. | Approx. Weight (Lbs.) |
|--------------------------|----------------|----------------|-----------|-------------|-----------|-------------------------------------|---------------|---------------|-----------------------|
| 35 VDC                   | 2000           | TG35D56C       | 50477     | 56C         | B5        | .04 Volt                            | .6245/.6250   | .6257/.6252   | 7                     |
| 35 VDC                   | 2000           | TG35D140TC     | 50478     | 180C-140TC  | B7        | .04 Volt                            | .8745/.8750   | .8757/.8752   | 7                     |

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# ACCESSORIES

## Magnetic Pick-up Assemblies



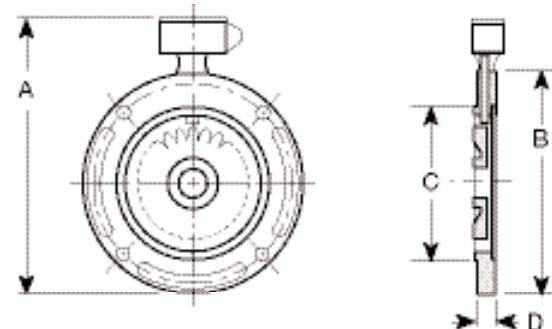
Magnetic pickup assemblies are used to deliver a 60 pulse per revolution signal for use with a tachometer to display the accurate speed of a motor.

The assemblies contain a 60 tooth gear, C-face adapter with conduit box and sensor.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Catalog Number | Item Code | NEMA C-FACE | Bore Code |
|----------------|-----------|-------------|-----------|
| MPA56C         | 60254     | 56C         | B5        |
| MPA140TC       | 60255     | 140TC       | B7        |
| MPA180TC       | 60256     | 180TC       | B9        |
| MPA210TC       | 60257     | 210TC       | B11       |
| MPA250TC       | 60258     | 250TC       | B13       |

### DIMENSIONS



#### ALL DIMENSIONS IN INCHES

| NEMA C-FACE         | A     | B    | C     | D    |
|---------------------|-------|------|-------|------|
| 56C, 140TC          | 9.32  | 6.50 | 4.500 | .750 |
| 180TC, 210TC, 250TC | 12.63 | 9.62 | 8.500 | .875 |

## Inline Amplifier and Pulse Shaper for Magnetic Pick-ups

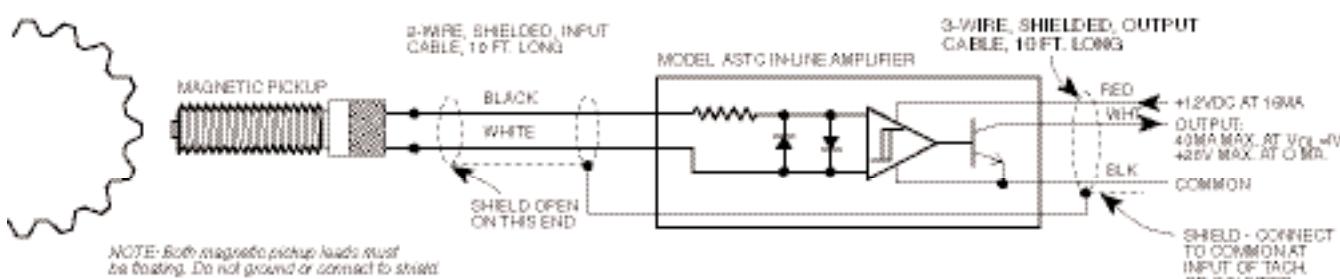
### ASTC Series

The ASTC boosts magnetic pickup signals by a factor of more than 100, and provides an NPN Open-Collector pulse output which is compatible with the DPT-1A and DPT-2A meters. The ASTC can be used at pulse rates to 10KHz. The NPN O.C. output is current limited to 40mA. The unit is epoxy encapsulated in a 3/4" Dia. stainless steel shell, with overall dimensions of 0.9"D x 4.5"L including Neoprene strain-reliefs on each end. In installations where long signal runs are to be made it is advisable to keep the ASTC close to the pickup and let its output cable make the long run. Input and output cables should not be run in conduit, cable troughs, or bundles with power or control voltage lines. Operating temperature is -18° to +60°C.

NOTE: This amplifier is recommended when using two or more meters (DPT series) from one magnetic pulse pick-up signal. Also when the meter is more than ten feet from the signal source.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Catalog Number | Item Code |
|----------------|-----------|
| ASTC           | 19132     |



**BOSTON GEAR®**

# ACCESSORIES

## 5 Digit Digital Pulse Tachometers

DPT Series

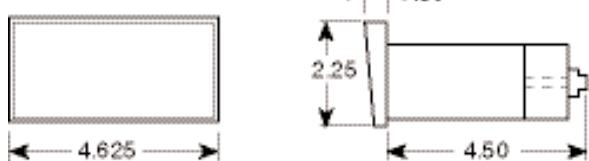


The DPT Series of digital tachometers are completely field programmable. The display updates to a new reading at the conclusion of each time base. The time base is set with switches, giving a choice of time bases from .001 seconds to 32.76 seconds in minimum increments of .001 seconds. In addition these tachometers have programmable decimal points and frequency doubling at the flip of a switch. This feature provides a count pulse at both the leading and trailing edges of the input pulse, which doubles the input information rate and allows the time base to be reduced by half.

Frequency doubling allows shorter update times for the readout for those applications where a longer rate is objectionable and otherwise unavoidable. For example, frequency doubling permits a 30 second time base to be used where a 60 second time base would normally be required.

When using two or more generators on the same magnetic pick-up signal or for distances over ten feet, it is recommended to use the ASTC amplifier shown on Page 51.

### DIMENSIONS



### ORDER BY CATALOG NUMBER OR ITEM CODE

| A.C. Line | Catalog Number | Item Code |
|-----------|----------------|-----------|
| 115V      | DPT-1A         | 48862     |
| 230V      | DPT-2A         | 48863     |

## Analog Meter

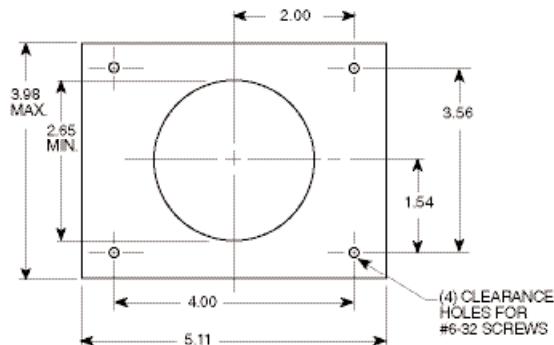


The RMA-1 meter is a 4-1/2" rectangular meter with additional printed circuitry and adjustment pot to permit the indication of RPM when connected to the various AC and DC voltages present on motor armatures and tachometer generators. Five voltage ranges are provided to permit inputs of 50 VAC or 50 VDC to 500 VDC.

The meter face is readily removed to enable you to substitute a face with special calibration, such as 0-100%, reducer RPM, FPM, etc.

Accuracy  $\pm 2\%$  full scale  
Tracking  $\pm 2\%$   
Repeatability 2%  
Balance (Horizontal to vertical)  $\pm 1\%$   
Temperature Effect (15°-35°C) 1%  
Damping Factor 2.5 min.  
Response Time 1.5 sec. max.

### DIMENSIONS



### ORDER BY CATALOG NUMBER OR ITEM CODE

| Catalog Number | Item Code | Approx. Weight |
|----------------|-----------|----------------|
| RMA-1          | 60879     | 1 Lb.          |

**BOSTON GEAR®**

# ACCESSORIES

## Digital Meter



The RMD-1 digital meter is low cost, reliable, accurate and physically interchangeable with existing 4-1/2 inch rectangular analog meters. Four input ranges accept minimum signals from 50 mV to 500 VDC, to read full scale (1999). The 20 turn calibration pot allows the output to be scaled to the indication required.

**DISPLAY:** 4 active digits (0 to 1999). 0.5 inch LED non-blinking with a 0.25 second update period. Optional decimal point before last digit.

**INPUT SIGNAL FREQUENCY:** Minimum fixed frequency input is 40 Hz. Minimum variable frequency input to produce maximum readout is 200 Hz. Maximum variable frequency input is 2000 Hz.

**INPUT SIGNAL VOLTAGE:** Minimum input to produce full reading is 50 millivolts dc, 100 millivolts ac. Maximum input voltage is 500 VDC, 460 VAC.

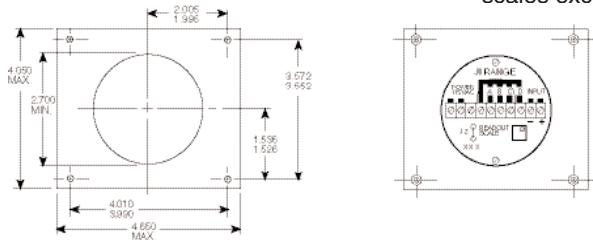
**INPUT SIGNAL DEVICE:** Any AC or DC shunt providing a 50 mV. or larger signal. An AC or DC signal source. A fixed pulse area digital tachometer.

**READOUT LINEARITY:** 0.5% F.S.  $\pm 1$  count.

**POWER REQUIREMENTS:** 115 VAC  $\pm 10$ V, 2 watts. Meter circuit is entirely isolated from line and case.

**OVERRANGE:** Indication by "EEE". 500% signal input over-voltage protection on all scales except high voltage scale.

## DIMENSIONS



### ORDER BY CATALOG NUMBER OR ITEM CODE

| Catalog Number | Item Code | Approx. Weight |
|----------------|-----------|----------------|
| RMD-1          | 60880     | 1 Lb.          |

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## NOTES

**BOSTON GEAR®**

# CLUTCHES AND BRAKES



A natural addition to constant speed motor/reductor drives and adjustable speed Ratiotrol systems, these products fill a need where high inertial loads exist or frequent starts and stops exceed the capabilities of standard motors.

These products are comprised of four groups; C-face clutch/brakes, C-face clutches, foot-mounted clutch-brakes and shaft-mounted clutches, brakes and combination clutch-brakes.

Boston Clutch and Brake products are a result of many years of manufacturing and application experience resulting in a reliable, rugged and sound design providing maximum performance and life.

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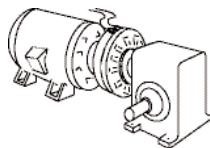
# CLUTCHES AND BRAKES

## General Information

These are a few common applications. Clutches and Brakes may be used wherever control of linear or rotary motion starts and stops are required.

Electric clutches and brakes perform controlled start and stop functions between a constantly-running prime mover and a load. Electrical commands are generated manually (pushbutton) or automatically (switch, photocell, tape, sequence programmer, etc.)

### CLUTCH – Acceleration



#### NO SHOCK

In this split-shaft application, the field and rotor are mounted to a motor and the armature to a reducer input shaft. A low setting of the potentiometer on the control allows the clutch to engage the reducer worm gears smoothly, eliminating shock to the machine system.

#### HIGH RESPONSE

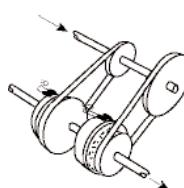
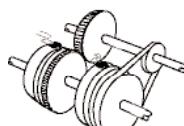
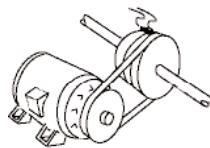
In this thru-shaft application, the potentiometer is set to full current. Engaging the clutch produces millisecond power transmission from motor to driven shaft.

#### REVERSING

In this application, the rotational direction of the driven shaft is determined by engaging different clutches.

#### SPEED CHANGING

The speed of the driven shaft is determined by engaging the appropriate clutch.



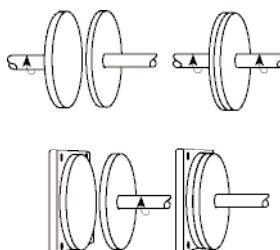
## CLUTCH & BRAKE BASICS

DC clutches and brakes are magnetically-activated mechanical power transmission members normally installed between a motor shaft and driven shaft – either a speed reducer or the final driven shafts.

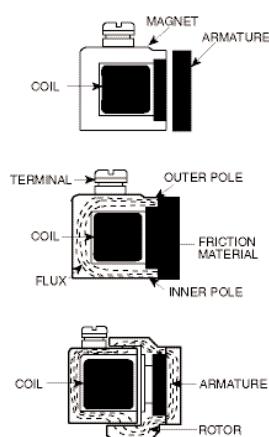
Both a clutch and brake transmit torque mechanically in response to an electrical signal.

In a clutch, a disc on a revolving shaft is connected by magnetic attraction to a disc on a stationary shaft thus starting the drive.

In a brake, one disc is fixed and magnetic attraction stops the revolving disc.



## THE DISCS ARE CONNECTED BY MEANS OF ELECTRO-MAGNETIC ATTRACTION

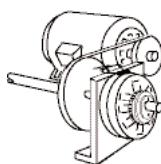


In a brake, one disc (the magnet) contains a coil embedded in a circular horseshoe shaped cavity. The other disc (the armature) consists of segments of iron attached to backing plate.

A friction face is embedded in the magnet of the brake between the inner pole and the outer pole. When direct current is applied to the coil, magnetic force attracts the armature to the magnet.

In the clutch, the magnet is stationary and the magnetic flux passes across an airgap and through a rotating rotor into the armature.

## BRAKE – Deceleration



#### NO SHOCK

Potentiometer low: controlled stop.

#### HIGH RESPONSE

Potentiometer full: fast precise stop.

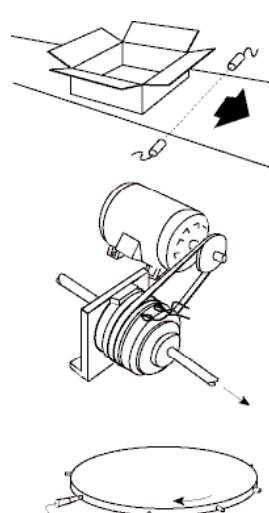
#### EMERGENCY STOP

Signal to brake brings malfunctioning system to a fast stop.

#### HOLDING

Fully engaged brake holds machine in stopped position.

## CLUTCH/BRAKE



#### LINEAR POSITIONING

Carton breaks the beam, disengaging the clutch, engaging the brake. Carton (counter timer, pressure switch, etc.) disengages the brake, engages the clutch.

#### JOGGING

Pushbutton IN, clutch is ON; button OUT, clutch is disengaged and brake is ON. Common in machine setup and registration controls.

#### ROTARY INDEXING

Proximity switch disengages the clutch, engages the brake for precise positioning.

#### CYCLING

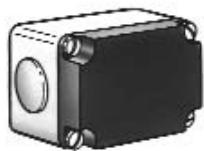
Programmed sequencer alternately engages the clutch and brake, producing programmed start-stop sequence.

# CLUTCHES AND BRAKES

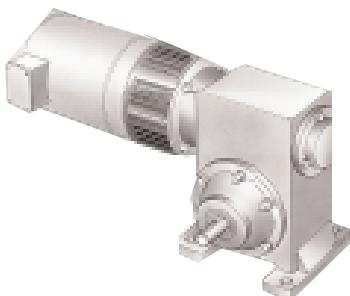
C-Face Mounted  
90 VDC

Clutches - CC Series  
Clutch Brakes - CBC Series

“CC” clutch and “CBC” clutch/brake modules may be mounted directly to NEMA C-face motors and reducers. (Modules have 90VDC coils)



NEMA C-Face Mounting

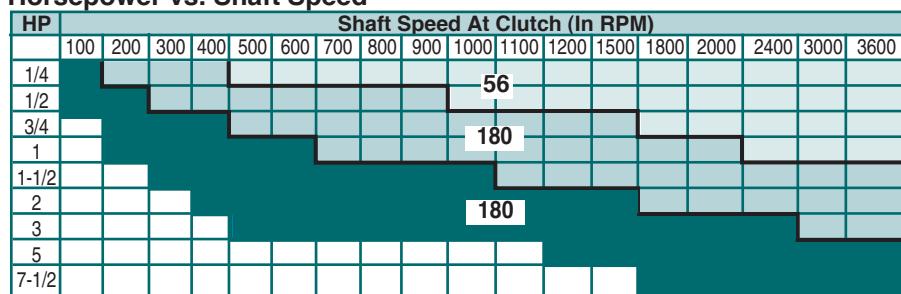


An optional conduit box is available. It has two conduit connection holes for 1/2" standard conduit connectors.

## To select the correct module package:

1. Determine the frame size, horsepower and output rpm of your motor.
2. Choose the right size module from the horsepower versus shaft speed chart and the NEMA mounting flange.

Horserpower vs. Shaft Speed



ORDER BY CATALOG NUMBER OR ITEM CODE

| Static<br>Torque<br>(Lb. Ft.) | Maximum<br>Motor HP<br>3600 RPM | NEMA-C<br>Frame            | Reducer<br>Bore<br>Code | Approx. Weight (lbs) |               | CC Series<br>Clutches |              | CBC Series<br>Clutch Brakes |              |
|-------------------------------|---------------------------------|----------------------------|-------------------------|----------------------|---------------|-----------------------|--------------|-----------------------------|--------------|
|                               |                                 |                            |                         | CC<br>Series         | CBC<br>Series | Catalog<br>Number     | Item<br>Code | Catalog<br>Number           | Item<br>Code |
| 16                            | 1                               | 56C/48Y                    | B5                      | 8.3                  | 10.0          | CC56-16A              | 82904        | CBC56-16A                   | 82907        |
| 30                            | 3                               | 143TC, 145TC<br>182C, 184C | B7                      | 10.3                 | 13.2          | CC180-30A             | 82905        | CBC180-30A                  | 82908        |
| 95                            | 7.5                             | 182TC, 184TC<br>213C, 215C | B9                      | 24.3                 | 30.6          | CC210-95A             | 82906        | CBC210-95A                  | 82909        |

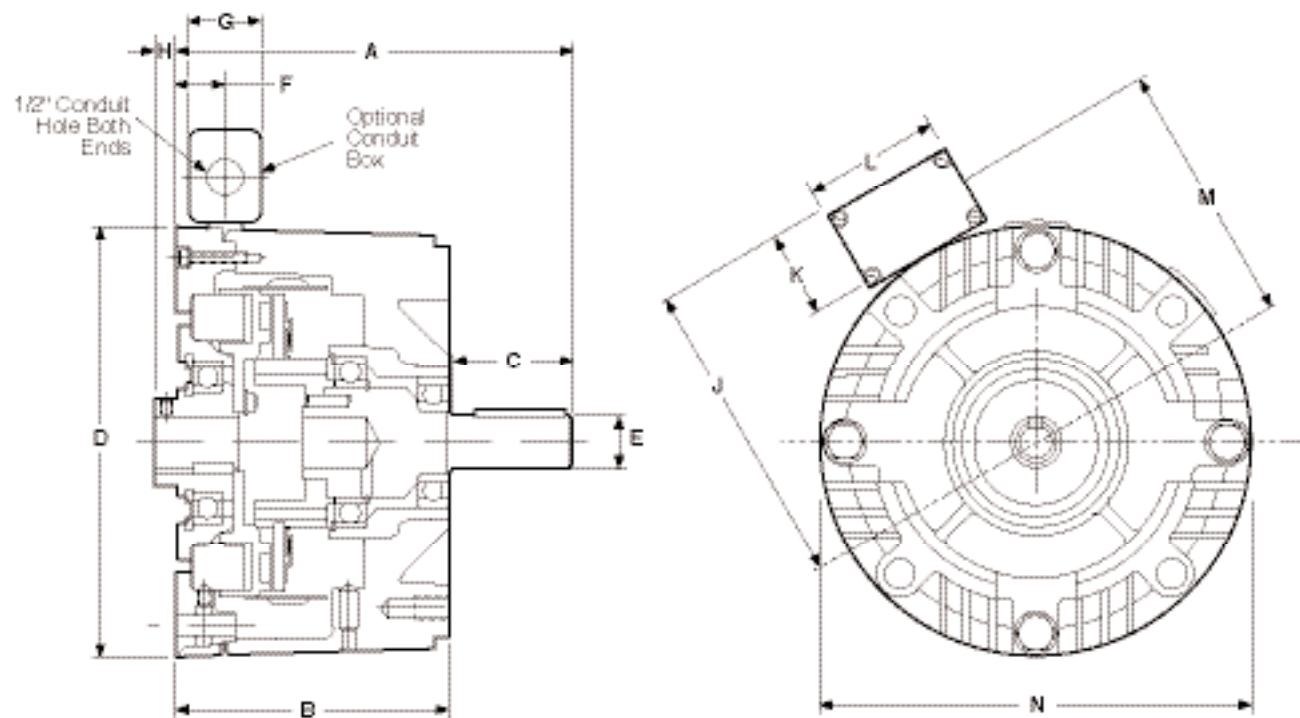
**BOSTON GEAR®**

Electrical Products Catalog

# CLUTCHES AND BRAKES

C-Face Mounted  
90 VDC

Clutches - CC Series  
Clutch Brakes - CBC Series



All dimensions are nominal, unless otherwise noted.

| SIZE*     | A     | B     | C     | D     | E     | F    | G     | H    |
|-----------|-------|-------|-------|-------|-------|------|-------|------|
| 56 - 16A  | 6.750 | 4.844 | 1.813 | 6.750 | .625  | .937 | 2.203 | ---- |
| 180 - 30A | 6.828 | 4.844 | 1.891 | 6.750 | .875  | .937 | 2.203 | ---- |
| 210 - 95A | 8.891 | 5.922 | 2.500 | 9.250 | 1.125 | .500 | 2.203 | .500 |

| SIZE*     | J     | K     | L     | M     | N     |
|-----------|-------|-------|-------|-------|-------|
| 56 - 16A  | 5.531 | 2.188 | 3.250 | 4.438 | 6.688 |
| 180 - 30A | 5.531 | 2.188 | 3.250 | 4.438 | 6.688 |
| 210 - 95A | 6.859 | 2.188 | 3.250 | 5.766 | 9.688 |

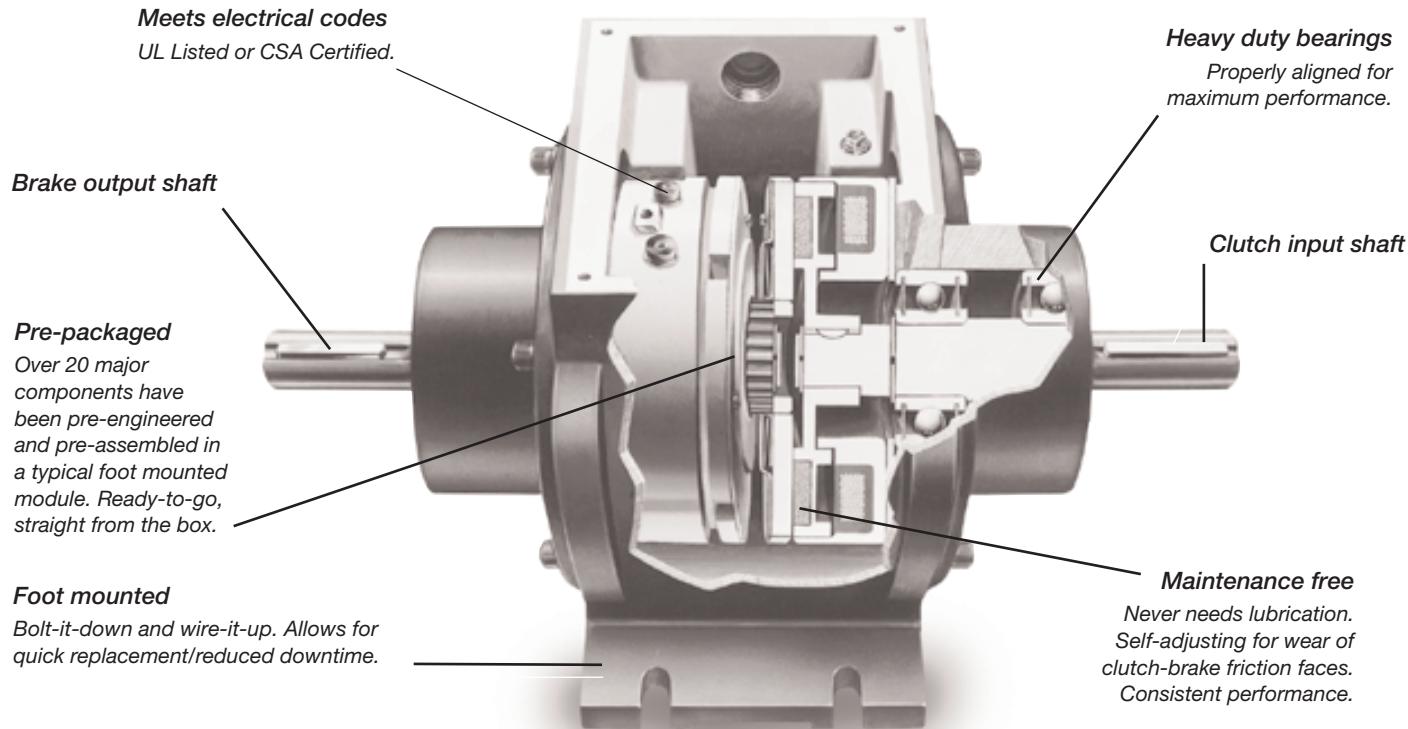
\* Dimensions are the same for "CC" and "CBC" Series

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# CLUTCHES AND BRAKES

Foot Mounted

Clutch Brakes - CBF Series  
90 VDC



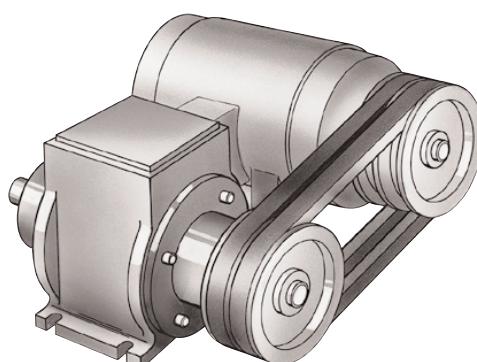
CBF Modules are rugged, pre-assembled clutch and brake combinations in an enclosed, foot mounted housing.

They are factory aligned and pre-assembled and have been designed to mate easily with industry standard motors and reducers with v-belts, pulleys, chain and sprockets, in line couplings and timing belt drives.

## FEATURES

- Bolt-it-down and wire-it-up . . . it's ready to go!
- Maintenance free
- Torque range from 22.5 lb. ft. to 50 lb. ft.

## TYPICAL APPLICATION



A foot mounted module combines with a motor in a parallel shaft drive application.

**BOSTON GEAR®**

Electrical Products Catalog

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# CLUTCHES AND BRAKES

Foot Mounted

Clutch Brakes - CBF Series

90 VDC

## SELECTION PROCEDURE

Determine the shaft speed at the clutch/brake module. The number listed at the intersection of horsepower and speed is the size clutch/brake module you require.

Horsepower vs. Shaft Speed

| HP    | Shaft Speed At Clutch (In RPM) |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
|-------|--------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|
|       | 100                            | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1500 | 1800 | 2000 | 2400 | 3000 | 3600 |
| 1/20  |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/12  |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/8   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/6   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/4   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/3   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1/2   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 3/4   |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1     |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 1-1/2 |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 2     |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
| 3     |                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |

## ORDER BY CATALOG NUMBER OR ITEM CODE

| Static<br>Torque<br>(Lb. Ft.) | Max.<br>RPM | Approx.<br>Weight<br>(Lbs.) | Totally Enclosed  |              |
|-------------------------------|-------------|-----------------------------|-------------------|--------------|
|                               |             |                             | Catalog<br>Number | Item<br>Code |
| 22.5                          | 4500        | 19.7                        | CBF22A            | 82902        |
| 50*                           | 4000        | 56                          | CBF50A            | 82903        |

\*Clutch is rated 40 Lb. Ft., brake is rated 50 Lb. Ft.

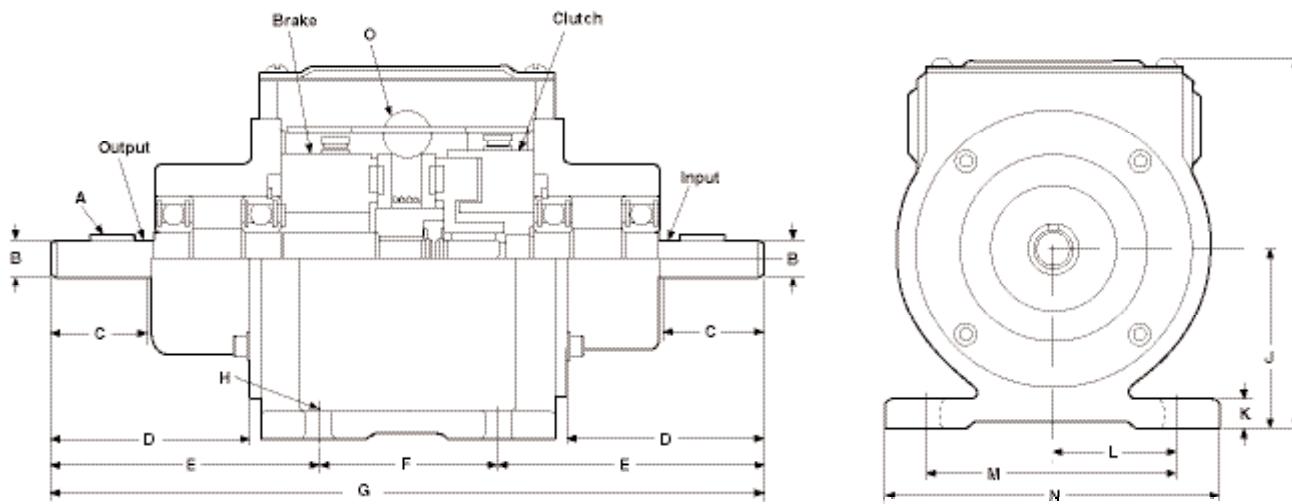
**BOSTON GEAR®**

# CLUTCHES AND BRAKES

Foot Mounted

Clutch Brakes - CBF Series

90 VDC



| Size   | A                      | B              | C Min. | D     | E     | F     | G Max. | H                      |
|--------|------------------------|----------------|--------|-------|-------|-------|--------|------------------------|
| CBF22A | 3/16 x 3/16 x<br>1-1/2 | .7495<br>.7485 | 1.875  | 3.515 | 4.593 | 2.500 | 11.781 | .312 Wide<br>(4 slots) |

| Size   | I     | J              | K    | L     | M     | N     | O               |
|--------|-------|----------------|------|-------|-------|-------|-----------------|
| CBF22A | 6.937 | .3474<br>.3464 | .500 | 2.578 | 5.156 | 6.000 | 1/2 conduit x 2 |

## SPECIFICATIONS

| Size   | Static Torque (lb. ft.) | Inertia-WR (lb-in <sup>2</sup> ) |       | Max. RPM | Weight lbs. |
|--------|-------------------------|----------------------------------|-------|----------|-------------|
|        |                         | Output                           | Input |          |             |
| CBF22A | 270                     | 2.566                            | 2.222 | 4500     | 19.7        |

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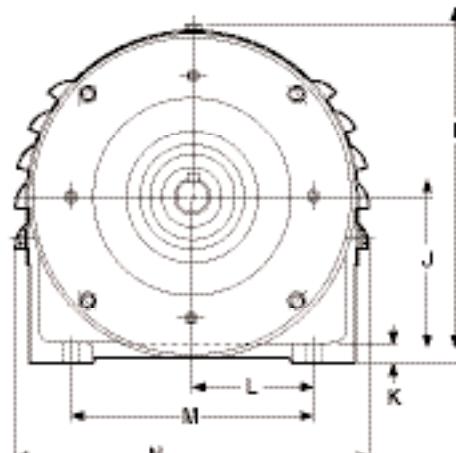
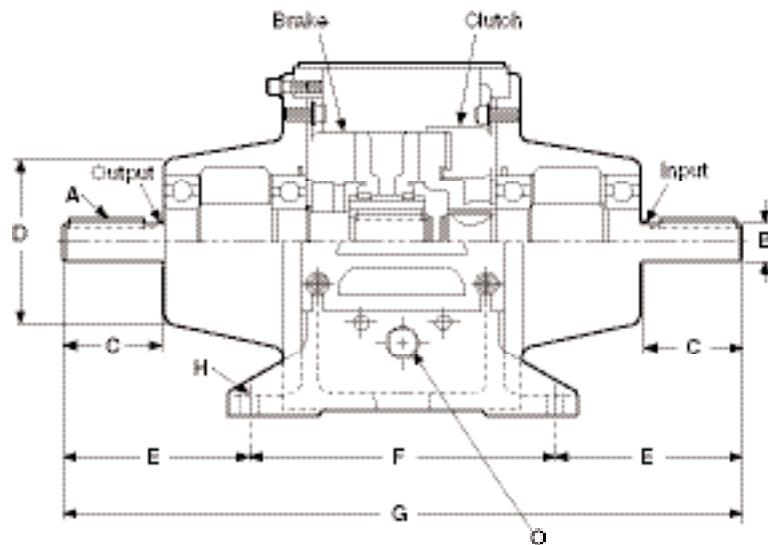
Electrical Products Catalog

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# CLUTCHES AND BRAKES

Foot Mounted

Clutch Brakes - CBF Series  
90 VDC



| Size   | A                     | B Dia.         | C Min. | D Max. Dia. | E     | F     | G Max. |
|--------|-----------------------|----------------|--------|-------------|-------|-------|--------|
| CBF50A | .3/16 X 3/16<br>1-3/4 | .8750<br>.8745 | 2.218  | 3.796       | 4.234 | 7.000 | 15.515 |

| Size   | H Dia.            | I     | J                     | K    | L     | M     | N Max. | O               |
|--------|-------------------|-------|-----------------------|------|-------|-------|--------|-----------------|
| CBF50A | .406<br>(4 holes) | 8.218 | $\frac{4.004}{3.992}$ | 5.00 | 2.937 | 5.875 | 8.734  | 1/2 conduit x 2 |

## SPECIFICATIONS

| Size   | Unit            | Static Torque (lb. ft.) | Inertia-WR <sup>2</sup> (lb-ft <sup>2</sup> ) | Max. RPM | Weight lbs. |
|--------|-----------------|-------------------------|---|----------|-------------|
| CBF50A | Clutch<br>Brake | 50<br>40                | 2.222   | 4000     | 56          |
|        |                 | Output<br>.063          | Input<br>.039                                 |          |             |

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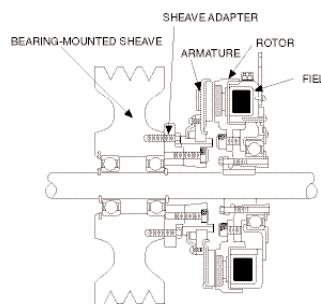
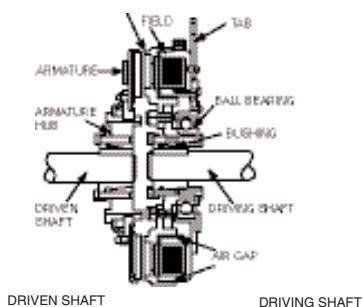
# CLUTCHES AND BRAKES

## DC Shaft Mounted Selection



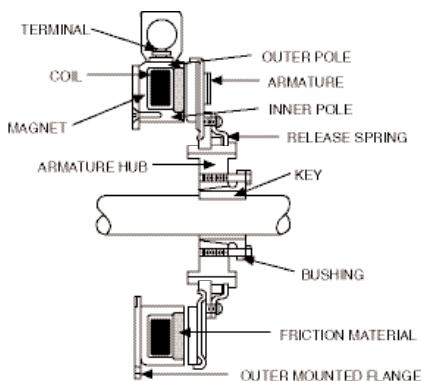
### CLUTCH, BEARING-MOUNTED, SPLIT SHAFT (TYPE S)

Clutches consist of a field, rotor, armature and its hub. The field is mounted on sealed ball bearings and remains stationary while the rotor revolves. The rotor extends through the field assembly and is attached to the drive shaft by a bushing, in many sizes. A small tab holds the field stationary. The armature is mounted on a splined hub held on the shaft by standard tapered bushings.



### BRAKE, FLANGE MOUNTED

The magnet is mounted to a machine member, or a stationary mounting plate by inner or outer mounted flanges. The space available determines which flange to use. Terminals are wired directly to the brake control terminals. The armature rides on a splined drive hub. Standard tapered bushings secure the hub to the rotating shaft, in most units.

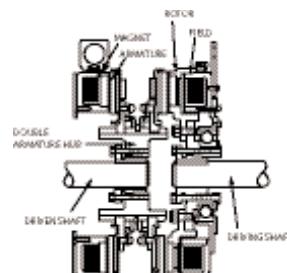


### CLUTCH, BEARING MOUNTED, THROUGH SHAFT (TYPE T)

The through-shaft mounting of the field and rotor is as described for the split-shaft version. The armature in this application is mounted to a bearing mounted sheave, sprocket or gear. A special sheave adapter is necessary to assist in the mounting of the armature sheave. (Typical C50 and larger)

### CLUTCH BRAKE

When the clutch field is energized and the brake coil is de-energized, the clutch and brake armatures rotate with the drive shaft. When the clutch coil is de-energized and the brake coil energized, the two armatures are stopped. The rotor continues to turn. Operation is the same whether the clutch is bearing or flange mounted.



# CLUTCHES AND BRAKES

## Clutches

C20 Series  
90 VDC



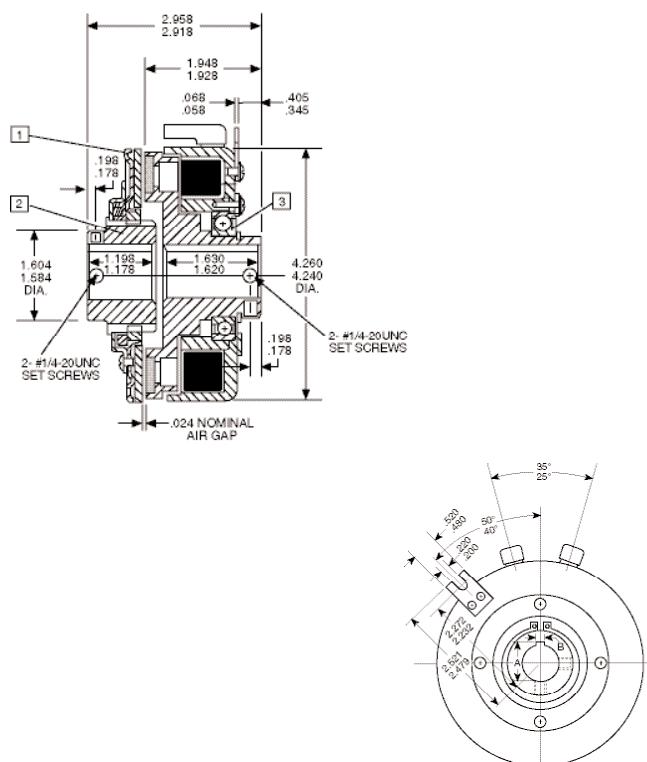
### RATINGS

**Static Torque:** 20 Lb. Ft.  
**Maximum Speed:** 4500 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:**  $1087 \pm 5\%$  ohms  
**Maximum Current:** .087 Amps  
**Maximum Watts:** 7.83  
**Coil Build-up:** 95 ms  
**Coil Decay:** 23 ms

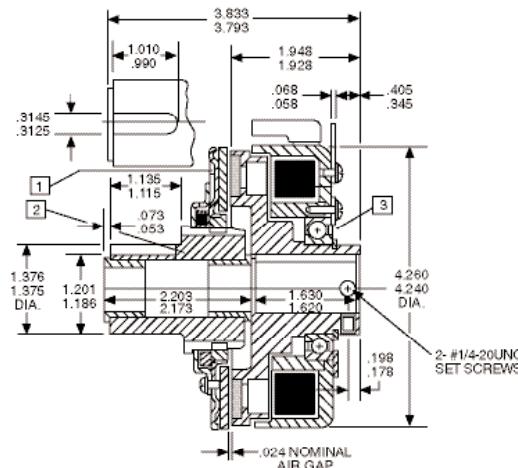
### INSTALLATION REQUIREMENTS — C20S

Angular alignment of shafts within .006" TIR at 5" diameter  
Armature mounting shaft concentric with rotor mounting shaft within .003" TIR

### SPLIT SHAFT MODELS — C20S



### THROUGH SHAFT MODELS — C20T



### AVERAGE WEIGHTS AND INERTIAS

| Part                | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|---------------------|------------|-------------------------------|
| Field and Rotor     | 3.890      | —                             |
| Field               | 2.343      | —                             |
| Rotor 3/4 bore      | 1.547      | .0159                         |
| Armature            | .815       | .0151                         |
| Armature hub (C20S) | .604       | .0023                         |
| Armature hub (C20T) | .802       | .0023                         |
| Total C20S          | 5.309      |                               |
| Total C20T          | 5.507      |                               |

### ALL DIMENSIONS IN INCHES

### ORDER BY ITEM CODE

| Nominal | Actual        | KEYWAY DIMENSIONS* |             |           | ITEM CODES        |                       |       |                                   |
|---------|---------------|--------------------|-------------|-----------|-------------------|-----------------------|-------|-----------------------------------|
|         |               | Keyway             | A           | B         | No. 1<br>Armature | No. 2<br>Armature Hub |       | No. 3 Field and<br>Rotor Assembly |
|         |               |                    |             |           | C20S/C20T         | C20S                  | C20T  | C20S/C20T                         |
| 1/2     | .5005/.5015   | 1/8 x 1/16         | .560/.565   | .126/.128 |                   | 45062                 | 45067 | 45070                             |
| 5/8     | .6255/.6270   | 3/16 x 3/32        | .709/.715   | .188/.190 |                   | 45063                 | 45068 | 45071                             |
| 3/4     | .7505/.7520   | 3/16 x 3/32        | .837/.845   | .188/.190 | 45061             | 45064                 | 45069 | 45072                             |
| 7/8†    | .8755/.8770   | 3/16 x 3/32        | .964/.970   | .188/.190 |                   | 45065                 | —     | 45073†                            |
| 1 †     | 1.0005/1.0020 | 1/4 x 1/8          | 1.114/1.122 | .251/.253 |                   | 45066                 | —     | 45074†                            |

\*Armature Hub Data not applicable to C20T.

†Not applicable to C20T.

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub (desired bore) and Field and Rotor Assembly (desired bore) for desired Type, C20S or C20T.

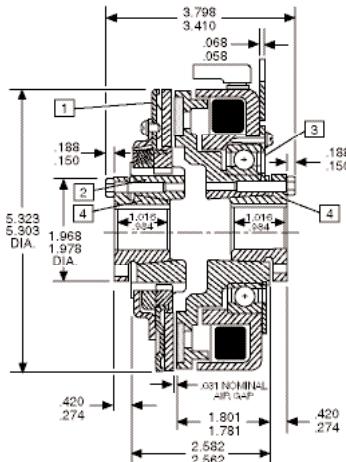
**BOSTON GEAR®**

# CLUTCHES AND BRAKES

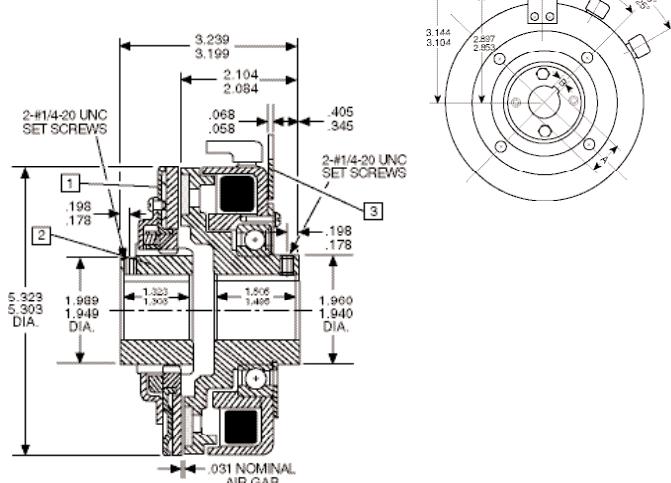
## Clutches

C50 Series  
90 VDC

### SPLIT SHAFT MODELS — C50S



### 1/2-1" BORES



### 1-1/8" & 1-1/4" BORES

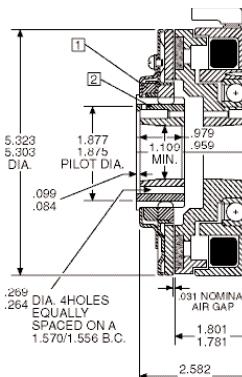
### RATINGS

Static Torque: 50 Lb. Ft.  
Maximum Speed: 4000 RPM  
Voltage: 90 VDC  
Resistance at 20°C: 237 ±5% ohms  
Maximum Current: 400 Amps  
Coil Build-up: 70 ms  
Coil Decay: 15 ms

### INSTALLATION REQUIREMENTS — C50S

Rotor shaft concentric with armature shaft within .004" TIR  
Angular misalignment of shafts within .008" TIR at 5" diameter.

### THROUGH SHAFT MODELS — C50T



### AVERAGE WEIGHTS AND INERTIAS

| Part                        | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|-----------------------------|------------|-------------------------------|
| Field and Rotor Assy        | 6.074      | —                             |
| Field                       | 3.408      | —                             |
| Rotor 3/4" bore             | 2.666      | .053                          |
| Armature                    | 1.516      | .044                          |
| Armature hub & 3/4" bushing | .958       | .005                          |
| Total                       | 8.548      | —                             |

| ALL DIMENSIONS IN INCHES |               |                   |             |             |       | ORDER BY ITEM CODE |                       |       |                                   |                   |           |
|--------------------------|---------------|-------------------|-------------|-------------|-------|--------------------|-----------------------|-------|-----------------------------------|-------------------|-----------|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             |             |       | ITEM CODES         |                       |       |                                   |                   |           |
| Nominal                  | Actual        | Keyway            | A           | B           |       | No. 1<br>Armature  | No. 2<br>Armature Hub |       | No. 3 Field and<br>Rotor Assembly | No. 4<br>Bushing* |           |
| 1/2                      | .5000/.5015   | —                 | .555/.565   | .124/.126   | 45091 | C50S/C50T          | C50S                  | C50T  | C50S                              | C50T              | C50S/C50T |
| 5/8                      | .6250/.6265   | —                 | .704/.714   | .1865/.1885 |       |                    | 45092                 | 45092 | 45095                             | 45095             |           |
| 3/4                      | .7500/.7515   | —                 | .832/.842   | .1865/.1885 |       |                    |                       |       |                                   |                   | 45164     |
| 7/8                      | .8750/.8765   | —                 | .959/.969   | .1865/.1885 |       |                    |                       |       |                                   |                   | 45165     |
| 1                        | 1.0000/1.0015 | —                 | 1.110/1.120 | .250/.252   |       |                    |                       |       |                                   |                   | 45166     |
| 1-1/8†                   | 1.1255/1.1270 | 1/4 x 1/8         | 1.241/1.251 | .251/.253   |       |                    |                       |       | 45096                             | —                 | 45167     |
| 1-1/4†                   | 1.2505/1.2520 | 1/4 x 1/8         | 1.367/1.377 | .251/.253   |       |                    |                       | 45097 | —                                 | —                 | —         |

\*Two required for C50S Models, one for C50T Models.

†Not applicable to C50T Models.

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub (desired bore), Field and Rotor Assembly and Bushing (desired bore and quantity required) for desired Type, C50S or C50T.

**BOSTON GEAR®**

Electrical Products Catalog

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# CLUTCHES AND BRAKES

## Clutches

C100 Series  
90 VDC



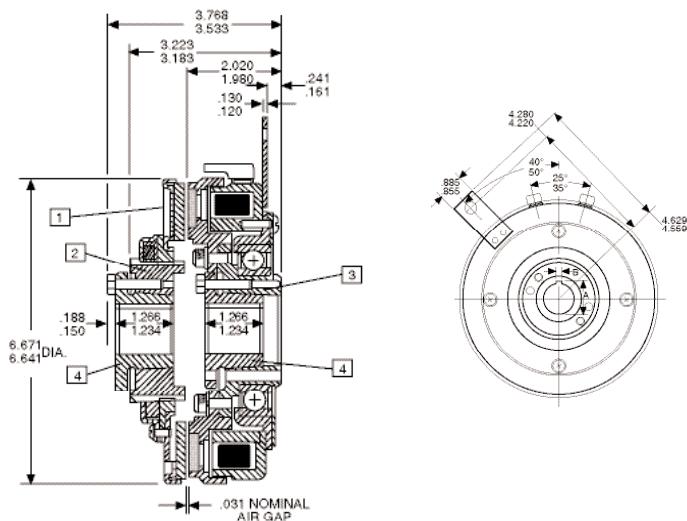
### RATINGS

**Static Torque:** 100 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:** 202 ±5% ohms  
**Maximum Current:** .469 Amps  
**Maximum Watts:** 42.3  
**Coil Build-up:** 65 ms  
**Coil Decay:** 15 ms

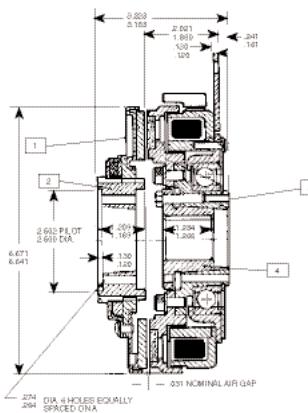
### INSTALLATION REQUIREMENTS

Rotor shaft concentric with armature shaft within .004" TIR  
 Angular misalignment of shafts within .008" TIR at 5" diameter

### SPLIT SHAFT MODELS — C100S



### THROUGH SHAFT MODELS — C100T



### AVERAGE WEIGHTS AND INERTIAS

| Part                         | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|------------------------------|------------|-------------------------------|
| Field and Rotor Assy         | 10.90      | —                             |
| Field                        | 6.25       | —                             |
| Rotor 3/4" bore              | 4.65       | .123                          |
| Armature                     | 2.43       | .115                          |
| Armature hub & 3/4" bushings | 1.79       | .015                          |
| Total                        | 15.12      |                               |

### ALL DIMENSIONS IN INCHES

### ORDER BY ITEM CODE

| Nominal | Actual        | KEYWAY DIMENSIONS |             | ITEM CODES        |                       |                                   |                   |
|---------|---------------|-------------------|-------------|-------------------|-----------------------|-----------------------------------|-------------------|
|         |               | A                 | B           | No. 1<br>Armature | No. 2<br>Armature Hub | No. 3 Field and<br>Rotor Assembly | No. 4<br>Bushing* |
| 1/2     | .5000/.5015   | .555/.565         | .124/.126   |                   |                       |                                   | 45168             |
| 5/8     | .6250/.6265   | .704/.714         | .1865/.1885 |                   |                       |                                   | 45169             |
| 3/4     | .7500/.7515   | .832/.842         | .1865/.1885 |                   |                       |                                   | 45170             |
| 7/8     | .8750/.8765   | .959/.969         | .1865/.1885 |                   |                       |                                   | 45171             |
| 1       | 1.0000/1.0015 | 1.110/1.120       | .249/.251   | 45119             |                       | 45121                             | 45172             |
| 1-1/8   | 1.125/1.127   | 1.236/1.246       | .249/.251   |                   | 45120                 |                                   | 45173             |
| 1-1/4   | 1.250/1.252   | 1.300/1.310       | .249/.251   |                   |                       |                                   | 45174             |
| 1-3/8   | 1.375/1.377   | 1.419/1.429       | .3115/.3135 |                   |                       |                                   | 45175             |
| 1-1/2   | 1.500/1.502   | 1.540/1.570       | .375/.377   |                   |                       |                                   | 45176             |

\*Two required for C100S Models, one for C100T Models.

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub, Field and Rotor Assembly and Bushing (desired bore and quantity required) for desired type, C100S or C100T.

**BOSTON GEAR®**

# CLUTCHES AND BRAKES

## Clutches

C150 Series  
90 VDC



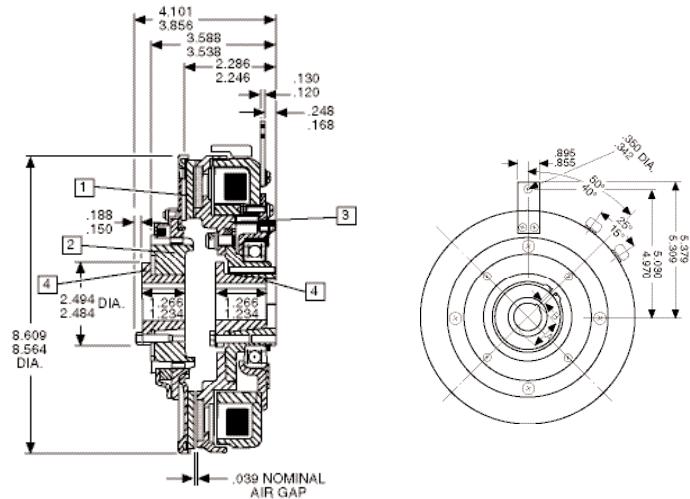
### RATINGS

**Static Torque:** 150 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:** 219 ±5% ohms  
**Maximum Current:** .433 Amps  
**Maximum Watts:** 39  
**Coil Build-up:** 155 ms  
**Coil Decay:** 36 ms

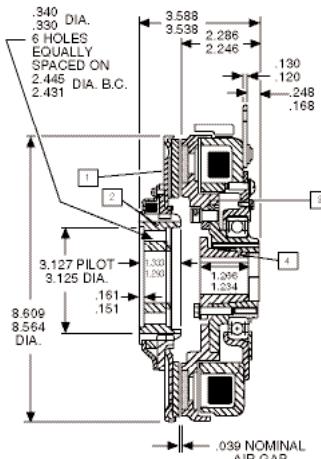
### INSTALLATION REQUIREMENTS

Rotor shaft concentric with armature shaft within .006" TIR  
 Angular misalignment of shafts within .010" TIR at 8" diameter

### SPLIT SHAFT MODELS — C150S



### THROUGH SHAFT MODELS — C150T



### AVERAGE WEIGHTS AND INERTIAS

| Part                         | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|------------------------------|------------|-------------------------------|
| Field and Rotor Assy         | 18.33      | —                             |
| Field                        | 10.85      | —                             |
| Rotor 3/4" bore              | 7.48       | .354                          |
| Armature                     | 4.85       | .326                          |
| Armature hub & 3/4" bushings | 2.74       | .033                          |
| Total                        | 25.92      |                               |

| ALL DIMENSIONS IN INCHES |               |                   |             | ORDER BY ITEM CODE |                       |                                   |                   |
|--------------------------|---------------|-------------------|-------------|--------------------|-----------------------|-----------------------------------|-------------------|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             | ITEM CODES         |                       |                                   |                   |
| Nominal                  | Actual        | A                 | B           | No. 1<br>Armature  | No. 2<br>Armature Hub | No. 3 Field and<br>Rotor Assembly | No. 4<br>Bushing* |
| 1/2                      | .5000/.5015   | .555/.565         | .124/.126   |                    |                       |                                   | 45168             |
| 5/8                      | .6250/.6265   | .704/.714         | .1865/.1885 |                    |                       |                                   | 45169             |
| 3/4                      | .7500/.7515   | .832/.842         | .1865/.1885 |                    |                       |                                   | 45170             |
| 7/8                      | .8750/.8765   | .959/.969         | .1865/.1885 |                    |                       |                                   | 45171             |
| 1                        | 1.0000/1.0015 | 1.110/1.120       | .249/.251   | 45136              | 45137                 | 45138                             | 45172             |
| 1-1/8                    | 1.125/1.127   | 1.236/1.246       | .249/.251   |                    |                       |                                   | 45173             |
| 1-1/4                    | 1.250/1.252   | 1.300/1.310       | .249/.251   |                    |                       |                                   | 45174             |
| 1-3/8                    | 1.375/1.377   | 1.419/1.429       | .3115/.3135 |                    |                       |                                   | 45175             |
| 1-1/2                    | 1.500/1.502   | 1.540/1.570       | .375/.377   |                    |                       |                                   | 45176             |

\*Two required for C150S Models, one for C150T Models.

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub, Field and Rotor Assembly and Bushing (desired bore and quantity required) for desired type C150S or C150T.

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# CLUTCHES AND BRAKES

## Brakes

B20 Series  
90 VDC

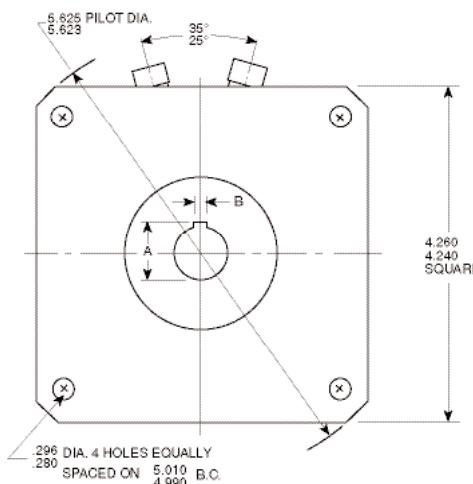
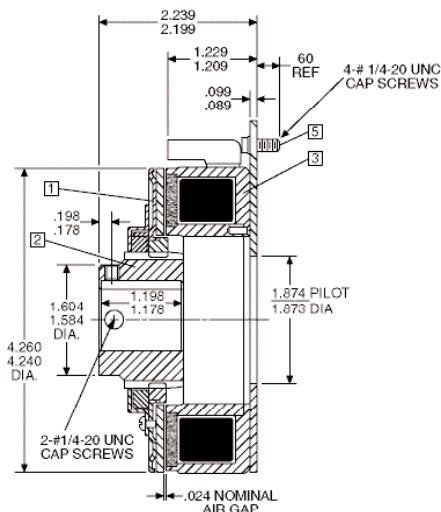


### RATINGS

**Static Torque:** 20 Lb. Ft.  
**Maximum Speed:** 4500 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:**  $1087 \pm 5\%$  ohms  
**Maximum Current:** .087 Amps  
**Maximum Watts:** 7.83  
**Coil Build-up:** 100 ms  
**Coil Decay:** 22 ms

### INSTALLATION REQUIREMENTS

Squareness of brake mounting surface with armature shaft within .006" TIR at 5" diameter.  
Concentricity of brake mounting pilot diameter with armature shaft within .006" TIR.



### AVERAGE WEIGHTS AND INERTIAS

| Part         | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|--------------|------------|-------------------------------|
| Field        | 2.586      | —                             |
| Armature     | .815       | .0151                         |
| Armature hub | .604       | .0023                         |
| Total        | 4.005      | .0174                         |

| ALL DIMENSIONS IN INCHES |               |                   |             |           | ORDER BY ITEM CODE       |                          |   |   |
|--------------------------|---------------|-------------------|-------------|-----------|--------------------------|--------------------------|---|---|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             |           | ITEM CODES               |                          |   |   |
| Nominal                  | Actual        | Keyway            | A           | B         | No. 1<br>Armature<br>Hub | No. 2<br>Armature<br>Hub | No. 3<br>Field Assembly<br>Outside<br>Mounted | No. 5<br>Field Mounting<br>Hardware<br>Outside Mounting |
| 1/2                      | .5005/.5015   | 1/8 x 1/16        | .560/.565   | .126/.128 |                          | 45062                    |   |   |
| 5/8                      | .6255/.6270   | 3/16 x 3/32       | .709/.715   | .188/.190 |                          | 45063                    |   |   |
| 3/4                      | .7505/.7520   | 3/16 x 3/32       | .837/.845   | .188/.190 |                          | 45064                    |   |   |
| 7/8                      | .8755/.8770   | 3/16 x 3/32       | .964/.970   | .188/.190 |                          | 45065                    |   |   |
| 1                        | 1.0005/1.0020 | 1/4 x 1/8         | 1.114/1.122 | .251/.253 | 45061                    | 45066                    | 45075   | 45081   |

HOW TO ORDER: Specify Item Codes for Armature, Armature Hub (desired bore), Field Assembly, and Field Mounting Hardware.

**BOSTON GEAR®**

# CLUTCHES AND BRAKES

## Brakes

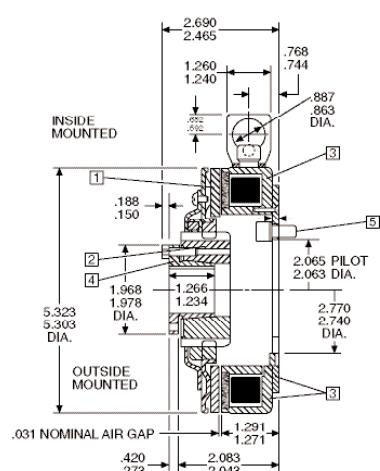
B50 Series  
90 VDC

### RATINGS

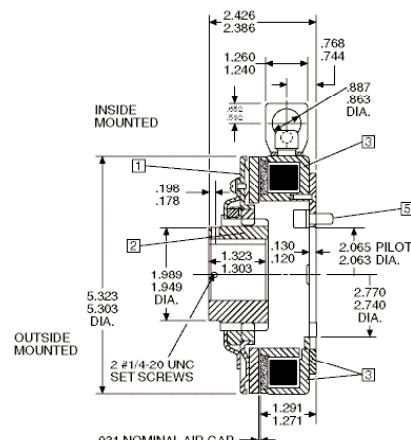
**Static Torque:** 50 Lb. Ft.  
**Maximum Speed:** 4000 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:** 237 ±5% ohms  
**Maximum Current:** .400 Amps  
**Maximum Watts:** 36  
**Coil Build-up:** 65 ms  
**Coil Decay:** 13 ms

### INSTALLATION REQUIREMENTS

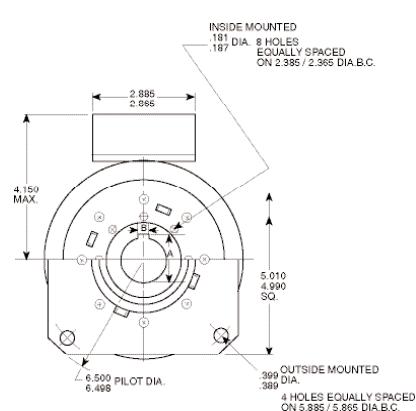
Squareness of brake mounting surface with armature shaft within .006" TIR at 4" diameter.  
Concentricity of brake mounting pilot diameter with armature shaft within .010" TIR.



1/2" To 1" MODELS



1-1/8" AND 1-1/4" MODELS



### AVERAGE WEIGHTS AND INERTIAS

| Part         | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|--------------|------------|-------------------------------|
| Field        | 3.763      | —                             |
| Armature     | 1.516      | .044                          |
| Armature hub | .958       | .005                          |
| Total        | 6.237      | .049                          |

| ALL DIMENSIONS IN INCHES |               |           |                   |             |                   | ORDER BY ITEM CODE       |            |         |                         |                  |                                     |
|--------------------------|---------------|-----------|-------------------|-------------|-------------------|--------------------------|------------|---------|-------------------------|------------------|-------------------------------------|
| STANDARD BORE            |               | Keyway    | KEYWAY DIMENSIONS |             | No. 1<br>Armature | No. 2<br>Armature<br>Hub | ITEM CODES |         | No. 3<br>Field Assembly | No. 4<br>Bushing | No. 5<br>Field Mounting<br>Hardware |
| Nominal                  | Actual        |           | A                 | B           |                   |                          | Inside     | Outside |                         |                  |                                     |
| 1/2                      | .5000/.5015   | —         | .555/.565         | .124/.126   |                   |                          |            |         | 45163                   |                  |                                     |
| 5/8                      | .6250/.6265   | —         | .704/.714         | .1865/.1885 |                   |                          |            |         | 45164                   |                  |                                     |
| 3/4                      | .7500/.7515   | —         | .832/.842         | .1865/.1885 | 45091             | 45092                    |            |         | 45165                   |                  |                                     |
| 7/8                      | .8750/.8765   | —         | .959/.969         | .1865/.1885 |                   |                          |            |         | 45099                   |                  |                                     |
| 1                        | 1.0000/1.0015 | —         | 1.110/1.120       | .250/.252   |                   |                          |            |         | 45167                   |                  |                                     |
| 1-1/8                    | 1.1255/1.1270 | 1/4 x 1/8 | 1.241/1.251       | .251/.253   |                   |                          | 45093      |         |                         | 45166            |                                     |
| 1-1/4                    | 1.2505/1.2520 | 1/4 x 1/8 | 1.367/1.377       | .251/.253   |                   |                          | 45094      |         |                         |                  | 45107                               |
|                          |               |           |                   |             |                   |                          |            |         |                         |                  | 45108                               |

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub (desired bore), Field Assembly, (inside or outside mounting) Bushing (desired bore) and Field Mounting Hardware.

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# CLUTCHES AND BRAKES

## Brakes

B100 Series  
90 VDC

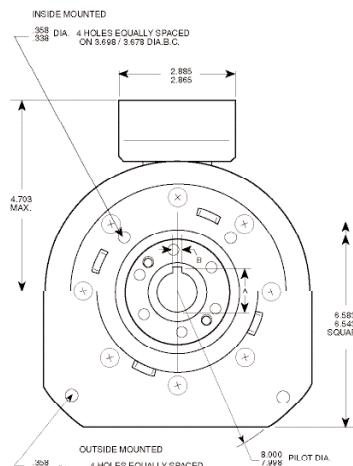
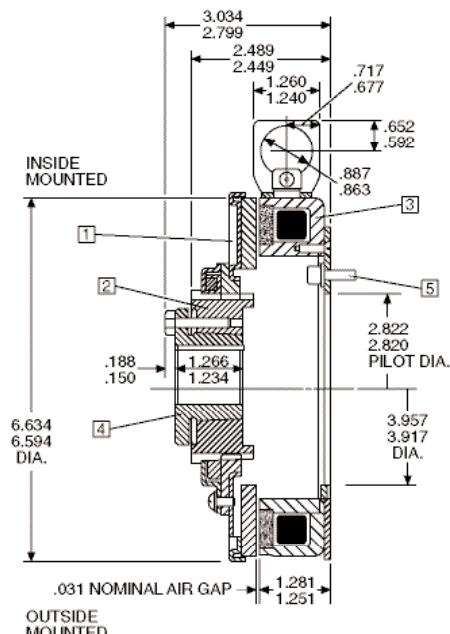


### RATINGS

**Static Torque:** 100 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:** 202 ±5% ohms  
**Maximum Current:** .469 Amps  
**Maximum Watts:** 42.3  
**Coil Build-up:** 76 ms  
**Coil Decay:** 12 ms

### INSTALLATION REQUIREMENTS

Squareness of brake mounting surface with armature shaft within .006" TIR at 5" diameter.  
Concentricity of brake mounting pilot diameter with armature shaft within .010" TIR.



### AVERAGE WEIGHTS AND INERTIAS

| Part         | Wt. (lbs.) | Inertia (lb ft <sup>2</sup> ) |
|--------------|------------|-------------------------------|
| Field        | 4.85       | —                             |
| Armature     | 2.43       | .115                          |
| Armature hub | 1.79       | .015                          |
| Total        | 9.07       | .130                          |

| ALL DIMENSIONS IN INCHES |               |                   |             | ORDER BY ITEM CODE |                    |                      |                 |               |                               |                  |
|--------------------------|---------------|-------------------|-------------|--------------------|--------------------|----------------------|-----------------|---------------|-------------------------------|------------------|
| STANDARD BORE            |               | KEYWAY DIMENSIONS |             | ITEM CODES         |                    |                      |                 |               |                               |                  |
| Nominal                  | Actual        | A                 | B           | No. 1 Armature     | No. 2 Armature Hub | No. 3 Field Assembly |                 | No. 4 Bushing | No. 5 Field Mounting Hardware |                  |
|                          |               |                   |             |                    |                    | Inside Mounted       | Outside Mounted |               | Inside Mounting               | Outside Mounting |
| 1/2                      | .5000/.5015   | .555/.565         | .124/.126   |                    |                    |                      |                 | 45168         |                               |                  |
| 5/8                      | .6250/.6265   | .704/.714         | .1865/.1885 |                    |                    |                      |                 | 45169         |                               |                  |
| 3/4                      | .7500/.7515   | .832/.842         | .1865/.1885 |                    |                    |                      |                 | 45170         |                               |                  |
| 7/8                      | .8750/.8765   | .959/.969         | .1865/.1885 |                    |                    |                      |                 | 45171         |                               |                  |
| 1                        | 1.0000/1.0015 | 1.110/1.120       | .249/.251   | 45119              | 45120              | 45122                | 45123           | 45172         | 45124                         | 45124            |
| 1-1/8                    | 1.125/1.127   | 1.236/1.246       | .249/.251   |                    |                    |                      |                 | 45173         |                               |                  |
| 1-1/4                    | 1.250/1.252   | 1.300/1.310       | .249/.251   |                    |                    |                      |                 | 45174         |                               |                  |
| 1-3/8                    | 1.375/1.377   | 1.419/1.429       | .3115/.3135 |                    |                    |                      |                 | 45175         |                               |                  |
| 1-1/2                    | 1.500/1.502   | 1.540/1.570       | .375/.377   |                    |                    |                      |                 | 45176         |                               |                  |

**HOW TO ORDER:** Specify Item Codes for Armature, Armature Hub, Field Assembly (inside or outside mounting), Bushing (desired bore) and Field Mounting Hardware.

**BOSTON GEAR®**

# CLUTCHES AND BRAKES

## Brakes

B150 Series  
90 VDC

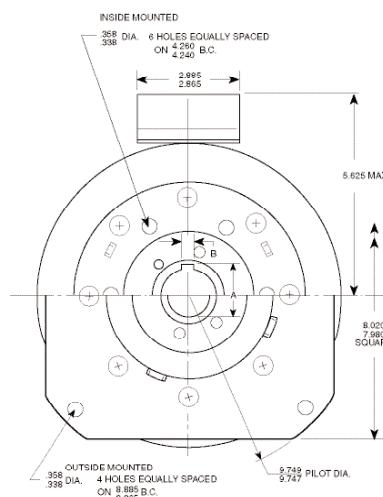
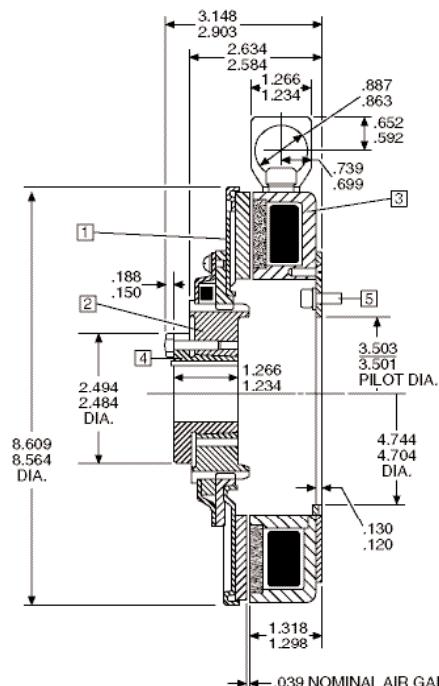


### RATINGS

**Static Torque:** 150 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Voltage:** 90 VDC  
**Resistance at 20°C:**  $219 \pm 5\%$  ohms  
**Maximum Current:** .433 Amps  
**Maximum Watts:** 39  
**Coil Build-up:** 110 ms  
**Coil Decay:** 20 ms

### INSTALLATION REQUIREMENTS

Squareness of brake mounting surface with armature shaft within .006" TIR at 6" diameter.  
Concentricity of brake mounting pilot diameter with armature shaft within .010" TIR.



# CLUTCHES AND BRAKES

## *Clutch/Brakes*

## CB-20S Series



## RATINGS

**Static Torque:** 20 Lb. Ft.  
**Maximum Speed:** 4500 RPM  
**Average Weight:** 9.01 Lbs.  
**Output Inertia:** .0336 Lb. Ft.<sup>2</sup>  
**Coil Build-up: (Clutch):** 95 ms, (Brake): 100 ms  
**Coil Decay: (Clutch):** 23 ms, (Brake): 22 ms  
**Voltage:** 90 VDC  
**Maximum Watts:** 7.83  
**Maximum Current:** .087 Amps  
**Resistance at 20°C:** 1087 ±5% ohms

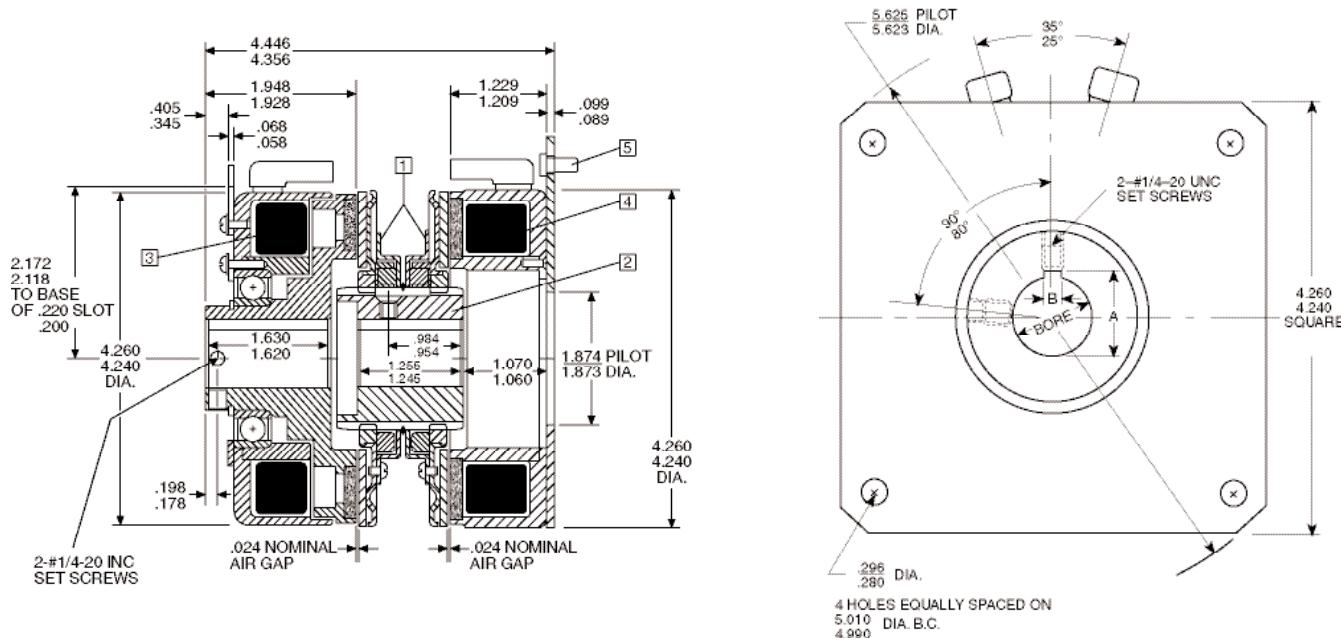
## INSTALLATION REQUIREMENTS

Angular alignment of shafts within .006" TIR at 5" diameter.

Angular alignment of shafts within .0003" TIB  
Shafts to be concentric within .003" TIB

Armature shaft square to brake mounting surface within .006" TIR at 5" diameter

Brake pilot diameter to be concentric with shaft within .006" TIR



| ALL DIMENSIONS IN INCHES |               |                   |             |           | ORDER BY ITEM CODE              |                          |                                  |                         |  |
|--------------------------|---------------|-------------------|-------------|-----------|---------------------------------|--------------------------|----------------------------------|-------------------------|--|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             |           | ITEM CODES                      |                          |                                  |                         |  |
| Nominal                  | Actual        | Keyway            | A           | B         | No. 1<br>Armature<br>(2 req'd.) | No. 2<br>Armature<br>Hub | No. 3<br>Field Rotor<br>Assembly | No. 4<br>Brake<br>Field | No. 5<br>Brake Field<br>Mounting Assy. |
| 1/2                      | .5005/.5015   | 1/8 x 1/16        | .560/.565   | .126/.128 |                                 | 45076                    | 45070                            |                         |  |
| 5/8                      | .6255/.6270   | 3/16 x 3/32       | .709/.715   | .188/.190 |                                 | 45077                    | 45071                            |                         |  |
| 3/4                      | .7505/.7520   | 3/16 x 3/32       | .837/.845   | .188/.190 | 45061                           | 45078                    | 45072                            |                         |  |
| 7/8                      | .8755/.8790   | 3/16 x 3/32       | .964/.970   | .188/.190 |                                 | 45079                    | 45073                            | 45075                   | 45081                                  |
| 1                        | 1.0005/1.0020 | 1/4 x 1/8         | 1.114/1.122 | .251/.253 |                                 | 45080                    | 45074                            |                         |  |

**HOW TO ORDER:** Specify Item Codes for Armatures, Armature Hub (desired bore), Field Rotor Assembly (desired bore), Brake Field and Brake Field Mounting Assembly.

**BOSTON GEAR®**

# CLUTCHES AND BRAKES

## Clutch/Brakes

CB-50S Series  
90 VDC

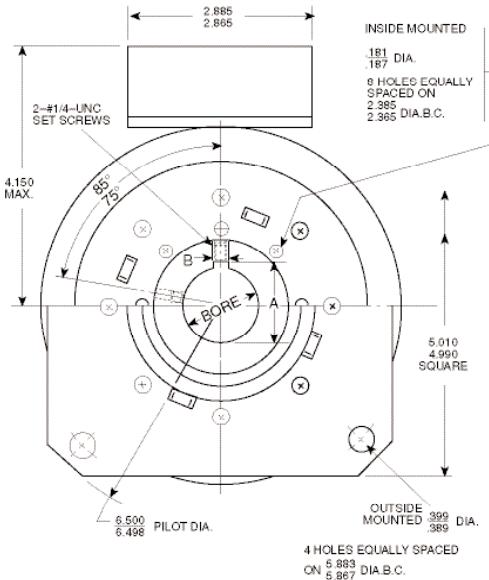
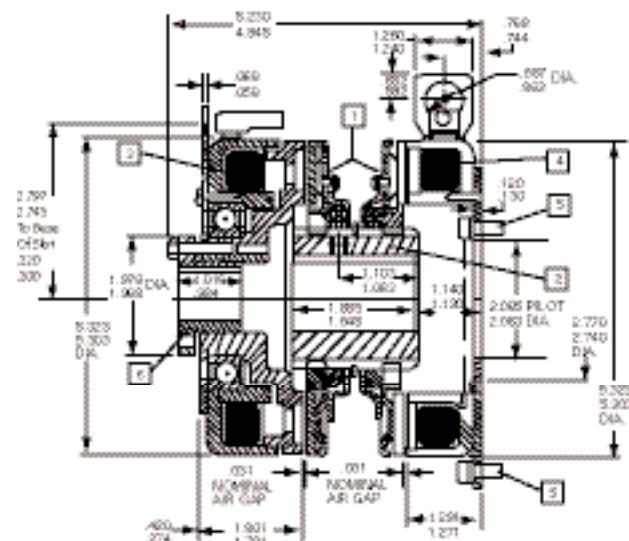


### RATINGS

**Static Torque:** 50 Lb. Ft.  
**Maximum Speed:** 4000 RPM  
**Average Weight:** 14.31 Lbs.  
**Output Inertia:** .0955 Lb. Ft.<sup>2</sup>  
**Coil Build-up: (Clutch):** 70 ms, (Brake): 65 ms  
**Coil Decay: (Clutch):** 15 ms, (Brake): 12 ms  
**Voltage:** 90 VDC  
**Maximum Watts:** 34  
**Maximum Current:** .38 Amps  
**Resistance at 20°C:** 237 ±5% ohms

### INSTALLATION REQUIREMENTS

Angular alignment of shafts within .008" TIR at 5" diameter.  
Shafts to be concentric within .004" TIR  
Armature shaft square to brake mounting surface within .006" TIR at 5" diameter  
Brake pilot diameter to be concentric with shaft within .010" TIR



| ALL DIMENSIONS IN INCHES |               |                   |             | ORDER BY ITEM CODE              |                          |                                     |                      |                   |   |                    |                     |       |
|--------------------------|---------------|-------------------|-------------|---------------------------------|--------------------------|-------------------------------------|----------------------|-------------------|---|--------------------|---------------------|-------|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             | ITEM CODES                      |                          |                                     |                      |                   |   |                    |                     |       |
| Nominal                  | Actual        | A                 | B           | No. 1<br>Armature<br>(2 Req'd.) | No. 2<br>Armature<br>Hub | No. 3<br>Field<br>Rotor<br>Assembly | No. 4<br>Brake Field |                   | No. 5 Brake<br>Field Mounting<br>Hardware |                    | No. 6<br>Bushing    |       |
| 1/2                      | .5000/.5015   | .555/.565         | .124/.126   |                                 | 45100                    |                                     |                      | Inside<br>Mounted | Outside<br>Mounted                        | Inside<br>Mounting | Outside<br>Mounting | 45163 |
| 5/8                      | .6250/.6265   | .704/.714         | .1865/.1885 | 45091                           | 45101                    | 45095                               | 45098                |                   |   |                    |                     | 45164 |
| 3/4                      | .7500/.7515   | .832/.842         | .1865/.1885 |                                 | 45102                    | 45103                               | 45099                |                   |   |                    |                     | 45165 |
| 7/8                      | .8750/.8765   | .959/.969         | .1865/.1885 |                                 | 45104                    | 45105                               | 45107                |                   |   |                    |                     | 45166 |
| 1                        | 1.0000/1.0015 | 1.110/1.120       | .250/.252   |                                 |                          | 45106                               | 45097                |                   |   |                    |                     | 45167 |
| 1-1/8                    | 1.1255/1.1270 | 1.241/1.251       | .251/.253   |                                 |                          |                                     |                      |                   |   |                    |                     | —     |
| 1-1/4                    | 1.2505/1.2520 | 1.367/1.377       | .251/.253   |                                 |                          |                                     |                      |                   |   |                    |                     | —     |

**HOW TO ORDER:** Specify Item Codes for Armatures, Armature Hub (desired bore), Field Rotor Assembly (desired bore), Brake Field (inside or outside mounting), Brake Field Mounting Hardware and Bushing (desired bore).

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# CLUTCHES AND BRAKES

## Clutch/Brakes

CB-100S Series  
90 VDC

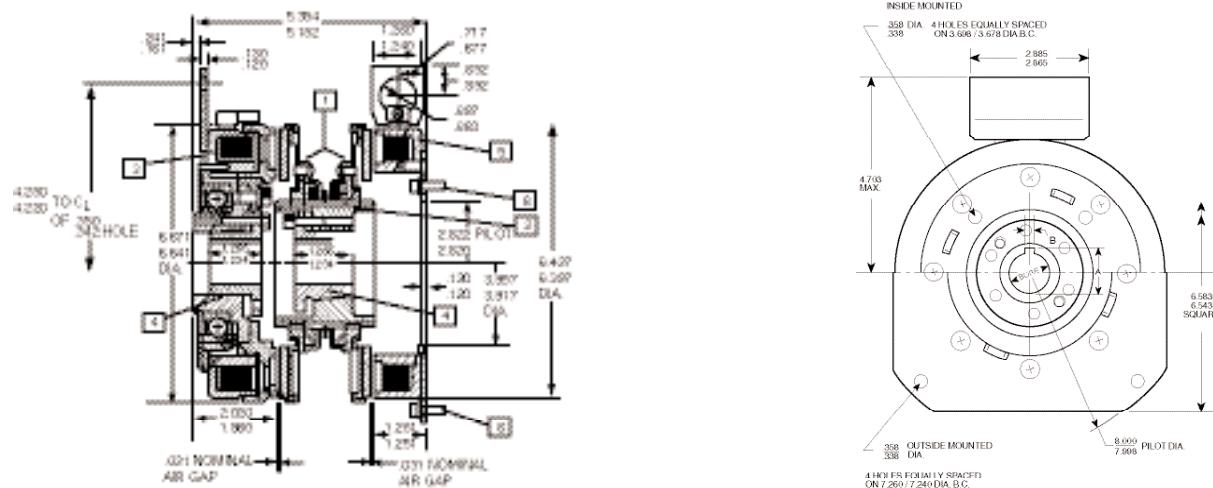


### RATINGS

**Static Torque:** 100 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Average Weight:** 23.30 Lbs.  
**Output Inertia:** .2525 Lb. Ft.<sup>2</sup>  
**Coil Build-up: (Clutch):** 65 ms, (Brake): 76 ms  
**Coil Decay: (Clutch):** 15 ms, (Brake): 12 ms  
**Voltage:** 90 VDC  
**Maximum Watts:** 42.3  
**Maximum Current:** .469 Amps  
**Resistance at 20°C:** 202 ±5% ohms

### INSTALLATION REQUIREMENTS

Angular alignment of shafts within .008" TIR at 5" diameter.  
 Shafts to be concentric within .004" TIR  
 Armature shaft square to brake mounting surface within .006" TIR at 5" diameter  
 Brake pilot diameter to be concentric with shaft within .010" TIR



| ALL DIMENSIONS IN INCHES |               |                   |             | ORDER BY ITEM CODE              |                          |                                     |                  |                         |                    |                                       |                     |
|--------------------------|---------------|-------------------|-------------|---------------------------------|--------------------------|-------------------------------------|------------------|-------------------------|--------------------|---------------------------------------|---------------------|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             | No. 1<br>Armature<br>(2 Req'd.) | No. 2<br>Armature<br>Hub | No. 3<br>Field<br>Rotor<br>Assembly | No. 4<br>Bushing | No. 5<br>Brake<br>Field |                    | No. 6<br>Brake Field<br>Mtg. Hardware |                     |
| Nominal                  | Actual        | A                 | B           |                                 |                          |                                     |                  | Inside<br>Mounted       | Outside<br>Mounted | Inside<br>Mounting                    | Outside<br>Mounting |
| 1/2                      | .5000/.5015   | .555/.565         | .124/.126   |                                 |                          |                                     | 45168            |                         |                    |                                       |                     |
| 5/8                      | .6250/.6265   | .704/.714         | .1865/.1885 |                                 |                          |                                     | 45169            |                         |                    |                                       |                     |
| 3/4                      | .7500/.7515   | .832/.842         | .1865/.1885 |                                 |                          |                                     | 45170            |                         |                    |                                       |                     |
| 7/8                      | .8750/.8765   | .959/.969         | .1865/.1885 | 45119                           | 45125                    | 45121                               | 45171            |                         |                    |                                       |                     |
| 1                        | 1.0000/1.0015 | 1.072/1.102       | .249/.251   |                                 |                          |                                     | 45172            |                         |                    |                                       |                     |
| 1-1/8                    | 1.125/1.127   | 1.236/1.246       | .249/.251   |                                 |                          |                                     | 45173            |                         |                    |                                       |                     |
| 1-1/4                    | 1.250/1.252   | 1.300/1.310       | .249/.251   |                                 |                          |                                     | 45174            |                         |                    |                                       |                     |
| 1-3/8                    | 1.375/1.377   | 1.419/1.429       | .3115/.3135 |                                 |                          |                                     | 45175            |                         |                    |                                       |                     |
| 1-1/2                    | 1.500/1.502   | 1.540/1.570       | .375/.377   |                                 |                          |                                     | 45176            |                         |                    |                                       |                     |

**HOW TO ORDER:** Specify Item Codes for Armatures, Armature Hub Field Rotor Assembly, Bushing (desired bore), Brake Field (inside or outside mounting) and Brake Field Mounting Hardware.

**BOSTON GEAR®**

# CLUTCHES AND BRAKES

## Clutch/Brakes

CB-150S Series

90 VDC

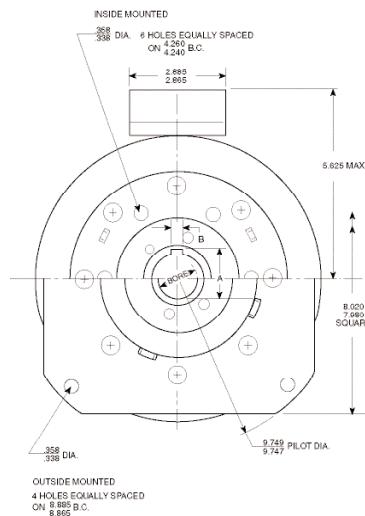
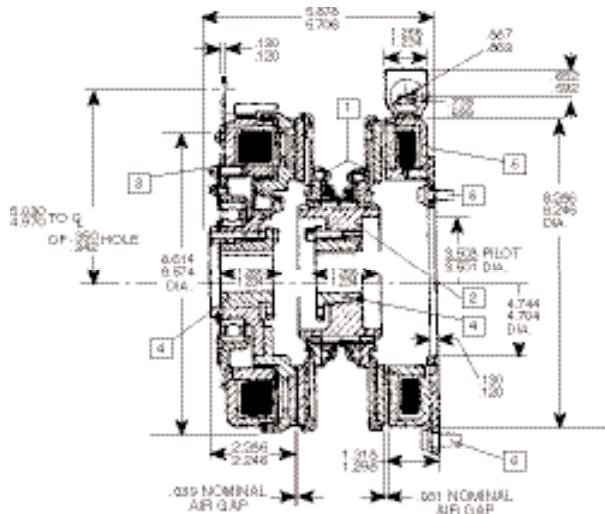


### RATINGS

**Static Torque:** 150 Lb. Ft.  
**Maximum Speed:** 3600 RPM  
**Average Weight:** 40.60 Lbs.  
**Output Inertia:** .7015 Lb. Ft.<sup>2</sup>  
**Coil Build-up (Clutch):** 155 ms (Brake): 110 ms  
**Coil Decay (Clutch):** 36 ms (Brake): 20 ms  
**Voltage:** 90 VDC  
**Maximum Watts:** 39  
**Maximum Current:** .433 Amps  
**Resistance at 20°C:** 219 ±5% ohms

### INSTALLATION REQUIREMENTS

Angular alignment of shafts within .010" TIR at 5" diameter.  
 Shafts to be concentric within .006" TIR  
 Armature shaft square to brake mounting surface within .006" TIR at 5" diameter  
 Brake pilot diameter to be concentric with shaft within .010" TIR



| ALL DIMENSIONS IN INCHES |               |                   |             | ORDER BY ITEM CODE              |                            |                                   |                            |                         |                    |   |                     |
|--------------------------|---------------|-------------------|-------------|---------------------------------|----------------------------|-----------------------------------|----------------------------|-------------------------|--------------------|---|---------------------|
| STANDARD BORES           |               | KEYWAY DIMENSIONS |             | No. 1<br>Armature<br>(2 Req'd.) | No. 2<br>Armature<br>Rotor | No. 3<br>Field<br>Assembly<br>Hub | No. 4<br>Inside<br>Bushing | No. 5<br>Brake<br>Field |                    | No. 6 Brake<br>Field Mounting<br>Hardware |                     |
| Nominal                  | Actual        | A                 | B           |                                 |                            |                                   |                            | Inside<br>Mounted       | Outside<br>Mounted | Inside<br>Mounting                        | Outside<br>Mounting |
| 1/2                      | .5000/.5015   | .555/.565         | .124/.126   |                                 |                            |                                   | 45168                      |                         |                    |   |                     |
| 5/8                      | .6250/.6265   | .704/.714         | .1865/.1885 |                                 |                            |                                   | 45169                      |                         |                    |   |                     |
| 3/4                      | .7500/.7515   | .832/.842         | .1865/.1885 |                                 |                            |                                   | 45170                      |                         |                    |   |                     |
| 7/8                      | .8750/.8765   | .959/.969         | .1865/.1885 | 45136                           | 45142                      | 45138                             | 45171                      | 45139                   | 45140              | 45141                                     | 45124               |
| 1                        | 1.0000/1.0015 | 1.110/1.120       | .249/.251   |                                 |                            |                                   | 45172                      |                         |                    |   |                     |
| 1-1/8                    | 1.125/1.127   | 1.236/1.246       | .249/.251   |                                 |                            |                                   | 45173                      |                         |                    |   |                     |
| 1-1/4                    | 1.250/1.252   | 1.300/1.310       | .249/.251   |                                 |                            |                                   | 45174                      |                         |                    |   |                     |
| 1-3/8                    | 1.375/1.377   | 1.419/1.429       | .3115/.3135 |                                 |                            |                                   | 45175                      |                         |                    |   |                     |
| 1-1/2                    | 1.500/1.502   | 1.540/1.570       | .375/.377   |                                 |                            |                                   | 45176                      |                         |                    |   |                     |

**HOW TO ORDER:** Specify Item Codes for Armatures, Armature Hub, Field Rotor Assembly, Bushing (desired bore), Brake Field (inside or outside mounting) and Brake Field Mounting Hardware.

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# CLUTCHES AND BRAKES

## DC Power Supplies/Controls



The following standard controls provide 90 VDC from 115 VAC lines and fulfill most clutch and brake power supply requirements.

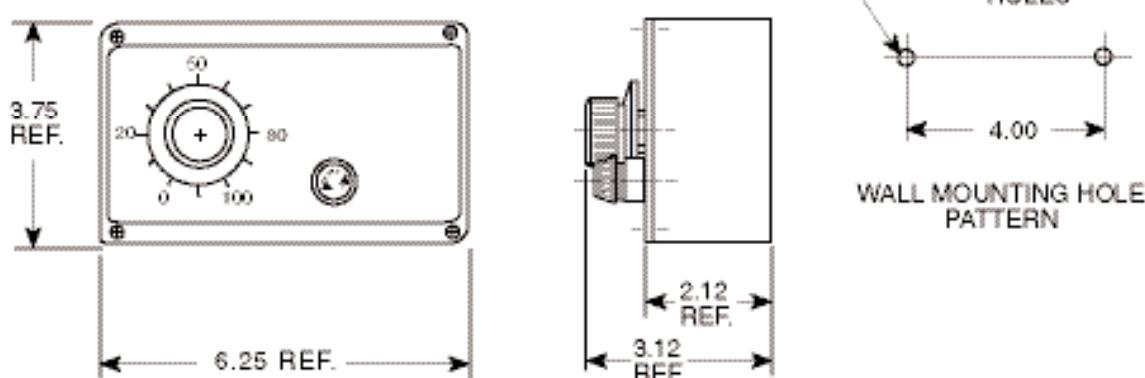
Other versions, modified or special, are available.

All controls operate one or two units – one unit at a time – through the use of SPDT switch, 15 Amp rated. (Customer supplied)

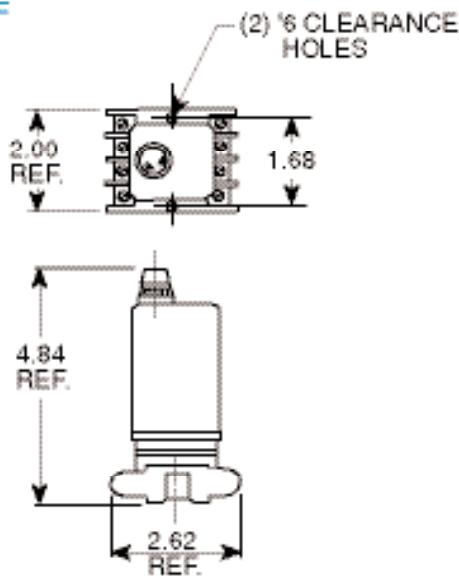
### ORDER BY CATALOG NUMBER OR ITEM CODE

| Description                                       | Catalog Number | Item Code |
|---|----------------|-----------|
| Basic Power Supply – Plug in Fixed output         | PS90B          | 45153     |
| As above, fused                                   | PS90F          | 45154     |
| Octal socket for PS90B, F                         | Octal Socket   | 67530     |
| Dual output, one fixed and one adjustable 0-90VDC | PS90-1         | 45156     |
| Dual output, both adjustable                      | PS90-2         | 45157     |
| Dual; relay output                                | PS90-2R        | 45158     |

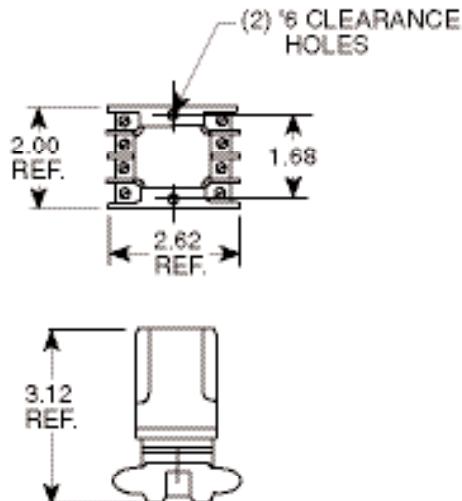
PS90 (-1, -2, -2R)



PS90F



PS90B



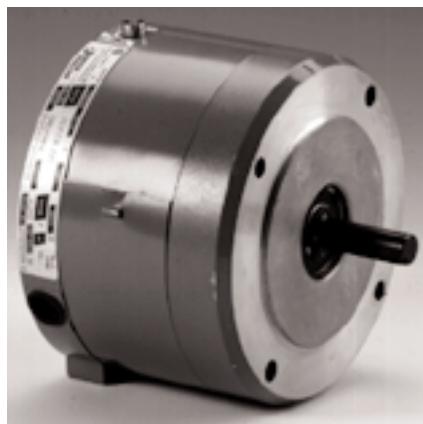
All Dimensions in Inches.  
Dimensions subject to change.

**BOSTON GEAR®**

# AC BRAKES

## Double C-Face AC Brakes

CMBA Series



These double C-Face Brakes are direct acting with only one moving part. They are spring set and electro-magnetically released. Movement is limited to a spring loaded pressure plate. Release is instantaneous. If power fails, the brake will immediately set and hold.

### FEATURES

- Automatic Reset
- Compact
- Continuous Duty
- Dependable
- Full Torque Stop
- Horizontal/Vertical Mount
- Instant Magnetic Release
- One Moving Part
- Ready to Mount
- Shock Mounted Magnet
- Direct Acting
- Flange/Foot Mounting
- Splined Hub
- Standard NEMA
- Voltages/Frequencies
- Superior Disc Life
- Superior Thermal Capacity
- Double C-Face

### OPERATION

Friction discs rotate with the motor shaft and are free to move axially on the hub. When the magnet coil is de-energized, a spring loaded pressure plate (magnet armature) presses against the rotating discs. Friction force stops and holds the motor shaft.

The pressure plate retracts against torque springs by magnetic force when the magnet is energized. Friction discs are then released and free to rotate with the hub and motor shaft. A manual release is also provided.

Brake coil leads connect directly to motor leads so that power is simultaneously supplied to both brake and motor. No control equipment is required. An instruction bulletin on mounting and hookup are included with each brake.

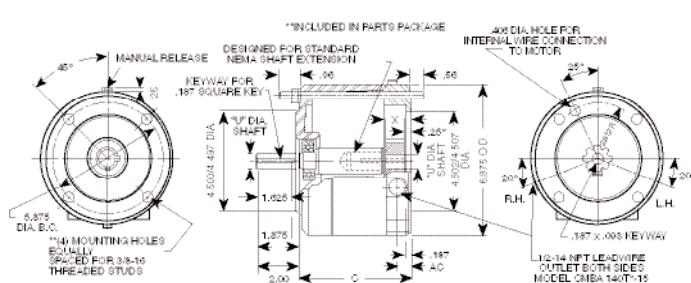
### SPLINED HUB

These C-Face brakes use splined hubs and internally splined friction discs as standard equipment. The spline design virtually eliminates backlash which is a delayed action effect caused by excessive clearances between hub and discs. Splines increase disc life because the many contact points between hub and discs reduce the concentration of stresses encountered with non-splined hubs having only a few contact points.

### ORDER BY CATALOG NUMBER OR ITEM CODE

| Torque<br>(Lb. Ft.) | NEMA<br>Frame | Bore<br>Code | Mounting            | Coil Voltage       |              |  |              |                   |              |
|---------------------|---------------|--------------|---------------------|--------------------|--------------|--|--------------|-------------------|--------------|
|                     |               |              |                     | 115/230 VAC, 60 Hz |              | 208-230/460 VAC, 60 Hz<br>190/380 VAC, 50 Hz |              | 575 VAC, 60 Hz    |              |
|                     |               |              |                     | Catalog<br>Number  | Item<br>Code | Catalog<br>Number                            | Item<br>Code | Catalog<br>Number | Item<br>Code |
| 3                   | 56C           | B5           | Horizontal/Vertical | CMBA56R-3          | 67545        | CMBA56U-3                                    | 67546        | CMBA56Y-3         | 67547        |
|                     |               | B5           | Horizontal          | CMBA56R-6          | 67548        | CMBA56U-6                                    | 67549        | CMBA56Y-6         | 67550        |
| 6                   | 140TC         | B7           | Horizontal          | CMBA140TR-6        | 67551        | CMBA140TU-6                                  | 67552        | CMBA140TY-6       | 67553        |
|                     |               | B7           | Vertical Shaft Up   | CMBA140TR-6U       | 67554        | CMBA140TU-6U                                 | 67556        | —                 | —            |
|                     |               | B7           | Vertical Shaft Down | CMBA140TR-6D       | 67555        | CMBA140TU-6D                                 | 67557        | —                 | —            |

### DIMENSIONS



| ALL DIMENSIONS IN INCHES |      |         |        |     |     |              |                |
|--------------------------|------|---------|--------|-----|-----|--------------|----------------|
| Size                     | AC   | C       | G      | X   | U   | Housing O.D. | Approx. Weight |
| 56-3                     | 9/16 | 4-15/16 | 1-3/16 | 7/8 | 5/8 | 6-7/8        | 12 Lbs.        |
| 56-6                     |      |         |        |     | 5/8 |              |                |
| 140T-6                   |      |         |        |     | 7/8 |              |                |

### PARTS

| ORDER BY ITEM CODE     |           |
|------------------------|-----------|
| Description            | Item Code |
| Base Kit               | 67561     |
| Coil-115/230 VAC 60 Hz | 67558     |
| Coil-208-230-460 VAC   | 67559     |
| Coil-575 VAC 60 Hz     | 67560     |
| Disc-Stationary        | 67562     |
| Disc-Rotating          | 67563     |

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## Double C-Face AC Brakes Washdown (BISSC)

CMBWB Series



Double C-Face brakes provide the simplest solution for adding a brake between a C-Face motor and a flanged gear reducer. These brakes offer the added feature of meeting BISSC standards, AAA standards and other food industry washdown requirements. The CMB-WB double C-Face brakes are a perfect compliment to our AC washdown motors.

### OPERATION

The brake hub is attached to the motor shaft. The friction disk fits around the hub and is free to move axially along the hub. When the motor and the brake solenoid coil are de-energized, the brake is in a set condition. In a set condition, the pressure spring applies a force against the pressure plate to clamp the friction disc against the stationary disc and endplate to retard motion. The clamped friction disc prevents the hub and motor shaft from rotating.

The brake is released electrically when voltage is applied to the solenoid coil of the brake. This produces an electromagnetic force which pulls the lever arm away from

the pressure plate, releasing the clamping force on the friction disc. This allows the brake hub and motor shaft to turn freely. An important feature of this spring set brake is its power failure characteristic. If a loss of electric power to the motor and brake occurs, the brake will automatically engage and hold the load provided that it has been properly applied and maintained.

The brake coil is connected directly to the motor leads so that power is simultaneously supplied to the brake and the motor. No additional control equipment is required.

### FEATURES

- BISSC Certified
- CSA Certified
- Meets National AAA Dairy Standards
- Complies with Wisconsin Food and Dairy Regulations
- White FDA Approved Epoxy Paint
- Stainless Steel Hardware
- Neoprene Gasketing
- Splined Hub for Increased Disc Life
- Sizes for NEMA 56C to 184TC Frame Motors
- Standard Torque Ranges from 3 to 10 lb-ft
- Maximum RPM: 5000 (56C and 140TC) and 4000 (180TC)
- Manual Adjust for Lining Wear (56C and 140TC)
- Self-Adjusting for Lining Wear (180TC only)
- Automatic Reset, Manual Brake Release
- Rated for Continuous Duty
- Available in AC or DC Voltages

### ORDER BY CATALOG NUMBER OR ITEM CODE

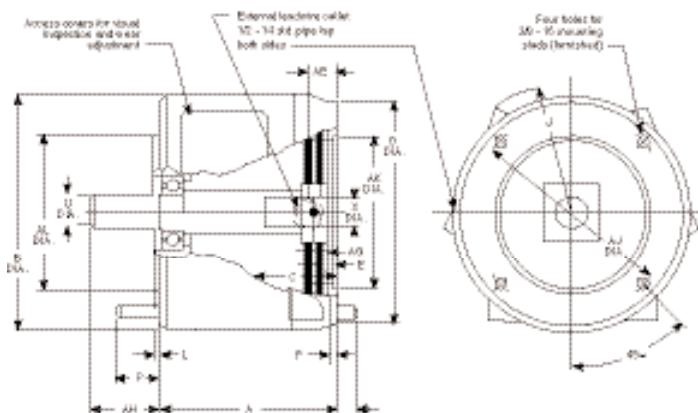
| Nominal Static Torque (Lb. Ft.) | Bore Code | NEMA Frame | Mounting                 | Coil Voltage           |           |  |           |                |           |
|---------------------------------|-----------|------------|--------------------------|------------------------|-----------|--|-----------|----------------|-----------|
|                                 |           |            |                          | 115/208-230 VAC, 60 Hz |           | 208-230/460 VAC, 60 Hz<br>190/380 VAC, 50 Hz |           | 575 VAC, 60 Hz |           |
|                                 |           |            |                          | Catalog Number         | Item Code | Catalog Number                               | Item Code | Catalog Number | Item Code |
| 3                               | B5        | 56C        | Horizontal/Vertical      | CMBWB-3-R-B5           | 58106     | CMBWB-3-U-B5                                 | 58107     | CMBWB-3-Y-B5   | 58108     |
| 6                               | B5        | 56C        | Horizontal/Vertical      | CMBWB-6-R-B5           | 58110     | CMBWB-6-U-B5                                 | 58111     | CMBWB-6-Y-B5   | 58112     |
| 6                               | B7        | 143/145TC  | Horizontal/Vertical      | CMBWB-6-R-B7           | 58114     | CMBWB-6-U-B7                                 | 58115     | CMBWB-6-Y-B7   | 58116     |
| 10                              | B9        | 182/184TC  | Horizontal/Vertical Down | CMBWB-10-R-B9          | 58125     | CMBWB-10-U-B9                                | 58126     | CMBWB-10-Y-B9  | 58127     |
|                                 |           |            | Vertical Up              | CMBWB-10U-R-B9         | 58128     | CMBWB-10U-U-B9                               | 58130     | CMBWB-10U-Y-B9 | 58131     |

# AC BRAKES

Double C-Face Brakes  
Washdown (BISSC)

CMB-WB Series

## DIMENSIONS



| DIMENSIONS   |      |      |     |      |             |             |       |      |      |      |     |
|--------------|------|------|-----|------|-------------|-------------|-------|------|------|------|-----|
| Unit*        | A    | AE   | AG  | AJ   | AK          | AL          | B     | C    | D    | E    | F   |
| CMBWB-3-*B5  | 5.22 | .88  | .41 | 5.88 | 4.502/4.507 | 4.500/4.497 | 7.00  | 2.19 | 6.50 | .25  | .19 |
| CMBWB-6-*B5  |      |      |     |      |             |             |       |      |      |      |     |
| CMBWB-6-*B7  | 5.22 | .88  | .41 | 5.88 | 4.502/4.507 | 4.500/4.497 | 7.00  | 2.19 | 6.50 | .25  | .19 |
| CMBWB-10-*B9 | 8.38 | 2.12 | .18 | 7.25 | 8.500/8.502 | 8.500/8.498 | 10.38 | 2.81 | 9.00 | 1.00 | .19 |

| Unit*        | J     | L   | P    | Q   | Input Shaft |           | Output Shaft |           | AH   |
|--------------|-------|-----|------|-----|-------------|-----------|--------------|-----------|------|
|              |       |     |      |     | X           | Keyway    | U            | Keyway    |      |
| CMBWB-3-*B5  | 3.88  | .12 | 1.25 | .56 | .626/.627   | .19 X .09 | .625/.624    | .19 X .09 | 2.00 |
| CMBWB-6-*B5  |       |     |      |     |             |           |              |           |      |
| CMBWB-6-*B7  | 3.88  | .12 | 1.25 | .56 | .876/.877   | .19 X .09 | .875/.874    | .19 X .09 | 2.00 |
| CMBWB-10-*B9 | 12.12 | .25 | —    | —   | 1.125/1.126 | .25 X .12 | 1.125/1.124  | .25 X .12 | 2.62 |

Dimensions for estimating only. For installation purposes, request certified prints.

\* Voltage

| SPECIFICATIONS |                               |                       |   |                       |  |  |  |                 |
|----------------|-------------------------------|-----------------------|---|-----------------------|--|--|--|-----------------|
| Unit*          | Nominal Static Torque (lb-ft) | No. of Friction Discs | Maximum Solenoid Cycle Rate <sup>1</sup> (cycles/min) | Max. RPM <sup>2</sup> | Thermal Capacity <sup>3</sup> (hp-sec/min) | Inertia (Wk <sup>2</sup> ) (lb-ft <sup>2</sup> ) | Kinetic Energy Absorption <sup>4</sup> (ft-lb) | Net Weight (lb) |
| CMBWB-3-*B5    | 3                             | 1                     | 40  | 5,000                 | 5  | .008   | 9,750  | 11              |
| CMBWB-6-*B5    |                               |                       |   |                       |  |  |  |                 |
| CMBWB-6-*B7    | 6                             | 1                     | 40  | 5,000                 | 5  | .008   | 9,750  | 11              |
| CMBWB-10-*B9   | 10                            | 1                     | 30  | 4,000                 | 20   | .078   | 34,000   | 57              |

1 Maximum solenoid cycle rate is based on ambient temperature of 72° F (22°C) with 50% duty cycle. Does not relate to brake cycle rate (see Thermal Capacity).

2 Maximum RPM rating based on horizontal operation. Contact factory for maximum RPM on vertical applications.

3 Thermal capacity rating is based on ambient temperature of 72°F (22°C), stop time of one second or less, with no heat absorbed from motor and brake mounted horizontally.

4 Total kinetic energy absorption is based on ambient temperatures at 100°F (38°C) or less, including motor heat, with brake mounted horizontally. At the given rating, a 1-1/2 hour cool-down interval between stops is required. (3 hours for 10 lb ft unit.)

\* Voltage

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# AC BRAKES

## AC Motor Brake Kit

### MBRK Series

#### BRAKE KITS

These brakes are for quick field conversion of stock Boston Gear brand motors to brakemotors\* using only hand tools.

All brakes are totally enclosed, fail-safe, spring set and electrically released for positive stop and hold operation. A manual release is provided for power off operation. The manual release automatically resets when power is restored.

The brake torque rating should equal 100% to 150% or more of the full load torque of the motor. The brake coils are AC single phase for use with single or three phase motors.

\*1/3 to 2 HP TEFC Motors Shown Below.



Kit includes all of the components needed for conversion of a 56C or 143-5TC frame totally enclosed fan cooled motor\* to a brakemotor. (Totally enclosed Stearns brake, replacement cast fan cover, shaft extension and fan/hub.) Mounts on fan end of motor. May be used on single or three phase motors.

Two 1/2" NPT holes with 18" leads are provided for connections. The BRAKE KIT adds 5-1/8" to the overall length of TEFC motors.

#### FOR MOTOR VOLTAGES—

##### 230/460 VOLTS THREE PHASE OR 230 VOLTS SINGLE PHASE

| Catalog Number | Item Code | Brake Rating (lb-ft) | Max HP @ 1725 RPM | Mounts to NEMA Frame |
|----------------|-----------|----------------------|-------------------|----------------------|
| MBRK3          | 60000     | 3                    | 1                 | 56C/143-5TC          |
| MBRK6          | 60002     | 6                    | 2                 | 56C/143-5TC          |
| MBRK10         | 60003     | 10                   | 3                 | 56C/143-5TC          |

#### FOR MOTOR VOLTAGES—

##### 575 VOLTS THREE PHASE

| Catalog Number | Item Code | Brake Rating (lb-ft) | Max HP @ 1725 RPM | Mounts to NEMA Frame |
|----------------|-----------|----------------------|-------------------|----------------------|
| MBR5K3         | 69765     | 3                    | 1                 | 56C/143-5TC          |
| MBR5K6         | 69766     | 6                    | 2                 | 56C/143-5TC          |
| MBR5K10        | 69767     | 10                   | 3                 | 56C/143-5TC          |

#### FOR USE WITH THESE MOTORS

| HP    | NEMA Mtg. | Bore Code | Voltage Phase-Hz | Catalog Number | Item Code |
|-------|-----------|-----------|------------------|----------------|-----------|
| 1/3   | 56C       | B5        | 115/230-1-60     | ERTF-W         | 65348     |
| 1/3   | 56C       | B5        | 230/460-3-60     | EUTF-W         | 65383     |
| 1/3   | 56C       | B5        | 575-3-60         | EYTF-W         | 65454     |
| 1/2   | 56C       | B5        | 115/230-1-60     | FRTF-W         | 65350     |
| 1/2   | 56C       | B5        | 230/460-3-60     | FUTF-W         | 65404     |
| 1/2   | 56C       | B5        | 575-3-60         | FYTF-W         | 65455     |
| 3/4   | 56C       | B5        | 115/230-1-60     | GRTF-W         | 65351     |
| 3/4   | 56C       | B5        | 230/460-3-60     | GUTF-W         | 65405     |
| 3/4   | 56C       | B5        | 575-3-60         | GYTF-W         | 65457     |
| 1     | 56C       | B5        | 115/230-1-60     | HRTF-5/8-W     | 65354     |
| 1     | 143TC     | B7        | 115/230-1-60     | HRTF-W         | 66234     |
| 1     | 56C       | B5        | 230/460-3-60     | HUTF-5/8-W     | 65406     |
| 1     | 143TC     | B7        | 230/460-3-60     | HUTF-W         | 65412     |
| 1     | 143TC     | B7        | 575-3-60         | HYTF-W         | 65460     |
| 1-1/2 | 145TC     | B7        | 115/230-1-60     | JRTF           | 63800     |
| 1-1/2 | 56C       | B5        | 230/460-3-60     | JUTF-5/8-W     | 65407     |
| 1-1/2 | 145TC     | B7        | 230/460-3-60     | JUTF-W         | 65437     |
| 1-1/2 | 145TC     | B7        | 575-3-60         | JYTF-W         | 65475     |
| 2     | 56C       | B5        | 230/460-3-60     | KUTF-5/8-W     | 65440     |
| 2     | 145TC     | B7        | 230/460-3-60     | KUTF-W         | 65445     |
| 2     | 145TC     | B7        | 575-3-60         | KYTF           | 64950     |

# MOTOR ENCLOSURES

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## *Motor Enclosures*

**ENCLOSURES** — Most applications can utilize open drip-proof motors; other enclosures are listed. For information purposes, the various enclosures are defined below.

**OPEN, DRIPPROOF** — Same as open, except the construction of motor prevents the entrance of drops of liquid or particles falling on the motor at any angle not greater than 15 degrees from vertical.

**TOTALLY-ENCLOSED** — A motor so constructed as to prevent free exchange of air between the inside and outside of the motor case, but not air-tight.

**TOTALLY-ENCLOSED, NON-VENTILATED (TENV)** — A totally-enclosed motor of sufficient size and mass to permit the necessary heat dissipation to eliminate the need for external cooling.

**TOTALLY-ENCLOSED FAN-COOLED (TEFC)** — Basically a TENV motor which has an external fan to blow cooling air over the motor. The additional cooling eliminates the necessity of a more costly oversized TENV motor. NOTE: TENV and TEFC construction are equal in all respects regarding application, temperature capabilities and performance.

**TOTALLY ENCLOSED, BLOWER COOLED (TEBC)** — A totally enclosed motor constructed with a fan on the opposite end of motor shaft designed to blow cooling air over the motor. The fan is powered separately from the motor to provide constant air flow whether the motor is running or stopped.

**EXPLOSION-PROOF** — A totally-enclosed motor designed and built to withstand an explosion within it and/or to prevent ignition of the atmosphere surrounding it. These motors may be either TENV or TEFC as determined by the design and the manufacturer. All are U.L. listed and bear a U.L. label indicating the class of hazardous atmospheres in which the motor may be operated. All Boston Gear explosion-proof motors are nameplated Class I Group D and Class II Groups F&G.

**WASHDOWN** — Totally enclosed motors, either TENV or TEFC; that are constructed to withstand washdown requirements.

**BISSC** — Motors that have the Baking Industry Sanitation Standards Committee certification.

## NOTES

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# DC MOTORS

Ratiotrol DC motors have specific characteristics to match the controls with which they operate. Thus, it is not necessary that a motor and control be mated; any stock motor will operate with a stock control of suitable rating within a series.

Standard motors have a base speed of 1750 RPM and are stocked in ratings from 1/6 through 5 HP. Operating characteristics, reliability and durability are similar; PM motors do offer advantages such as smaller size, lower weight and the absence of field hum on critical applications. In addition, installation is simplified since only two armatures leads need be connected.

Service factor for PM and V series motors is 1.0.

## SPEED RANGE

All listed Ratiotrol 90 VDC and 180 VDC motors for Boston controllers have been designed to operate continuously at full rated torque throughout the specified speed range of the control. All shunt wound motors can operate continuously at 20:1 speed range and permanent magnet at 50:1 speed range.

Full torque operation is possible at even lower speeds if duty is intermittent. In many cases, reduced loads will permit continuous operation at speeds as low as 100:1 speed range.

## MOUNTING

Separate listings are shown for NEMA C-face mounted motors for use with flange reductors and rigid base mounted motors for coupled loads.

## AMBIENT TEMPERATURES

All standard motors are rated for continuous full load operation at ambient temperatures not exceeding 40°C (104°F). The insulation used varies with motor design; therefore, when higher temperatures than normal are expected, please contact the factory with complete details i.e., maximum temperature, HP, enclosure, mounting, etc.

## CATALOG NUMBERING SYSTEM

With few exceptions, noted below, motor catalog numbers indicate voltage HP and enclosure.

### V9 SERIES – 1/6 – 1 HP, 90 VDC armature, 50/100 VDC field.

|    |    |   |   |   |   |   |
|----|----|---|---|---|---|---|
| V9 | 16 | 0 | 0 | — | — | B |
|    |    |   |   |   |   |   |
| A  | B  | C | D | E | F |   |

A – Series designation

B – 16 - 1/6 HP  
25 - 1/4 HP  
33 - 1/3 HP  
50 - 1/2 HP  
75 - 3/4 HP  
100 - 1 HP

C – 0 - 1750 RPM (Standard)  
1 - 1150 RPM  
2 - 2500 RPM  
3 - 3450 RPM

D – Mounting

0 – NEMA C-Face  
1 – Rigid Base

E – Enclosure\*

No letter – Open dripproof  
T – TENV  
TF – TEFC  
X – Explosion-proof

F – Manufacturer

B – Baldor

### V18 SERIES – 3/4-5 HP, 180VDC armature, 100/200VDC field.

|     |    |   |    |    |
|-----|----|---|----|----|
| V18 | 10 | 0 | TF | —B |
|     |    |   |    |    |
| A   | B  | C | D  | E  |

A – Series designation

B – HP  
10 - 1 HP  
15 - 1-1/2 HP  
20 - 2 HP  
30 - 3 HP  
50 - 5 HP

C – Mounting

0 – NEMA C-Face  
1 – Rigid Base

D – Enclosure\*

No letter – Open dripproof  
T – TENV  
TF – TEFC  
X – Explosion-proof

E – Manufacturer  
B – Baldor

## PM MOTORS

|    |   |    |    |    |
|----|---|----|----|----|
| PM | 9 | 16 | AT | —B |
|    |   |    |    |    |
| A  | B | C  | D  | E  |

A – PM Series designation

B – Voltage, armature  
9-90VDC  
18-180VDC

C – HP

16 - 1/6 HP  
25 - 1/4 HP  
33 - 1/3 HP  
50 - 1/2 HP  
75 - 3/4 HP

|    |    |     |    |    |
|----|----|-----|----|----|
| PM | 18 | 100 | AT | —I |
|    |    |     |    |    |
| A  | B  | C   | D  | E  |

D – Enclosure\*

No letter – Open dripproof  
AT, T – TENV  
ATF, TF – TEFC

WB – Washdown (BISSC)

E – Manufacturer  
B – Baldor  
I – Indiana General

## OPTIONS AND MODIFICATIONS

From an economic and delivery standpoint, it is, of course, preferable that standard stock motors be specified for an application. However, many other types of motors and optional features are available on a special order basis. Some modifications are more readily available on fractional HP motors than integral HP and vice versa. Among the many options are:

**Base-Speeds** other than 1750 RPM such as 3450, 2500 and 1150 RPM.

**Severe Duty** and corrosion-proof enclosures.

**Explosion-Proof** enclosures—specify Class and Group of hazardous atmosphere.

**Brakemotors**—brakes are AC.

**Double Shafts**, extended shafts, etc.

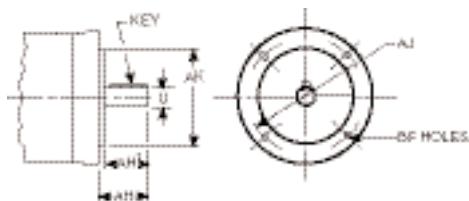
**Motor-Mounted Tachometer Generators**—for those motors not adaptable to standard tachometer packages. See Pages 49 and 50 for stock tachometer generators.

\*Motor Enclosures described on Page 81.

**BOSTON GEAR®**

# DC MOTORS

## NEMA C-Face Motor Bolt Circle Dimensions

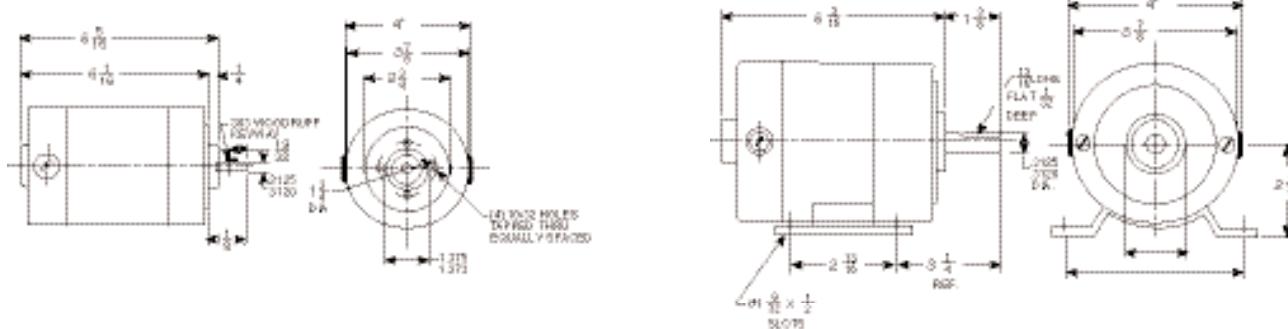


| Boston Gear Bore Code | NEMA Frame No.       | U                | AK             | Max. AH | Max. AH' | Key  |       | AJ    | BF     |
|-----------------------|----------------------|------------------|----------------|---------|----------|------|-------|-------|--------|
|                       |                      |                  |                |         |          | SQ.  | LG.   |       |        |
| B4                    | 42CZ                 | .5000<br>.4995   | 3.000<br>2.997 | 1-5/16  | —        | 1/8  | 3/4   | 3.750 | 1/4-20 |
| B5                    | 56C                  | .6250<br>.6245   | 4.500<br>4.497 | 2-5/32  | —        | 3/16 | 1-3/8 | 5.875 | 3/8-16 |
| B7                    | 56CZ<br>182C<br>184C | .8750<br>.8745   | 4.500<br>4.497 | 2-5/32  | —        | 3/16 | 1-3/8 | 5.875 | 3/8-16 |
|                       | 143TC<br>145TC       |                  |                |         |          |      |       |       |        |
| B9                    | 213C<br>215C         | 1.1250<br>1.1245 | 8.500<br>8.497 | —       | 2-25/32  | 1/4  | 1-3/4 | 7.250 | 1/2-13 |
|                       | 182TC<br>184TC       |                  |                |         |          |      |       |       |        |
| B11                   | 254UC<br>256UC       | 1.3750<br>1.3745 | 8.500<br>8.497 | —       | 3-17/32  | 5/16 | 2-3/8 | 7.250 | 1/2-13 |
|                       | 213TC<br>215TC       |                  |                |         |          |      |       |       |        |
| B13                   | 254TC<br>256TC       | 1.6250<br>1.6240 | 8.500<br>8.497 | —       | 3-13/16  | 3/8  | 2-7/8 | 7.250 | 1/2-13 |

Flanged Reducers are designed for use with motors having NEMA "C" face and shaft dimensions as shown. AH and AH' must not be exceeded.

## Permanent Magnet TENV

1/12 Horsepower



### ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                    | Volts<br>Armature | Catalog<br>Number | Item<br>Code | NEMA<br>Mounting | Approximate<br>Weight<br>(Lbs.) |
|-----------------------|-------------------|-------------------|--------------|------------------|---------------------------------|
| <b>C-FACE MOUNTED</b> |                   |                   |              |                  |                                 |
| 1/12                  | 90                | PM908T-B          | 69825        | Special          | 4                               |
| <b>BASE MOUNTED</b>   |                   |                   |              |                  |                                 |
| 1/12                  | 90                | BPM908T-B         | 64803        | Special          | 4                               |

**BOSTON GEAR®**

Electrical Products Catalog

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# DC MOTORS

NEMA C-Face  
w/Removable Bases

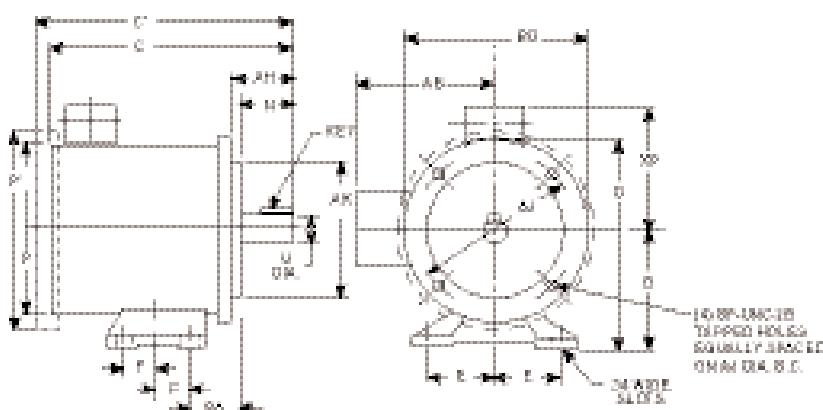
Permanent Magnet

TENV & TEFC

1/6-5 HP

1750

RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP    | Volts<br>Armature | Catalog<br>Number | Item<br>Code | Bore<br>Code | NEMA<br>MTG | Encl. | C     | C'    | D    | E    | F     | N    | O     | P    | P'   |
|-------|-------------------|-------------------|--------------|--------------|-------------|-------|-------|-------|------|------|-------|------|-------|------|------|
| 1/6   | 90                | APM916AT-B        | 19117        | B4           | 42CYZ       | TENV  | 9.50  | —     | 3.50 | 2.44 | 1.50  | 1.13 | 5.88  | 4.68 | —    |
|       |                   | APM916T           | 59475        | B4           | 42CYZ       | TENV  | 8.47  | —     | 3.50 | 2.44 | 1.50  | 1.17 | 5.75  | 4.87 | —    |
| 1/4   | 90                | PM916AT-B         | 19120        | B5           | 56C         | TENV  | 10.31 | —     | 3.50 | 2.44 | 1.50  | 1.94 | 5.88  | 4.68 | —    |
|       |                   | PM916T            | 59476        | B5           | 56C         | TENV  | 9.19  | —     | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | —    |
| 1/4   | 90                | APM925AT-B        | 19118        | B4           | 42CYZ       | TENV  | 10.44 | —     | 3.50 | 2.44 | 1.50  | 1.13 | 5.88  | 4.68 | —    |
|       |                   | APM925T           | 59477        | B4           | 42CYZ       | TENV  | 8.97  | —     | 3.50 | 2.44 | 1.50  | 1.17 | 5.75  | 4.87 | —    |
| 1/3   | 90                | PM925AT-B         | 19121        | B5           | 56C         | TENV  | 11.25 | —     | 3.50 | 2.44 | 1.50  | 1.94 | 5.88  | 4.68 | —    |
|       |                   | PM925T            | 59478        | B5           | 56C         | TENV  | 9.72  | —     | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | —    |
| 1/3   | 90                | APM933AT-B        | 19119        | B4           | 42CYZ       | TENV  | 11.38 | —     | 3.50 | 2.44 | 1.50  | 1.13 | 5.88  | 4.68 | —    |
|       |                   | APM933T           | 59479        | B4           | 42CYZ       | TENV  | 9.47  | —     | 3.50 | 2.44 | 1.50  | 1.17 | 5.75  | 4.87 | —    |
| 1/3   | 90                | PM933AT-B         | 19122        | B5           | 56C         | TENV  | 12.18 | —     | 3.50 | 2.44 | 1.50  | 1.94 | 5.88  | 4.68 | —    |
|       |                   | PM933T            | 59480        | B5           | 56C         | TENV  | 10.19 | —     | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | —    |
| 1/2   | 90                | PM950AT-B         | 19123        | B5           | 56C         | TENV  | 13.94 | —     | 3.50 | 2.44 | 1.50  | 1.94 | 5.88  | 4.68 | —    |
|       |                   | PM950TF           | 59481        | B5           | 56C         | TEFC  | —     | 11.81 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | 5.16 |
| 1/2   | 180               | PM1850TF-B        | 19186        | B5           | 56C         | TEFC  | —     | 13.75 | 3.50 | 2.44 | 1.50  | 1.94 | 6.38  | 5.81 | 6.13 |
|       |                   | PM1850TF          | 59482        | B5           | 56C         | TEFC  | —     | 11.81 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | 5.16 |
| 3/4   | 90                | PM975TF-B         | 69853        | B5           | 56C         | TEFC  | —     | 13.75 | 3.50 | 2.44 | 1.50  | 1.94 | 6.38  | 5.81 | 6.13 |
|       |                   | PM975TF           | 59483        | B5           | 56C         | TEFC  | —     | 14.31 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | 5.16 |
| 3/4   | 180               | PM1875TF-B        | 69866        | B5           | 56C         | TEFC  | —     | 13.75 | 3.50 | 2.44 | 1.50  | 1.94 | 6.38  | 5.81 | 6.13 |
|       |                   | PM1875TF          | 59484        | B5           | 56C         | TEFC  | —     | 13.81 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 4.87 | 5.16 |
| 1     | 90                | PM9100TF-B        | 69867        | B7           | 56CZ        | TEFC  | —     | 14.68 | 3.50 | 2.44 | 1.50  | 2.00 | 6.38  | 5.81 | 6.13 |
|       |                   | PM9100TF          | 59485        | B7           | 56CZ        | TEFC  | —     | 16.31 | 3.50 | 2.44 | 1.50  | 1.90 | 6.38  | 5.61 | 5.88 |
| 1     | 180               | PM9100TF-5/8-B    | 50421        | B5           | 56C         | TEFC  | —     | 14.63 | 3.50 | 2.44 | 1.50  | 1.94 | 6.38  | 5.81 | 6.13 |
|       |                   | PM9100TF-5/8      | 59486        | B5           | 56C         | TEFC  | —     | 15.81 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 5.61 | 5.88 |
| 1     | 180               | PM18100TF-B       | 69869        | B7           | 56CZ        | TEFC  | —     | 14.68 | 3.50 | 2.44 | 1.50  | 2.00 | 6.38  | 5.81 | 6.13 |
|       |                   | PM18100TF         | 59487        | B7           | 56CZ        | TEFC  | —     | 15.31 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 5.61 | 5.88 |
| 1     | 180               | PM18100TF-5/8-B   | 50424        | B5           | 56C         | TEFC  | —     | 14.63 | 3.50 | 2.44 | 1.50  | 1.94 | 6.38  | 5.81 | 6.13 |
|       |                   | PM18100TF-5/8     | 59488        | B5           | 56C         | TEFC  | —     | 14.81 | 3.50 | 2.44 | 1.50  | 1.90 | 6.75  | 5.61 | 5.88 |
| 1-1/2 | 180               | PM18150TF-B       | 69870        | B7           | 56CZ        | TEFC  | —     | 17.19 | 3.50 | 2.44 | 1.50  | 2.00 | 6.88  | 6.50 | 7.19 |
|       |                   | PM18150TF         | 59489        | B7           | 143/145TC   | TEFC  | —     | 18.34 | 3.50 | 2.75 | 2.00† | 1.96 | 6.75  | 6.55 | 7.16 |
| 2     | 180               | PM18200TF-B       | 68783        | B7           | 56CZ        | TEFC  | —     | 18.19 | 3.50 | 2.44 | 1.50  | 2.00 | 6.88  | 6.50 | 7.19 |
|       |                   | PM18200TF         | 59490        | B7           | 143/145TC   | TEFC  | —     | 19.34 | 3.50 | 2.75 | 2.00† | 1.96 | 6.75  | 6.55 | 7.16 |
| 3     | 180               | PM18300TF-B       | 69411        | B9           | 184TC       | TEFC  | —     | 24.09 | 4.50 | 3.75 | 2.75  | 2.50 | 10.00 | 7.88 | 8.88 |
| 5     | 180               | PM18500TF-B       | 69412        | B9           | 1810ATC     | TEFC  | —     | 27.59 | 4.50 | 3.75 | 2.75  | 2.00 | 10.00 | 7.88 | 8.88 |

†Includes 6 mounting holes

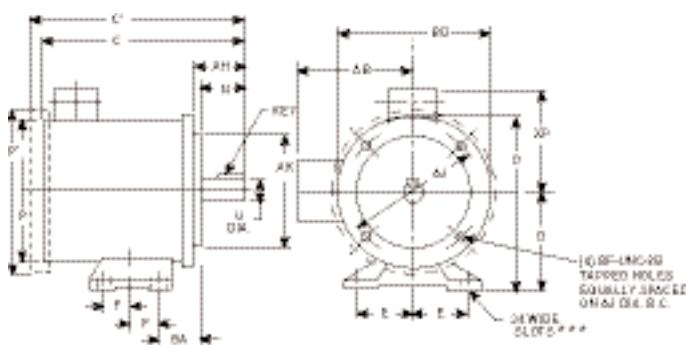
All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# DC MOTORS

NEMA C-Face  
w/Removable Bases

Permanent Magnet  
TENV & TEFC  
1/6-5 HP  
1750 RPM  
(Continued)



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP    | Volts<br>Armature | Catalog<br>Number | Bore<br>Code | NEMA<br>MTG | U<br>+.0000<br>-.0005 | Key  |      | AH   | AJ   | AK   | BA   | BD   | BF     | XP     | Approx.<br>Weight<br>(Lbs.) | AB   |
|-------|-------------------|-------------------|--------------|-------------|-----------------------|------|------|------|------|------|------|------|--------|--------|-----------------------------|------|
|       |                   |                   |              |             |                       | SQ.  | Long |      |      |      |      |      |        |        |                             |      |
| 1/6   | 90                | APM916AT-B        | B4           | 42CYZ       | .5000                 | 1/8  | .75  | 1.28 | 3.75 | 3.00 | 2.75 | 4.63 | 1/4-20 | 4.56   | 21                          | —    |
|       |                   | APM916T           | B4           | 42CYZ       | .5000                 | 1/8  | .88  | 1.31 | 3.75 | 3.00 | 2.69 | —    | 1/4-20 | —      | 19                          | 4.47 |
|       | 90                | PM916AT-B         | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.75 | 6.50 | 3/8-16 | 4.56   | 21                          | —    |
|       |                   | PM916T            | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 19                          | 4.47 |
| 1/4   | 90                | APM925AT-B        | B4           | 42CYZ       | .5000                 | 1/8  | .75  | 1.28 | 3.75 | 3.00 | 2.75 | 4.63 | 1/4-20 | 4.56   | 22                          | —    |
|       |                   | APM925T           | B4           | 42CYZ       | .5000                 | 1/8  | .88  | 1.31 | 3.75 | 3.00 | 2.69 | —    | 1/4-20 | —      | 21                          | 4.47 |
|       | 90                | PM925AT-B         | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.75 | 6.50 | 3/8-16 | 4.56   | 22                          | —    |
|       |                   | PM925T            | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 23                          | 4.47 |
| 1/3   | 90                | APM933AT-B        | B4           | 42CYZ       | .5000                 | 1/8  | .75  | 1.28 | 3.75 | 3.00 | 2.75 | 4.63 | 1/4-20 | 4.56   | 26                          | —    |
|       |                   | APM933T           | B4           | 42CYZ       | .5000                 | 1/8  | .88  | 1.31 | 3.75 | 3.00 | 2.69 | —    | 1/4-20 | —      | 24                          | 4.47 |
|       | 90                | PM933AT-B         | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.75 | 6.50 | 3/8-16 | 4.56   | 26                          | —    |
|       |                   | PM933T            | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 23                          | 4.47 |
| 1/2   | 90                | PM950AT-B         | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.75 | 6.50 | 3/8-16 | 4.56   | 32                          | —    |
|       |                   | PM950TF           | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 26                          | 4.47 |
|       | 180               | PM1850TF-B        | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 32                          | —    |
|       |                   | PM1850TF          | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 26                          | 4.47 |
| 3/4   | 90                | PM975TF-B         | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 39                          | —    |
|       |                   | PM975TF           | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 37                          | 4.47 |
|       | 180               | PM1875TF-B        | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 39                          | —    |
|       |                   | PM1875TF          | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 37                          | 4.47 |
| 1     | 90                | PM9100TF-B        | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 44                          | —    |
|       |                   | PM9100TF          | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 47                          | 4.87 |
|       | 180               | PM9100TF-5/8-B    | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 44                          | —    |
|       |                   | PM9100TF-5/8      | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 47                          | 4.87 |
| 1 1/2 | 180               | PM18100TF-B       | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 44                          | —    |
|       |                   | PM18100TF         | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 43                          | 4.87 |
|       | 180               | PM18100TF-5/8-B   | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.63 | 3/8-16 | 4.00   | 44                          | —    |
|       |                   | PM18100TF-5/8     | B5           | 56C         | .6250                 | 3/16 | 1.38 | 2.06 | 5.88 | 4.50 | 2.69 | 6.50 | 3/8-16 | —      | 42                          | 4.87 |
| 1-1/2 | 180               | PM18150TF-B       | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.13 | 5.88 | 4.50 | 2.88 | 6.63 | 3/8-16 | 4.25   | 73                          | —    |
|       |                   | PM18150TF         | B7           | 143/145TC   | .8750                 | 3/16 | 1.38 | 2.13 | 5.88 | 4.50 | 3.00 | —    | 3/8-16 | —      | 76                          | 5.31 |
| 2     | 180               | PM18200TF-B       | B7           | 56CZ        | .8750                 | 3/16 | 1.38 | 2.13 | 5.88 | 4.50 | 2.88 | 6.63 | 3/8-16 | 4.25   | 75                          | —    |
|       |                   | PM18200TF         | B7           | 143/145TC   | .8750                 | 3/16 | 1.38 | 2.13 | 5.88 | 4.50 | 3.00 | —    | 3/8-16 | —      | 83                          | 5.31 |
| 3     | 180               | PM18300TF-B       | B9           | 184TC       | 1.1250                | 1/4  | 1.75 | 2.63 | 7.25 | 8.50 | 2.88 | 9.00 | 1/2-13 | 6.06** | 116                         | —    |
| 5     | 180               | PM18500TF-B       | B9           | 1810ATC     | 1.1250                | 1/4  | 2.00 | 2.13 | 7.25 | 8.50 | 2.88 | 9.00 | 1/2-13 | 6.06** | 157                         | —    |

\*\* The conduit box is located 90 degrees to the base

\*\*\* .41 wide slots on 3 & 5 HP motors

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

Electrical Products Catalog

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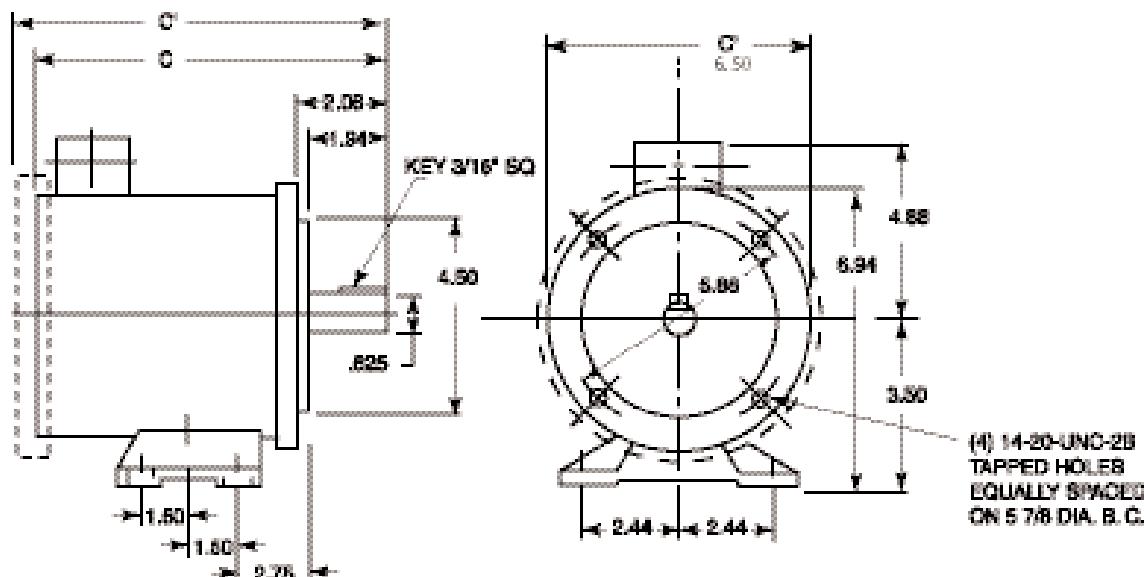
# DC MOTORS

NEMA C-Face  
Washdown

Permanent Magnet  
TENV/TEFC

1/4-1 1/2 Horsepower  
1750 RPM

Boston's Permanent Magnet Washdown Motors are specifically designed for use where dust, dirt and moisture are present in industrial and washdown environments. These motors retard the entrance of water during cleaning operations and release any water that does enter the motor. Extra protection for the motor's interior prevents rust and corrosion build-up and drains release trapped moisture to insure a longer life than possible with a standard motor. The motors are constructed using stainless steel shafts, hardware and nameplates, sealed ball bearings and forsheda seals to prevent water leakage into the motor.



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP    | Volts<br>Arma-<br>ture | Catalog<br>Number | Item<br>Code | Bore<br>Code | NEMA<br>Mtg. | Encl. | C     | C'    |
|-------|------------------------|-------------------|--------------|--------------|--------------|-------|-------|-------|
| 1/4   | 90                     | PM925T-WD         | 59354        | B5           | 56C          | TENV  | 10.69 | —     |
| 1/3   | 90                     | PM933T-WD         | 59355        | B5           | 56C          | TENV  | 11.69 | —     |
| 1/2   | 90                     | PM950T-WD         | 59356        | B5           | 56C          | TENV  | 13.69 | —     |
|       | 180                    | PM1850T-WD        | 59357        | B5           | 56C          | TENV  | 13.69 | —     |
| 3/4   | 90                     | PM975T-WD         | 59364        | B5           | 56C          | TENV  | 15.69 | —     |
|       | 180                    | PM1875T-WD        | 59365        | B5           | 56C          | TENV  | 15.69 | —     |
| 1     | 90                     | PM9100TF-5/8-WD   | 59366        | B5           | 56C          | TEFC  | —     | 15.81 |
|       | 180                    | PM18100TF-5/8-WD  | 59367        | B5           | 56C          | TEFC  | —     | 14.81 |
| 1-1/2 | 180                    | PM18150TF-5/8-WD  | 59368        | B5           | 56C          | TEFC  | —     | 16.81 |

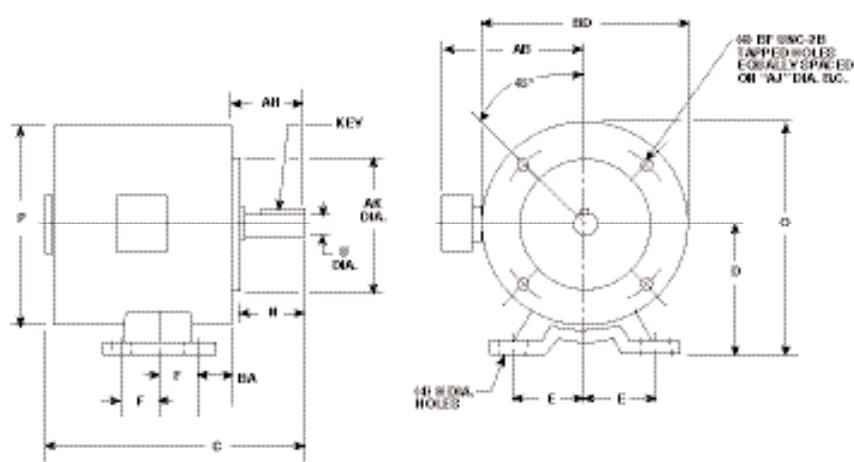
All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# DC MOTORS

NEMA C-FACE  
With Removable Bases

Shunt Wound  
Open Driproof  
1/6-5 HP  
1750 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP    | Volts<br>Armature | Volts<br>Field | Catalog<br>Number | Item<br>Code | Bore<br>Code | NEMA<br>Mtg | C     | D    | E    | F    | H*     | N    | O     | P     |
|-------|-------------------|----------------|-------------------|--------------|--------------|-------------|-------|------|------|------|--------|------|-------|-------|
| 1/6   | 90                | 50/100         | V91600-B          | 66666        | B5           | 56C         | 11.94 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
| 1/4   | 90                | 50/100         | V92500-B          | 66669        | B5           | 56C         | 11.94 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
| 1/3   | 90                | 50/100         | V93300-B          | 66672        | B5           | 56C         | 11.94 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
| 1/2   | 90                | 50/100         | V95000-B          | 66675        | B5           | 56C         | 12.94 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
| 3/4   | 90                | 50/100         | V97500-B          | 66678        | B5           | 56C         | 13.56 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
|       | 180               | 100/200        | V18750-B          | 66681        | B5           | 56C         | 13.56 | 3.50 | 2.44 | 1.50 | .34(S) | 1.94 | 6.38  | 5.68  |
| 1     | 90                | 50/100         | V9100-B           | 66897        | B5           | 56CZ        | 15.06 | 3.50 | 2.44 | 1.50 | .34(S) | 2.00 | 6.88  | 6.50  |
|       | 180               | 100/200        | V18100A-B         | 66684        | B7           | 56CZ        | 15.06 | 3.50 | 2.44 | 1.50 | .34(S) | 2.00 | 6.88  | 6.50  |
| 1-1/2 | 180               | 100/200        | V18150A-B         | 66690        | B7           | 184C        | 15.06 | 4.50 | 3.75 | 2.75 | .41    | 2.00 | 8.44  | 7.88  |
| 2     | 180               | 100/200        | V18200A-B         | 66696        | B7           | 184C        | 18.38 | 4.50 | 3.75 | 2.75 | .41    | 2.00 | 8.44  | 7.88  |
| 3     | 180               | 100/200        | 18300-B           | 66702        | B9           | 215C        | 20.94 | 5.25 | 4.25 | 3.50 | .41    | 2.75 | 9.94  | 9.38  |
| 5     | 180               | 100/200        | 18500A-B          | 66790        | B11          | 256UC       | 23.38 | 6.25 | 5.00 | 5.00 | .53    | 3.25 | 11.94 | 11.38 |

| HP    | Catalog<br>Number | Item<br>Code | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK    | BA   | BD   | BF     | Approx.<br>Weight<br>(lbs.) |
|-------|-------------------|--------------|-----------------------|------|------|------|------|------|-------|------|------|--------|-----------------------------|
|       |                   |              |                       | Sq.  | Long |      |      |      |       |      |      |        |                             |
| 1/6   | V91600-B          | 66666        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 22                          |
| 1/4   | V92500-B          | 66669        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 22                          |
| 1/3   | V93300-B          | 66672        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 23                          |
| 1/2   | V95000-B          | 66675        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 28                          |
| 3/4   | V97500-B          | 66678        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 34                          |
|       | V18750-B          | 66681        | .6250                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 34                          |
| 1     | V9100-B           | 66897        | .8750                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 61                          |
|       | V18100-B          | 66684        | .8750                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 61                          |
| 1-1/2 | V18150A-B         | 66690        | .8750                 | 3/16 | 1.38 | 5.88 | 2.13 | 5.88 | 4.500 | 2.88 | 7.88 | 3/8-16 | 87                          |
| 2     | V18200A-B         | 66696        | .8750                 | 3/16 | 1.38 | 5.88 | 2.13 | 5.88 | 4.500 | 2.88 | 7.88 | 3/8-16 | 105                         |
| 3     | 18300-B           | 66702        | 1.1250                | 1/4  | 1.75 | 7.38 | 3.00 | 7.25 | 8.500 | 3.50 | 9.00 | 1/2-13 | 155                         |
| 5     | 18500A-B          | 66790        | 1.3750                | 5/16 | 2.38 | 8.88 | 3.50 | 7.25 | 8.500 | 4.50 | 9.63 | 1/2-13 | 290                         |

\*(S) Slotted (Dim is Width)

All dimensions in inches. Dimensional information for estimating purposes only.

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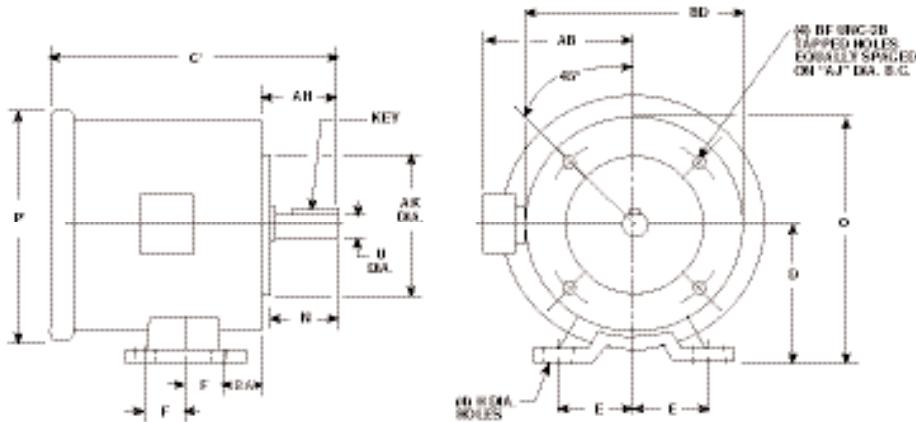
Electrical Products Catalog

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# DC MOTORS

NEMA C-FACE  
With Removable Bases

Shunt Wound  
TEFC  
1/6-5 HP  
1750 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP    | Volts<br>Armature | Volts<br>Field | Catalog<br>Number          | Item<br>Code   | Bore<br>Code | NEMA<br>Mfg  | C'             | D            | E            | F            | H*            | N            | O            | P'           |
|-------|-------------------|----------------|----------------------------|----------------|--------------|--------------|----------------|--------------|--------------|--------------|---------------|--------------|--------------|--------------|
| 1/6   | 90                | 50/100         | V91600TF-B                 | 66741          | B5           | 56C          | 12.56          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
| 1/4   | 90                | 50/100         | V92500TF-B                 | 66744          | B5           | 56C          | 13.25          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
| 1/3   | 90                | 50/100         | V93300TF-B                 | 66747          | B5           | 56C          | 13.25          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
| 1/2   | 90                | 50/100         | V95000TF-B                 | 66750          | B5           | 56C          | 14.25          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
| 3/4   | 90                | 50/100         | V97500TF-B                 | 66752          | B5           | 56C          | 14.75          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
|       | 180               | 100/200        | V18750TF-B                 | 66755          | B5           | 56C          | 14.75          | 3.50         | 2.44         | 1.50         | .34(S)        | 1.94         | 6.38         | 6.13         |
| 1     | 90                | 50/100         | V9100BTF-B                 | 66901          | B7           | 56CZ         | 15.50          | 3.50         | 2.44         | 1.50         | .34(S)        | 2.00         | 6.88         | 7.18         |
|       | 180               | 100/200        | V18100BTF-B<br>V18100ATF-B | 66757<br>66761 | B7           | 56CZ<br>182C | 16.24<br>15.56 | 3.50<br>4.50 | 2.44<br>3.75 | 1.50<br>2.75 | .34(S)<br>.41 | 2.00<br>2.00 | 6.88<br>8.44 | 7.18<br>8.50 |
| 1-1/2 | 180               | 100/200        | V18150ATF-B                | 66767          | B7           | 184C         | 17.31          | 4.50         | 3.75         | 2.75         | .41           | 2.00         | 8.44         | 8.50         |
| 2     | 180               | 100/200        | V18200ATF-B                | 66773          | B7           | 184C         | 18.56          | 4.50         | 3.75         | 2.75         | .41           | 2.00         | 8.44         | 8.50         |
| 3     | 180               | 100/200        | 18300ATF-B                 | 66778          | B9           | 215C         | 21.18          | 5.25         | 4.25         | 3.50         | .41           | 2.75         | 9.94         | 10.18        |
| 5     | 180               | 100/200        | 18500ATF-B                 | 66791          | B11          | 256UC        | 24.38          | 6.25         | 5.00         | 5.00         | .53           | 3.50         | 11.94        | 12.38        |

| HP    | Catalog Number | Item Code | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK    | BA   | BD   | BF     | XP   | Approx.<br>Weight<br>(lbs.) |
|-------|----------------|-----------|-----------------------|------|------|------|------|------|-------|------|------|--------|------|-----------------------------|
|       |                |           |                       | Sq.  | Long |      |      |      |       |      |      |        |      |                             |
| 1/6   | V91600TF-B     | 66741     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 22                          |
| 1/4   | V92500TF-B     | 66744     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 22                          |
| 1/3   | V93300TF-B     | 66747     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 23                          |
| 1/2   | V95000TF-B     | 66750     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 28                          |
| 3/4   | V97500TF-B     | 66752     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 36                          |
|       | V18750TF-B     | 66755     | .6250                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.00 | 34                          |
| 1     | V9100BTF-B     | 66901     | .8750                 | 3/16 | 1.38 | —    | 2.13 | 5.88 | 4.500 | 2.69 | 6.63 | 3/8-16 | 4.25 | 61                          |
|       | V18100BTF-B    | 66757     | .8750                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.500 | 2.75 | 6.63 | 3/8-16 | —    | 61                          |
|       | V18100ATF-B    | 66761     | .8750                 | 3/16 | 1.38 | 6.00 | 2.13 | 5.88 | 4.500 | 3.00 | 6.50 | 3/8-16 | —    | 81                          |
| 1-1/2 | V18150ATF-B    | 66767     | .8750                 | 3/16 | 1.38 | 6.00 | 2.13 | 5.88 | 4.500 | 3.00 | 6.50 | 3/8-16 | —    | 90                          |
| 2     | V18200ATF-B    | 66773     | .8750                 | 3/16 | 1.38 | 6.00 | 2.13 | 5.88 | 4.500 | 3.00 | 6.50 | 3/8-16 | —    | 105                         |
| 3     | 18300ATF-B     | 66778     | 1.1250                | 1/4  | 2.00 | 7.38 | 3.00 | 7.25 | 8.500 | 3.50 | 9.00 | 1/2-13 | —    | 167                         |
| 5     | 18500ATF-B     | 66791     | 1.3750                | 5/16 | 2.38 | 9.06 | 3.75 | 7.25 | 8.500 | 4.50 | 9.63 | 1/2-13 | —    | 306                         |

\*(S) Slotted (Dim is Width)

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

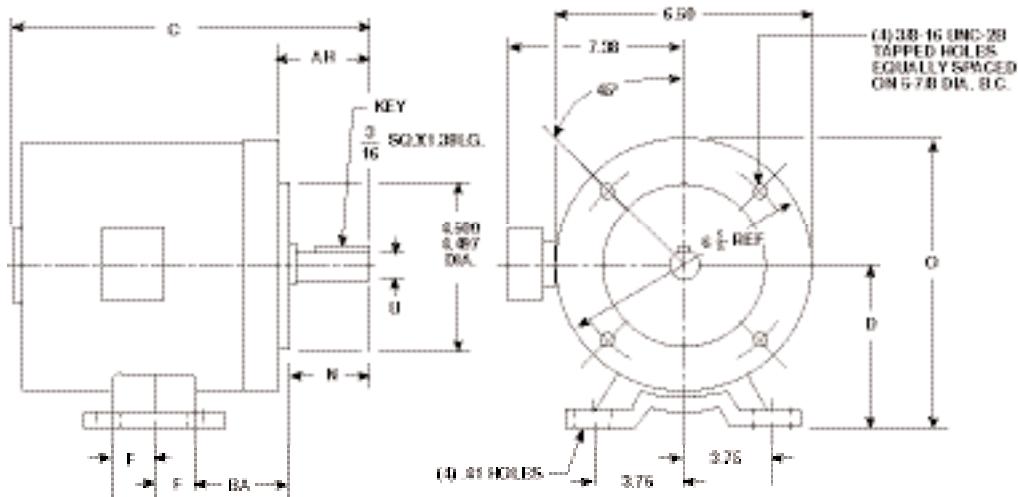
# DC MOTORS

NEMA C-FACE  
With Removable Base

Shunt Wound  
Explosion Proof  
1/2-1 HP  
1750 RPM



**CONTINUOUS DUTY**  
**1.0 SERVICE FACTOR**  
**CLASS I, GROUP D**  
**CLASS II, GROUP F & G**



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | Volts<br>Armature | Volts<br>Field | Catalog<br>Number | Item<br>Code | Bore<br>Code | NEMA<br>Mtg* | F    | BA   | D    | N    | U<br>+.0000<br>-.0005 | AH   | O    | C     | Approximate<br>Weight<br>(lbs.) |
|-----|-------------------|----------------|-------------------|--------------|--------------|--------------|------|------|------|------|-----------------------|------|------|-------|---------------------------------|
| 1/2 | 90                | 50/100         | V95000X-B         | 69871        | B5           | 182CZ        | 2.25 | 2.75 | 4.50 | 1.94 | .6250                 | 2.06 | 8.44 | 18.62 | 103                             |
| 3/4 | 90                | 50/100         | V97500X-B         | 69872        | B5           | 66CZ         | 2.50 | 3.06 | 4.13 | 1.94 | .6250                 | 2.06 | 7.94 | 15.56 | 105                             |
| 1   | 180               | 100/200        | V18100X-B         | 69873        | B7           | 182C         | 2.75 | 2.75 | 4.50 | 2.00 | .8750                 | 2.13 | 8.44 | 18.68 | 103                             |

All dimensions in inches. Dimensional information for estimating purposes only.

\*56C Shaft and face mounting only, base mounting and shaft height differs from standard NEMA dimensions.

**BOSTON GEAR®**

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## NOTES

**BOSTON GEAR®**



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# AC MOTORS

Boston Gear AC motors are general purpose motors selected for use with Boston Gear Reductors and Flanged Reductors and are suitable for all common industrial applications.

**HORSEPOWER** — Motor's listed range from 1/20 to 75 HP. Larger HP motors can be supplied.

**VOLTAGES** — All motors listed are for 60 Hz (cycle) power; fractional HP motors are also stocked in 50 Hz single phase ratings.

**SINGLE-PHASE** motors are split phase 1/20 HP through 1/6 HP. Some 1/6 HP motors and all 1/4 HP motors and larger are capacitor start. Standard 60 Hz voltages are 115V, 230V or 115/230V. 50 Hz voltages are 110/220. NOTE: 50 Hz motors have a speed of 1425 RPM, nominal. Single phase 60 Hz motors cannot be used on 50 Hz power.

**POLYPHASE** motors are all NEMA design B induction motors. Standard 60 Hz voltages are 208-230/460 and 575V. 50 Hz Voltage are 220/380/440. NOTE: 50Hz motors have a speed of 1425 RPM nominal.

**MOUNTING** — Separate listings are shown for NEMA C-face mounted motors for use with flange reducers and rigid base mounted motors for coupled loads.

**SERVICE FACTORS** indicate the allowable overload on a motor. The service factors vary from motor to motor. Please consult factory for the service factor on any particular motor.

**ALLOWABLE STARTS AND STOPS**—based on no external inertia and each start from a standstill:

Three phase motors .....up to 20 times per min.  
Single phase—split phase motors.....up to 20 times per hour  
Single phase—capacitor motors .....up to 30 times per hour

NOTE: Motor enclosures description on page 81.

**BOSTON GEAR MOTOR CATALOG NUMBERS** consists generally of two or more letters denoting horsepower, voltage, enclosure and mounting for motors 1/6 HP and larger.

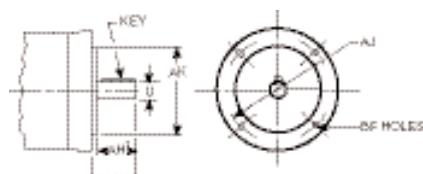
| Prefix        | H.P.      | Voltage             | Enclosure          | Suffix      | Manufacturer |
|---------------|-----------|---------------------|--------------------|-------------|--------------|
| A-Small Frame | A - 1/20  | R 115/230-1-60      | No letter-Driproof | B-Brake     | B-Baldor     |
| B-Rigid Base  | AA - 1/12 | S 115-1-60          | T-TENV             | 35-3450 RPM | W-WEG        |
|               | B - 1/8   | T 230-1-60          | TF-TEFC            | 11-1150 RPM |              |
|               | C - 1/6   | U 230/460-3-60      | X-Explosion Proof  |             |              |
|               | D - 1/4   | Y 575-3-60          | WB-Washdown BISSC  |             |              |
|               | E - 1/3   | R5 110/220-1-50     | BC-TEBC            |             |              |
|               | F - 1/2   | S5 110-1-50         |                    |             |              |
|               | G - 3/4   | T5 230-1-50         |                    |             |              |
|               | H - 1     | U5 220/380/440-3-50 |                    |             |              |
|               | J - 1-1/2 |                     |                    |             |              |
|               | K - 2     |                     |                    |             |              |
|               | L - 3     |                     |                    |             |              |
|               | M - 5     |                     |                    |             |              |
|               | N - 7-1/2 |                     |                    |             |              |
|               | P - 10    |                     |                    |             |              |
|               | R - 15    |                     |                    |             |              |
|               | S - 20    |                     |                    |             |              |
|               | T - 25    |                     |                    |             |              |
|               | U - 30    |                     |                    |             |              |
|               | V - 40    |                     |                    |             |              |
|               | W - 50    |                     |                    |             |              |
|               | X - 60    |                     |                    |             |              |
|               | Y - 75    |                     |                    |             |              |
|               | Z - 100   |                     |                    |             |              |

NOTE: A dash followed by a letter indicates the motor manufacturer eg -"B" - Baldor or "W" - WEG  
Example - FUTF-B 1/2 HP, 230/460-3-60, TEFC, Baldor.

**REVERSING**—All listed motors are reversible with standard motor reversing switches or suitable manual or magnetic reversing starters. Single phase motors must stop before reversing; polyphase may be instantly reversed by reversing any two of the three incoming power leads with a suitable starter.

**AMBIENT TEMPERATURES** — All standard motors are rated for continuous full load operation at ambient temperatures not exceeding 40°C (104°F). The insulation used varies with motor design; therefore, when higher temperatures than normal are expected, please contact the factory with complete details i.e., maximum temperature, HP, enclosure, mounting, etc.

## NEMA C-Face Bolt Circle Dimensions



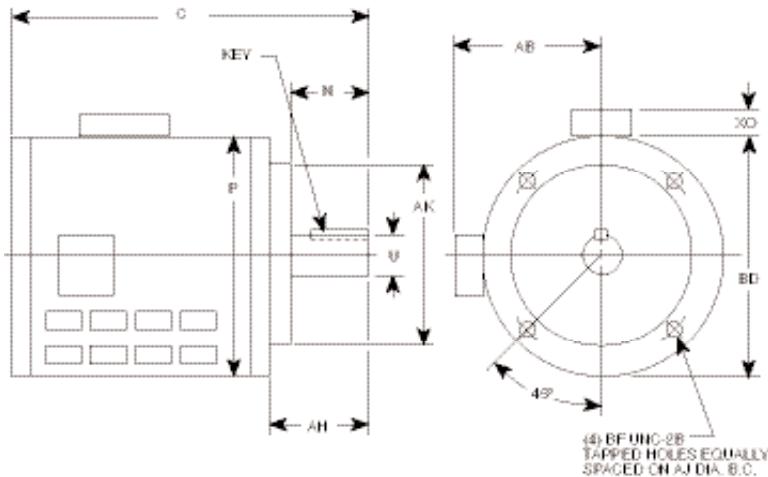
| Boston Gear Bore Code | NEMA Frame No. | U                | AK             | Max. AH | Max. AH' | Key  |       | AJ   | BF     |
|-----------------------|----------------|------------------|----------------|---------|----------|------|-------|------|--------|
|                       |                |                  |                |         |          | Sq.  | Lg.   |      |        |
| B4                    | 42CZ           | .5000<br>.4995   | 3.000<br>2.997 | 1-5/16  | —        | 1/8  | 3/4   | 3.75 | 1/4-20 |
| B5                    | 56C            | .6250<br>.6245   | 4.500<br>4.497 | 2-5/32  | —        | 3/16 | 1-3/8 | 5.88 | 3/8-16 |
| B7                    | 182C<br>184C   | .8750<br>.8745   | 4.500<br>4.497 | 2-5/32  | —        | 3/16 | 1-3/8 | 5.88 | 3/8-16 |
|                       | 143TC<br>145TC |                  |                |         |          |      |       |      |        |
| B9                    | 213C<br>215C   | 1.1250<br>1.1245 | 8.500<br>8.497 | —       | 2-25/32  | 1/4  | 1-3/4 | 7.25 | 1/2-13 |
|                       | 182TC<br>184TC |                  |                |         |          |      |       |      |        |
| B11                   | 254UC<br>256UC | 1.3750<br>1.3745 | 8.500<br>8.497 | —       | 3-17/32  | 5/16 | 2-3/8 | 7.25 | 1/2-13 |
|                       | 213TC<br>215TC |                  |                |         |          |      |       |      |        |
| B13                   | 254TC<br>256TC | 1.6250<br>1.6240 | 8.500<br>8.497 | —       | 3-13/16  | 3/8  | 2-7/8 | 7.25 | 1/2-13 |

**BOSTON GEAR®**

# AC MOTORS

110/220 VAC 1 $\phi$  50 Hz  
115 VAC 1 $\phi$  60 Hz  
115/230 VAC 1 $\phi$  60 Hz

Open Driproof  
NEMA C-Face  
Single Phase  
1/4-1-1/2 Horsepower



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | RPM  | F.L.A.<br>@Max<br>Volts | NEMA<br>Mtg | Bore<br>Code | Catalog<br>Number | Item<br>Code | C     | N    | P    | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | XO   | Wt.<br>Lbs |
|---|------|-------------------------|-------------|--------------|-------------------|--------------|-------|------|------|-----------------------|------|------|------|------|------|------|------|--------|------|------------|
|   |      |                         |             |              |                   |              |       |      |      |                       | Sq.  | Long |      |      |      |      |      |        |      |            |
| <b>110/220 VAC 1<math>\phi</math> 50 Hz</b> |      |                         |             |              |                   |              |       |      |      |                       |      |      |      |      |      |      |      |        |      |            |
| 1/4   | 1425 | 2.8                     | 56C         | B5           | DR5-B             | 66854        | 10.25 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.75 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 1.54 | 22         |
| 1/3   | 1425 | 3.2                     | 56C         | B5           | ER5-B             | 66866        | 10.69 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.75 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 1.54 | 25         |
| 1/2   | 1425 | 4.4                     | 56C         | B5           | FR5-B             | 66872        | 11.56 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.75 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 1.54 | 27         |
| 3/4   | 1425 | 6.5                     | 56C         | B5           | GR5-B             | 66878        | 11.06 | 1.94 | 6.63 | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25 | 35         |
| <b>115 VAC 1<math>\phi</math> 60 Hz</b>     |      |                         |             |              |                   |              |       |      |      |                       |      |      |      |      |      |      |      |        |      |            |
| 1/20  | 1725 | 1.35                    | SP          | SPL          | AST-B             | 65403        | 8.98  | 0.93 | 3.86 | 0.313                 | See  | Note | —    | 1.18 | 1.75 | 1.38 | 4.64 | 10/32  | —    | 10         |
| 1/12  | 1725 | 2.0                     | SP          | SPL          | AAST-B            | 65402        | 8.98  | 0.93 | 3.86 | 0.313                 | See  | Note | —    | 1.18 | 1.75 | 1.38 | 4.64 | 10/32  | —    | 10         |
| 1/4   | 1725 | 2.7                     | 56C         | B5           | DS                | 63316        | 8.88  | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 1.94 | 16         |
| 1/4   | 1725 | 5.0                     | 56C         | B5           | DS-B              | 66112        | 10.25 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.50 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54 | 22         |
| 1/4   | 1725 | 5.3                     | 56C         | B5           | DS-W              | 65220        | 9.65  | 1.91 | 5.71 | 0.625                 | 3/16 | 1.10 | —    | 2.06 | 5.88 | 4.50 | 5.75 | 3/8-16 | —    | 19         |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b> |      |                         |             |              |                   |              |       |      |      |                       |      |      |      |      |      |      |      |        |      |            |
| 1/6   | 1725 | 2.0                     | 56C         | B5           | CR-W              | 65221        | 9.65  | 1.91 | 5.71 | 0.625                 | 3/16 | 1.10 | —    | 2.06 | 5.88 | 4.50 | 5.75 | 3/8-16 | —    | 18         |
| 1/6   | 1725 | 1.9                     | 56C         | B5           | CR-B              | 85773        | 10.09 | 1.93 | —    | 0.625                 | 3/16 | 1.38 | 4.41 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 1.41 | 18         |
| 1/4   | 1725 | 2.7                     | 56C         | B5           | DR                | 63315        | 8.88  | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-20 | 1.94 | 16         |
| 1/4   | 1725 | 2.7                     | 56C         | B5           | DR-W              | 65222        | 9.65  | 1.91 | 5.71 | 0.625                 | 3/16 | 1.10 | —    | 2.06 | 5.88 | 4.50 | 5.75 | 3/8-16 | —    | 19         |
| 1/4   | 1725 | 2.5                     | 56C         | B5           | DR-B              | 66109        | 10.25 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54 | 22         |
| 1/3   | 1725 | 3.1                     | 56C         | B5           | ER                | 63317        | 9.38  | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-20 | 1.94 | 19         |
| 1/3   | 1725 | 3.1                     | 56C         | B5           | ER-W              | 65223        | 10.55 | 1.91 | 5.71 | 0.625                 | 3/16 | 1.10 | —    | 2.06 | 5.88 | 4.50 | 5.45 | 3/8-16 | —    | 22         |
| 1/3   | 1725 | 3.0                     | 56C         | B5           | ER-B              | 66121        | 10.25 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54 | 25         |
| 1/2   | 1725 | 4.4                     | 56C         | B5           | FR                | 63318        | 9.88  | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-20 | 1.94 | 19         |
| 1/2   | 1725 | 4.4                     | 56C         | B5           | FR-W              | 65224        | 10.55 | 1.91 | 5.71 | 0.625                 | 3/16 | 1.10 | —    | 2.06 | 5.88 | 4.50 | 5.75 | 3/8-16 | —    | 24         |
| 1/2   | 1725 | 4.2                     | 56C         | B5           | FR-B              | 66130        | 11.56 | 1.94 | 5.69 | 0.625                 | 3/16 | 1.38 | 4.75 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 1.54 | 27         |
| 3/4   | 1725 | 5.4                     | 56C         | B5           | GR                | 63319        | 10.88 | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —    | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 1.94 | 26         |
| 3/4   | 1725 | 5.6                     | 56C         | B5           | GR-B              | 66139        | 11.56 | 1.94 | 6.63 | 0.625                 | 3/16 | 1.38 | 5.88 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25 | 34         |
| 1   | 1725 | 6.7                     | 56C         | B5           | HR-5/8-B          | 19183        | 12.24 | 1.94 | 6.63 | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.18 | 35         |
| 1   | 1725 | 6.5                     | 143TC       | B7           | HR-B              | 66145        | 12.13 | 1.94 | 6.63 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25 | 35         |
| 1-1/2                                       | 1725 | 9.0                     | 145TC       | B7           | JR-B              | 66154        | 12.13 | 1.94 | 6.63 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25 | 41         |

All Dimensions in Inches. Dimensional Information for Estimating Purposes Only  
NOTE: #302.5 Woodruff Key (3/32 wide)

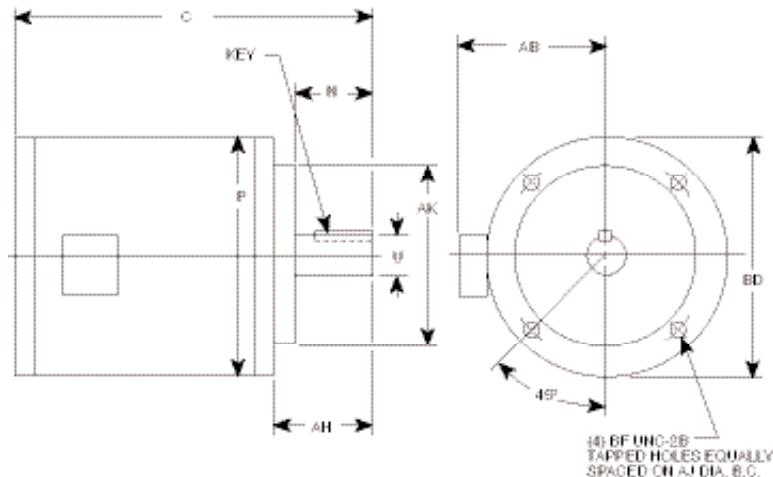
**BOSTON GEAR®**

# AC MOTORS

208-230/460 VAC 3Ø 60 Hz



Open Driproof  
NEMA C-Face  
Three Phase  
1/6 – 20 Horsepower



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                                | RPM  | F.L.A.<br>@Max<br>Volt | NEMA<br>Mtg | Bore<br>Code | Catalog<br>Number | Item<br>Code | C     | N    | P     | U<br>+.0000<br>-.0005 |      | Key     |      | AB   | AH   | AJ   | AK   | BD     | BF  | Wt.<br>Lbs |
|-----------------------------------|------|------------------------|-------------|--------------|-------------------|--------------|-------|------|-------|-----------------------|------|---------|------|------|------|------|------|--------|-----|------------|
|                                   |      |                        |             |              |                   |              |       |      |       | Sq.                   | Long | Key Sq. | Long |      |      |      |      |        |     |            |
| <b>208 – 230/460 VAC 3Ø 60 Hz</b> |      |                        |             |              |                   |              |       |      |       |                       |      |         |      |      |      |      |      |        |     |            |
| 1/6                               | 1725 | 0.45                   | 56C         | B5           | CU-B              | 85774        | 10.10 | 1.93 | —     | 0.625                 | 3/16 | 1.38    | 4.41 | 2.06 | 5.88 | 4.50 | 5.87 | 3/8-16 | 19  |            |
| 1/6                               | 1725 | 0.55                   | 56C         | B5           | CU-W              | 65237        | 10.32 | 1.91 | 6.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 19  |            |
| 1/4                               | 1725 | 0.65                   | 56C         | B5           | DU                | 63531        | 9.38  | 1.94 | 5.61  | 0.625                 | 3/16 | 1.38    | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 16  |            |
| 1/4                               | 1725 | 0.65                   | 56C         | B5           | DU-W              | 65238        | 10.32 | 1.91 | 9.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 19  |            |
| 1/4                               | 1725 | 0.65                   | 56C         | B5           | DU-B              | 66115        | 10.25 | 1.94 | 5.69  | 0.625                 | 3/16 | 1.38    | 4.88 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 18  |            |
| 1/3                               | 1725 | 0.8                    | 56C         | B5           | EU                | 63532        | 9.38  | 1.94 | 5.61  | 0.625                 | 3/16 | 1.38    | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 18  |            |
| 1/3                               | 1725 | 0.8                    | 56C         | B5           | EU-W              | 65239        | 10.32 | 1.91 | 6.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 19  |            |
| 1/3                               | 1725 | 0.8                    | 56C         | B5           | EU-B              | 66124        | 10.25 | 1.94 | 5.69  | 0.625                 | 3/16 | 1.38    | 4.88 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 21  |            |
| 1/2                               | 1725 | 1.0                    | 56C         | B5           | FU                | 63533        | 9.88  | 1.94 | 5.61  | 0.625                 | 3/16 | 1.38    | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 20  |            |
| 1/2                               | 1725 | 1.0                    | 56C         | B5           | FU-W              | 65241        | 10.32 | 1.91 | 6.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 20  |            |
| 1/2                               | 1725 | 1.0                    | 56C         | B5           | FU-B              | 66133        | 10.31 | 1.94 | 5.69  | 0.625                 | 3/16 | 1.38    | 4.75 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 22  |            |
| 3/4                               | 1725 | 1.4                    | 56C         | B5           | GU                | 63536        | 10.88 | 1.94 | 5.61  | 0.625                 | 3/16 | 1.38    | —    | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 22  |            |
| 3/4                               | 1725 | 1.4                    | 56C         | B5           | GU-W              | 65243        | 11.10 | 1.91 | 6.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 24  |            |
| 3/4                               | 1725 | 1.5                    | 56C         | B5           | GU-B              | 66142        | 11.56 | 1.94 | 5.69  | 0.625                 | 3/16 | 1.38    | 4.75 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 26  |            |
| 1                                 | 1725 | 1.7                    | 56C         | B5           | HU-5/8            | 63537        | 10.88 | 1.94 | 6.53  | 0.625                 | 3/16 | 1.38    | —    | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 31  |            |
| 1                                 | 1725 | 1.7                    | 56C         | B5           | HU-5/8-W          | 65246        | 11.10 | 1.91 | 6.50  | 0.625                 | 3/16 | 1.10    | —    | 2.06 | 5.88 | 4.50 | 6.54 | 3/8-16 | 26  |            |
| 1                                 | 1725 | 1.7                    | 56C         | B5           | HU-5/8-B          | 50427        | 11.06 | 1.94 | 6.63  | 0.625                 | 3/16 | 1.38    | 5.63 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 33  |            |
| 1                                 | 1725 | 1.7                    | 56C         | B5           | HU                | 63538        | 10.88 | 1.94 | 6.53  | 0.875                 | 3/16 | 1.38    | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 31  |            |
| 1                                 | 1725 | 1.7                    | 143TC       | B7           | HU-B              | 66148        | 11.13 | 2.00 | 6.63  | 0.875                 | 3/16 | 1.38    | 5.63 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 33  |            |
| 1-1/2                             | 1725 | 2.3                    | 145TC       | B7           | JU                | 63539        | 11.38 | 1.94 | 6.53  | 0.875                 | 3/16 | 1.38    | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 35  |            |
| 1-1/2                             | 1725 | 2.4                    | 145TC       | B7           | JU-B              | 66157        | 11.13 | 2.00 | 6.63  | 0.875                 | 3/16 | 1.38    | 5.63 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 34  |            |
| 2                                 | 1725 | 3.1                    | 145TC       | B7           | KU                | 63540        | 11.38 | 1.94 | 6.53  | 0.875                 | 3/16 | 1.38    | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 37  |            |
| 2                                 | 1725 | 3.2                    | 145TC       | B7           | KU-B              | 66163        | 12.13 | 2.00 | 6.63  | 0.875                 | 3/16 | 1.38    | 5.63 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 37  |            |
| 3                                 | 1725 | 4.4                    | 182TC       | B9           | LU                | 63542        | 12.63 | 2.63 | 8.46  | 1.125                 | 1/4  | 1.75    | 6.30 | 2.89 | 7.25 | 8.50 | 8.88 | 1/2-13 | 65  |            |
| 3                                 | 1725 | 4.3                    | 182TC       | B9           | LU-B              | 66166        | 13.63 | 2.63 | 7.88  | 1.125                 | 1/4  | 1.75    | 5.88 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | 66  |            |
| 5                                 | 1725 | 7.2                    | 182TC       | B9           | MU                | 63543        | 13.13 | 2.63 | 8.46  | 1.125                 | 1/4  | 1.75    | 6.30 | 2.89 | 7.25 | 8.50 | 8.88 | 1/2-13 | 62  |            |
| 5                                 | 1725 | 7.0                    | 184TC       | B9           | MU-B              | 66170        | 15.00 | 2.63 | 7.88  | 1.125                 | 1/4  | 1.75    | 5.88 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | 80  |            |
| 7-1/2                             | 1725 | 11.0                   | 213TC       | B11          | NU-B              | 66174        | 17.06 | 3.13 | 9.58  | 1.375                 | 5/16 | 2.38    | 7.38 | 3.38 | 7.25 | 8.50 | 9.00 | 1/2-13 | 114 |            |
| 10                                | 1725 | 14.0                   | 215TC       | B11          | PU-B              | 66176        | 17.06 | 3.13 | 9.96  | 1.375                 | 5/16 | 2.38    | 7.38 | 3.38 | 7.25 | 8.50 | 9.00 | 1/2-13 | 118 |            |
| 15                                | 1760 | 19.9                   | 254TC       | B13          | RU-B              | 66180        | 20.00 | 3.75 | 11.50 | 1.625                 | 3/8  | 2.88    | 8.94 | 4.00 | 7.25 | 8.50 | 9.13 | 1/2-13 | 220 |            |
| 20                                | 1760 | 26.0                   | 256TC       | B13          | SU-B              | 66184        | 21.50 | 3.75 | 11.50 | 1.625                 | 3/8  | 2.88    | 8.94 | 4.00 | 7.25 | 8.50 | 9.13 | 1/2-13 | 261 |            |

All dimensions in inches. Dimensional information for estimating purposes only.

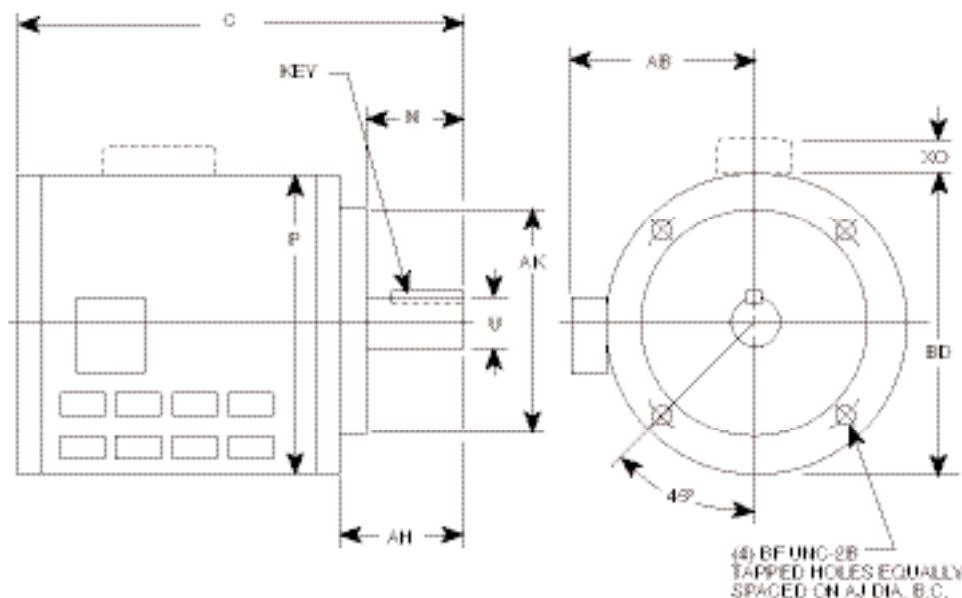
**BOSTON GEAR®**

# AC MOTORS

115/230 1 $\phi$  60 Hz  
208 – 230/460 3 $\phi$  60 Hz



TENV  
NEMA C-Face  
Single and Three Phase  
1/6 – 1/2 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | RPM  | F.L.A.<br>@ Max<br>Volt | NEMA<br>Mfg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C     | N    | P    | U<br>+.0000<br>-.0005 | Key  |      | AB    | AH   | AJ   | AK   | BD   | BF     | XO   | Wt.<br>Lbs. |
|---|------|-------------------------|--------------|--------------|-------------------|--------------|-------|------|------|-----------------------|------|------|-------|------|------|------|------|--------|------|-------------|
|   |      |                         |              |              |                   |              |       |      |      |                       | Sq.  | Long |       |      |      |      |      |        |      |             |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b>       |      |                         |              |              |                   |              |       |      |      |                       |      |      |       |      |      |      |      |        |      |             |
| 1/6   | 1725 | 2.1                     | 56C          | B5           | CRT-B             | 85775        | 10.25 | 1.94 | —    | 0.625                 | 3/16 | 1.38 | 4.90  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.50 | 23          |
| 1/6   | 1725 | 1.7                     | 42CZ         | B4           | ACRT-W            | 65320        | 8.29  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.23  | 1.26 | 3.75 | 3.00 | 4.80 | 1/4-20 | —    | 14.1        |
| 1/4   | 1725 | 2.4                     | 56C          | B5           | DRT               | 63544        | 9.94  | 1.94 | 6.53 | 0.625                 | 3/16 | 1.38 | —     | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97 | 27          |
| 1/4   | 1725 | 2.7                     | 42CZ         | B4           | ADRT-W            | 65325        | 9.67  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.23  | 1.26 | 3.75 | 3.00 | 4.80 | 1/4-20 | —    | 18.3        |
| 1/3   | 1725 | 2.9                     | 56C          | B5           | ERT               | 63732        | 9.94  | 1.94 | 6.53 | 0.625                 | 3/16 | 1.38 | —     | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97 | 29          |
| 1/3   | 1725 | 3.8                     | 42CZ         | B4           | AERT-W            | 65346        | 9.43  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.704 | 1.26 | 3.75 | 3.00 | 5.75 | 1/4-20 | —    | 18.3        |
| <b>208 – 230/460 VAC 3<math>\phi</math> 60 Hz</b> |      |                         |              |              |                   |              |       |      |      |                       |      |      |       |      |      |      |      |        |      |             |
| 1/6   | 1725 | 0.6                     | 42CZ         | B4           | ACUT-B            | 69728        | 8.52  | 1.14 | —    | 0.500                 | 1/8  | 0.88 | 4.03  | 1.26 | 3.75 | 3.00 | 4.62 | 1/4-20 | —    | 17          |
| 1/6   | 1725 | 0.4                     | 56C          | B5           | CUT-B             | 85776        | 10.25 | 1.94 | 5.68 | 0.625                 | 3/16 | 1.38 | 4.51  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 19          |
| 1/6   | 1725 | 0.5                     | 42CZ         | B4           | ACUT-W            | 65368        | 7.89  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.65  | 1.26 | 3.75 | 3.00 | 4.80 | 1/4-20 | —    | 17          |
| 1/4   | 1725 | 0.6                     | 56C          | B5           | DUT               | 63801        | 9.44  | 1.94 | 5.61 | 0.625                 | 3/16 | 1.38 | —     | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | —    | 16          |
| 1/4   | 1725 | 0.6                     | 42CZ         | B4           | ADUT-W            | 65374        | 8.65  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.65  | 1.26 | 3.75 | 3.00 | 4.80 | 1/4-20 | —    | 17          |
| 1/3   | 1725 | 0.65                    | 56C          | B5           | EUT               | 63952        | 9.44  | 1.94 | 6.53 | 0.625                 | 3/16 | 1.38 | —     | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | —    | 20          |
| 1/3   | 1725 | 0.7                     | 42CZ         | B4           | AEUT-W            | 65381        | 8.65  | 1.10 | —    | 0.500                 | 1/8  | 0.98 | 4.65  | 1.26 | 3.75 | 3.00 | 4.80 | 1/4-20 | —    | 18          |
| 1/2   | 1725 | 1.0                     | 56C          | B5           | FUT               | 63959        | 10.44 | 1.94 | 6.53 | 0.625                 | 3/16 | 1.38 | —     | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | —    | 25          |

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

Electrical Products Catalog

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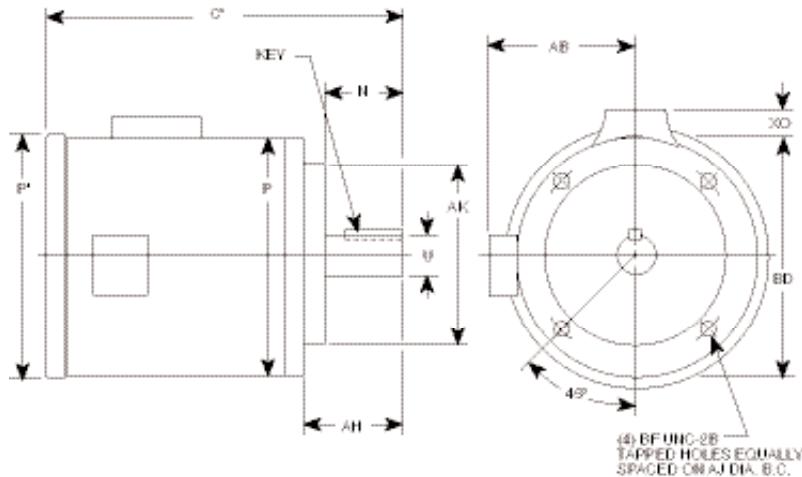
# AC MOTORS

115/230 VAC 1 $\phi$  60 Hz

TEFC

NEMA C-Face  
Single Phase

1/6 – 1 1/2 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | RPM  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C'     | N    | P    | P'   | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | XO     | Wt.<br>Lbs. |
|---|------|--------------------------|--------------|--------------|-------------------|--------------|--------|------|------|------|-----------------------|------|------|------|------|------|------|------|--------|--------|-------------|
|   |      |                          |              |              |                   |              |        |      |      |      |                       | Sq.  | Lg.  |      |      |      |      |      |        |        |             |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b> |      |                          |              |              |                   |              |        |      |      |      |                       |      |      |      |      |      |      |      |        |        |             |
| 1/6   | 1725 | 1.9                      | 42CZ         | B4           | ACRTF-B           | 69725        | 9.31   | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03 | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 1.66   | 20          |
| 1/6   | 1725 | 1.9                      | 56C          | B5           | CRTF-B            | 85777        | 11.35  | 1.93 | 6.19 | —    | 0.625                 | 3/16 | 1.38 | 4.90 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.56   | 19          |
| 1/6   | 1725 | 2.0                      | 56C          | B5           | CRTF-W            | 65315        | 11.10  | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 20          |
| 1/4   | 1725 | 2.3                      | 42CZ         | B4           | ADRTF-B           | 69726        | 10.31  | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03 | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 1.66   | 21          |
| 1/4   | 1725 | 2.7                      | 56C          | B5           | DRTF-W            | 65326        | 11.10  | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 20          |
| 1/4   | 1725 | 2.5                      | 56C          | B5           | DRTF-B            | 66199        | 11.38  | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 34          |
| 1/4   | 1725 | 2.2                      | 56C          | B5           | DR5TF-W           | 65346        | 11.10  | 1.91 | —    | —    | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 23          |
| 1/4   | 1725 | 2.7                      | 56C          | B5           | DRTF              | 63545        | 9.81   | 1.94 | 5.61 | 5.88 | 0.625                 | 3/16 | 1.38 | 4.87 | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 2.00   | 20          |
| 1/4   | 1725 | 5.0                      | 56C          | B5           | DSTF-B*           | 66202        | 11.38  | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54   | 23          |
| 1/3   | 1725 | 3.1                      | 42CZ         | B4           | AERTF-B           | 69727        | 10.31  | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03 | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 1.66   | 23          |
| 1/3   | 1725 | 3.2                      | 56C          | B5           | ERTF-W            | 65348        | 11.10  | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 22          |
| 1/3   | 1725 | 3.0                      | 56C          | B5           | ERTF-B            | 66211        | 11.38  | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54   | 26          |
| 1/3   | 1725 | 3.2                      | 56C          | B5           | ERTF              | 63750        | 10.94  | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 26          |
| 1/2   | 1725 | 4.4                      | 56C          | B5           | FRTF              | 65350        | 10.94  | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 29          |
| 1/2   | 1725 | 3.7                      | 56C          | B5           | FRTF-B            | 66219        | 12.00  | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54   | 30          |
| 3/4   | 1725 | 5.8                      | 56C          | B5           | GRTF-W            | 65351        | 11.102 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 28          |
| 3/4   | 1725 | 5.5                      | 56C          | B5           | GRTF-B            | 66228        | 13.31  | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.63 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25   | 42          |
| 3/4   | 1725 | 5.8                      | 56C          | B5           | GRTF              | 63755        | 11.44  | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 30          |
| 1   | 1725 | 6.4                      | 56C          | B5           | HRTF-5/8-W        | 65354        | 12.28  | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | —      | 34          |
| 1   | 1725 | 6.2                      | 56C          | B5           | HRTF-5/8-B        | 19178        | 13.31  | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 34          |
| 1   | 1725 | 6.4                      | 56C          | B5           | HRTF-5/8          | 63795        | 11.94  | 1.94 | 6.53 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 34          |
| 1   | 1740 | 6.4                      | 143TC        | B7           | HRTF              | 63797        | 11.94  | 1.94 | 6.53 | 7.16 | 0.875                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25   | 47          |
| 1   | 1725 | 6.2                      | 143TC        | B7           | HRTF-B            | 66234        | 13.38  | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.78** | 47          |
| 1-1/2                                       | 1740 | 8.6                      | 145TC        | B7           | JRTF              | 63800        | 12.44  | 1.94 | 6.53 | 7.16 | 0.875                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25   | 58          |
| 1-1/2                                       | 1725 | 8.0                      | 145TC        | B7           | JRTF-B            | 66243        | 14.25  | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 5.88 | 3/8-16 | 1.97   | 34          |

\*115 VAC Single Phase 60 Hz only  
All dimensions in inches. Dimensional information for estimating purposes only.

\*\*Two capacitors

**BOSTON GEAR®**

# AC MOTORS

208-230/460 VAC 3Ø 60 Hz

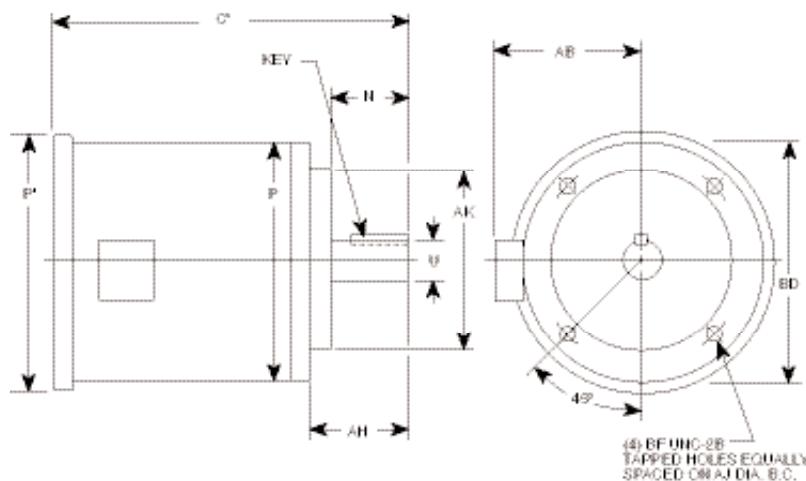
TEFC

NEMA C-Face

Three Phase

1/6 – 1 Horsepower

1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                              | RPM  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C'    | N    | P    | P'   | U<br>+.0000<br>-.0005 | Key  |      | AB    | AH   | AJ   | AK   | BD   | BF     | Wt.<br>Lbs. |
|---------------------------------|------|--------------------------|--------------|--------------|-------------------|--------------|-------|------|------|------|-----------------------|------|------|-------|------|------|------|------|--------|-------------|
|                                 |      |                          |              |              |                   |              |       |      |      |      |                       | Sq.  | Long |       |      |      |      |      |        |             |
| <b>208-230/460 VAC 3Ø 60 Hz</b> |      |                          |              |              |                   |              |       |      |      |      |                       |      |      |       |      |      |      |      |        |             |
| 1/6                             | 1725 | 0.55                     | 56C          | B5           | CUTF-W            | 65371        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 19          |
| 1/6                             | 1725 | 0.45                     | 56C          | B5           | CUTF-B            | 85778        | 11.35 | 1.93 | —    | 6.19 | 0.625                 | 3/16 | 1.38 | 4.90  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 19          |
| 1/4                             | 1725 | 0.60                     | 42CZ         | B4           | ADUTF-B           | 69729        | 10.31 | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03  | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 21          |
| 1/4                             | 1725 | 0.65                     | 56C          | B5           | DUTF-W            | 65380        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 20          |
| 1/4                             | 1725 | 0.65                     | 56C          | B5           | DUTF-B            | 66205        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 19          |
| 1/4                             | 1725 | 0.70                     | 56C          | B5           | DUTF              | 63949        | 9.81  | 1.94 | 5.61 | 5.88 | 0.625                 | 3/16 | 1.38 | 4.87  | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 18          |
| 1/3                             | 1725 | 0.70                     | 42CZ         | B4           | AEUTF-B           | 69730        | 10.31 | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03  | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 21          |
| 1/3                             | 1725 | 0.65                     | 56C          | B5           | EUTF-W            | 65383        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 22          |
| 1/3                             | 1725 | 0.65                     | 56C          | B5           | EUTF              | 63958        | 10.94 | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09  | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 20          |
| 1/3                             | 1725 | 0.80                     | 56C          | B5           | EUTF-B            | 66214        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 19          |
| 1/2                             | 1725 | 1.0                      | 56C          | B5           | FUTF-W            | 65404        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 24          |
| 1/2                             | 1725 | 1.0                      | 56C          | B5           | FUTF-B            | 66223        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 22          |
| 1/2                             | 1725 | 1.0                      | 56C          | B5           | FUTF              | 63961        | 10.94 | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09  | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 25          |
| 3/4                             | 1725 | 1.4                      | 56C          | B5           | GUTF-W            | 65405        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 27          |
| 3/4                             | 1725 | 1.5                      | 56C          | B5           | GUTF-B            | 66231        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89  | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 32          |
| 3/4                             | 1725 | 1.4                      | 56C          | B5           | GUTF              | 63979        | 11.44 | 1.94 | 6.53 | 7.16 | 0.625                 | 3/16 | 1.38 | 5.09  | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 26          |
| 1                               | 1725 | 1.7                      | 56C          | B5           | HUTF-5/8-W        | 65406        | 12.28 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.42 | 5.43  | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 31          |
| 1                               | 1725 | 1.7                      | 56C          | B5           | HUTF-5/8-B        | 50428        | 12.31 | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.75  | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 35          |
| 1                               | 1725 | 1.7                      | 143TC        | B7           | HUTF-W            | 65412        | 13.07 | 1.97 | —    | 7.32 | 0.875                 | 3/16 | 1.42 | 5.433 | 2.13 | 5.87 | 4.50 | 5.88 | 3/8-16 | 33          |
| 1                               | 1740 | 1.7                      | 143TC        | B7           | HUTF-B            | 66237        | 12.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75  | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 35          |
| 1                               | 1725 | 1.7                      | 143TC        | B7           | HUTF              | 63981        | 11.63 | 1.94 | 6.53 | 7.16 | 0.875                 | 3/16 | 1.38 | 5.09  | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 33          |

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

Electrical Products Catalog

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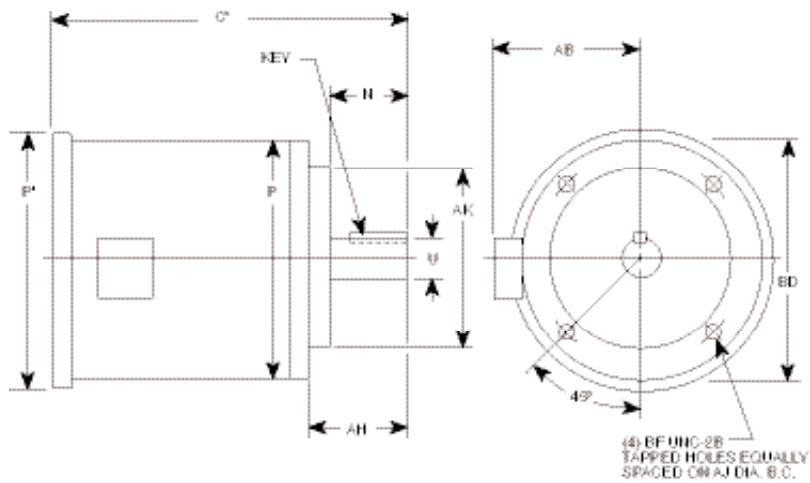
# AC MOTORS

208-230/460 VAC 3Ø 60 Hz

TEFC

NEMA C-Face  
Three Phase

1-1/2 – 20 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                              | RPM  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C'    | N    | P     | P'    | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | Wt.<br>Lbs. |
|---------------------------------|------|--------------------------|--------------|--------------|-------------------|--------------|-------|------|-------|-------|-----------------------|------|------|------|------|------|------|------|--------|-------------|
|                                 |      |                          |              |              |                   |              |       |      |       |       |                       | Sq.  | Long |      |      |      |      |      |        |             |
| <b>208-230/460 VAC 3Ø 60 Hz</b> |      |                          |              |              |                   |              |       |      |       |       |                       |      |      |      |      |      |      |      |        |             |
| 1-1/2                           | 1725 | 2.3                      | 56C          | B5           | JUTF-5/8-W        | 65407        | 12.28 | 1.91 | —     | 7.32  | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 35          |
| 1-1/2                           | 1725 | 2.5                      | 56C          | B5           | JUTF-5/8-B        | 19784        | 12.31 | 1.94 | 6.63  | 7.19  | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 37          |
| 1-1/2                           | 1725 | 2.3                      | 56C          | B5           | JUTF-5/8          | 63988        | 12.44 | 1.94 | 6.53  | 7.16  | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 37          |
| 1-1/2                           | 1740 | 2.3                      | 145TC        | B7           | JUTF-W            | 65437        | 13.07 | 1.97 | —     | 7.32  | 0.875                 | 3/16 | 1.42 | 5.43 | 2.13 | 5.87 | 4.50 | 6.54 | 3/8-16 | 35          |
| 1-1/2                           | 1725 | 2.0                      | 145TC        | B7           | JUTF-B            | 66246        | 12.38 | 2.00 | 6.63  | 7.19  | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 37          |
| 1-1/2                           | 1725 | 2.4                      | 145TC        | B7           | JUTF              | 64281        | 12.44 | 1.94 | 6.53  | 7.16  | 0.875                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 37          |
| 2                               | 1725 | 3.1                      | 56C          | B5           | KUTF-5/8          | 64769        | 12.44 | 1.94 | 6.53  | 7.16  | 0.625                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 42          |
| 2                               | 1725 | 3.1                      | 56C          | B5           | KUTF-5/8-W        | 65440        | 13.46 | 1.91 | —     | 7.32  | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 43          |
| 2                               | 1725 | 3.1                      | 56C          | B5           | KUTF-5/8-B        | 19785        | 13.31 | 1.94 | 6.63  | 7.19  | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 42          |
| 2                               | 1740 | 3.1                      | 145TC        | B7           | KUTF-W            | 65445        | 14.25 | 1.97 | —     | 7.32  | 0.875                 | 3/16 | 1.42 | 5.43 | 2.13 | 5.87 | 4.50 | 6.54 | 3/8-16 | 43          |
| 2                               | 1725 | 3.1                      | 145TC        | B7           | KUTF-B            | 66252        | 13.38 | 2.00 | 6.63  | 7.19  | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 45          |
| 2                               | 1725 | 3.1                      | 145TC        | B7           | KUTF              | 64770        | 12.44 | 1.94 | 6.53  | 7.16  | 0.875                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 42          |
| 3                               | 1740 | 3.9                      | 182TC        | B9           | LUTF-W            | 65446        | 15.86 | 2.38 | —     | —     | 1.125                 | 1/4  | 1.97 | 6.61 | 2.63 | 7.25 | 8.50 | 8.88 | 1/2-13 | 73          |
| 3                               | 1725 | 4.3                      | 182TC        | B9           | LUTF-B            | 66258        | 15.18 | 2.63 | 7.88  | 8.50  | 1.125                 | 1/4  | 1.75 | 5.88 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | 94          |
| 3                               | 1725 | 4.4                      | 182TC        | B9           | LUTF              | 64771        | 13.91 | 2.63 | 8.46  | 9.09  | 1.125                 | 1/4  | 1.75 | 6.36 | 2.89 | 7.25 | 8.50 | 8.58 | 1/2-13 | 65          |
| 5                               | 1740 | 6.7                      | 184TC        | B9           | MUTF-W            | 65448        | 15.86 | 2.38 | —     | —     | 1.125                 | 1/4  | 1.97 | 6.61 | 2.63 | 7.25 | 8.50 | 8.88 | 1/2-13 | 80          |
| 5                               | 1725 | 6.6                      | 184TC        | B9           | MUTF-B            | 66262        | 16.56 | 2.63 | 7.88  | 8.50  | 1.125                 | 1/4  | 1.75 | 5.88 | 2.89 | 7.25 | 8.50 | 8.88 | 1/2-13 | 84          |
| 5                               | 1725 | 6.7                      | 184TC        | B9           | MUTF              | 64772        | 14.91 | 2.63 | 8.46  | 9.09  | 1.125                 | 1/4  | 1.75 | 6.36 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | 102         |
| 7-1/2                           | 1725 | 10.0                     | 213TC        | B11          | NUTF-B            | 66266        | 18.69 | 3.13 | 9.56  | 10.19 | 1.375                 | 5/16 | 2.38 | 7.38 | 3.38 | 7.25 | 8.50 | 9.00 | 1/2-13 | 113         |
| 10                              | 1725 | 13.0                     | 215TC        | B11          | PUTF-B            | 66270        | 19.44 | 3.13 | 9.56  | 10.19 | 1.375                 | 5/16 | 2.38 | 7.38 | 3.38 | 7.25 | 8.50 | 9.00 | 1/2-13 | 146         |
| 15                              | 1725 | 19.6                     | 254TC        | B13          | RUTF-B            | 66274        | 22.00 | 3.75 | 12.94 | 13.25 | 1.625                 | 3/8  | 2.38 | 9.63 | 4.00 | 7.25 | 8.50 | 9.13 | 1/2-13 | 312         |
| 20                              | 1725 | 26.0                     | 256TC        | B13          | SUTF-B            | 66278        | 22.00 | 3.75 | 12.94 | 13.25 | 1.625                 | 3/8  | 2.38 | 9.63 | 4.00 | 7.25 | 8.50 | 9.13 | 1/2-13 | 312         |

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# AC MOTORS

575 VAC 3Ø 60 Hz

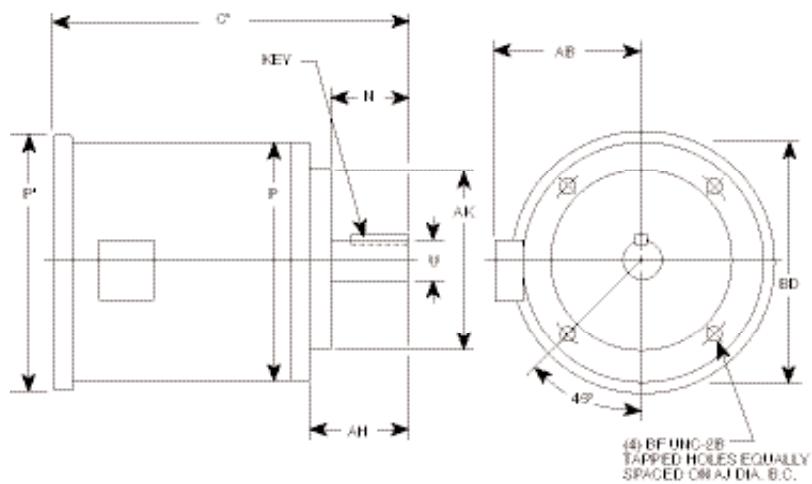
TEFC

NEMA C-Face

Three Phase

1/4 – 5 Horsepower

1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                      | RPM  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C'    | N    | P    | P'   | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | Wt.<br>Lbs. |
|-------------------------|------|--------------------------|--------------|--------------|-------------------|--------------|-------|------|------|------|-----------------------|------|------|------|------|------|------|------|--------|-------------|
|                         |      |                          |              |              |                   |              |       |      |      |      |                       | Sq.  | Long |      |      |      |      |      |        |             |
| <b>575 VAC 3Ø 60 Hz</b> |      |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/4                     | 1725 | 0.56                     | 56C          | B5           | DYTF              | 64963        | 9.81  | 1.94 | 5.61 | 5.88 | 0.625                 | 3/16 | 1.38 | 4.87 | 2.06 | 5.88 | 4.50 | 5.61 | 3/8-16 | 18          |
| 1/4                     | 1725 | 0.48                     | 56C          | B5           | DYTF-B            | 66208        | 11.38 | 1.94 | 5.69 | 6.13 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 19          |
| 1/3                     | 1725 | 0.52                     | 56C          | B5           | EYTF-W            | 65454        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 22          |
| 1/3                     | 1725 | 0.64                     | 56C          | B5           | ETYF-B            | 66217        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 19          |
| 1/2                     | 1725 | 0.80                     | 56C          | B5           | FYTF-W            | 65455        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 24          |
| 1/2                     | 1725 | 0.80                     | 56C          | B5           | FYTF-B            | 66226        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 22          |
| 3/4                     | 1725 | 1.1                      | 56C          | B5           | GYTF-W            | 65457        | 11.10 | 1.91 | —    | 7.32 | 0.625                 | 3/16 | 1.10 | 5.43 | 2.06 | 5.87 | 4.50 | 6.54 | 3/8-16 | 27          |
| 3/4                     | 1725 | 1.2                      | 56C          | B5           | GYTF-B            | 66831        | 12.31 | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 32          |
| 1                       | 1725 | 1.4                      | 56C          | B5           | HYTF-5/8-B        | 19179        | 12.31 | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 35          |
| 1                       | 1740 | 1.4                      | 143TC        | B7           | HYTF-W            | 65460        | 13.07 | 1.97 | —    | 7.32 | 0.875                 | 3/16 | 1.42 | 5.43 | 2.13 | 5.87 | 4.50 | 6.54 | 3/8-16 | 31          |
| 1                       | 1725 | 1.4                      | 143TC        | B7           | HYTF-B            | 66240        | 12.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 35          |
| 1-1/2                   | 1740 | 1.9                      | 145TC        | B7           | JYTF-W            | 65475        | 13.07 | 1.97 | —    | 7.32 | 0.875                 | 3/16 | 1.42 | 5.43 | 2.13 | 5.84 | 4.50 | 6.54 | 3/8-16 | 35          |
| 1-1/2                   | 1725 | 1.9                      | 145TC        | B7           | JYTF-B            | 66249        | 12.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 37          |
| 2                       | 1740 | 2.5                      | 145TC        | B7           | KYTF              | 64950        | 12.44 | 1.94 | 6.53 | 7.16 | 0.875                 | 3/16 | 1.38 | 5.09 | 2.06 | 5.88 | 4.50 | 5.88 | 3/8-16 | 37          |
| 2                       | 1725 | 2.5                      | 145TC        | B7           | KYTF-B            | 66255        | 13.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 45          |
| 3                       | 1740 | 3.5                      | 182TC        | B9           | LYTF              | 64954        | 13.91 | 2.63 | 8.46 | 9.09 | 1.125                 | 1/4  | 1.75 | 6.36 | 2.88 | 7.25 | 8.50 | 8.58 | 1/2-13 | 60          |
| 3                       | 1725 | 3.6                      | 182TC        | B9           | LYTF-B            | 66260        | 15.18 | 2.63 | 7.88 | 8.50 | 1.125                 | 1/4  | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | 94          |
| 5                       | 1740 | 5.4                      | 184TC        | B9           | MYTF              | 64955        | 14.91 | 2.63 | 8.46 | 9.09 | 1.125                 | 1/4  | 1.75 | 6.36 | 2.88 | 7.25 | 8.50 | 8.58 | 1/2-13 | 77          |
| 5                       | 1725 | 5.3                      | 184TC        | B9           | MYTF-B            | 66264        | 16.56 | 2.63 | 7.88 | 8.50 | 1.125                 | 1/4  | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | 102         |

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

Electrical Products Catalog **101**

# AC MOTORS

110/220 1 $\phi$  50 Hz

220/380/440 3 $\phi$  50 Hz

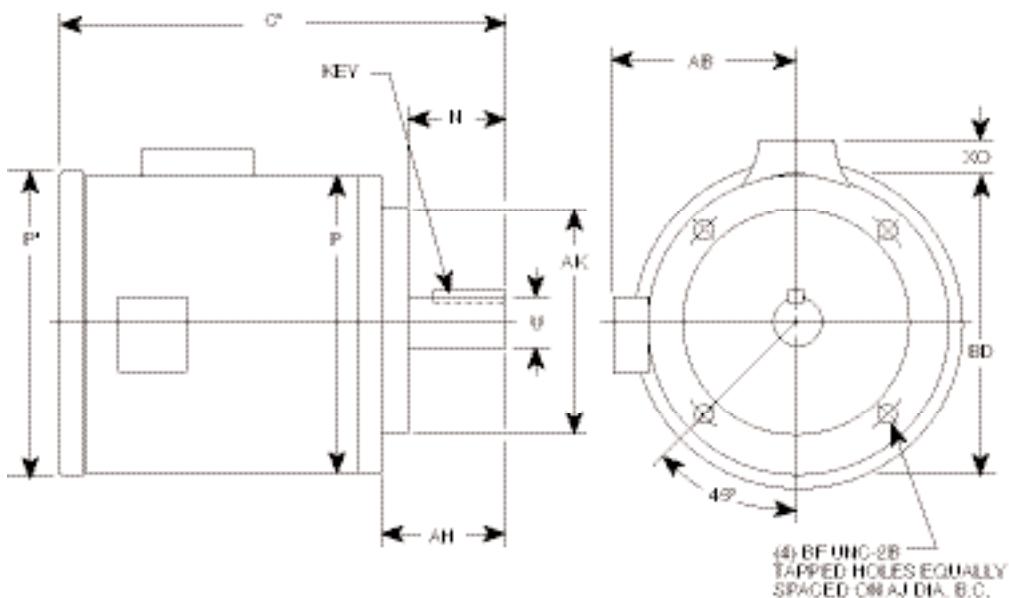
TEFC

NEMA C-Face

Single and Three Phase, 50 Hz

1/6 – 1-1/2 Horsepower

1425 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | RPM  | F.L.A.<br>@ Max.<br>Volt. | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C     | N    | P    | P'   | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | XO   | Wt.<br>Lbs. |
|---|------|---------------------------|--------------|--------------|-------------------|--------------|-------|------|------|------|-----------------------|------|------|------|------|------|------|------|--------|------|-------------|
|   |      |                           |              |              |                   |              |       |      |      |      |                       | Sq.  | Long |      |      |      |      |      |        |      |             |
| <b>110/220 VAC 1<math>\phi</math> 50 Hz</b>         |      |                           |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |      |             |
| 1/6   | 1425 | 2.1                       | 42CZ         | B4           | ACR5TF-B          | 50480        | 9.31  | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03 | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 1.66 | 20          |
| 1/4   | 1425 | 2.3                       | 42CZ         | B4           | ADR5TF-B          | 66970        | 9.31  | 1.15 | 4.69 | 5.19 | 0.500                 | 1/8  | 0.75 | 4.03 | 1.28 | 3.75 | 3.00 | 4.63 | 1/4-20 | 1.66 | 21          |
| 1/4   | 1425 | 2.8                       | 56C          | B5           | DR5TF-B           | 66858        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.51 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.56 | 23          |
| 1/3   | 1425 | 3.1                       | 56C          | B5           | ER5TF-B           | 66869        | 12.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.51 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.56 | 26          |
| 1/2   | 1425 | 4.0                       | 56C          | B5           | FR5TF-B           | 66875        | 12.88 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.51 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.56 | 30          |
| 3/4   | 1425 | 6.4                       | 56C          | B5           | GR5TF-B           | 66881        | 13.31 | 1.94 | 6.63 | 7.19 | 0.625                 | 3/16 | 1.38 | 5.25 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.25 | 42          |
| <b>220/380/415-440 VAC 3<math>\phi</math> 50 Hz</b> |      |                           |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |      |             |
| 1/2   | 1425 | 1.0                       | 56C          | B5           | FU5TF-B           | 50337        | 11.38 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.51 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 22          |
| 3/4   | 1425 | 1.3                       | 56C          | B5           | GU5TF-B           | 50338        | 12.00 | 1.94 | 5.69 | 6.19 | 0.625                 | 3/16 | 1.38 | 4.51 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 32          |
| 1   | 1425 | 1.5                       | 143TC        | B7           | HU5TF-B           | 50339        | 12.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 35          |
| 1-1/2   | 1425 | 2.1                       | 145TC        | B7           | JU5TF-B           | 50340        | 13.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 37          |

All dimensions in inches. Dimensional information for estimating purposes only.

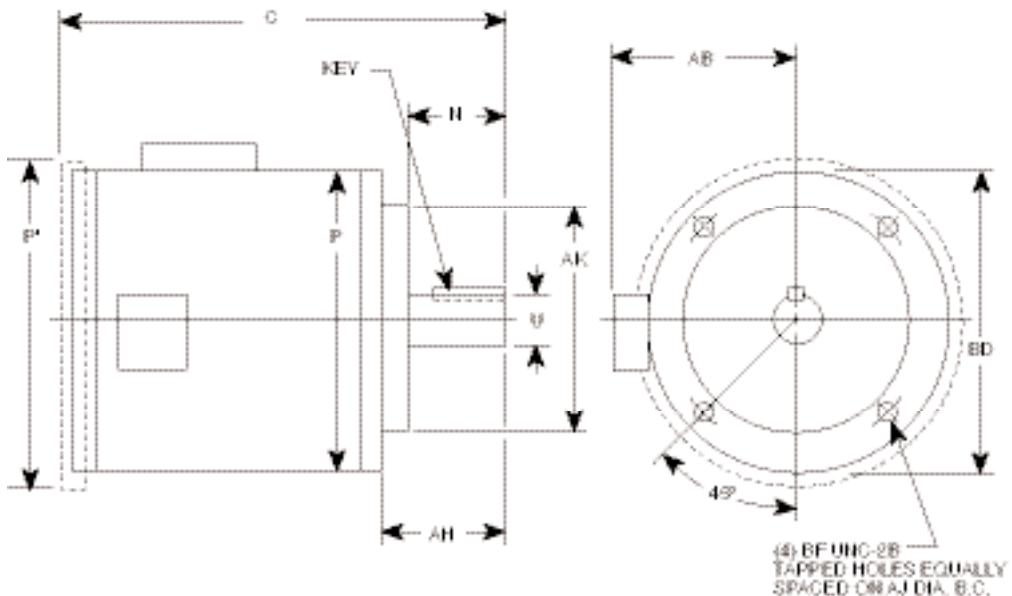
**BOSTON GEAR®**

# AC MOTORS

208-230/460 VAC 3Ø 60 Hz  
575 VAC 3Ø 60 Hz

BISSC Approved Washdown  
& Stainless Steel

NEMA C-Face  
Three Phase  
TENV-TEFC  
1/2 – 5 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C     | N    | P    | P'   | U<br>+.0000<br>-.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | Wt.<br>Lbs. |
|---|--------------------------|--------------|--------------|-------------------|--------------|-------|------|------|------|-----------------------|------|------|------|------|------|------|------|--------|-------------|
|   |                          |              |              |                   |              |       |      |      |      |                       | Sq.  | Lg.  |      |      |      |      |      |        |             |
| <b>208-230/460 VAC 3Ø 60 Hz BISSC Approved</b>  |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/2   | 0.80                     | 56C          | B5           | FUT-WB-B          | 69105        | 11.06 | 1.94 | 6.63 | —    | 0.625                 | 3/16 | 1.38 | 5.25 | 2.06 | 5.88 | 4.50 | 6.62 | 3/8-16 | 30          |
| 3/4   | 1.1                      | 56C          | B5           | GUT-WB-B          | 69106        | 11.06 | 1.94 | 6.63 | —    | 0.625                 | 3/16 | 1.38 | 5.25 | 2.06 | 5.88 | 4.50 | 6.62 | 3/8-16 | 34          |
| 1   | 1.5                      | 56C          | B5           | HUT-WB-5/8-B      | 69123        | 12.13 | 1.94 | 6.63 | —    | 0.625                 | 3/16 | 1.38 | 5.25 | 2.06 | 5.88 | 4.50 | 6.62 | 3/8-16 | 38          |
| 1   | 1.7                      | 143TC        | B7           | HUT-WB-B          | 69107        | 12.13 | 2.00 | 6.63 | —    | 0.875                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.62 | 3/8-16 | 39          |
| 1-1/2   | 2.5                      | 145TC        | B7           | JUTF-WB-B *       | 69110        | 12.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.62 | 3/8-16 | 40          |
| 2   | 3.1                      | 145TC        | B7           | KUTF-WB-B *       | 69111        | 13.38 | 2.00 | 6.63 | 7.19 | 0.875                 | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.62 | 3/8-16 | 44          |
| 3   | 4.3                      | 182TC        | B9           | LUTF-WB-B *       | 69112        | 15.19 | 2.62 | 7.88 | 8.50 | 1.125                 | 1/4  | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | 61          |
| 5   | 6.6                      | 184TC        | B9           | MUTF-WB-B *       | 69113        | 16.56 | 2.62 | 7.88 | 8.50 | 1.125                 | 1/4  | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | 76          |
| <b>208-230/460 VAC 3Ø 60 Hz Stainless Steel</b> |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/2   | 1.4                      | 56C          | B5           | FYT-SS            | 46488        | 11.56 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 34          |
| 3/4   | 2.2                      | 56C          | B5           | GYT-SS            | 46630        | 12.06 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 38          |
| 1   | 2.9                      | 56C          | B5           | HYT-5/8-SS        | 46634        | 12.06 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 39          |
| 1   | 2.9                      | 143TC        | B7           | HYT-SS            | 46635        | 12.13 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 39          |
| 1-1/2   | 4.4                      | 145TC        | B7           | JYT-SS            | 46636        | 14.25 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 46          |
| 2   | 6.0                      | 145TC        | B7           | KYT-SS            | 46639        | 14.25 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 49          |
| <b>575 VAC 3Ø 60 Hz Stainless Steel</b>         |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/2   | 1.4                      | 56C          | B5           | FYT-SS            | 59000        | 11.56 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 34          |
| 3/4   | 2.2                      | 56C          | B5           | GYT-SS            | 59001        | 12.06 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 38          |
| 1   | 2.9                      | 56C          | B5           | HYT-5/8-SS        | 59003        | 12.06 | 1.94 | 6.53 | —    | 0.625                 | 3/16 | 1.38 | 5.44 | 2.06 | 5.88 | 4.50 | 6.53 | 3/8-16 | 39          |
| 1   | 2.9                      | 143TC        | B7           | HYT-SS            | 59002        | 12.13 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 39          |
| 1-1/2   | 4.4                      | 145TC        | B7           | JYT-SS            | 59004        | 14.25 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 46          |
| 2   | 6.0                      | 145TC        | B7           | KYT-SS            | 59005        | 14.25 | 2.00 | 6.53 | —    | 0.875                 | 3/16 | 1.38 | 5.44 | 2.13 | 5.88 | 4.50 | 6.53 | 3/8-16 | 49          |

All dimensions in inches. Dimensional information for estimating purposes only.  
\*TEFC, All other TENV

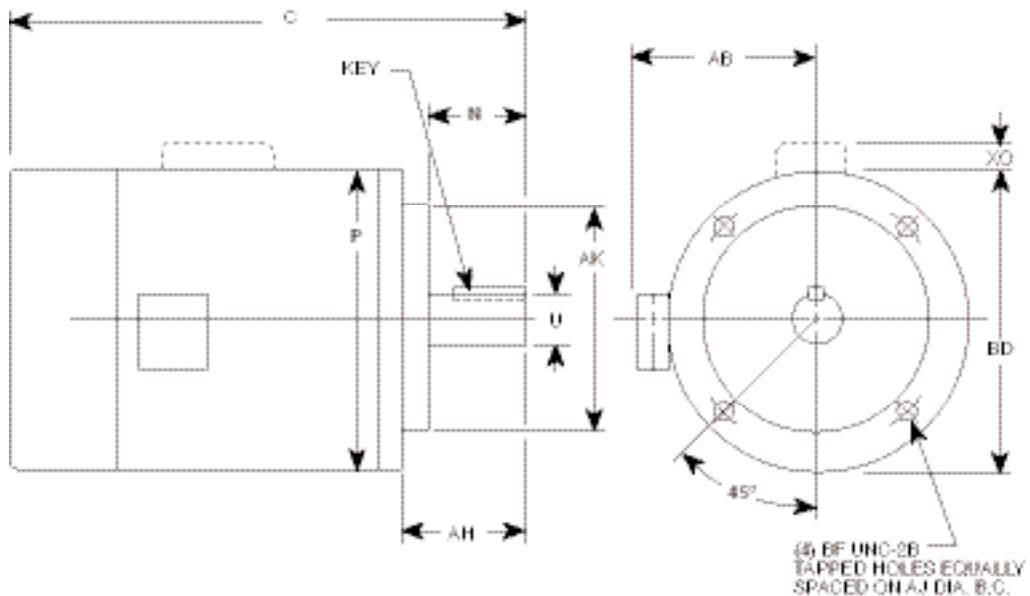
**BOSTON GEAR®**

# AC MOTORS

115/230 1 $\phi$  60 Hz  
208-230/460 3 $\phi$  60 Hz



*Brake Motors, Open Driproof  
NEMA C-Face  
Single and Three Phase  
1/4 – 5 Horsepower  
1725 RPM*



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | Brake Rating (Lb. Ft.) | F.L.A. @ Max. VOLT | NEMA MTG. | Bore CODE | Catalog Number | Item Code | C     | N    | P    | U +.0000 -.0005 | Key  |      | AB   | AH   | AJ   | AK   | BD   | BF     | XO   | Wt. Lbs. |
|---|------------------------|--------------------|-----------|-----------|----------------|-----------|-------|------|------|-----------------|------|------|------|------|------|------|------|--------|------|----------|
|   |                        |                    |           |           |                |           |       |      |      |                 | Sq.  | Lg.  |      |      |      |      |      |        |      |          |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b>     |                        |                    |           |           |                |           |       |      |      |                 |      |      |      |      |      |      |      |        |      |          |
| 1/4   | 3                      | 2.5                | 56C       | B5        | DRB-B          | 66361     | 14.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 2.20 | 34       |
| 1/3   | 3                      | 3.0                | 56C       | B5        | ERB-B          | 66370     | 15.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 2.20 | 34       |
| 1/2   | 3                      | 4.2                | 56C       | B5        | FRB-B          | 66379     | 16.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 2.20 | 38       |
| 3/4   | 3                      | 5.4                | 56C       | B5        | GRB-B          | 66388     | 15.25 | 1.88 | 6.63 | .625            | 3/16 | 1.38 | 5.63 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.28 | 45       |
| <b>208-230/460 VAC 3<math>\phi</math> 60 Hz</b> |                        |                    |           |           |                |           |       |      |      |                 |      |      |      |      |      |      |      |        |      |          |
| 1/4   | 3                      | 0.65               | 56C       | B5        | DUB-B          | 66364     | 14.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 26       |
| 1/3   | 3                      | 0.80               | 56C       | B5        | EUB-B          | 66373     | 14.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 28       |
| 1/2   | 3                      | 1.0                | 56C       | B5        | FUB-B          | 66382     | 14.19 | 1.88 | 5.69 | .625            | 3/16 | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 31       |
| 3/4   | 3                      | 1.5                | 56C       | B5        | GUB-B          | 66391     | 15.25 | 1.88 | 6.63 | .625            | 3/16 | 1.38 | 5.63 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 41       |
| 1   | 3                      | 1.7                | 56C       | B5        | HUB-5/8-B      | 19181     | 15.25 | 1.88 | 6.63 | .625            | 3/16 | 1.38 | 5.47 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 31       |
| 1   | 3                      | 1.7                | 143TC     | B7        | HUB-B          | 66397     | 15.31 | 2.00 | 6.63 | .875            | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 40       |
| 1-1/2   | 6                      | 2.4                | 145TC     | B7        | JUB-B          | 66403     | 15.31 | 2.00 | 6.63 | .875            | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 43       |
| 2   | 6                      | 3.2                | 145TC     | B7        | KUB-B          | 66409     | 16.31 | 2.00 | 6.63 | .875            | 3/16 | 1.38 | 5.25 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 53       |
| 3   | 10                     | 4.3                | 182TC     | B9        | LUB-B          | 66415     | 18.19 | 2.63 | 7.88 | 1.125           | 1/4  | 1.75 | 5.88 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | —    | 73       |
| 5   | 10                     | 7.0                | 184TC     | B9        | MUB-B          | 66834     | 19.56 | 2.63 | 7.88 | 1.125           | 1/4  | 1.75 | 5.88 | 2.89 | 7.25 | 8.50 | 9.00 | 1/2-13 | —    | 84       |

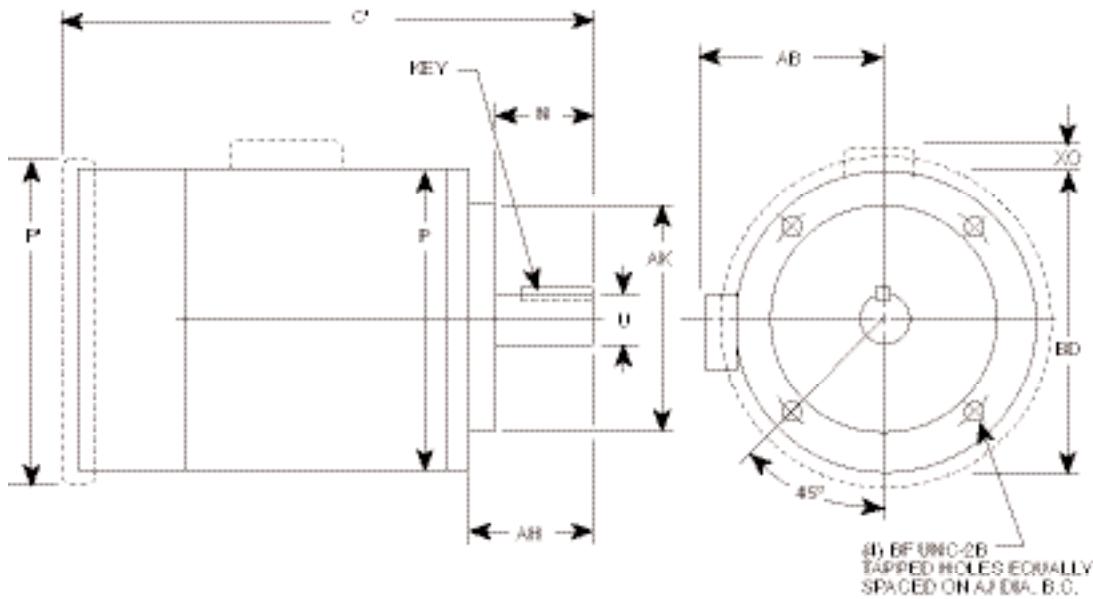
All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# AC MOTORS

115/230 VAC 1 $\phi$  60 Hz  
208-230/460 VAC 3 $\phi$  60 Hz  
575 VAC 3 $\phi$  60 Hz

Brake Motors  
TEFC & TENV  
NEMA C-Face  
Single and Three Phase  
1/4 – 5 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | Brake Rating (lb ft) | F.L.A. @ Max. Volt | NEMA Mfg. | Bore Code | Catalog Number | Item Code | C'    | N    | P    | P'    | U      |        | Key  |      | AB   | AH   | AJ   | AK   | BD     | BF   | XO  | Approx. Wght. (lb) |
|---|----------------------|--------------------|-----------|-----------|----------------|-----------|-------|------|------|-------|--------|--------|------|------|------|------|------|------|--------|------|-----|--------------------|
|   |                      |                    |           |           |                |           |       |      |      |       | +.0000 | -.0005 | Sq.  | Lg.  |      |      |      |      |        |      |     |                    |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b>     |                      |                    |           |           |                |           |       |      |      |       |        |        |      |      |      |      |      |      |        |      |     |                    |
| 1/4   | 3                    | 2.5                | 56C       | B5        | DRTB-B         | 66419     | 15.19 | 1.88 | 5.68 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54 | 34  |                    |
| 1/3   | 3                    | 2.4                | 56C       | B5        | ERTB-B         | 66431     | 16.19 | 1.88 | 5.68 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | 1.54 | 38  |                    |
| 1/2   | 3                    | 3.4                | 56C       | B5        | FRTB-B         | 66440     | 16.25 | 1.88 | 6.63 | —     | .625   | 3/16   | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.30 | 39  |                    |
| 3/4   | 3                    | 5.6                | 56C       | B5        | GRTFB-B*       | 66449     | 17.88 | 1.88 | 6.63 | 7.18  | .625   | 3/16   | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 2.30 | 48  |                    |
| <b>208-230/460 VAC 3<math>\phi</math> 60 Hz</b> |                      |                    |           |           |                |           |       |      |      |       |        |        |      |      |      |      |      |      |        |      |     |                    |
| 1/4   | 3                    | 0.60               | 56C       | B5        | DUTB-B         | 66425     | 14.19 | 1.88 | 5.68 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 25  |                    |
| 1/3   | 3                    | 0.70               | 56C       | B5        | EUTB-B         | 66434     | 14.19 | 1.88 | 5.68 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 27  |                    |
| 1/2   | 3                    | 0.90               | 56C       | B5        | FUTB-B         | 66443     | 14.81 | 1.88 | 5.69 | —     | .625   | 3/16   | 1.38 | 4.89 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 30  |                    |
| 3/4   | 3                    | 1.1                | 56C       | B5        | GUTB-B         | 66452     | 15.25 | 1.88 | 6.63 | —     | .625   | 3/16   | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 40  |                    |
| 1   | 3                    | 1.5                | 56C       | B5        | HUTB-B         | 19182     | 16.25 | 1.88 | 6.63 | —     | .625   | 3/16   | 1.38 | 5.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 41  |                    |
| 1   | 3                    | 1.5                | 145TC     | B7        | HUTB-B         | 66458     | 16.31 | 2.00 | 6.63 | —     | .875   | 3/16   | 1.38 | 5.75 | 2.3  | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 41  |                    |
| 1-1/2   | 6                    | 2.5                | 145TC     | B7        | JUTFB-B*       | 66464     | 16.94 | 2.00 | 6.63 | 7.18  | .875   | 3/16   | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 43  |                    |
| 2   | 6                    | 3.1                | 145TC     | B7        | KUTFB-B*       | 66470     | 17.94 | 2.00 | 6.63 | 7.18  | .875   | 3/16   | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 51  |                    |
| 3   | 10                   | 4.3                | 182TC     | B9        | LUTFB-B*       | 66474     | 19.81 | 2.63 | 8.50 | 7.18  | 1.125  | 1/4    | 1.75 | 5.88 | 2.88 | 7.85 | 8.50 | 9.00 | 1/2-13 | —    | 76  |                    |
| 5   | 25                   | 6.6                | 184TC     | B9        | MUTFB-B*       | 66838     | 21.18 | 2.63 | 7.89 | 10.18 | 1.125  | 1/4    | 1.75 | 5.97 | 2.88 | 7.25 | 8.50 | 8.86 | 1/2-13 | —    | 118 |                    |
| <b>575 VAC 3<math>\phi</math> 60 Hz</b>         |                      |                    |           |           |                |           |       |      |      |       |        |        |      |      |      |      |      |      |        |      |     |                    |
| 1/4   | 3                    | .40                | 56C       | B5        | DYTB-B         | 66428     | 15.25 | 1.88 | 6.63 | —     | .625   | 3/16   | 1.38 | 5.63 | 2.06 | 5.08 | 4.50 | 5.81 | 3/8-16 | —    | 30  |                    |
| 1/2   | 3                    | .72                | 56C       | B5        | FYTB-B         | 66446     | 15.19 | 1.88 | 5.81 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 30  |                    |
| 3/4   | 3                    | 1.2                | 56C       | B5        | GYTB-B         | 66455     | 15.19 | 1.88 | 5.81 | —     | .625   | 3/16   | 1.38 | 4.88 | 2.06 | 5.88 | 4.50 | 5.81 | 3/8-16 | —    | 40  |                    |
| 1   | 3                    | 1.2                | 145TC     | B7        | HYTB-B         | 66461     | 16.31 | 2.00 | 6.63 | —     | .875   | 3/16   | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 51  |                    |
| 1-1/2   | 6                    | 2.0                | 145TC     | B7        | JYTFB-B*       | 66467     | 16.94 | 2.00 | 6.63 | 7.18  | .875   | 3/16   | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 43  |                    |
| 2   | 6                    | 2.5                | 145TC     | B7        | KYTFB-B*       | 66472     | 17.94 | 2.00 | 6.63 | 7.18  | .875   | 3/16   | 1.38 | 5.75 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | —    | 51  |                    |
| 3   | 10                   | 3.6                | 182TC     | B9        | LYTFB-B*       | 66476     | 19.81 | 2.63 | 8.50 | 7.18  | 1.125  | 1/4    | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | —    | 76  |                    |
| 5   | 25                   | 5.3                | 184TC     | B9        | MYTFB-B*       | 66840     | 21.18 | 2.63 | 8.50 | 7.18  | 1.125  | 1/4    | 1.75 | 5.88 | 2.88 | 7.25 | 8.50 | 9.00 | 1/2-13 | —    | 112 |                    |

\*TEFC, All others TENV.

All dimensions in inches. Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# AC MOTORS

115/230 VAC 1 $\phi$  60 Hz  
208-230/460 VAC 3 $\phi$  60 Hz

Explosion Proof  
NEMA C-Face  
Single and Three Phase  
1/4-5 Horsepower  
1725 RPM

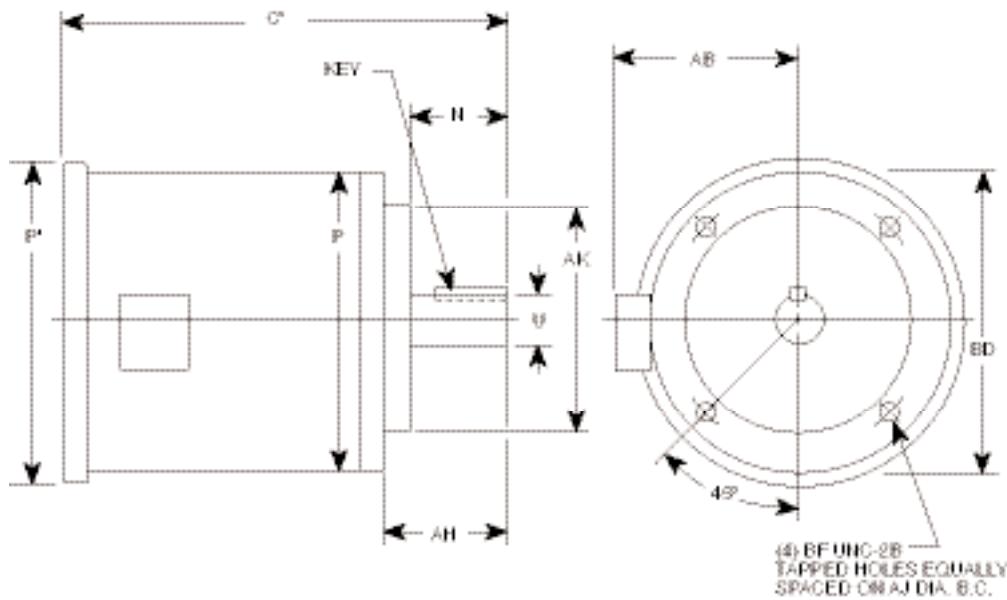


## CONTINUOUS DUTY

### 1.0 SERVICE FACTOR

### CLASS I GROUP D

### CLASS II GROUPS F & G



#### ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>Mtg. | Bore<br>Code | Catalog<br>Number | Item<br>Code | C'    | N    | P    | P'   | U<br>+.0000<br>-.0005 | KEY  |      | AB   | AH   | AJ   | AK   | BD   | BF     | Wt.<br>Lbs. |
|---|--------------------------|--------------|--------------|-------------------|--------------|-------|------|------|------|-----------------------|------|------|------|------|------|------|------|--------|-------------|
|   |                          |              |              |                   |              |       |      |      |      |                       | Sq.  | Lg.  |      |      |      |      |      |        |             |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b>     |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/4   | 2.5                      | 56C          | B5           | DRX-B             | 66292        | 14.38 | 1.94 | 6.68 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 42          |
| 1/3   | 3.0                      | 56C          | B5           | ERX-B             | 66304        | 14.38 | 1.94 | 6.68 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 42          |
| 1/2   | 3.8                      | 56C          | B5           | FRX-B             | 66313        | 14.38 | 1.94 | 6.75 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 49          |
| 3/4   | 5.3                      | 56C          | B5           | GRX-B             | 66322        | 15.25 | 1.94 | 6.75 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 54          |
| <b>208-230/460 VAC 3<math>\phi</math> 60 Hz</b> |                          |              |              |                   |              |       |      |      |      |                       |      |      |      |      |      |      |      |        |             |
| 1/4   | 0.65                     | 56C          | B5           | DUX-B             | 66298        | 14.38 | 1.94 | 6.68 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 42          |
| 1/3   | 0.80                     | 56C          | B5           | EUX-B             | 66307        | 13.22 | 1.94 | 6.68 | 6.20 | 0.625                 | 3/16 | 1.38 | 6.50 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 28          |
| 1/2   | 1.0                      | 56C          | B5           | FUX-B             | 66316        | 14.38 | 1.94 | 6.68 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 42          |
| 3/4   | 1.5                      | 56C          | B5           | GUX-B             | 66325        | 14.38 | 1.94 | 6.68 | 7.19 | 0.625                 | 3/16 | 1.38 | 6.75 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 43          |
| 1   | 1.8                      | 56C          | B5           | HUX-5/8-B         | 19180        | —     | 1.94 | 6.68 | 6.20 | 0.625                 | 3/16 | 1.38 | 6.50 | 2.06 | 5.88 | 4.50 | 6.50 | 3/8-16 | 44          |
| 1   | 1.7                      | 143TC        | B7           | HUX-B             | 66334        | —     | 2.00 | 6.68 | 7.19 | 0.875                 | 3/16 | 1.38 | 6.92 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 39          |
| 1-1/2   | 2.5                      | 145TC        | B7           | JUX-B             | 66343        | —     | 2.00 | 6.88 | 7.19 | 0.875                 | 3/16 | 1.38 | 6.92 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 43          |
| 2   | 3.1                      | 145TC        | B7           | KUX-B             | 66349        | —     | 2.00 | 6.75 | 7.19 | 0.875                 | 3/16 | 1.38 | 6.92 | 2.13 | 5.88 | 4.50 | 6.50 | 3/8-16 | 50          |
| 3   | 4.3                      | 182TC        | B9           | LUX-B             | 66353        | 17.50 | 2.63 | 7.88 | 8.49 | 1.125                 | 1/4  | 1.75 | 7.52 | 2.88 | 7.25 | 8.50 | 8.98 | 1/2-13 | 81          |
| 5   | 6.5                      | 184TC        | B9           | MUX-B             | 66357        | —     | 2.63 | 7.88 | 8.82 | 1.125                 | 1/4  | 1.75 | 7.52 | 2.88 | 7.25 | 8.50 | 8.98 | 1/2-13 | 111         |

All dimensions in inches. Dimensional information for estimating purposes only.

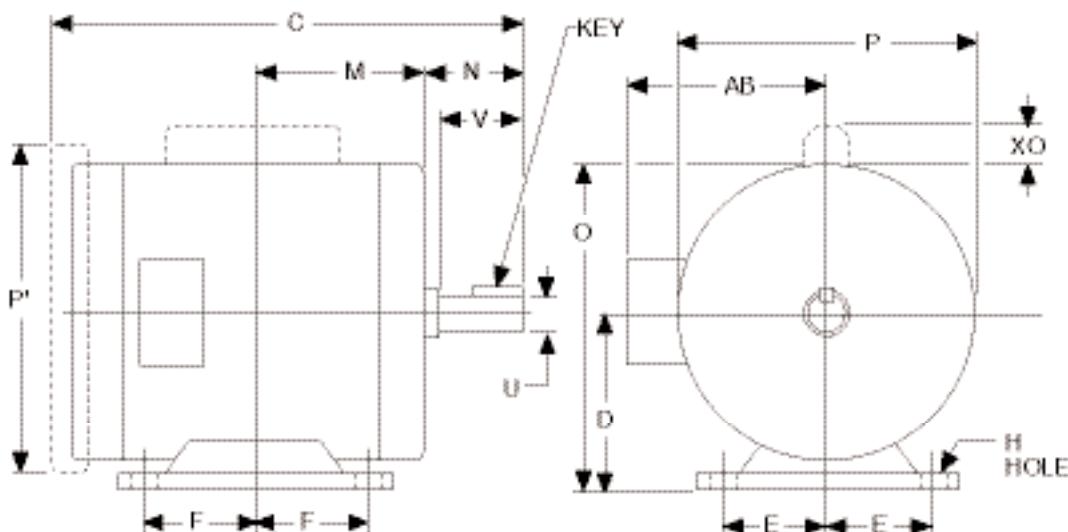
**BOSTON GEAR®**

# AC MOTORS

115/230 VAC 1 $\phi$  60 Hz  
208-230/460 VAC 3 $\phi$  60 Hz

TEFC

Rigid Base  
Single and Three Phase  
1/2 – 50 Horsepower  
1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP  | RPM  | F.L.A.<br>@ Max.<br>Volt | NEMA<br>MTG | Catalog<br>Number | Item<br>Code | C     | D    | E    | F    | H*     | M     | N    | O     | P     | P'    | U<br>+.0000<br>-.0005 | Key  |      | V    | AB    | X0   | Wt.<br>(Lbs.) |  |
|---|------|--------------------------|-------------|-------------------|--------------|-------|------|------|------|--------|-------|------|-------|-------|-------|-----------------------|------|------|------|-------|------|---------------|--|
|   |      |                          |             |                   |              |       |      |      |      |        |       |      |       |       |       |                       | SQ   | Long |      |       |      |               |  |
| <b>115/230 VAC 1<math>\phi</math> 60 Hz</b>     |      |                          |             |                   |              |       |      |      |      |        |       |      |       |       |       |                       |      |      |      |       |      |               |  |
| 1/2   | 1725 | 3.7                      | 56          | BFRTF-B           | 66530        | 11.95 | 3.50 | 2.44 | 1.50 | .34(S) | 3.63  | 2.50 | 6.34  | 5.68  | 6.13  | .625                  | 3/16 | 1.38 | 1.88 | 4.88  | 1.50 | 27            |  |
| 3/4   | 1725 | 5.6                      | 56          | BGRTF-B           | 66536        | 13.31 | 3.50 | 2.44 | 1.50 | .34(S) | 3.69  | 2.50 | 6.88  | 6.63  | 7.18  | .625                  | 3/16 | 1.38 | 1.88 | 5.75  | 2.25 | 35            |  |
| 1   | 1725 | 6.2                      | 143T        | BHRTF-B           | 66542        | 13.31 | 3.50 | 2.75 | 2.00 | .34(S) | 4.00  | 2.50 | 6.81  | 6.63  | 7.18  | .875                  | 3/16 | 1.38 | 2.25 | 5.75  | 2.25 | 39            |  |
| 1-1/2   | 1725 | 8.0                      | 145T        | BJRTF-B           | 66548        | 14.19 | 3.50 | 2.75 | 2.00 | .34(S) | 4.00  | 2.50 | 6.81  | 6.63  | 7.18  | .875                  | 3/16 | 1.38 | 2.25 | 5.75  | 2.25 | 48            |  |
| <b>208-230/460 VAC 3<math>\phi</math> 60 Hz</b> |      |                          |             |                   |              |       |      |      |      |        |       |      |       |       |       |                       |      |      |      |       |      |               |  |
| 1/2   | 1725 | 1.0                      | 56          | BFUTF-B           | 66533        | 11.38 | 3.60 | 2.44 | 1.50 | .34(S) | 3.63  | 2.50 | 6.38  | 5.68  | 6.13  | .625                  | 3/16 | 1.38 | 1.88 | 4.88  | —    | 23            |  |
| 3/4   | 1725 | 1.5                      | 56          | BGUTF-B           | 66538        | 12.38 | 3.50 | 2.44 | 1.50 | .34(S) | 3.63  | 2.50 | 6.38  | 5.68  | 6.13  | .625                  | 3/16 | 1.38 | 1.88 | 4.88  | —    | 26            |  |
| 1   | 1725 | 1.7                      | 143T        | BHUTF-B           | 66544        | 12.38 | 3.50 | 2.75 | 2.00 | .34(S) | 4.00  | 2.50 | 6.88  | 6.63  | 7.18  | .875                  | 3/16 | 1.38 | 2.25 | 5.75  | —    | 32            |  |
| 1-1/2   | 1725 | 2.5                      | 145T        | BJUTF-B           | 66550        | 13.31 | 3.50 | 2.75 | 2.00 | .34(S) | 4.00  | 2.50 | 6.81  | 6.63  | 7.18  | .875                  | 3/16 | 1.38 | 2.25 | 5.75  | —    | 41            |  |
| 2   | 1725 | 3.1                      | 145T        | BKUTF-B           | 66554        | 13.38 | 3.50 | 2.75 | 2.00 | .34(S) | 4.00  | 2.50 | 6.88  | 6.63  | 7.18  | .875                  | 3/16 | 1.38 | 2.25 | 5.75  | —    | 42            |  |
| 3   | 1750 | 4.3                      | 182T        | BLUTF-B           | 61314        | 15.18 | 4.50 | 3.75 | 2.25 | .41    | 4.19  | 3.56 | 8.44  | 7.88  | 8.50  | 1.125                 | 1/4  | 1.75 | 2.75 | 5.88  | —    | 55            |  |
| 5   | 1750 | 6.6                      | 184T        | BMUTF-B           | 61316        | 16.56 | 4.50 | 3.75 | 2.25 | .41    | 4.19  | 3.56 | 8.44  | 7.88  | 8.50  | 1.125                 | 1/4  | 1.75 | 2.75 | 5.88  | —    | 75            |  |
| 7-1/2   | 1750 | 10.0                     | 213T        | BNUTF-B           | 61318        | 17.94 | 5.25 | 4.25 | 2.75 | .41    | 5.75  | 3.88 | 10.06 | 9.56  | 10.18 | 1.375                 | 5/16 | 2.38 | 3.38 | 7.38  | —    | 99            |  |
| 10  | 1750 | 13.0                     | 215T        | BPUTF-B           | 61320        | 19.06 | 5.25 | 4.25 | 2.75 | .41    | 5.75  | 3.88 | 10.06 | 9.56  | 10.18 | 1.375                 | 5/16 | 2.38 | 3.38 | 7.38  | —    | 127           |  |
| 15  | 1760 | 19.6                     | 254T        | BRUTF-B           | 66886        | 21.09 | 6.25 | 5.00 | 4.13 | .53    | 8.06  | 4.31 | 12.18 | 12.94 | 10.62 | 1.625                 | 3/8  | 3.00 | 4.00 | 8.86  | —    | 244           |  |
| 20  | 1760 | 26.0                     | 256T        | BSUTF-B           | 61341        | 23.18 | 6.25 | 5.00 | 5.00 | .53    | 8.94  | 4.31 | 12.88 | 12.94 | 13.25 | 1.625                 | 3/8  | 3.00 | 4.00 | 9.50  | —    | 269           |  |
| 25  | 1760 | 30.0                     | 284T        | BTUTF-B           | 61343        | 27.28 | 7.00 | 5.50 | 4.75 | .53    | 9.44  | 4.75 | 15.56 | 14.63 | 15.00 | 1.875                 | 1/2  | 3.63 | 4.63 | 12.63 | —    | 359           |  |
| 30  | 1760 | 37.0                     | 286T        | BUUTF-B           | 61345        | 27.76 | 7.00 | 5.50 | 5.50 | .53    | 10.29 | 4.75 | 14.44 | 14.63 | 15.00 | 1.875                 | 1/2  | 3.63 | 4.63 | 13.12 | —    | 433           |  |
| 40  | 1760 | 46.5                     | 324T        | BVUTF-B           | 61347        | 30.25 | 8.00 | 6.25 | 5.25 | .66    | 10.31 | 5.44 | 16.25 | 17.38 | 16.94 | 2.125                 | 1/2  | 4.25 | 5.25 | 14.62 | —    | 583           |  |
| 50  | 1760 | 62.0                     | 326T        | BWUTF-B           | 61349        | 30.25 | 8.00 | 6.25 | 6.00 | .66    | 11.06 | 5.44 | 16.50 | 17.38 | 16.94 | 2.125                 | 1/2  | 4.25 | 5.25 | 14.13 | —    | 526           |  |

All dimensions in inches. Dimensional information for estimating purposes only.

\*(S) Slotted (Dimension is Width)

**BOSTON GEAR®**

# AC MOTORS

*Totally Enclosed  
Nonventilated*

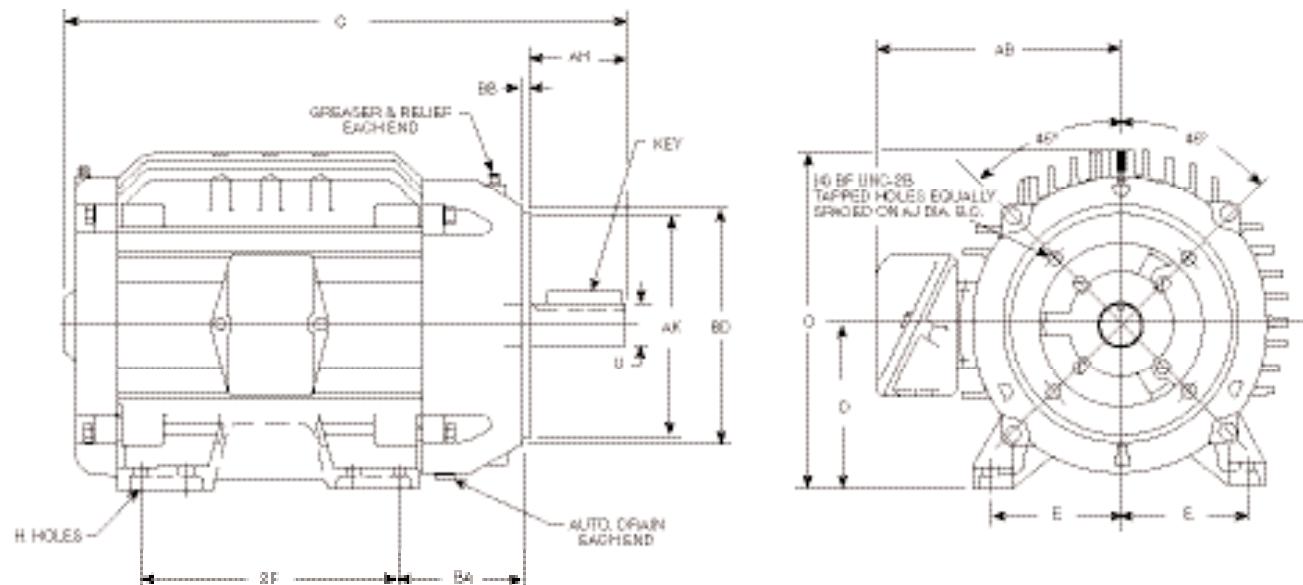
*Inverter Duty*

*1/3-10 Horsepower*



Boston Gear's Inverter Drive motors are specifically designed for today's tough adjustable speed applications. The design uses a rugged ribbed (for cooling) cast iron frame\*, endplates and connection box. The motors feature a cast iron base and C-face mounting. Locked bearings allow for vertical wall and horizontal mountings without modifications. These motors are fully insulated (Class H) for protection against voltage spikes which could cause phase to phase or turn to turn shorts. Also included are normally closed thermal protectors for overheating protection. These motors are offered at 1800 RPM base speed in a TENV or TEBC enclosure. Also available 1150 RPM Base Speed in a TEBC Enclosure.

\*1 HP and above



## ORDER BY CATALOG NUMBER

| HP                                      | RPM @ 60 Hz | F.L.A. @ Max. Volt | NEMA Mfg. | Bore Code | Catalog Number | C     | D    | E    | 2F    | H     | O     | U +.0000 -.0005 | Key  |      | AB   | AH   | AJ   | AK   | BA   | BB  | BD   | BF     | Wt. Lbs. |
|---|-------------|--------------------|-----------|-----------|----------------|-------|------|------|-------|-------|-------|-----------------|------|------|------|------|------|------|------|-----|------|--------|----------|
|   |             |                    |           |           |                |       |      |      |       |       |       |                 | Sq   | Long |      |      |      |      |      |     |      |        |          |
| <b>Totally Enclosed, Non-Ventilated</b> |             |                    |           |           |                |       |      |      |       |       |       |                 |      |      |      |      |      |      |      |     |      |        |          |
| 1/3                                     | 1725        | 0.50               | 56C       | B5        | EUT-ID-B       | 10.25 | 3.50 | 2.44 | 3.00  | 34(S) | 6.34  | .625            | 3/16 | 1.38 | 4.51 | 1.94 | 5.88 | 4.50 | 2.69 | .12 | 5.81 | 3/8-16 | 24       |
| 1/2                                     | 1725        | 0.65               | 56C       | B5        | FUT-ID-B       | 10.88 | 3.50 | 2.44 | 3.00  | 34(S) | 6.34  | .625            | 3/16 | 1.38 | 4.51 | 1.94 | 5.88 | 4.50 | 2.69 | .12 | 5.81 | 3/8-16 | 26       |
| 3/4                                     | 1725        | 0.65               | 56C       | B5        | GUT-ID-B       | 11.50 | 3.50 | 2.44 | 3.00  | 34(S) | 6.88  | .625            | 3/16 | 1.38 | 5.25 | 1.94 | 5.88 | 4.50 | 2.69 | .12 | 6.50 | 3/8-16 | 42       |
| 1                                       | 1725        | 1.6                | 143TC     | B7        | HUT-ID-B       | 11.82 | 3.50 | 2.75 | 4.00  | .38   | 7.59  | .875            | 3/16 | 1.38 | 6.33 | 2.00 | 5.88 | 4.50 | 2.38 | .12 | 6.50 | 3/8-16 | 54       |
| 1-1/2                                   | 1725        | 2.1                | 143TC     | B7        | JUT-ID-B       | 11.82 | 3.50 | 2.75 | 4.00  | .38   | 7.59  | .875            | 3/16 | 1.38 | 6.33 | 2.00 | 5.88 | 4.50 | 2.38 | .12 | 6.50 | 3/8-16 | 63       |
| 2                                       | 1725        | 2.9                | 182TC     | B9        | KUT-ID-B       | 14.86 | 4.50 | 3.75 | 4.50  | .41   | 9.23  | 1.125           | 1/4  | 1.75 | 7.08 | 2.62 | 7.25 | 8.50 | 3.38 | .25 | 9.00 | 1/2-13 | 105      |
| 3                                       | 1750        | 4.0                | 184TC     | B9        | LUT-ID-B       | 14.86 | 4.50 | 3.75 | 5.50  | .41   | 9.23  | 1.125           | 1/4  | 1.75 | 7.08 | 2.62 | 7.25 | 8.50 | 3.38 | .25 | 9.00 | 1/2-13 | 124      |
| 5                                       | 1760        | 6.7                | 213TC     | B11       | MUT-ID-B       | 18.07 | 5.25 | 4.25 | 5.50  | .41   | 10.99 | 1.375           | 5/16 | 2.38 | 8.61 | 3.12 | 7.25 | 8.50 | 4.25 | .25 | 9.06 | 1/2-13 | 170      |
| 7-1/2                                   | 1760        | 10.0               | 254TC     | B13       | NUT-ID-B       | 21.67 | 6.25 | 5.00 | 8.25  | .53   | 12.87 | 1.625           | 3/8  | 2.88 | 9.42 | 3.75 | 7.25 | 8.50 | 4.75 | .25 | 9.09 | 1/2-13 | 204      |
| 10                                      | 1760        | 12.8               | 256TC     | B13       | PUT-ID-B       | 21.67 | 6.25 | 5.00 | 10.00 | .53   | 12.87 | 1.625           | 3/8  | 2.88 | 9.42 | 3.75 | 7.25 | 8.50 | 4.75 | .25 | 9.09 | 1/2-13 | 265      |

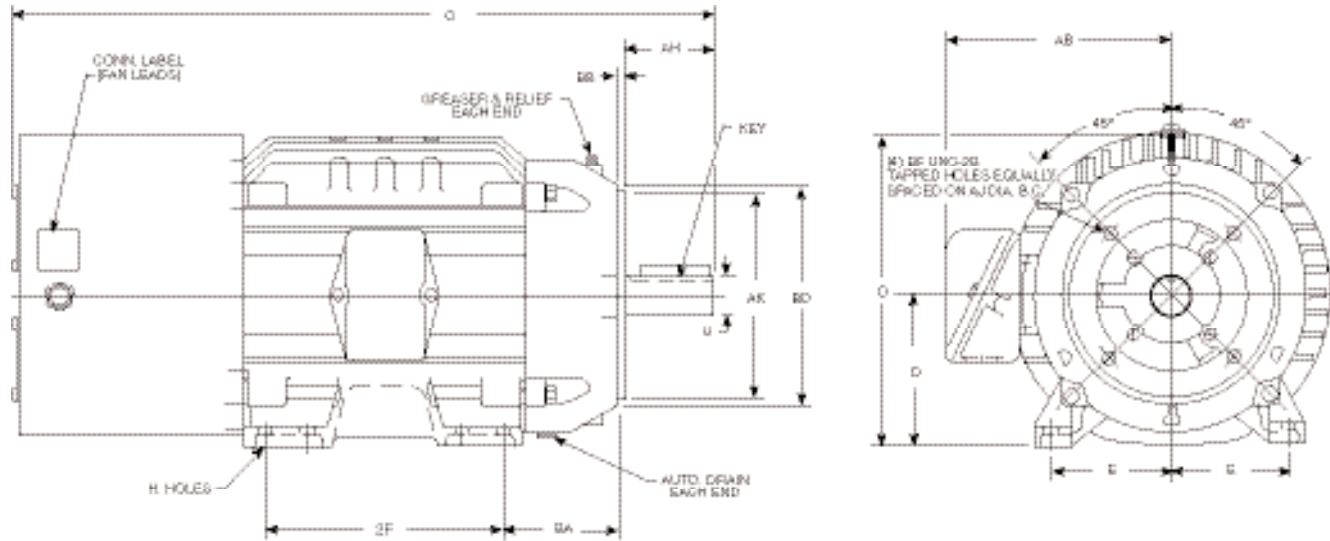
All dimensions in inches. (S) Slotted (Dimension is width).  
Dimensional information for estimating purposes only.

**BOSTON GEAR®**

# AC MOTORS

208-230/460 VAC 3Ø 60 Hz

Inverter Duty  
Blower Cooled  
NEMA C-Face  
1-75 Horsepower  
1150 & 1725 RPM



## ORDER BY CATALOG NUMBER OR ITEM CODE

| HP                                     | RPM @ 60 Hz | F.L.A. @ Max. Volt | NEMA Mfg. | Bore Code | Catalog Number | C     | D    | E    | 2F    | H   | O     | U +.0000<br>-.0005 | Key  |      | Long  | AB   | AH    | AJ    | AK   | BA  | BB    | BD     | BF  | Wt. Lbs. |
|--|-------------|--------------------|-----------|-----------|----------------|-------|------|------|-------|-----|-------|--------------------|------|------|-------|------|-------|-------|------|-----|-------|--------|-----|----------|
|  |             |                    |           |           |                |       |      |      |       |     |       |                    | Sq   | Long |       |      |       |       |      |     |       |        |     |          |
| <b>Totally Enclosed, Blower Cooled</b> |             |                    |           |           |                |       |      |      |       |     |       |                    |      |      |       |      |       |       |      |     |       |        |     |          |
| 1                                      | 1725        | 1.7                | 143TC     | B7        | HUBC-ID-B      | 18.65 | 3.50 | 2.75 | 4.00  | .38 | 7.59  | .875               | 3/16 | 1.38 | 6.33  | 2.00 | 5.88  | 4.50  | 2.38 | .12 | 6.50  | 3/8-16 | 58  |          |
| 1                                      | 1150        | 1.5                | 145TC     | B7        | HUBC-11-ID-B   | 18.65 | 3.50 | 2.75 | 5.00  | .38 | 7.59  | .875               | 3/16 | 1.38 | 6.33  | 2.00 | 5.88  | 4.50  | 2.38 | .12 | 6.50  | 3/8-16 | 60  |          |
| 1-1/2                                  | 1725        | 2.5                | 145TC     | B7        | JUBC-ID-B      | 18.65 | 3.50 | 2.75 | 5.00  | .38 | 7.59  | .875               | 3/16 | 1.38 | 6.33  | 2.00 | 5.88  | 4.50  | 2.38 | .12 | 6.50  | 3/8-16 | 61  |          |
| 1-1/2                                  | 1140        | 2.6                | 182TC     | B9        | JUBC-11-ID-B   | 21.73 | 4.50 | 3.75 | 4.50  | .41 | 9.23  | 1.125              | 1/4  | 1.75 | 7.08  | 2.63 | 7.25  | 8.50  | 3.38 | .25 | 9.00  | 1/2-13 | 96  |          |
| 2                                      | 1750        | 3.1                | 145TC     | B7        | KUBC-ID-B      | 18.65 | 3.50 | 2.75 | 5.00  | .38 | 7.59  | .875               | 3/16 | 1.38 | 6.33  | 2.00 | 5.88  | 4.50  | 2.25 | .12 | 6.50  | 3/8-16 | 67  |          |
| 2                                      | 1160        | 2.8                | 184TC     | B9        | KUBC-11-ID-B   | 21.73 | 4.50 | 3.75 | 5.50  | .41 | 9.23  | 1.125              | 1/4  | 1.75 | 7.08  | 2.63 | 7.25  | 8.50  | 3.38 | .25 | 9.00  | 1/2-13 | 100 |          |
| 3                                      | 1760        | 4.5                | 184TC     | B9        | LUBC-ID-B      | 21.73 | 4.50 | 3.75 | 5.50  | .41 | 9.23  | 1.125              | 1/4  | 1.75 | 7.08  | 2.63 | 7.25  | 8.50  | 3.38 | .25 | 9.00  | 1/2-13 | 113 |          |
| 3                                      | 1160        | 5.0                | 213TC     | B11       | LUBC-11-ID-B   | 25.39 | 5.25 | 4.25 | 5.50  | .41 | 10.99 | 1.375              | 5/16 | 2.38 | 8.61  | 3.12 | 7.25  | 8.50  | 4.25 | .25 | 9.06  | 1/2-13 | 157 |          |
| 5                                      | 1760        | 6.8                | 184TC     | B9        | MUBC-ID-B      | 21.73 | 4.50 | 3.75 | 5.50  | .41 | 9.23  | 1.125              | 1/4  | 1.75 | 7.08  | 2.63 | 7.25  | 8.50  | 3.38 | .25 | 9.00  | 1/2-13 | 132 |          |
| 5                                      | 1160        | 7.7                | 215TC     | B11       | MUBC-11-ID-B   | 25.39 | 5.25 | 4.25 | 7.00  | .41 | 10.99 | 1.375              | 5/16 | 2.38 | 8.61  | 3.12 | 7.25  | 8.50  | 4.25 | .25 | 9.06  | 1/2-13 | 182 |          |
| 7-1/2                                  | 1760        | 9.8                | 213TC     | B11       | NUBC-ID-B      | 25.39 | 5.25 | 4.25 | 5.50  | .41 | 10.99 | 1.375              | 5/16 | 2.38 | 8.61  | 3.12 | 7.25  | 8.50  | 4.25 | .25 | 9.06  | 1/2-13 | 180 |          |
| 7-1/2                                  | 1170        | 10.2               | 254TC     | B13       | NUBC-11-ID-B   | 29.29 | 6.25 | 5.00 | 8.25  | .53 | 12.87 | 1.625              | 3/8  | 2.88 | 9.42  | 3.75 | 7.25  | 8.50  | 4.75 | .25 | 9.09  | 1/2-13 | 235 |          |
| 10                                     | 1760        | 12.7               | 215TC     | B11       | PUBC-ID-B      | 25.39 | 5.25 | 4.25 | 7.00  | .41 | 10.99 | 1.375              | 5/16 | 2.38 | 8.61  | 3.12 | 7.25  | 8.50  | 4.25 | .25 | 9.06  | 1/2-13 | 210 |          |
| 10                                     | 1170        | 14.0               | 256TC     | B13       | PUBC-11-ID-B   | 29.29 | 6.25 | 5.00 | 10.00 | .53 | 12.87 | 1.625              | 3/8  | 2.88 | 9.42  | 3.75 | 7.25  | 8.50  | 4.75 | .25 | 9.09  | 1/2-13 | 300 |          |
| 15                                     | 1760        | 18.0               | 256TC     | B13       | RUBC-ID-B      | 29.29 | 6.25 | 5.00 | 10.00 | .53 | 12.87 | 1.625              | 3/8  | 2.88 | 9.42  | 3.75 | 7.25  | 8.50  | 4.75 | .25 | 9.09  | 1/2-13 | 275 |          |
| 15                                     | 1170        | 19.5               | 284TC     | *         | RUBC-11-ID-B   | 32.82 | 7.00 | 5.50 | 9.50  | .56 | 14.44 | 1.875              | 1/2  | 3.25 | 12.96 | 4.38 | 9.00  | 10.50 | 4.75 | .25 | 11.21 | 1/2-13 | 450 |          |
| 20                                     | 1780        | 24.0               | 256TC     | B13       | SUBC-ID-B      | 29.29 | 6.25 | 5.00 | 10.00 | .53 | 12.87 | 1.625              | 3/8  | 2.88 | 9.42  | 3.75 | 7.25  | 8.50  | 4.75 | .25 | 9.09  | 1/2-13 | 311 |          |
| 20                                     | 1170        | 26.0               | 286TC     | *         | SUBC-11-ID-B   | 32.82 | 7.00 | 5.50 | 11.00 | .56 | 14.44 | 1.875              | 1/2  | 3.25 | 12.96 | 4.38 | 9.00  | 10.50 | 4.75 | .25 | 11.21 | 1/2-13 | 459 |          |
| 25                                     | 1780        | 30.4               | 284TC     | *         | TUBC-ID-B      | 32.82 | 7.00 | 5.50 | 9.50  | .56 | 14.44 | 1.875              | 1/2  | 3.25 | 12.96 | 4.38 | 9.00  | 10.50 | 4.75 | .25 | 11.21 | 1/2-13 | 408 |          |
| 25                                     | 1180        | 29.8               | 324TC     | *         | TUBC-11-ID-B   | 35.23 | 8.00 | 6.25 | 10.50 | .65 | 16.23 | 2.125              | 1/2  | 3.88 | 14.46 | 5.00 | 11.00 | 12.50 | 5.25 | .25 | 13.40 | 5/8-11 | 571 |          |
| 30                                     | 1780        | 35.5               | 286TC     | *         | UUBC-ID-B      | 32.82 | 7.00 | 5.50 | 11.00 | .56 | 14.44 | 1.875              | 1/2  | 3.25 | 12.96 | 4.38 | 9.00  | 10.50 | 4.75 | .25 | 11.21 | 1/2-13 | 470 |          |
| 30                                     | 1180        | 36.0               | 326TC     | *         | UUBC-11-ID-B   | 35.23 | 8.00 | 6.25 | 12.00 | .65 | 16.23 | 2.123              | 1/2  | 3.88 | 14.46 | 5.00 | 11.00 | 12.50 | 5.25 | .25 | 13.40 | 5/8-11 | 612 |          |
| 40                                     | 1780        | 46.5               | 324TC     | *         | VUBC-ID-B      | 35.23 | 8.00 | 6.25 | 10.50 | .65 | 16.23 | 2.125              | 1/2  | 3.88 | 14.46 | 5.00 | 11.00 | 12.50 | 5.25 | .25 | 13.40 | 5/8-11 | 547 |          |
| 40                                     | 1180        | 47.0               | 364TC     | *         | VUBC-11-ID-B   | 37.13 | 9.00 | 7.00 | 11.25 | .66 | 18.38 | 2.375              | 5/8  | 4.25 | 14.80 | 5.62 | 11.00 | 12.50 | 5.88 | .25 | 12.89 | 5/8-11 | 747 |          |
| 50                                     | 1780        | 57.5               | 326TC     | *         | WUBC-ID-B      | 35.23 | 8.00 | 6.25 | 12.00 | .65 | 16.23 | 2.125              | 1/2  | 3.88 | 14.46 | 5.00 | 11.00 | 12.50 | 5.25 | .25 | 13.40 | 5/8-11 | 670 |          |
| 50                                     | 1180        | 59.0               | 365TC     | *         | WUBC-11-ID-B   | 37.13 | 9.00 | 7.00 | 12.25 | .66 | 18.38 | 2.375              | 5/8  | 4.25 | 14.80 | 5.62 | 11.00 | 12.50 | 5.88 | .25 | 12.89 | 5/8-11 | 835 |          |
| 60                                     | 1780        | 71.0               | 364TC     | *         | XUBC-ID-B      | 37.13 | 9.00 | 7.00 | 11.25 | .66 | 18.38 | 2.375              | 5/8  | 4.25 | 14.80 | 5.62 | 11.00 | 12.50 | 5.88 | .25 | 12.89 | 5/8-11 | 797 |          |
| 75                                     | 1780        | 86.0               | 365TC     | *         | YUBC-ID-B      | 37.13 | 9.00 | 7.00 | 12.25 | .66 | 18.38 | 2.375              | 5/8  | 4.25 | 14.80 | 5.62 | 11.00 | 12.50 | 5.88 | .25 | 12.89 | 5/8-11 | 869 |          |

All dimensions in inches. Dimensional information for estimating purposes only.

\*Not standard BG mounting.

**BOSTON GEAR®**

Electrical Products Catalog **109**

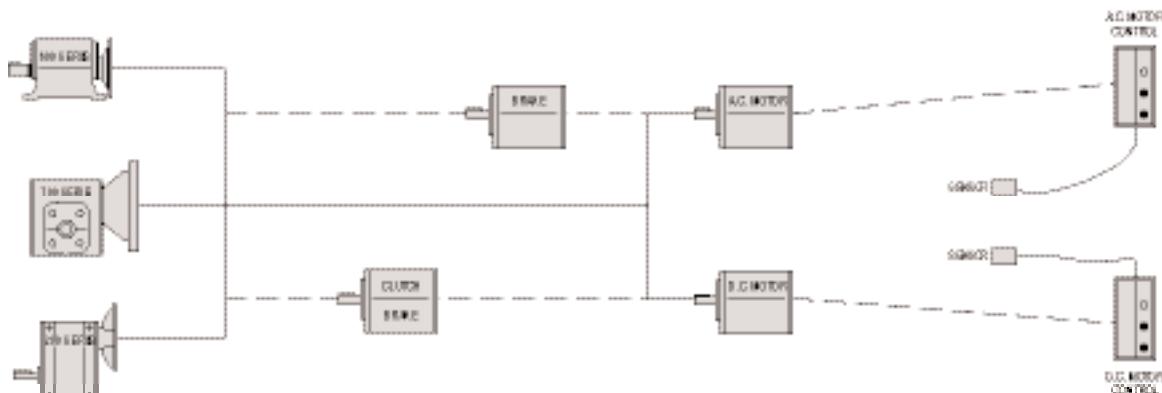
## NOTES

**BOSTON GEAR®**

# **WASHDOWN PRODUCTS**

Boston Gear has developed a wide range of power transmission products specifically for the food and beverage industry. Working with design and maintenance personnel we have designed certain mechanical, electrical and electronic products to meet their harsh washdown applications.

## A COMPLETE VARIABLE SPEED WASHDOWN POWER DRIVE SYSTEM



Mechanical • Electrical • Electronic

## SPEED REDUCERS



#### 700 Series – Stainless *Bost-Kleen*™

- Durable stainless steel epoxy coating system utilizes a unique stainless steel leafing pigment
- USDA Approved for use in food processing and handling industry where incidental food contact may occur
- BISSC Certified
- Washable and scrubbable
- Corrosion resistant
- Prelubricated with USDA Approved Mobil SHC634 synthetic oil
- Double lipped oil seals
- Excluder seal on output shaft
- Limited lifetime warranty
- Available up to 25 HP in 1" to 6" Center distances

## DC CONTROLLERS



## BETA II/Beta Plus DC Controllers

- NEMA 4 washdown enclosure
- 1/12 to 2 horsepower range
- Reconnectable 115/230 VAC input
- Run/Stop/Job & Forward/Reverse operation
- Rugged, compact design
- Durable non-absorbent, non-toxic white epoxy finish, USDA approved
- NEMA 4 washdown duty AC inverters also available

## AC BRAKE



## Double C-Face AC Brakes *BISSC Certified*

- Standard torque ranges from 3 to 10 lb-ft
- Available with DC voltage coils
- Automatic reset, manual brake release
- Rated for continuous duty
- Available from stock

# WASHDOWN PRODUCTS

## AC/DC MOTORS



### AC Motors (pg. 103)

- 1/2 – 5 Horsepower
- 230/460-3-60 VAC
- BISSC Certified
- Durable White Epoxy Finish
- Totally Enclosed Design
- NEMA C-Face Mounting
- Weep Holes

### DC Motors (pg. 88)

- 1/4 – 3/4 Horsepower
- 90 & 180 VAC
- BISSC Certified
- Durable White Epoxy
- TENV
- NEMA C-Face Mounting
- Permanent Magnet

## 800 SERIES



### 800 Series Bost-Kleen™\*

- Durable non-absorbent, non-toxic white (BK) or stainless epoxy finish (SBK)
- Washable & scrubbable
- Includes all the standard 800 features
- Single, double and triple reduction ratios from 1:5:1 to 250:1
- Helical gearing
- Standard NEMA C-face or projecting input shaft configurations

## 700 SERIES



### Bost-Kleen™\*

- Boston Gear's proven 700 Series quality
- Limited lifetime warranty
- Pressure relief valves standard
- Double lipped oil seals
- Available from stock up to 25 hp in 1" to 6" center distances
- Single Reduction Ratios 5:1 to 60:1
- Double Reduction Ratios 100:1 to 1800:1

### BISSC Certified

- All single reduction 700 series Quill type & nonflanged unit
- Cast iron horizontal base standard
- Pre-lubricated standard with SHC634 synthetic oil, USDA approved
- Smooth flat machined surfaces to resist dirt build-up. Bolt heads and nuts are exposed so contaminants can easily be removed to simplify washdown
- Durable, non-absorbent, non-toxic white epoxy finish, USDA approved
- Single Reduction Ratios 5:1 to 60:1

## AC MOTORS



### Stainless Steel AC Motors

- AC Motors 1/2-2 horsepower range
- All surfaces of the end bells and conduit box are hard anodized and processed with a USDA approved resin-bound Fluorocarbon Duplex Coating Process to enhance chemical and corrosion resistance
- Shaft seals, slingers and one-way stainless steel drains to retard entrance of contaminants and water into the motor
- Bearings are double sealed and prelubricated with moisture resistant Shell Dolium R lubricant
- Construction is CSA Certified for safety and energy efficiency verification programs
- NEMA C-face mounting

## 200 SERIES



### 200 Series – Bost-Kleen™\*

- Washable & Scrubbable
- Durable, non-absorbent, non-toxic white epoxy finish, USDA approved
- Corrosion resistant
- 1/4 to 20 horsepower range
- Single and double reduction ratios – 4:1 to 24:1
- Standard NEMA C-face and projecting input shaft configurations
- Horizontal and vertical mounting kits
- Projecting and hollow output shafts

## 600 SERIES



### 600 Series – Bost-Kleen™\*

- Washable & Scrubbable
- Durable non-absorbent, non-toxic white epoxy finish
- Single, double and triple reductions 1.6:1 to 160:1 ratios
- Helical gearing
- Output flange available

\*Located in the Enclosed Gear Drives Catalog

**BOSTON GEAR®**

# APPLICATION ENGINEERING

## AC & DC Controllers

### ADJUSTABLE SPEED DRIVES – WHAT THEY ARE, HOW THEY WORK

The primary function of any adjustable speed drive is to control the speed, torque, acceleration, deceleration and direction of rotation of a machine. Unlike constant speed systems, the adjustable speed drive permits the selection of an infinite number of speeds within its operating range.

Most multi-purpose production machines benefit from adjustable speed control, since frequently their speeds must change to optimize the machine process or adapt it to various tasks for improved product quality, production speed or safety. Lathes and other machine tools run small diameter work pieces at high speed and large diameter pieces at low speeds to optimize the feed rate into the cutting tool. A printing press is operated at the speed that produces the best quality product, which may vary greatly with the weight and coating of paper, and the characteristics of the inks used. Also, the controlled acceleration provided by an adjustable speed drive allows the press to accelerate smoothly to prevent breaking the web of paper. A pump supplying water in a high rise building may run at very slow speeds at 3 o'clock AM to maintain system pressure, but be called upon at 3 o'clock PM to run at high speeds to provide high flow rates necessitated by water usage by the inhabitants.

While early types of adjustable speed drives based upon mechanical and hydraulic principles still remain in limited usage, the overwhelming choice today for industrial applications is the electrical adjustable speed drive. No other type offers the combined benefits of high performance, high efficiency, low maintenance, versatility and moderate initial cost. Electrical adjustable speed drives are offered in a number of basic types, but the two most versatile for general purpose applications and therefore the most common, are direct current (DC drives) and adjustable frequency (AC drives) as manufactured by Boston Gear. Electrical adjustable speed drives typically consist of three principle elements, as shown by the system block diagram in Figure 1.

#### 1. OPERATOR CONTROL STATION – THE BOSS

Allows the operator to start and stop the drive controller by push buttons or switches, and set the motor speed by turning a potentiometer to the desired dial setting. Operator controls may be integrated into the controller or mounted remotely from the drive controller.



#### 2. DRIVE CONTROLLER – THE BRAINS

Converts the fixed voltage and frequency of the alternating current (AC) plant power source into an adjustable power output to control the drive motor over a wide speed range. The output is established by the speed control potentiometer. The controller includes sensing circuits to hold or regulate the motor at the desired speed with variations in the source voltage and changes in motor load. The controller also includes protective circuitry and devices to prevent damage from overloads, power source transients and output power faults.



#### 3. DRIVE MOTOR – THE MUSCLE

Translates electrical energy into mechanical motion. The output is a shaft rotation (RPM), which varies in proportion to the power applied by the drive controller. The motor shaft is normally coupled to a gear reducer or other mechanical power transmission device to further reduce the motor speed to a level useable by the driven machine.

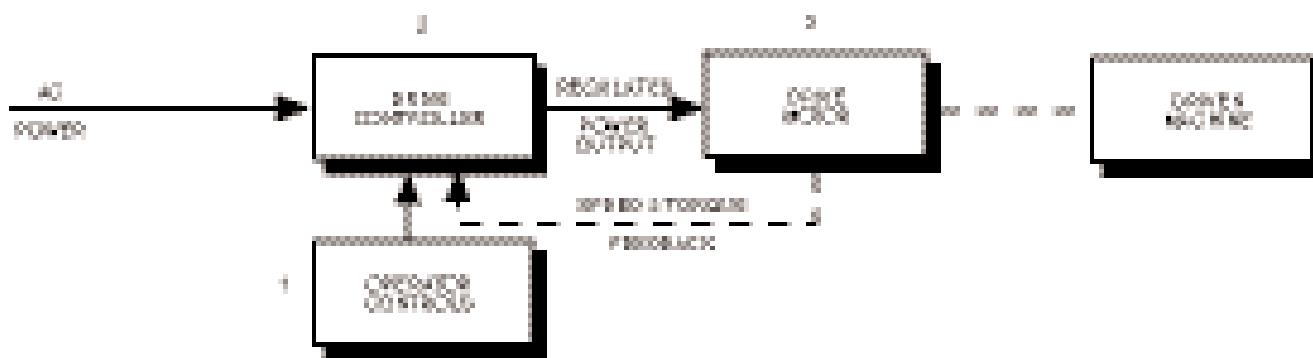


FIGURE 1.

**BOSTON GEAR®**

# APPLICATION ENGINEERING

## AC & DC Controllers

### DC DRIVES – PRINCIPLES OF OPERATION

DC drives, because of their simplicity, ease of application, reliability and favorable cost remain the backbone of industrial applications. A typical adjustable speed drive using a silicon controller rectifier (SCR) power conversion section, common for this type unit, is shown in Figure 2. The SCR, (also termed a thyristor) power converter converts the fixed voltage alternating current (AC) of the power source to an adjustable voltage, controlled direct current (DC) output which is applied to the armature of a DC motor.

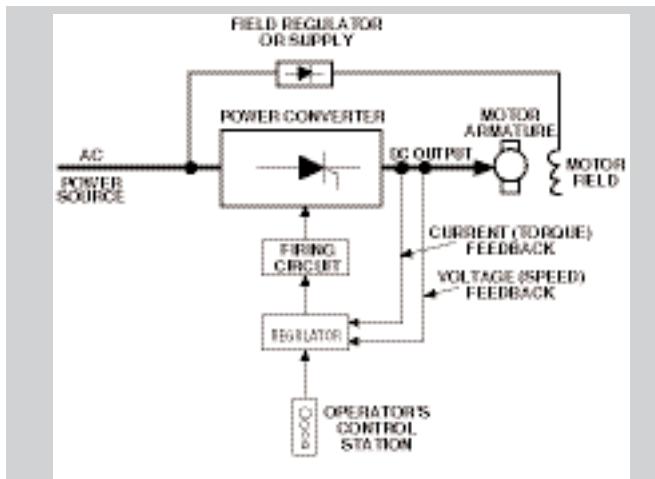


FIGURE 2. TYPICAL DC DRIVE

SCR's provide a controllable power output by "phase angle control", so called because the firing angle (a point in time where the SCR is triggered into conduction) is synchronized with the phase rotation of the AC power source. If the device is triggered early in half cycle, maximum power is delivered to the motor; late triggering in the half cycle provides minimum power, as illustrated by Figure 3. The effect is similar to a very high speed switch, capable of being turned on and "conducted" off at an infinite number of points within each half cycle. This occurs at a rate of 60 times a second on a 60 Hz line, to deliver a precise amount of power to the motor. The efficiency of this form of power control is extremely high since a very small amount of triggering energy can enable the SCR to control a great deal of output power.

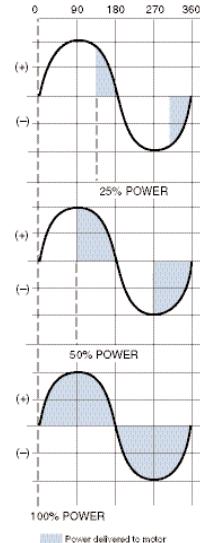


FIGURE 3. TRIGGERING POINTS FOR VARIOUS POWER OUTPUTS

### DC DRIVE TYPES

**Nonregenerative DC Drives**—Nonregenerative DC drives are the most conventional type in common usage. In their most basic form they are able to control motor speed and torque in one direction only as shown by Quadrant I in Figure 4. The addition of an electromechanical (magnetic) armature

reversing contactor or manual switch permits reversing the controller output polarity and therefore the direction of rotation of the motor armature as illustrated in Quadrant III. In both cases torque and rotational direction are the same.

**Regenerative DC Drives**—Regenerative adjustable speed drives, also known as four-quadrant drives, are capable of controlling not only the speed and direction of motor rotation, but also the direction of motor torque. This is illustrated by Figure 4.

The term regenerative describes the ability of the drive under braking conditions to convert the mechanical energy of the motor and connected load into electrical energy which is returned (or regenerated) to the AC power source.

When the drive is operating in Quadrants I and III, both motor rotation and torque are in the same direction and it functions as a conventional nonregenerative unit. The unique characteristics of a regenerative drive are apparent only in Quadrants II and IV. In these quadrants, the motor torque opposes the direction of motor rotation which provides a controlled braking or retarding force. A high performance regenerative drive, is able to switch rapidly from motoring to braking modes while simultaneously controlling the direction of motor rotation.

A regenerative DC drive is essentially two coordinated DC drives integrated within a common package. One drive operates in Quadrants I and IV, the other operates in Quadrants II and III. Sophisticated electronic control circuits provide interlocking between the two opposing drive sections for reliable control of the direction of motor torque and/or direction of rotation.

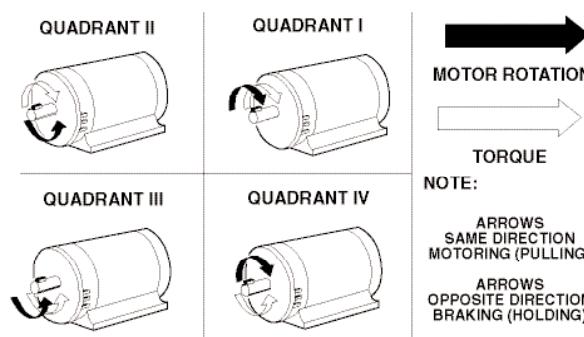


FIGURE 4.

TABLE 1. COMPARISON OF NONREGENERATIVE VS. REGENERATIVE DC DRIVE CAPABILITIES

|                            | Nonregenerative  | Regenerative   |
|----------------------------|--|--|
| Braking                    | No inherent braking capability. Requires the addition of a dynamic braking circuit which dissipates the braking energy as heat in a resistor. Braking effort is exponential with initial high torque which reduces to zero at zero speed. Braking circuits are rated for stopping only, not continuous hold back, or as a holding brake. | Inherent electronically by regeneration whereby the kinetic energy of the motor and driven machine is restored to the AC power source. Can be regulated to control the braking torque down to, and at zero speed. Typically capable of continuous braking torque for hold back applications. |
| Reversing                  | No inherent reversing capability. Requires the addition of reversing contactors or a switch to reverse the polarity of DC voltage applied to the motor. Normally rated for occasional reversals.   | An inherent capability. Motor polarity is reversed electronically with no contacts to arc, burn or wear. Desirable for applications requiring frequent reversals.  |
| Simplicity                 | The least complex and least expensive form of electronic adjustable speed motor control.   | More complex since it includes double the nonregenerative circuitry.   |
| Efficiency and Speed Range | Controller efficiency up to 99%, complete drive with motor 87%. Speed range up to 50:1 without a feedback tachometer, 200:1 and greater with a tachometer.   |  |

# APPLICATION ENGINEERING

## AC & DC Controllers

**Converter Types** – The power conversion or rectified power section of a DC drive is commonly called the converter. The individual characteristics of the various converter types used in standard industrial applications have had a definite influence in the design of compatible DC motors as shown in Table 2.

TABLE 2.

| Series                             | Rectified Power Source   |           |                            |                          | Motor Ratings |          |              |                              |
|------------------------------------|--|-----------|----------------------------|--------------------------|---------------|----------|--------------|------------------------------|
|                                    | Converter Type   | NEMA Code | Form <sup>(2)</sup> Factor | Ripple <sup>(2)</sup> Hz | Source VAC    | HP Range | Armature VDC | Field VDC                    |
| P40<br>P60<br>DP60<br>DP60RG       | Full Converter<br>6 SCR  | C         | 1.01                       | 360                      | 230           | 5-125    | 240          | 150                          |
|                                    | Nonregenerative<br>12 SCR  |           |                            |                          | 460           | 5-1000   | 500          | 300                          |
| P25                                | Semiconverter<br>3 SCR, 4 Diode  | D         | 1.05                       | 180                      | 230           | 5-10     | 240          | 150                          |
|                                    |  |           |                            |                          | 460           | 5-20     | 500          | 300                          |
| Ratiopax<br>BETA II<br>DCX         | Semiconverter<br>2 SCR,<br>3 Diode <sup>(1)</sup>                                  | K         | 1.35                       | 120                      | 115,230       | 1-3      | 90, 180      | 50,100<br>100,200<br>100,200 |
| BETApplus<br>VEplus<br>VED<br>VERG | Full Converter<br>4 SCR<br>Nonregenerative<br>8 SCR<br>Regenerative <sup>(1)</sup> | –         | –                          | 120                      | 115,230       | 1-5      | 90,180       | 100,200                      |

NOTES: (1) Single-phase: others are three-phase

(2) Ripple frequency quoted for 60 Hz power source. 50 Hz power sources result in ripple currents 20% higher than those for a 60 Hz source under the same operating conditions. The higher ripple produces additional heating which may be compensated by reducing the continuous load capability below base speed by approximately 5%. Form factor is at base speed, full load. Form factor of the current is the ratio of the rms current to the average current. For pure DC, such as a battery, the form factor is 1.0. For motors operated on rectified power the AC ripple content of the rectified current causes additional heating which increases as the square of the form factor. A motor is suitable for continuous operation of the form factor stamped on the data plate at rated load and rated speed. Actual motor heating when run from a half-wave converter should be determined by test, and is the responsibility of the purchaser.

### DC MOTOR CONTROL CHARACTERISTICS

A shunt-wound motor is a direct-current motor in which the field windings and the armature may be connected in parallel across a constant-voltage supply. In adjustable speed applications, the field is connected across a constant-voltage supply and the armature is connected across an independent adjustable-voltage supply. Permanent magnet motors have similar control characteristics but differ primarily by their integral permanent magnet field excitation.

The speed (N) of a DC motor is proportional to its armature voltage; the torque (T) is proportional to armature current, and the two quantities are independent, as illustrated in Figure 5.

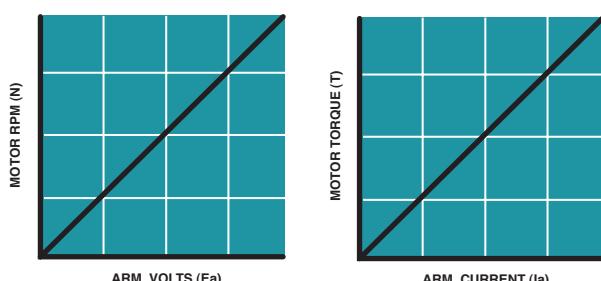


FIGURE 5. DC MOTOR CHARACTERISTICS

### CONSTANT TORQUE APPLICATIONS

Armature voltage controlled DC drives are constant torque drives. They are capable of providing rated torque at any speed between zero and the base (rated) speed of the motor as shown by Figure 6. Horsepower varies in direct proportion to speed, and 100% rated horsepower is developed only at 100% rated motor speed with rated torque.

### CONSTANT HORSEPOWER APPLICATIONS

**Armature Controlled DC Drives** – Certain applications require constant horsepower over a specified speed range. The screened area, under the horsepower curve in Figure 6, illustrates the limits of constant horsepower operation for armature controlled DC drives. As an example, the motor could provide constant horsepower between 50% speed and 100% speed, or a 2:1 range. However, the 50% speed point coincides with the 50% horsepower point. Any constant horsepower application may be easily calculated by multiplying the desired horsepower by the ratio of the speed range over which horsepower must remain constant. If 5 HP is required over a 2:1 range, an armature only controlled drive rated for 10 (5 x 2) horsepower would be required.

Table 3 provides a convenient listing of horsepower output at various operating speeds for constant torque drives.

**Field Controlled DC Drives** – Another characteristic of a shunt-wound DC motor is that a reduction in field voltage to less than the design rating will result in an increase in speed for a given armature voltage. It is important to note, however, that this results in a higher armature current for a given motor load. A simple method of accomplishing this is by inserting a resistor in series with the field voltage source. This may be useful for trimming to an ideal motor speed for the application. An optional, more sophisticated method uses a variable voltage field source as shown by Figure 6. This provides coordinated automatic armature and field voltage control for extended speed range and constant HP applications. The motor is armature voltage controlled for constant torque-variable HP operation to base speed where it is transferred to field control for constant HP-variable torque operation to motor maximum speed.

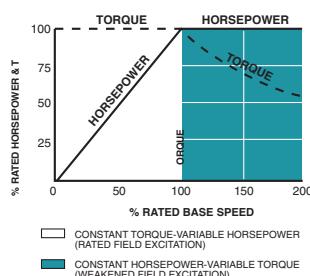


FIGURE 6.

### AC DRIVES – PRINCIPLES OF OPERATION

Adjustable frequency AC motor drive controllers frequently termed inverters are typically more complex than DC controllers since they must perform two power section functions, that of conversion of the AC line power source to DC and finally an inverter changes the DC to a coordinated adjustable frequency and voltage output to the AC motor. The appeal of the adjustable frequency drive is based upon the simplicity and reliability of the AC drive motor, which has no brushes, commutator or other parts that require routine

(Continued)

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## AC & DC Controllers

TABLE 3. HORSEPOWER OUTPUT AT VARIOUS MOTOR SPEEDS WITH 1750 RPM BASE SPEED CONSTANT TORQUE DRIVES

| Rated HP<br>At 1750 RPM<br>Base Speed | Rated Torque<br>At All Speeds<br>Lb. -Ft. (1) | HP Ratings at Various Motor RPM |         |        |        |        |        |        |        |        |       |       |
|---------------------------------------|---|---------------------------------|---------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
|                                       |   | 1575                            | 1400    | 1225   | 1050   | 875    | 700    | 525    | 350    | 175    | 87.5  | 35    |
| 1/6                                   | 0.50  | .150                            | .133    | .117   | .100   | .083   | .067   | .050   | .033   | .017   | .008  | .003  |
| 1/4                                   | 0.75  | .225                            | .200    | .175   | .150   | .125   | .100   | .075   | .050   | .025   | .013  | .005  |
| 1/3                                   | 1.00  | .300                            | .267    | .233   | .200   | .167   | .133   | .100   | .067   | .033   | .017  | .007  |
| 1/2                                   | 1.50  | .450                            | .400    | .350   | .300   | .250   | .200   | .150   | .100   | .050   | .025  | .010  |
| 3/4                                   | 2.25  | .675                            | .600    | .525   | .450   | .375   | .300   | .225   | .150   | .075   | .038  | .015  |
| 1                                     | 3.00  | .900                            | .800    | .700   | .600   | .500   | .400   | .300   | .200   | .100   | .050  | .020  |
| 1-1/2                                 | 4.50  | 1.350                           | 1.200   | 1.050  | .900   | .750   | .600   | .450   | .300   | .150   | .075  | .030  |
| 2                                     | 6.00  | 1.800                           | 1.600   | 1.400  | 1.200  | 1.000  | .800   | .600   | .400   | .200   | .100  | .040  |
| 3                                     | 9.00  | 2.700                           | 2.400   | 2.100  | 1.800  | 1.500  | 1.200  | .900   | .600   | .300   | .150  | .060  |
| 5                                     | 15.00   | 4.500                           | 4.000   | 3.500  | 3.000  | 2.500  | 2.000  | 1.500  | 1.000  | .500   | .250  | .100  |
| 7-1/2                                 | 22.50   | 6.750                           | 6.000   | 5.250  | 4.500  | 3.750  | 3.000  | 2.250  | 1.500  | .750   | .375  | .150  |
| 10                                    | 30.00   | 9.000                           | 8.000   | 7.000  | 6.000  | 5.000  | 4.000  | 3.000  | 2.000  | 1.000  | .500  | .200  |
| 15                                    | 45.00   | 13.500                          | 12.000  | 10.500 | 9.000  | 7.500  | 6.000  | 4.500  | 3.000  | 1.500  | .750  | .300  |
| 20                                    | 60.00   | 18.000                          | 16.000  | 14.000 | 12.000 | 10.000 | 8.000  | 6.000  | 4.000  | 2.000  | 1.000 | .400  |
| 25                                    | 75.00   | 22.500                          | 20.000  | 17.500 | 15.000 | 12.500 | 10.000 | 7.500  | 5.000  | 2.500  | 1.250 | .500  |
| 30                                    | 90.00   | 27.000                          | 24.000  | 21.000 | 18.000 | 15.000 | 12.000 | 9.000  | 6.000  | 3.000  | 1.500 | .600  |
| 40                                    | 120.00  | 36.000                          | 32.000  | 28.000 | 24.000 | 20.000 | 16.000 | 12.000 | 8.000  | 4.000  | 2.000 | .800  |
| 50                                    | 150.00  | 45.000                          | 40.000  | 35.000 | 30.000 | 25.000 | 20.000 | 15.000 | 10.000 | 5.000  | 2.500 | 1.000 |
| 60                                    | 180.00  | 54.000                          | 48.000  | 42.000 | 36.000 | 30.000 | 24.000 | 18.000 | 12.000 | 6.000  | 3.000 | 1.200 |
| 75                                    | 225.00  | 67.500                          | 60.000  | 52.500 | 45.000 | 37.000 | 30.000 | 22.500 | 15.000 | 7.500  | 3.750 | 1.500 |
| 100                                   | 300.00  | 90.000                          | 80.000  | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 | 5.000 | 2.00  |
| 125                                   | 375.00  | 112.500                         | 100.000 | 87.500 | 75.000 | 62.500 | 50.000 | 37.500 | 25.000 | 12.500 | 6.250 | 2.50  |
| Percent of Base Speed                 |   | 90                              | 80      | 70     | 60     | 50     | 40     | 30     | 20     | 10     | 5     | 2     |

Motors may require supplemental cooling when operated continuously at rated load at reduced speeds. See Motor Specifications.

NOTE: (1) lb-in = lb - ft  $\times$  12

(1) Torque ratings for other base speed motors:  
2500 RPM Motor = 1750 RPM Torque  $\times$  .7 Approx.  
1150 RPM Motor = 1750 RPM Torque  $\times$  1.52 Approx.  
850 RPM Motor = 1750 RPM Torque  $\times$  2.06 Approx.

maintenance, which more than compensates for the complexity of the AC controller. The robust construction, and low cost of the AC motor makes it very desirable for a wide range of uses. Also, the ability to make an existing standard constant speed AC motor an adjustable speed device simply by the addition of an adjustable frequency controller creates a very strong incentive for this type of drive.

### AC CONTROLLER TYPES

A number of different types of AC motor controllers are currently in common use as general purpose drives: Six-Step or Variable Voltage Input (VVI), Pulse Width Modulated (PWM), Current Source Input (CSI), and the Load Commutated Inverter (LCI). Each type offers specific benefits and characteristics but the Six-Step and PWM types have been selected by Boston Gear as offering the best combination of simplicity, performance and economy for general purpose applications. Table 4 shows comparative advantages and disadvantages.

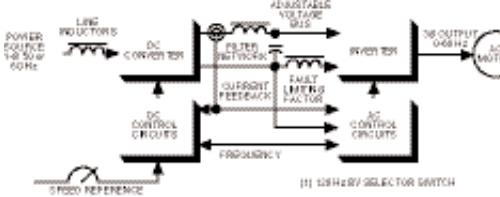


FIGURE 7.

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**Six Step Controllers** – Six-Step controllers, so called due to their output voltage waveform, utilize an adjustable voltage, linkcoupled inverter system as shown in Figure 7.

The controller converts the AC power source to an adjustable DC voltage proportional to the speed reference command. The DC voltage is smoothed by a filter network and directed to a six-step inverter. The inverter changes the DC to AC at a frequency proportional to the speed reference. Output voltage and frequency are simultaneously coordinated and regulated to maintain a specific relationship of voltage and frequency (volts/Hz ratio) throughout the normal speed range. The voltage waveform applied to the motor is a stepped wave approximation of a true sinusoidal waveform as shown by Figure 8. The low harmonic content of this waveform has little adverse effect on the motor.



FIGURE 8.

# APPLICATION ENGINEERING

## AC & DC Controllers

TABLE 4. COMPARISON OF PWM VERSUS SIX-STEP ADJUSTABLE FREQUENCY AC CONTROLLER CAPABILITIES

| Type     | Advantages  | Disadvantages   |
|----------|---|---|
| PWM      | <ul style="list-style-type: none"> <li>Microprocessor based PWM units are typically less expensive than six-step units which commonly use SCR phase converters and analog techniques.</li> <li>30:1 and greater, constant torque speed range with smooth, noncogging low speed operation.</li> <li>High Power Factor—Displacement power factor is 96% or better over entire speed range at rated load.</li> <li>High Efficiency – Controller only 96%. Complete drive powered by a 3-phase source 83%, 70-80% when powered from a single-phase source, dependent upon motor efficiency.</li> <li>Power section with simple diode bridge AC to DC front end converter.</li> <li>Diode converter causes no line notching.</li> <li>Complex microprocessor circuitry easily serviced by substitution.</li> </ul> | <ul style="list-style-type: none"> <li>Audible motor noise may be objectionable for some applications. This can be minimized/eliminated with higher carrier frequencies, but this reduces controller efficiency (IGBT units allow higher switching frequencies, therefore less audible motor noise).</li> <li>Microprocessor control common to PWM inverters and high frequency power output tends to produce radiated, radio frequency interference (RFI) which may be objectionable in sensitive environments such as hospitals, communications centers, etc.</li> <li>Up to 2.5 times greater distortion of the AC voltage source than phase control input six step drives.</li> </ul> |
| Six-Step | <ul style="list-style-type: none"> <li>Quiet motor operation with minimal audible noise.</li> <li>Radiated RFI well within F.C.C. guidelines (non-microprocessor designs) making them desirable for sensitive applications such as hospitals.</li> <li>Minimal distortion of the AC voltage source with phase control input designs.</li> <li>Power factor 95% or less, variable with speed and load.</li> </ul>  | <ul style="list-style-type: none"> <li>Speed range limited to 10:1 constant torque. Rated torque operation produces motor cogging at and below this speed.</li> <li>Phase controlled converter may produce notches in the AC line power source.</li> <li>Power factor reduces with speed and load.</li> <li>SCR phase converters and analog circuitry common to these units usually make them more expensive than PWM designs.</li> </ul>   |

**PWM Controllers**—The PWM controller converts the AC power source to a fixed DC voltage by a full-wave rectifier. The resultant DC voltage is smoothed by a filter network and applied to a pulse width modulated inverter using high power transistors. These transistors are normally Darlington, MOSFET (Metal Oxide Semiconductor Field Effect Transistor) or IGBT (Insulated Gate Bipolar Transistor) types. The MOSFET and IGBT types allow higher switching frequencies and therefore, less audible motor noise. The speed reference command is directed to the microprocessor which simultaneously optimizes the carrier (chopping) frequency and inverter output frequency to maintain a proper volts/Hz ratio and high efficiency throughout the normal speed range. See Block Diagram, Figure 9.

The voltage applied to the motor is a pulsed approximation of a true sinusoidal waveform as shown in Figure 10. This is

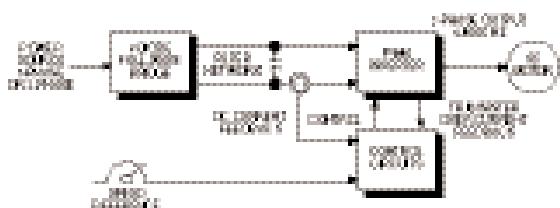


FIGURE 9.

commonly called a PWM waveform because both the carrier frequency and pulse-width is changed (modulated) to change the effective voltage amplitude and frequency. The current waveform very closely follows the shape of a sine wave and therefore provides improved low speed motor performance, efficiency, and minimizes motor heating.

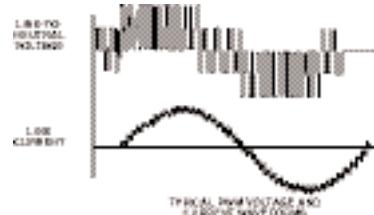


FIGURE 10.

### AC MOTOR CONTROL CHARACTERISTICS

The synchronous speed of an AC induction motor is directly proportional to the applied frequency.

$$\text{Speed} = \frac{120 \times \text{Frequency}}{\text{No. of Motor Poles}}$$

The synchronous speed is the speed of the rotating electrical field, not the actual motor rotor speed. The difference between the synchronous speed and the full-load motor speed is called slip, which is normally expressed in percent. The percentage of slip is determined by the design of the motor, primarily the rotor resistance. NEMA has assigned code letters (A, B, C, D, etc.) to standardize motor characteristics including slip. The type most commonly used is NEMA Design B with 3% slip at rated operating conditions. Figure 11 shows typical speed/torque curves for NEMA Design B and D motors.

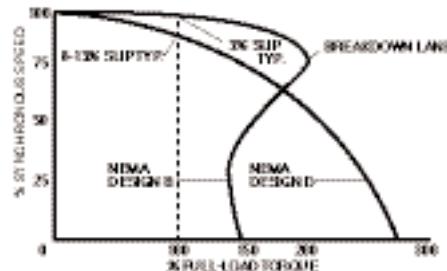


FIGURE 11.

As the applied frequency is changed, the motor will run faster or slower as shown by Figure 12. The actual full-load motor slip (as a percent of the motor synchronous speed) varies in inverse proportion to the frequency, where a 3% slip motor 60 Hz would have a 6% slip at 30 Hz or 1 1/2 % slip at 120 Hz. Motor speed is limited only by the maximum inverter output frequency, load torque requirements, and the mechanical integrity of the motor.

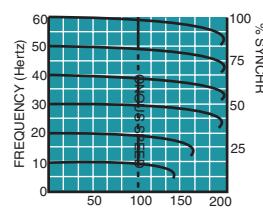


FIGURE 12. TYPICAL SPEED TORQUE CURVES FOR 60 HZ NEMA DESIGN B MOTOR (WITHOUT VOLTAGE BOOST)

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### MOTOR SELECTION

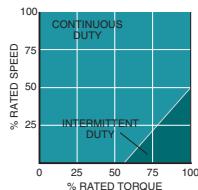
**Constant Torque Applications**—About 90% of all general industrial machines, other than fans and pumps, are constant torque systems where the machine's torque requirement is independent of its speed. If the machine speed is doubled, its horsepower requirement doubles. Conversely a reduction in machine speed by 50% will result in an equal reduction in horsepower, but no reduction in torque.

1. Standard three-phase AC motors, designed for fixed speed operation at standard line frequency, may be easily adapted for use with the AC controller by considering the following:

a. A slight increase in motor losses occurs with inverter power.

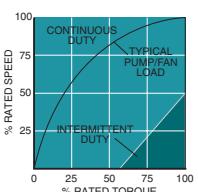
b. The motor thermal capacity must typically be derated as a function of the minimum, continuous operating speed in accord with Figure 13, due to the reduced ventilation provided by the integral motor fan. Where the application requires 100% rated torque at speeds below 50% of synchronous speed, a separately powered ventilation blower, a nonventilated motor with greater reserve thermal capacity or, a motor with higher rated capacity should be used. When a separately powered ventilation blower is used, a thermostat should be built into the motor to prevent damage which may result from a failure in the ventilation system.

2. Any three-phase synchronous or induction AC motor designed expressly for adjustable speed service by inverter control may normally be used over its design speed range with the AC controller.



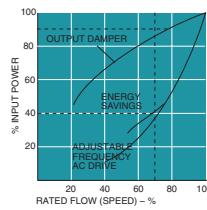
**FIGURE 13. TYPICAL STANDARD AC MOTORS ADJUSTABLE SPEED OPERATION**

**Variable Torque Applications**—The application of standard AC motors to adjustable speed variable torque applications such as centrifugal fans or pumps is ideal from a motor cooling standpoint. The torque characteristics of a variable torque (cubed exponential horsepower) load are such that the load falls off rapidly as the motor speed is reduced. The variable torque load eliminates the necessity to derate the motor due to excessive heat resulting from diminished motor cooling at reduced speeds. Figure 14 illustrates the relationship between speed and torque in variable torque applications.



**FIGURE 14. TYPICAL STANDARD AC MOTOR APPLICATION WITH VARIABLE TORQUE LOADS**

**Potential Power Savings**—Most fan and pump applications require the system to run for sustained periods at reduced outputs by either reducing the speed of the motor or by mechanically altering the flow. Figure 15 illustrates typical energy savings, in percent of rated power, which can be realized when using an adjustable frequency



**FIGURE 15. ENERGY SAVINGS**

controller to reduce motor speed and thereby system flow as opposed to a constant speed motor which has its system flow varied by an outlet damper.

### Constant Torque Operation

The ability of the AC controller to maintain a constant volts/Hz relationship is ideal from a motor standpoint. This permits operation of the motor at rated torque from near standstill to rated speed.

Figure 16 represents the relationship between torque, horsepower and motor speed with a maintained volts/Hz ratio using a 60 Hz controller for illustration. A standard 4-pole 460V motor can be controlled by this method to its synchronous speed of 1800 RPM. If the same motor were wound for 50% of the input voltage (230V), it could be controlled with constant torque to double the normal rated speed and horsepower. The motor would not be "overvoltaged" because the volts/Hz ratio could be maintained e.g.: a motor wound for 230 VAC can supply constant torque to twice the AC line frequency when used on a 460V power source without overvoltage the motor because the volts/Hz ratio of 230V/60 Hz is the same as 460V/120 Hz. The horsepower would also double since the same torque would be developed at twice the normal rated speed.

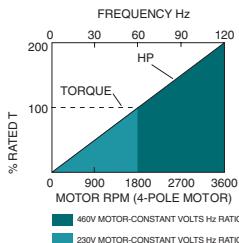
Caution must be observed when applying standard motors for continuous low speed, rated torque operation. The motor's self-cooling capability is dependent upon self-ventilation schemes with efficiency that is considerably reduced at lower operating speeds.

### Constant Horsepower Operation

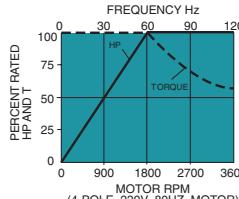
AC motor controllers are also adaptable to constant horsepower operation as shown by Figure 17. With this mode of operation, the volts/Hz ratio is maintained to a specific frequency, normally 50 or 60 Hz. At this point, the voltage is "clamped" at a constant level while the frequency is adjusted further to achieve the desired maximum speed. Since the controller maximum output voltage is limited to the voltage of the AC power source, the volts/Hz ratio must decrease beyond this point as the frequency increases. The motor becomes "voltage starved" above the clamping point and torque decreases as speed increases, resulting in constant horsepower output.

As shown in Figure 17 the drive provides conventional constant torque/variable horsepower operation up to 60 Hz which is equivalent to the 1800 RPM base speed of the 60 Hz motor. Between 1800 and 3600 RPM, the drive provides constant horsepower/variable torque operation. If constant horsepower is required between 900 and 3600 RPM (a 4:1 speed range) – using the same 1800 RPM base speed motor, the drive rated horsepower must be increased since 900 RPM intersects the curve at a point which is 50% of rated horsepower.

Constant HP operation (above synchronous speed) is limited to induction motors only. In addition, at some point, typically around three times base speed for a four-pole induction motor, the breakdown torque of the motor prevents further constant horsepower operation. Synchronous reluctance motor characteristics prevent operation in this mode.



**FIGURE 16. CONSTANT TORQUE OPERATION**



**FIGURE 17. TYPICAL CONSTANT HP OPERATION**

# APPLICATION ENGINEERING

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### Multiple Motor Operation (From a Common Controller) –

An adjustable frequency AC motor controller is ideally suited for simultaneous control of multiple motors in process line applications. All motors are operated at a common frequency and are therefore synchronized at a common speed. Tracking accuracy between the individual motors varies only the difference in their loads, typically 0.5% to 3% with standard NEMA Design B motors and 0.0% with synchronous reluctance types.

Where tracking ratios other than 1:1 are desirable, gear boxes, fixed or adjustable sheaves may be used to attain the desired individual speeds. Two-pole, four-pole and six-pole motors may also be mixed to obtain various individual motor operating speeds when operated from a common adjustable frequency controller. Selection of a properly rated controller should be made with consideration for the total KVA required by all the motors which are normally started and stopped simultaneously. Some process line applications require the ability to selectively start and stop one or more of the motors while the others are operated at the desired speed. A standard motor started under this condition instantaneously draws locked-rotor current of 600-800%. Unless this factor is considered in the selection of an adequately rated controller, the additional load may exceed the capacity of the power unit, reducing the voltage to the entire system which could cause the line to stall or trip off.

### AC VS. DC DRIVE COMPARISON

AC and DC drives both continue to offer unique benefits and features that may make one type or other better suited for certain applications.

#### AC drives may be better because . . .

- They use conventional, low cost, 3-phase AC induction motors for most applications.
- AC motors require virtually no maintenance and are preferred for applications where the motor is mounted in an area not easily reached for servicing or replacement.
- AC motors are smaller, lighter, more commonly available, and less expensive than DC motors.
- AC motors are better suited for high speed operation (over 2500 rpm) since there are no brushes, and commutation is not a problem.
- Whenever the operating environment is wet, corrosive or explosive and special motor enclosures are required. Special AC motor enclosure types are more readily available at lower prices.
- When multiple motors in a system must operate simultaneously at a common frequency/speed.
- When it is desirable to use an existing constant speed AC motor already mounted and wired on a machine.
- When the application load varies greatly and light loads may be encountered for prolonged periods. DC motor commutators and brushes may wear rapidly under this condition.
- When low cost electronic motor reversing is required.
- Whenever it is important to have a back up (constant speed) if the controller should fail.

#### DC drives may be better because . . .

- DC drives are less complex with a single power conversion from AC to DC.
- DC drives are normally less expensive for most horsepower ratings.
- DC motors have a long tradition of use as adjustable speed machines and a wide range of options have evolved for this purpose:
- Cooling blowers and inlet air flanges provide cooling air for a wide speed range at constant torque.
- Accessory mounting flanges and kits for mounting feedback tachometers and encoders.
- DC regenerative drives are available for applications requiring continuous regeneration for overhauling loads. AC drives with this capability would be more complex and expensive.
- When properly applied brush and commutator maintenance is minimal.
- DC motors are capable of providing starting and accelerating torques in excess of 400% of rated.
- Some AC drives may produce audible motor noise which is undesirable in some applications.
- DC SCR drives have been the first choice of industry for over 25 years. Their maintenance, technology, serviceability and reliability are well understood by plant maintenance personnel.

### BASIC MECHANICS

The curve in Figure 6 shows a distinct relationship between speed, torque and horsepower. Torque is constant at any speed while there is a direct proportional relationship between horsepower and speed; horsepower varies directly with the speed. Therefore, horsepower is motion dependent, torque is not.

### TORQUE

A force applied in a manner that tends to produce rotation, such as a pipe wrench on a shaft. Torque (force) without rotation is termed static torque, since no motion is produced.

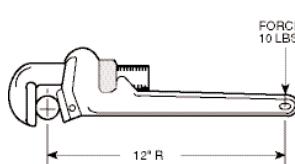


FIGURE 18

Torque is measured in lb-in or lb-ft which is the product of the force in pounds (lb) x the distance in inches (in) or feet (ft) from the center of the point of apparent rotation. Figure 18 shows 120 lb-in (12 inches x 10 lbs) or 10 lb-ft torque.

Because most power transmission is based upon rotating elements, torque is important as a measurement of the effort required to produce work (horsepower).

### POWER (Horsepower)

A force applied in a manner that produces motion and, therefore, work over a specified time period. A common unit of power is horsepower. **One horsepower (HP) is defined as the force required to lift 33,000 lbs, one foot in one minute.**

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## AC & DC Controllers

### THREE BASIC FACTORS ARE INVOLVED:

| Factor               | Unit             |
|----------------------|------------------|
| Distance (Radius)    | Foot (or inches) |
| Force (Push or Pull) | Pounds           |
| Time                 | One (1) Minute   |

$$HP = \frac{F \text{ (Load in Pounds)} \times \text{Feet per Minute}}{33,000}$$

### HORSEPOWER-TORQUE, GETTING IT TOGETHER

As shown in Figure 19, the 50 lb load is acting on the 5 inch radius (distance) of the winch, producing a load torque of 250 lb-in (50 lbs  $\times$  5 inches) that must be overcome to lift the load. Since the hand crank arm has a 10 inch radius (distance), a minimum force of 25 lbs must be exerted to overcome the load torque ( $25 \text{ lbs} \times 10^{\text{in}} = 250 \text{ lb-in}$ ). If no motion is involved, the system is in balance. Although torque is being exerted, no work is accomplished and no horsepower is developed.

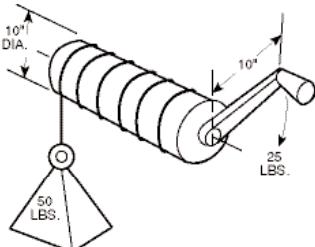


FIGURE 19

The winch diameter is 10 inches. Therefore, each revolution of the hand crank will lift the weight 10 inches  $\times \pi = 31.416$  inches (2.618 feet).

If the crank is turned at 10 RPM, 50 lbs will be lifted a distance of 26.18 feet in one minute:

$$HP = \frac{\text{Load in Pounds} \times \text{Feet per Minute}}{33,000}$$

$$HP = \frac{50 \times 26.18}{33,000} = .03966 \text{ HP}$$

Turning the crank twice as fast (20 RPM) will develop twice the horsepower.

$$HP = \frac{50 \times 52.36}{33,000} = .07933 \text{ HP}$$

Thus, the horsepower of rotating elements can be calculated from the following formula:

$$HP = \frac{F \times 2\pi \times R \times RPM}{33,000} = \frac{T \times RPM}{5252}$$

Where,

F = force in pounds

R = radius (lever length in feet)

RPM or N = revolutions per minute

T = torque in lb-ft (F  $\times$  R)

### SELECTING A DRIVE FOR A MACHINE

The application of an adjustable speed drive to power a machine is a mechanical, rather than an electrical problem. When applying the drive, the speed – torque – horsepower characteristics developed at the drive motor shaft must be considered, and how well these characteristics suit the machine.

Four essential parameters are

1. Breakaway Torque
2. Process Torque
3. Accelerating Torque
4. Running Torque

### BREAKAWAY TORQUE –

The torque required to start the machine in motion.

It is most always greater than the torque required to maintain motion (running torque). Breakaway torque combined with process torque frequently determines drive selection. Table 5 lists typical breakaway torques for various machine types.

TABLE 5. TYPICAL BREAKAWAY TORQUES FOR VARIOUS MACHINE TYPES

| Machine Types   | Breakaway Torque*   | Drive Selection  |
|---|---|--|
| Machines with ball or roller bearings   | 110 to 125%   | Standard drive rating  |
| Machines with sleeve bearings   | 130 to 150%   | Standard drive rating  |
| Conveyors and machines with excessive sliding friction  | 160 to 250%   | Oversize drive   |
| Machines that have "high" load spots in their cycle, e.g., printing and punch presses, and machines with cam or crank operated mechanisms       | 250% to 600%  | Oversize drive   |
| High Inertia – Machines with fly-wheels or other heavy rotating masses. Also, some machines that move large masses by cranks, centrifuges, etc. | Nominal rating of drive will depend on the breakaway torque requirement | Drive rating dependent upon desired acceleration time and drive torque |

\*Typical percentages of running torque

### PROCESS TORQUE –

The torque required to pull, push, compress, stretch or otherwise process or act upon the material being transported by or through the machine.

On some machines, process torque may be so significant as to determine the drive power rating. On other machines, this load may be insignificant. The process torque load is superimposed on all other static and dynamic torque requirements of the machine.

### ACCELERATING TORQUE –

The torque required to bring the machine to an operating speed within a given time.

With most machines, the load is largely friction and a standard drive rating may have adequate torque for satisfactory acceleration. However, certain machines classified as "high inertia" with flywheels, bull gears or other large rotating masses may require drive selection based upon the power required to accelerate the load within a given time.

### RUNNING TORQUE –

The torque required to maintain machine motion after it accelerates to the desired operating speed.

The characteristics of the speed-torque curves of various machines are very important to proper adjustable speed drive selection. Most machines fall into four basic categories:

1. Constant Torque (Figure 20)
2. Constant Horsepower (Figure 21)
3. Squared Exponential Horsepower (Figure 22)
4. Cubed Exponential Horsepower (Figure 23)

Some machines may have operating characteristics which are a composite of the basic types.

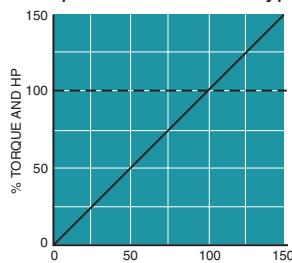


Figure 20. Constant Torque

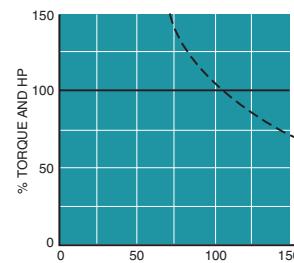


Figure 21. Constant Horsepower

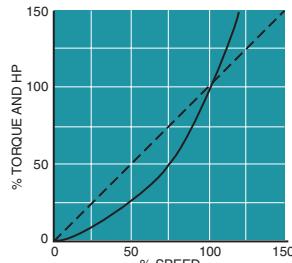


Figure 22. Squared Exponential Horsepower

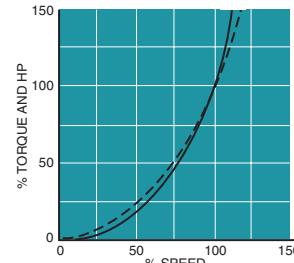


Figure 23. Cubed Exponential Horsepower

— — — Torque      — — HP

### CONSTANT TORQUE –

Most industrial machine applications, other than pumps, are constant torque systems.

The machine's torque requirement is independent of its speed. If the machine speed is doubled, its horsepower requirement doubles. This fact must be kept in mind when replacing a constant speed drive with an adjustable speed drive and the machine operating speed is increased.

### CONSTANT HORSEPOWER –

For machines with constant horsepower loads, the power demand is independent of speed, and torque varies inversely with speed.

This type is most often found in the machine-tool industry and with center driven winders. When drilling, shaping, milling, or turning metal, the loads all tend toward constant horsepower. At low speed there is high torque; at high speed, light torque. A drive must be selected for its highest torque condition which is at the lowest speed of the range. With most machines, the "constant horsepower range" seldom exceeds a 3:1 range.

### SQUARED-EXPONENTIAL LOADS –

With machines of this type, torque varies directly as the speed, and power as the square of speed.

Such relationships are frequently found in positive-displacement pumps and mixer applications.

### CUBED-EXPONENTIAL LOADS –

It is characteristic of these machines that torque varies as the square of speed, and power as the cube of speed.

This type of load is imposed on centrifugal pump drives and most fan or blower drives. In some uses, fan or blower horsepower varies as the fifth power of speed. The exponential relationship is characteristic of these machines. This fact must be considered when sizing motors for adjustable speed drives. If the speed of a centrifugal pump is doubled, its power requirement increases by a factor of eight.

### OTHER APPLICATION FACTORS

#### CONSTANT TORQUE SPEED RANGE –

On large motors, minimum operating speed limitations may be necessary for self-ventilated motors, since their cooling is entirely dependent upon motor speed and, therefore, diminishes as speed is reduced. Where rated torque operation is required continuously at lower speeds, either a higher rated drive motor or supplemental motor ventilation, such as a motor mounted cooling blower or external air duct, is required.

#### TORQUE LIMITATIONS –

Most adjustable speed drives feature a torque limiter to protect the drive and the machine from torque overloads. The torque limiter (current limit) is normally adjusted to 150% of rated torque to allow extra momentary torque for breakaway, acceleration or cyclic overloads. Most drive systems are capable of sustaining the 150% torque overload for one minute or less.

#### DUTY CYCLE –

Certain applications may require continuous reversals, long acceleration times at high torque due to inertia loads, frequent high rate acceleration, or cyclic overloads which may result in severe motor heating if not considered in the selection of the drive. Most drives with 150% overload capability will operate successfully if there are compensating periods of operation where motor temperatures can be normalized.

#### MEASURING MACHINE TORQUE

To measure the torque required to drive a machine, fasten a pulley securely to the shaft which the motor is to drive. Fasten one end of a cord to the outer surface of the pulley and wrap a few turns of the cord around the pulley. Tie the other end of the cord to a spring scale. See Figure 24.

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Figure 24.

Pull on scale until the shaft turns. The force in pounds or ounces, indicated on the scale, multiplied by the radius of the pulley (measured from the centerline of the machine shaft) in inches gives the torque value in lb-inches or oz-inches. On some machines, this torque may vary as the shaft rotates. The highest value of torque must be used when selecting a motor.

The running torque required by a machine will be approximately equal to the starting torque if the load is composed almost entirely of friction. If the load is primarily inertia or windage, the characteristics of the inertia or windage producing elements must be determined.

The running torque of a machine can be accurately determined by making a test run with an armature controlled DC drive (with a shunt wound or permanent magnet DC motor) of known horsepower rating. The DC drive should have an ammeter in the armature circuit so significant current readings can be observed and recorded throughout the speed range of the machine. Since armature current and torque are directly proportional within very close limits, the current readings will provide accurate information for selecting the drive rating required by the machine.

Most machines require a higher torque value for breakaway, but once running, the torque requirement will decrease. Many drives have 150% load capability for one minute, which may allow the required additional breakaway torque to be obtained without increasing the drive horsepower rating.

If the running torque is equal to or less than the breakaway torque divided by 1.5, use the breakaway torque divided by 1.5 as the full-load torque required to determine the motor horsepower.

If the running torque is greater than the breakaway torque divided by 1.5, but less than the breakaway torque, use the running torque as the full load rated torque required to determine the motor horsepower.

### MECHANICAL FORMULAS

#### HOW TO CALCULATE TORQUE

If the horsepower and base speed of a motor are known, the full-load torque of the motor is determined by:

$$T = \frac{(5250) (HP)}{N}$$

Where,  $T$  = Torque (lb-ft)

HP = Horsepower

N = Base speed of motor (RPM)

#### HOW TO CALCULATE HORSEPOWER

For Rotating Objects:

$$HP = \frac{TN}{63,025}$$

Where,  $T$  = Torque (lb-in)  
 $N$  = Speed (RPM)

or:

$$HP = \frac{TN}{5250}$$

Where,  $T$  = Torque (lb-ft)  
 $N$  = Speed (RPM)

For Objects in Linear Motion:

$$HP = \frac{FV}{396,000}$$

Where,  $F$  = Force (lb)  
 $V$  = Velocity (IPM)

or:

$$HP = \frac{FV}{33,000}$$

Where,  $F$  = Force (lb)  
 $V$  = Velocity (FPM)

For Pumps:

$$HP = \frac{(GPM) \times (\text{Head in Feet}) \times (\text{Specific Gravity})}{3950 \times (\text{Efficiency of Pump})}$$

For Fans and Blowers:

$$HP = \frac{CFM \times (\text{Pressure in Pounds/Sq ft})}{33,000 \times \text{Efficiency}}$$

When calculated horsepower falls between standard motor ratings, select the next higher rating.

#### CALCULATING ACCELERATING FORCE FOR LINEAR MOTION.

The following formula can be used to calculate the approximate accelerating force required for linear motion. However, before sizing the drive, add the torque required to accelerate the motor armature, gears, pulleys, etc. to the linear-motion accelerating force converting to torque.

$$\text{Acceleration Force (F)} = \frac{W(\Delta V)}{1933t}$$

Where,  $W$  = Weight (lb)

$\Delta V$  = Change in velocity (FPM)

$t$  = Time (seconds) to accelerate weight

#### CALCULATING ACCELERATING TORQUE FOR ROTARY MOTION

When, in addition to the selection of a motor with proper torque capacity to start and maintain machine motion, a desired time for acceleration is involved and the required torque value may be affected, an additional formula must be considered. This formula makes it possible to calculate the average torque required over the complete range of speed change to accelerate a known inertia ( $WK^2$ ).

On high inertia loads, accelerating torque may be the major factor in the drive selection.

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The formula to calculate acceleration torque (torque required above load torque) or a rotating member:

$$T = \frac{(WK^2)(\Delta N)}{308t}$$

Where,  $T$  = Acceleration torque (lb-ft)  
 $WK^2$  = Total system inertia (lb-ft<sup>2</sup>) that the motor must accelerate. This value includes motor armature, reducer and load.  
 $\Delta N$  = Change in speed required (RPM)  
 $t$  = Time to accelerate total system load (seconds)

The same formula can also be used to determine the minimum acceleration time of a given drive, or if it can accomplish the desired change in speed within the required time period.

$$t = \frac{(WK^2)(\Delta N)}{308T}$$

### INERTIA (WK<sup>2</sup>)

The factor  $WK^2$  is the weight (lbs) of an object multiplied by the square of the radius of gyration ( $K$ ). The unit measurement of the radius of gyration is expressed in feet.

For solid or hollow cylinders, inertia may be calculated by the equations shown in Figure 25.

$$WK^2 = \text{lb-ft}^2$$

$D$ ,  $D_1$ ,  $D_2$  and  $L$  = in.

$$\rho = \text{lb./in.}^3$$

$$\rho \text{ (aluminum)} = .0924$$

$$\rho \text{ (bronze)} = .320$$

$$\rho \text{ (cast iron)} = .260$$

$$\rho \text{ (steel)} = .282$$

The inertia of solid steel shafting per inch of shaft length is given in Table 6. To calculate for hollow shafts, take the difference between the inertia values for the O.D. and I.D. as the value per inch. For shafts of materials other than steel, multiply the value for steel by the factors in Table 7.

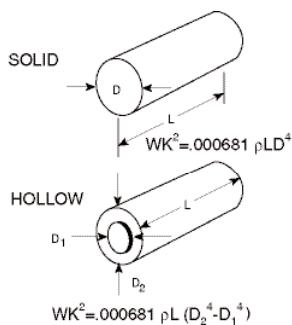


FIGURE 25.

### FORMULAS TO APPROXIMATE WK<sup>2</sup>

$$\text{For a solid cylinder or disc} = W \times \frac{r^2}{2}$$

where  $r$  = radius in feet and  $W$  is weight in pounds.

$$\text{For a hollow cylinder: } WK^2 = W \times \frac{r_1^2 + r_2^2}{2}$$

where  $r_1$  is  $\frac{ID}{2}$  and  $r_2$  is  $\frac{OD}{2}$ .

TABLE 6. INERTIA OF STEEL SHAFTING  
(PER INCH OF LENGTH)

| Diam. (IN.) | WK <sup>2</sup> (lb Ft <sup>2</sup> ) | Diam. (IN.) | WK <sup>2</sup> (lb Ft <sup>2</sup> ) |
|-------------|---------------------------------------|-------------|---------------------------------------|
| 3/4         | 0.00006                               | 10-1/2      | 2.35                                  |
| 1           | 0.0002                                | 10-3/4      | 2.58                                  |
| 1-1/4       | 0.0005                                | 11          | 2.83                                  |
| 1-1/2       | 0.001                                 | 11-1/4      | 3.09                                  |
| 1-3/4       | 0.002                                 | 11-1/2      | 3.38                                  |
| 2           | 0.003                                 | 11-3/4      | 3.68                                  |
| 2-1/4       | 0.005                                 | 12          | 4.00                                  |
| 2-1/2       | 0.008                                 | 12-1/4      | 4.35                                  |
| 2-3/4       | 0.011                                 | 12-1/2      | 4.72                                  |
| 3           | 0.016                                 | 12-3/4      | 5.11                                  |
| 3-1/2       | 0.029                                 | 13          | 5.58                                  |
| 3-3/4       | 0.038                                 | 13-1/4      | 5.96                                  |
| 4           | 0.049                                 | 13-1/2      | 6.42                                  |
| 4-1/4       | 0.063                                 | 13-3/4      | 6.91                                  |
| 4-1/2       | 0.079                                 | 14          | 7.42                                  |
| 5           | 0.120                                 | 14-1/4      | 7.97                                  |
| 5-1/2       | 0.177                                 | 14-1/2      | 8.54                                  |
| 6           | 0.250                                 | 14-3/4      | 9.15                                  |
| 6-1/4       | 0.296                                 | 15          | 9.75                                  |
| 6-1/2       | 0.345                                 | 16          | 12.59                                 |
| 6-3/4       | 0.402                                 | 17          | 16.04                                 |
| 7           | 0.464                                 | 18          | 20.16                                 |
| 7-1/4       | 0.535                                 | 19          | 25.03                                 |
| 7-1/2       | 0.611                                 | 20          | 30.72                                 |
| 7-3/4       | 0.699                                 | 21          | 37.35                                 |
| 8           | 0.791                                 | 22          | 44.99                                 |
| 8-1/4       | 0.895                                 | 23          | 53.74                                 |
| 8-1/2       | 1.00                                  | 24          | 63.71                                 |
| 8-3/4       | 1.13                                  | 25          | 75.02                                 |
| 9           | 1.27                                  | 26          | 87.76                                 |
| 9-1/4       | 1.41                                  | 27          | 102.06                                |
| 9-1/2       | 1.55                                  | 28          | 118.04                                |
| 9-3/4       | 1.75                                  | 29          | 135.83                                |
| 10          | 1.93                                  | 30          | 155.55                                |
| 10-1/4      | 2.13                                  | —           | —                                     |

TABLE 7.

| SHAFT MATERIAL | FACTOR |
|----------------|--------|
| Rubber         | .121   |
| Nylon          | .181   |
| Aluminum       | .348   |
| Bronze         | 1.135  |
| Cast Iron      | .922   |

The inertia of complex concentric rotating parts is calculated by breaking the part up into simple rotating cylinders, calculating their inertia and summing their values, as shown in Figure 26.

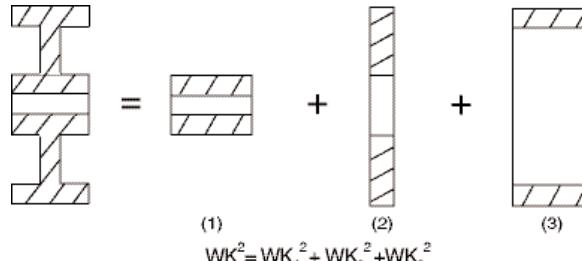


FIGURE 26.

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### WK<sup>2</sup> OF ROTATING ELEMENTS

In practical mechanical systems, all the rotating parts do not operate at the same speed. The WK<sup>2</sup> of all moving parts operating at each speed must be reduced to an equivalent WK<sup>2</sup> at the motor shaft, so that they can all be added together and treated as a unit, as follows:

$$\text{Equivalent WK}^2 = \text{WK}^2 \left[ \frac{N}{N_M} \right]^2$$

Where, WK<sup>2</sup> = Inertia of the moving part

N = Speed of the moving part (RPM)

N<sub>M</sub> = Speed of the driving motor (RPM)

When using speed reducers, and the machine inertia is reflected back to the motor shaft, the equivalent inertia is equal to the machine inertia divided by the square of the drive

$$\text{Equivalent WK}^2 = \frac{\text{WK}^2}{(\text{DR})^2}$$

$$\text{Where, DR} = \text{drive reduction ratio} = \frac{N_M}{N}$$

reduction ratio.

### WK<sup>2</sup> OF LINEAR MOTION

Not all driven systems involve rotating motion. The equivalent WK<sup>2</sup> of linearly moving parts can also be reduced to the motor

$$\text{Equivalent WK}^2 = \frac{W(V)^2}{39.5(N_M)^2}$$

shaft speed as follows:

Where, W = Weight of load (lbs)

V = Linear velocity of rack and load or conveyor and load (FPM)

N<sub>M</sub> = Speed of the driving motor (RPM)

**NOTE:** This equation can only be used where the linear speed bears a continuous fixed relationship to the motor speed, such as a conveyor.

### ELECTRICAL FORMULAS

#### OHMS Law:

$$\text{Amperes} = \frac{\text{Volts}}{\text{Ohms}}$$

$$\text{Ohms} = \frac{\text{Volts}}{\text{Amperes}}$$

$$\text{Volts} = \text{Amperes} \times \text{Ohms}$$

### POWER IN DC CIRCUITS:

$$\text{Watts} = \text{Volts} \times \text{Amperes}$$

$$\text{Horsepower} = \frac{\text{Volts} \times \text{Amperes}}{746}$$

$$\text{Kilowatts} = \frac{\text{Volts} \times \text{Amperes}}{1000}$$

$$\text{Kilowatt-Hours} = \frac{\text{Volts} \times \text{Amperes} \times \text{Hours}}{1000}$$

### POWER IN AC CIRCUITS:

$$\text{Kilovolt - Amperes (KVA)}$$

$$\text{KVA (Single-Phase)} = \frac{\text{Volts} \times \text{Amperes}}{1000}$$

$$\text{KVA (Three-Phase)} = \frac{\text{Volts} \times \text{Amperes} \times 1.73}{1000}$$

$$\text{Kilowatt (Kw)}$$

$$\text{Kw (Single-Phase)} = \frac{\text{Volts} \times \text{Amperes} \times \text{Power Factor}}{1000}$$

$$\text{Kw (Two-Phase)} = \frac{\text{Volts} \times \text{Amperes} \times \text{Power Factor} \times 1.42}{1000}$$

$$\text{Kw (Three-Phase)} = \frac{\text{Volts} \times \text{Amperes} \times \text{Power Factor} \times 1.73}{1000}$$

$$\text{Power Factor} = \frac{\text{Kilowatts}}{\text{Kilovolts} \times \text{Amperes}}$$

### CONVERSION FACTORS

|                   | MULTIPLY   | BY  | TO OBTAIN  |
|-------------------|--|---|--|
| Length            | Meters<br>Meters<br>Inches<br>Feet<br>Millimeters  | 3.281<br>39.37<br>.0254<br>.3048<br>.0394           | Feet<br>Inches<br>Meters<br>Meters<br>Inches   |
| Torque            | Newton-Meters<br>Lb-Ft<br>Lb-In<br>Lb-Ft   | .7376<br>1.3558<br>.0833<br>12.00                   | Lb-Ft<br>Newton-Meter<br>Lb-Ft<br>Lb-In  |
| Rotation          | RPM<br>RPM<br>Degrees/Sec.<br>Rad./Sec.  | 6.00<br>.1047<br>.1667<br>9.549                     | Degrees/Sec.<br>Rad./Sec.<br>RPM<br>RPM  |
| Moment of Inertia | Newton-Meters <sup>2</sup><br>Oz-In <sup>2</sup><br>Lb-In <sup>2</sup><br>Slug-Ft <sup>2</sup><br>Oz-In-Sec <sup>2</sup><br>Lb-In-Sec <sup>2</sup> | 2.42<br>.000434<br>.00694<br>32.17<br>.1675<br>2.68 | Lb-Ft <sup>2</sup><br>Lb-Ft <sup>2</sup><br>Lb-Ft <sup>2</sup><br>Lb-Ft <sup>2</sup><br>Lb-Ft <sup>2</sup><br>Lb-Ft <sup>2</sup> |
| Power             | Watts<br>Lb-Ft/Min   | .00134<br>.0000303                                  | HP<br>HP   |
| Temperature       | Degree C = (Degree F - 32) × 5/9<br>Degree F = (Degree C × 9/5) + 32   |   |  |

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### CURRENT RATINGS OF INSULATED COPPER CONDUCTORS

TABLE 8. ALLOWABLE CURRENT CARRYING CAPACITIES

(Amperes) of Insulated Copper Conductors. Not more than three conductors in raceway or direct burial, based on 30°C (86°F) ambient (Condensed from National Electrical Code)

| Type of Insulation                      | Maximum Operating Temperature | Wire Size AWG or MCM   |    |    |    |    |    |     |     |     |     |     |     | *Correction Factors |         |
|---|-------------------------------|------------------------|----|----|----|----|----|-----|-----|-----|-----|-----|-----|---------------------|---------|
|   |                               | 14                     | 12 | 10 | 8  | 6  | 4  | 3   | 2   | 1   | 0   | 00  | 000 |                     |         |
|   |                               | Allowable Line Amperes |    |    |    |    |    |     |     |     |     |     |     | 31–40°C             | 41–50°C |
| T-TW                                    | 60°C                          | 15                     | 20 | 30 | 40 | 55 | 70 | 80  | 95  | 110 | 125 | 145 | 165 | .82                 | .58     |
| RH,RHW, THW,THWN, XHHW                  | 75°C                          | 15                     | 20 | 30 | 45 | 65 | 85 | 100 | 115 | 130 | 150 | 175 | 200 | .88                 | .75     |
| V-C(V)<br>V-C(AVB)<br>THHN,RHH,<br>XHHW | 85-90°C                       | 25                     | 30 | 40 | 50 | 70 | 90 | 105 | 120 | 140 | 155 | 185 | 210 | .90                 | .80     |

| Type of Insulation                      | Maximum Operating Temperature | Wire Size AWG or MCM   |     |     |     |     |     |     |     |     |     |     |      | *Correction Factors |         |
|---|-------------------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|---------------------|---------|
|   |                               | 0000                   | 250 | 300 | 350 | 400 | 500 | 600 | 700 | 750 | 800 | 900 | 1000 |                     |         |
|   |                               | Allowable Line Amperes |     |     |     |     |     |     |     |     |     |     |      | 31–40°C             | 41–50°C |
| T-TW                                    | 60°C                          | 195                    | 215 | 240 | 260 | 280 | 320 | 355 | 385 | 400 | 410 | 435 | 455  | .82                 | .58     |
| RH,RHW, THW,THWN, XHHW                  | 75°C                          | 230                    | 255 | 285 | 310 | 335 | 380 | 420 | 460 | 475 | 490 | 520 | 545  | .88                 | .75     |
| V-C(V)<br>V-C(AVB)<br>THHN,RHH,<br>XHHW | 85-90°C                       | 235                    | 270 | 300 | 325 | 360 | 405 | 455 | 490 | 500 | 515 | 555 | 585  | .90                 | .80     |

\*For room temperatures above 30°C.

### DEFINITIONS

Performance specifications listed for the basic Boston Gear adjustable-speed drives in the standard specification sheets and those provided with companion functional options are based upon the following conditions:

### DRIVE SPEED REGULATION

The motor speed change between minimum load and full-load torque, expressed as a percentage of the full-load motor speed. This change is measured after all transient disturbances, due to load change, have terminated.

(1)

$$\% \text{ Regulation} = \frac{(\text{Min-Load Speed}) - (\text{Full-Load Speed})}{(\text{Motor Rated Speed})} \times 100$$

Minimum-load is normally expressed as 5% of rated full load.

For drives with armature controlled DC motors, the rated speed is the motor operating speed when developing full-load torque with 100% rated armature voltage and field power applied. This is normally termed base speed.

For drives operated in the field weakened range, regulation is specified as a percentage of top speed.

Speed regulation for standard drives is expressed as a percentage of base speed. Set speed regulation is expressed as a percentage change in speed from an operating point (set speed) due to load changes. If a drive had 1% regulation of base speed, a 2% change of set speed could result at 1/2 motor speed.

Formula (1) is more realistic than Formula (2), since the friction in the driven machine normally loads the motor appreciably, and the changing work load on the machine subjects the motor to a smaller speed change than from absolute no-load to full-load torque.

(2)

$$\% \text{ Regulation} = \frac{(\text{No-Load Speed}) - (\text{Full-Load Speed})}{(\text{Motor Rated Speed})} \times 100$$

### DRIVE SPEED RANGE

Any motor speed between minimum and maximum that can be obtained in a stable manner. For most static, electronic drives it is normally specified that the minimum speed is zero and the maximum speed is the motor base speed.

"Controlled Speed Range" specifies the operating range with respect to the quoted drive speed regulation. This is typically expressed as a ratio of the minimum to maximum speeds such as 20:1, 50:1, etc. Typically, high performance drives will offer close speed regulation along with wide speed range capability.

### DRIVE SERVICE FACTOR

A multiplier, which when applied to the drive rated horsepower, indicates a permissible maximum loading at which the drive can be operated continuously. To determine the horsepower required for greater than standard service factor, multiply the rated horsepower by the service factor. If the rating thus calculated is not standard, select a drive (same base speed motor) with the next higher rating. Boston Gear's standard drives have a 1.0 service factor.

**BOSTON GEAR®**

# APPLICATION ENGINEERING

## AC & DC Controllers

### STEADY-STATE REGULATION

The regulated value due to the following variation in operating parameters occurring independently or simultaneously. (Load remaining constant for speed and voltage regulators.)

| VARIABLE                         | VARIATION  | RANGE  |
|----------------------------------|--|--|
| AC Supply Voltage                | 10% with rate of change not to exceed 2.5% per second            | ±10% of nominal voltage                            |
| AC Supply Frequency              | 2 Hz variation with rate of change not to exceed 2.5% per second | 58-62 Hz (60 nominal)<br>48.5-51.5 Hz (50 nominal) |
| Ambient Temperature Random Drift | 15°C<br>8 hour period after 1 hour warmup                        | 0 to 40°C  |

### TEMPERATURE

A change in ambient temperature produces a change in the control variable expressed as a percentage change for a specified temperature change of  $\pm 10^{\circ}\text{C}$ . All standard units are designed to operate with a maximum enclosure interior temperature of  $55^{\circ}\text{C}$  surrounding the regulator power conversion module.

### TRANSIENT DEVIATION

A momentary speed change from a speed set point, occurring at the result of a specified rate of load change. Performance is dependent on load inertia, motor inertia, load friction, etc.

### TRANSIENT RESPONSE TIME

Time required to recover and maintain speed within the specified regulation tolerance after a specified change in load. Performance is dependent on load inertia, motor inertia, load friction, etc.

### RANDOM DRIFT

A change from initial set speed during an unchanging load condition over specified time period with constant reference input, constant temperature, constant line voltage, and constant line frequency. Equipment must be operating at a specified ambient condition for a warm-up of one hour before the drift specification is applicable. Drift is specified as a percentage change (may be plus or minus) of base speed, unless otherwise stated. Drift is caused by random changes in operating characteristics of drive components.

### DISPLACEMENT POWER FACTOR

The ratio of the active power of the fundamental wave to the apparent power of the fundamental wave in rms voltamperes. Displacement power factor is the power factor for which electric power utility companies charge penalties for low power factor.

### CALCULATED POWER FACTOR

Expressed by the formula:  $\text{Watts} = 3 \times E \text{ Line (rms)} \times I \text{ Line (rms)} \times \text{Cos } \theta$  (Power-Factor), represents the ratio of total watts input to total rms voltamperes input. This considers the harmonic content of line input, as well as the fundamental wave of the line, and is always lower than the displacement power factor.

# APPLICATION ENGINEERING

## Electrical Enclosures

### NEMA DEFINITIONS

Extracted from NEMA Standard (ICS-110)

| ENCLOSURES | DESCRIPTION  | NEMA 12                               | Industrial Use – Dusttight and Driptight – Indoor.   |
|------------|--|---------------------------------------|--|
| NEMA 1     | <b>General Purpose – Indoor.</b><br>Intended for use indoors, primarily to prevent accidental contact of personnel with the enclosed equipment. In addition, they provide protection against falling dirt.   |                                       | Intended for use indoors to protect the enclosed equipment against fibers, flyings, lint, dust and dirt, and light splashing, seepage, drippings and external condensation of non-corrosive liquids.   |
| NEMA 3     | <b>Dusttight, Raintight and Sleet (Ice) Resistant – Outdoor.</b><br>Intended for use outdoors to protect the enclosed equipment against windblown dust and water. They are not sleet (ice) proof.  | NEMA 13                               | <b>Oiltight and Dusttight – Indoor.</b><br>Intended for use indoors primarily to house pilot devices such as limit switches, foot switches, pushbuttons, selector switches, pilot lights, etc., and to protect these devices against lint and dust, seepage, external condensation, and spraying of water, oil or coolant.         |
| NEMA 3R    | <b>Rainproof and Sleet (Ice) Resistant – Outdoor.</b><br>Intended for use outdoors to protect the enclosed equipment against rain. They are not dust, snow, nor sleet (ice) proof.   |                                       |  |
| NEMA 3S    | <b>Dusttight, Raintight and Sleet (Ice) Proof – Outdoor.</b><br>Intended for use outdoors to protect the enclosed equipment against windblown dust and water and to provide for its operation when the enclosure is covered by external ice or sleet. Does not protect the enclosed equipment against malfunction resulting from internal icing. |                                       |  |
| NEMA 4     | <b>Watertight and Dusttight – Indoor.</b><br>Intended for use indoors to protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation.   |                                       |  |
| NEMA 4X    | <b>Watertight and Dusttight – Indoor.</b><br>Same provisions as NEMA 4 enclosures and, in addition, are corrosion resistant.   | NEMA 7, Class I<br>Group A, B,C, or D | The term "explosion-proof" has been so loosely applied that NEMA deprecates its use. As defined by the National Electrical Code, the term "explosion-proof" applies only to NEMA 7 and 10 enclosures which, when properly installed and maintained, are designed to contain an internal explosion without causing external hazard. |
| NEMA 5     | <b>Superseded by NEMA 12.</b>  |                                       | Intended for use indoors, in the atmospheres and locations defined as Class I and Group A, B, C or D in the National Electrical Code. The letters indicate the gas or vapor in the hazardous location.   |
| NEMA 6     | <b>Submersible, Watertight, Dusttight and Sleet (Ice) Resistant – Indoor and Outdoor.</b><br>Intended for use indoors or outdoors where occasional submersion is encountered.  | NEMA 9, Class II<br>Group E, F, or G  | Intended for use indoors in the atmospheres defined as Class II and Group E, F or G in the National Electrical Code. The letters E, F or G indicate the dust in the hazardous location.  |
|            |  | NEMA 10                               | Designed to meet the requirements of the U.S. Bureau of Mines which relate to atmospheres containing mixtures of methane and air, with or without coal dust.   |

**BOSTON GEAR®**

# TERMS AND CONDITIONS

ALL QUOTATIONS AND SALES BY BOSTON GEAR. THE CONTRACTING PARTY HERETO, A DIVISION OF ALTRA INDUSTRIAL MOTION. HEREAFTER CALLED "COMPANY" ARE MADE ON THE FOLLOWING TERMS AND CONDITIONS

## 1- QUOTATIONS and THEIR ACCEPTANCE

Unless otherwise specified, quotations on stock products are for immediate acceptance, subject to prior sales. Quotations on special products are made subject to acceptance within thirty (30) days from date thereof, but in making such quotations, the Company reserves the right to change or cancel them at any time prior to the receipt of the customer's written acceptance. All quotations for special products are based upon supplying up to plus or minus 5% of quantity ordered unless otherwise stated in the quotation. All quotations are made F.O.B. shipping point.

## 2- PRICES

Prices are in accordance with current Company price lists, are based on quantity specified and are subject to minimum order requirements of the Company. In the event the Company consents to the cancellation or suspension of orders, it shall be entitled to charge for work done and material ordered or used up to the time of giving its written consent to such cancellation or suspension. When work is to be done on material furnished by the customer, prices are based on the quantity specified being delivered by the customer at one time within a reasonable time after acceptance of order. Quotations will be made on special products of all types or on cutting only. Prices, specifications, and terms and conditions, as well as all statements appearing in the Company's catalogs and advertisements, and made elsewhere by the Company are subject to change without notice. Changes by the customer in specifications or delivery requirements will be subject to change in price. Whenever the net price of an order amounts to less than \$25.00, a minimum charge of \$25.00 will be made.

## 3- CREDIT TERMS

To those customers and prospective customers whose credit is satisfactory to the Company, terms are net thirty (30) days, from date of invoice, with the option of paying semi-monthly. The Company may at any time when, in its opinion, the financial condition of the customer or prospective customer warrants it, either alter or suspend credit, or discontinue deliveries, and render a charge covering the value of any partially finished special products which are then being manufactured for the customer. In those instances where credit is not established, and in cases where satisfactory references are not given, the terms are cash with order. For special products in those instances where credit is not established to the satisfaction of the Company, a deposit of at least 50% of total value of the order is required. Remittances should be made by check or money order, payable to the Boston Gear, Quincy, Massachusetts. 02171, U.S.A. Delays in transportation shall not extend the terms of payment.

## 4- MATERIAL FURNISHED BY THE CUSTOMER

Unless otherwise specified, quotations are based on material furnished by the customer being of ordinary hardness, normal allowance for finish, uniform specification, and machine work being of ordinary commercial accuracy. If material furnished by the customer involves the Company in expense not contemplated by the contract, the customer will be charged for all such additional expense. If serious defects are found in the material furnished by the customer, the customer will be

charged for the actual work done. The Company assumes no responsibility for, and will not be liable for loss of or damage to samples, blueprints, diagrams, and other material of any nature submitted or furnished by the customer or prospective customer, provided the Company has exercised reasonable care in the handling of the same. The Company does not assume transportation and insurance costs on any of the foregoing items. In all cases where the customer or prospective customer makes no statement in writing, concerning the disposition of any of the foregoing material when submitted, the Company reserves the right to dispose of such material according to its best judgment.

## 5- DIMENSIONS

When dimensions of rims, bores, and hubs are not clearly specified, quotations are based on ordinary dimensions. Before the customer's blanks are accepted by the Company for cutting, the diameter, holes, rims and ends of holes must be finished; for bevel gears, hubs, must be of uniform length. There should also be an allowance of extra blanks to cover possible spoilage. Unless otherwise specified, dimensions are in inches.

## 6- SAMPLES

In no case are samples furnished free. If agreed to by the Company, a few products in advance of a regular quantity order will be furnished but only at an agreed upon price over the regular quantity price.

## 7- TAXES

If any tax is at any time levied or imposed by the federal or any state or local government, or any other taxing authority, upon the products covered hereby, or in respect of the production, processing, manufacture, storage, sale, use, or consumption thereof, or, in the case of goods delivered at the Company's expense, upon the transportation thereof, including freight charges thereon, the amount of such tax shall be added to the purchase price above specified and shall be borne by the customer. The Company will accept a valid exemption certificate from the customer if applicable; however, if any exemption certificate previously accepted is not recognized by the taxing authority involved and the Company is required to pay the tax covered by such exemption certificate, the customer shall be required to promptly reimburse the Company for the taxes so paid.

## 8- SHIPMENTS

All shipments are made F.O.B. shipping point (subject to freight allowance under conditions stated in separate price schedules). When ordering, the customer's desired method of shipment must be clearly stated. Where instructions for shipping do not appear on the order, shipment will be made according to the Company's best judgment. Fully risk of loss (including transportation delays and losses) shall pass to the customer upon delivery of the products to F.O.B. point. Unless otherwise instructed, all Parcel Post shipments are insured at the customer's expense. Parcel Post shipments without insurance are at the customer's risk. Deliveries by Messenger Service to a terminal are made at the customer's risk and expense. Partial shipments shall be permitted and the Company may invoice each shipment separately.

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## 9- REFUSAL of SHIPMENT

In case of the refusal or inability of the customer to accept any shipment in accordance with the terms of the order, the customer shall be liable for freight, express, storage, extra cost of handling and all other expenses incurred by the Company as a result of such refusal or inability.

## 10- DELAY or NONPERFORMANCE

The Company shall not be liable for any delay or loss of any nature or failure in performance due to or caused by fire, flood, strike, or other differences with workmen, accidents, labor or material or transportation shortages, war (declared or undeclared), insurrection, riot, or by any governmental orders or regulations, legal interferences or prohibitions, defaults on the part of suppliers or other causes beyond the Company's reasonable control.

## 11- CLAIMS and REJECTED MATERIAL

Any products which have been altered or damaged are not returnable except with the Company's written consent. To reject products on inspection as defective, customer must notify the Company in writing within ten (10) days from receipt of the products. Before allowing or rejecting claim, the Company shall then have the option of reinspection at the customer's plant or its own. Defects that do not impair service shall not be a cause for rejection. The Company shall have the right to replace within a reasonable time any product or products which in its opinion do not conform to the order. No claim will be allowed for any products damaged by the customer or damaged in transit. Expenses incurred in connection with claims for which the Company is not liable, will be charged to the customer. The Company will not be responsible for any work done to correct errors unless such work is authorized by the written consent of the Company. The Company assumes no liability for any claim for infringement of any foreign or domestic patent.

## 12- LIMITED WARRANTY

The Company warrants that products manufactured or sold by it shall be free from defects in material and workmanship. Any products which shall within two (2) years of delivery, be proved to the Company's satisfaction to have been defective at the time of delivery in these respects will be replaced or repaired by the Company at its option. Freight is the responsibility of the customer. The Company's liability under this limited warranty is limited to such replacement or repair and it shall not be held liable in any form of action for direct or consequential damages to property or person. THE FOREGOING LIMITED WARRANTY IS EXPRESSLY MADE IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER. EXPRESS, IMPLIED AND STATUTORY AND INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS.

No employee, agent, distributor, or other person is authorized to give additional warranties on behalf of Boston Gear, nor to assume for Boston Gear any other liability in connection with any of its products, except an officer of Boston Gear by a signed writing.

## 13- WAIVER OF BREACH

No waiver by the Company of any breach of these provisions shall constitute a waiver of any other breach.

## 14- CONSEQUENTIAL DAMAGES

The Company shall not be liable to the customer or others claiming through the customer for special or consequential charges for any reason whatsoever.

## 15- LAWS

To the best of the Company's knowledge and belief it is in compliance with all local, state and federal laws. All orders are subject to the condition that the Company's obligation under such local, state and federal laws and Executive Orders. Rules and Regulations issued thereunder, whether now in force or hereafter made effective, shall be no greater as a result of this agreement and no greater than required by such laws and the Company expressly disclaims assumptions of any of the customer's obligations under such laws.

## 16- GENERAL

Any terms and conditions of a customer's order which are inconsistent with or additional to the terms and conditions hereof shall not be binding on the Company and shall not be considered applicable to any sale or shipment of the Company's products. All such terms and conditions are hereby expressly rejected. No waiver, alteration or modification of any of the Company's terms and conditions shall be binding on the Company unless made in writing and agreed to by a duly authorized official of the Company.

## 17- PRINTERS, STENOGRAPHIC, and CLERICAL ERRORS

The Company is not responsible for printers' errors made in any of its publications and other forms of printed matter, or for any stenographic and clerical errors. All such errors are subject to correction.