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Compumotor

DB Drive User Guide

Compumotor Division
Parker Hannifin Corporation
p/n 88-006895-04 A

Parker

Important User Information

To ensure that the equipment described in this user guide, as well as all the equipment connected to and used with it, operates satisfactorily and safely, all applicable local and national codes that apply to installing and operating the equipment must be followed. Since codes can vary geographically and can change with time, it is the user's responsibility to identify and comply with the applicable standards and codes. **WARNING:** ***Failure to comply with applicable codes and standards can result in damage to equipment and/or serious injury to personnel.***

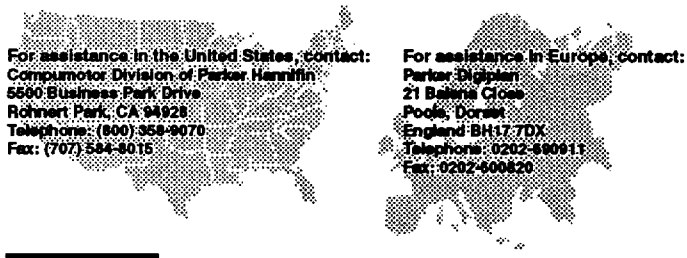
Personnel who are to install and operate the equipment should study this user guide and all referenced documentation prior to installation and/or operation of the equipment.

In no event will the provider of the equipment be liable for any incidental, consequential, or special damages of any kind or nature whatsoever, including but not limited to loss profits arising from or in any way connected with the use of this user guide or the equipment.

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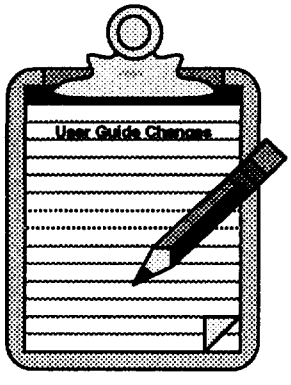


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User Guide Changes



*The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 88-006985-04**A**, supersedes version 88-006985-04**Y**.*

This entire user guide has been changed according to the new Compumotor user guide styles and illustration standards. Also, the chapters have been renumbered and reorganized.

Technical changes are summarized below:

New Speed Torque Curves

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How To Use This User Guide

This user guide is designed to help you install, develop, and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section will help you find and use the information in this user guide.

Assumptions

To use this product and its instructions effectively, you should have a fundamental understanding of the following information.

- ❑ Electronics concepts (voltage, switches, current, etc.)
- ❑ Motion control concepts (torque, velocity, distance, force, etc.)

User Guide Contents

CHAPTER 1: INTRODUCTION

This chapter provides a description of the product and a brief account of its specific features.

CHAPTER 2: INSTALLATION

This chapter contains a shipkit list of items you should have received with your DB Drive. Instructions to mount and connect the system properly are included. Upon completion of this chapter, your system should be completely installed and ready to perform basic operations.

CHAPTER 3: SPECIFICATIONS

This chapter contains information on system specifications (speed torque curves and environmental).

Installation Process Overview

To ensure trouble-free operation, pay special attention to the environment in which the equipment will operate, the layout and mounting, and the recommended wiring and grounding. These recommendations will help you easily and safely integrate the DB Drive into your manufacturing facility. If your environment contains conditions that may adversely affect solid-state equipment (electrical noise or atmospheric contamination), be sure to follow any special instruction to ensure the safety and long life of your equipment.

Installation Preparation

Before you install this product, complete the following steps:

1. Review this user guide. Become familiar with the user guide's contents so that you can quickly find the information you need.
2. Develop a basic understanding of all system components, their functions, and interrelationships.

3. Complete the basic system configuration and wiring instructions provided in *Chapter 2, Installation.*
4. Perform as many basic functions as you can with the preliminary configuration. Try to simulate the task(s) that you expect to perform when you permanently install your application (however, do not attach a load at this time). This will give you a realistic preview of what to expect from the complete configuration.
5. After you have tested the system's functions and become familiar with the system's basic features, carefully read Chapter 2.
6. After you have read Chapter 2 and clearly understand what must be done to properly install the system, begin the installation process. Do not deviate from the instructions provided.
7. Before you customize your system, check all of the system functions and features to ensure that you have completed the installation process correctly.

The successful completion of these steps will prevent subsequent performance problems and allow you to isolate and resolve potential system difficulties before they affect your system's operation.

Warnings & Cautions

Warning and caution notes alert you to problems that may occur if you do not follow the instructions correctly. Situations that may cause bodily injury are presented as warnings. Situations that may cause system damage are presented as cautions.

WARNING
Do not touch the motor immediately after it has been in use for an extended period of time. The motor may be hot.

CHAPTER ①

Introduction

Chapter Objective

The information in this chapter will enable you to:

- ❑ Understand the product's basic functions and features

Product Description

The DB Drive is a bipolar, high performance, low cost microstepping drive designed specifically for OEM applications. Designed to work with any standard two phase hybrid step motor, the DB provides eight user selectable resolutions from 200 to 25,400 steps/rev.

Microprocessor control and ultra-efficient, MOSFET PWM power amplifiers assure smooth, cool, and drift-free operation at currents up to 4 amps/phase in ambient temperatures up to 50°C.

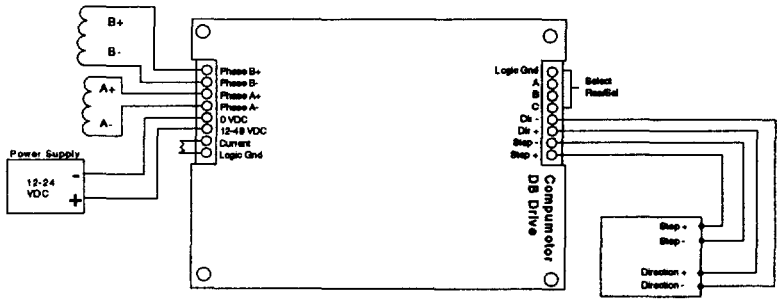
The drive's electronics are encased in a compact die cast housing. This rugged and thermally efficient package allows the DB to be mounted almost anywhere.

All that is required to operate the DB is an external source of step and direction signals (provided by the user or by any Compumotor indexer) and a single unregulated 12-48VDC power supply.

Product Features

- ❑ Low profile compact package 4.6" wide x 7.3" long x 1.1" deep
- ❑ Microprocessor controlled microstepping for high accuracy and smoothness
- ❑ Eight jumper selectable resolutions from 200 to 25,400 steps/rev
- ❑ Resistor selectable motor currents from 0-4 amps/phase
- ❑ Powered from a single, external, unregulated 12-48VDC supply
- ❑ Ultra efficient bipolar MOSFET 20 KHZ pulse width modulated amplifiers for cool and inaudible operation
- ❑ Short circuit protection
- ❑ Optically isolated Step and Direction command inputs for electrical noise immunity
- ❑ Designed to operate with virtually any two phase permanent magnet hybrid step motor

BLOCK DIAGRAM



CHAPTER ②

Installation

Chapter Objective

The information in this chapter will enable you to:

- ❑ Verify that each component of your system has been delivered safely and completely
- ❑ Become familiar with the components and their interrelationships
- ❑ Mount the unit within recommended specifications

Shipkit

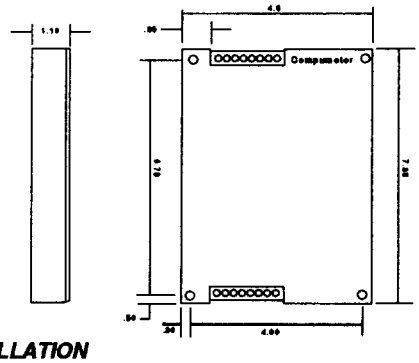
Inspect the DB Drive upon receipt for obvious damage to its shipping container. Report any such damage to the shipping company. Parker Compumotor cannot be held responsible for damage incurred in shipment. You should receive a drive and a user guide. Compare your order with the units shipped.

Description	Part Number
Drive	DB Drive
User Guide	88-006895-04

Mounting

The DB Drive relies on radiation for cooling. The drive should be mounted in an area that will allow sufficient air to circulate over the heatsink. The heatsink should never be allowed to exceed a temperature of 65°C (150°F). This will normally not be a problem when the drive is operated with a 21°C (70°F) environment. If the unit is operating at maximum power in an enclosed area, providing cooling air over the heatsink may be required to keep the heatsink below 65°C. In general, the DB Drive will not require forced air cooling.

Dimensional Drawing



Motors

Most standard 4 lead 1.8 degree, two phase, hybrid stepping motors will operate with the DB Drive. Phase current is resistor selectable. Most motor manufacturers specify current ratings with unipolar drive techniques. Bipolar drives provide double the current of unipolar drives with the same *current setting*. Divide the manufacturer's motor current rating by two to set the bipolar drive.

Step motors are available in a variety of phase current and inductance ratings. The correct motor winding depends on the individual application. Lower inductance windings offer better high speed performance at increased current. These motors will generally operate better from lower voltage power supplies than high inductance motors, but will produce higher heat if operated at high voltages and speeds. Higher inductance motors provide high torques at low currents, but have limited speed.

Note: *Minimum phase inductance as a function of input voltage:*
12V 0.5 mH
24V 1.0 mH
36V 1.5 mH
48V 2.0 mH

Motor Requirements

Type: Two phase hybrid permanent magnet. Normally 200 steps/rev (1.8 deg/step).

Inductance: Minimum inductance is a function of supply voltage (see above note). There is no maximum. This is end-to-end inductance. Most motor manufacturers specify center-to-end inductance in their data sheets.

Connecting the Motor

Motor connections are made on J2 pins 1-4. Pin assignments are as follows:

J2 Pin 1 - Phase B+
J2 Pin 2 - Phase B-
J2 Pin 3 - Phase A+
J2 Pin 4 - Phase A-

The Compumotor provided motor is an eight lead motor. It can be configured to run in series or parallel. Series connected motors generally have a higher torque at low speeds (below about 10 rps), and parallel connected motors have higher torque at speeds greater than 10 rps. Check your application and DB speed torque curves to determine which motor connection is most appropriate to use.

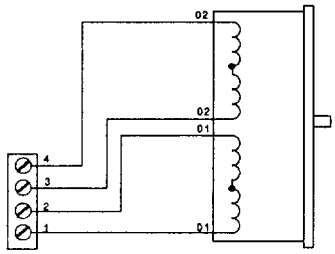
The following tables show the color codes for the motor leads to the DB Drive motor connections for the following motors:

- ❑ DB57-51
- ❑ DB57-83
- ❑ DB57-102
- ❑ DB83-62
- ❑ DB83-93

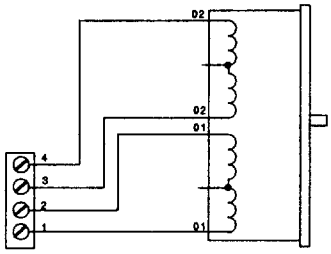
Series Connections		Parallel Connections	
Pin #	**Color**	**Pin #**	**Color**
B+	White	B+	White & Brown
B-	Green	B-	Green & Orange
A+	Red	A+	Red & Blue
A-	Black	A-	Black & Yellow

For series connections tie yellow and blue together and tie orange and brown together and insulate.

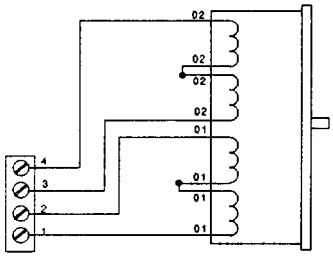
Note: It is not recommended to configure the DB83-62 or DB83-93 in parallel because the DB Drive outputs up to four amps and each of these motors require more than four amps for optimum performance.



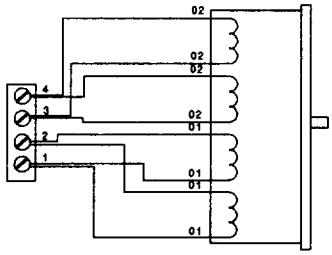
4-Lead



6-Lead



8-Lead Series



8-Lead Series

SETTING THE PHASE CURRENT

Use the table below to determine phase current for Compumotor supplied motors. Consult manufacturer specifications to determine phase current for non Compumotor supplied motors. Phase current is set in the DB Drive by placing a resistor between pins 7 and 8 on J1. One amp of current will be delivered to the motor for every 1k ohms of resistance between pins 7 and 8 (for example, a 2.5k ohm resistor between pins 7 and 8 on connector J2 will configure the drive to deliver 2.5 amps to each phase of the motor). The phase current rating for the DB Drive refers to the peak (not peak-to-peak) current value delivered to each phase of the motor.

The absence of a current select resistor will cause overcurrent shutdown cycles to occur. Actual values (tolerances) of the resistors will determine the exact current. Since motor current does not flow through this resistor, a simple 1/4 watt resistor will suffice.

In general, the recommended current setting will provide smooth operation. If a particular application needs enhanced smoothness, reducing the current 10-15% will improve low speed smoothness at the expense of torque. In general, a given motor's torque is proportional to the applied current until magnetic saturation occurs (about 125% of rated current). Increasing the current up to this level will provide additional torque, but the motor may run rougher and hotter.

SERIES CONNECTIONS

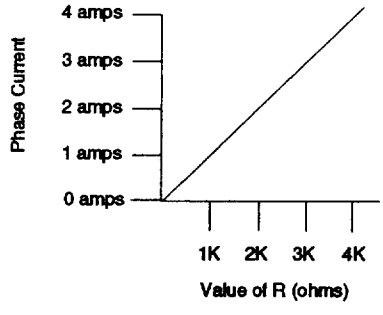
Model	Current Value (Amps)	Resistor Value (Ohms)
57-40	1.18	1.18Ω ±1%
57-51	1.52	1.50Ω ±1%
57-83	1.71	1.69Ω ±1%
57-102	2.19	2.15Ω ±1%
83-62	2.85	2.80Ω ±1%

PARALLEL CONNECTIONS

Model	Current Value (Amps)	Resistor Value (Ohms)
57-40	2.28	2.26Ω ±1%
57-51	3.09	3.09Ω ±1%
57-83	3.47	3.40Ω ±1%
57-102	4.00	4.02Ω ±1%
83-62	4.00	4.02Ω ±1%

Note: Phase currents are given with a ±10% tolerance. The actual values given may need to be adjusted within this tolerance for optimum motor smoothness.

Phase Current vs. Current Select Resistor



Selecting the Resolution

To verifying operation of the DB drive, the resolution select inputs (J1 pins 5-7) can be left alone, and the default resolution of 25,000 steps/rev will be used. The resolution of the drive is determined by the state of these inputs at power up. A 1 indicates that the input is at +5VDC (no jumper to logic ground installed)*, a 0 indicates that the input is at logic ground (jumper to logic ground installed)*.
**These inputs are normally high (+5VDC).*

Resolution	Pin A	Pin B	Pin C
25,000.	1	1	1
25,400.	0	1	1
18,000.	1	0	1
10,000.	0	0	1
5,000.	1	1	0
2,000.	0	1	0
400.	1	0	0
200.	0	0	0

All resolutions are in steps per revolution and assume the use of a 1.8 degree (200 steps/revolution) hybrid permanent magnet step motor.

Connecting the Indexer

Indexer connections are made on connector J1 Pins 1-4. Connections should be made as follows:

J1 Pin 1 - Step+ — 0 to +5VDC @ 20 ma. (Red*)

J1 Pin 2 - Step- — 1usec min pulse width. (Black*)

J1 Pin 3 - Direction+ — 0 to +5VDC (Green*)

J1 Pin 4 - Direction- — @ 20 ma. (White*)

* Color Coding for Compumotor indexer cables.

Step and direction lines are optically isolated within the drive, and the user must ensure that each signal is >3.5 volts in amplitude at a current of at least 20 milliamps. This ensures that the opto-couplers' LEDs are properly driven. The Step Input must be at least 1.2 ms.

The DB Drive steps the motor a single microstep for each pulse received on the Step Input. The state of the Direction Input at the time of the Step Pulse determines rotational direction. This input must be stable for 80 microseconds before the Step Pulse is received.

I/O Connectors

J1 — INDEXER CONNECTOR

Pin #	Type	Description
1	Step +	This input causes the motor to be incremented one microstep for each pulse it receives. This pulse or pulse train input must be TTL (0 to +5VDC @ 20ma) level and have a minimum of one µs pulse width. There is no maximum pulse width. Velocity of the motor will be proportional to the frequency of the input pulse train, and distance will be equal (in µs) to the number of pulses received. This input is optically isolated. Return is Step- (J1 pin 2).
2	Step-	This input provides a return for the Step+ Input. This input is optically isolated and should **not** be connected to logic ground (J1 pin 8 and J2 pin 8).
3	Dir+	The state of this input determines the direction the motor will move when step pulses are received on the Step+ Input. This is a TTL level input with a logic high (5V @ 20ma) corresponding to CW motion of the motor, and a logic low (0V) corresponding to CCW motion. This input must be defined 80µs before a step pulse is received and must remain in that state for the duration of the move. This input is optically isolated. Return is Dir- (J1 pin 4).
4	Dir-	This input provides a return for the Dir+ Input. This input is optically isolated and should **not** be connected to logic ground (J1 pin 8 and J2 pin 8).
5	Res Sel C	The state of this input along with the state of J1 pins 6 and 7 determines the resolution of the DB Drive. The state of this input is read only at power-up. Changes in state to this input after power-up will have no effect.
6	Res Sel B	The state of this input along with the state of J1 pins 5 and 7 determine the resolution of the DB Drive. The state of this input is read only at power-up. Changes in state to this input after power-up will have no effect.
7	Res Sel A	The state of this input along with the state of J1 pins 5 and 6 determine the resolution of the DB Drive. The state of this input is read only at power-up. Changes in state to this input after power-up will have no effect.
8	Logic Gnd	This input provides a ground for configuring the state of the resolution select inputs. This is internally connected to the logic ground input on J2 pin 8. This input should **never** be connected to earth ground.

J2 — MOTOR CONNECTOR

1	Phase B+	Motor output for phase B
2	Phase B-	Motor output for phase B
3	Phase A-	Motor output for phase A
4	Phase A+	Motor output for phase A
5	Supply Gnd	This input is used as the return for the power supply.
6	±12/58 VDC	This input is the power supply input. Allowable ripple is ±0.5V for every 12V of the supply. For example, if the DB is powered by a 36V supply, the allowable ripple would be 1.5V. If the supply voltage is below 11V the DB will brown out. This input should be shielded.
7	Current	This input is used to select the output current the drive will deliver to the motor. A single quarter-watt resistor between this terminal and Logic Ground (J2 pin 8) is all that is required. The DB Drive will output 1A of current to the motor for every 1kΩ of this resistor. For example, if the motor being driven requires 3.5 Amps/phase, a 3.5KΩ resistor would be used.
8	Logic Gnd	This input provides a return path for the current select resistor connected to J2 pin 7. It is internal ground on J1 pin 8. Do not connect this input to earth ground.

Power Supplies

The DB drive is powered by an external DC power supply, in the range from 12 to 48V. Both the motor and the logic power supplies are derived internally from it. An internal brownout circuit will shut down the drive if the external supply falls below 11.5V. Maximum ripple is ±0.5V @ 12VDC, ±1V @ 24VDC. Maximum power requirement is 50 watts.

The voltage required is a function of phase inductance and desired top speed. High speed operation (above 300 RPM) typically requires higher motor voltages. The lowest voltage that produces the desired speed/torque profile is the most desirable. The drive voltage must not exceed 48V and may be as low as 12V. The current rating of the supply will vary depending upon the motor used. Because the

stepping motor, when switched, circulates currents in and out of the power supply, the phase currents are large compared to the average current actually drawn through the supply. A 4 amp phase motor will pull about 1.0 amp @ 48V through the supply on a continuous basis. This means that the transformer, rectifier, and filter capacitors for the motor supply do not need to be very large for most applications. The DB Drive will operate from modestly sized power supplies due to its efficient power conversion. Bulky dropping resistors are not needed.

CONNECTING THE POWER SUPPLY

The power supply is connected to J2 pins 5 and 6. Power supply ground is connected to J2 pin 5, +12 to +48VDC is connected to J2 pin 6.

CAUTION

The power supply should never be connected or disconnected from the DB drive while power is on.

Power supply wires should also be shielded and their shield should be returned to earth ground.

VOLTAGE

The DB Drive operates from a single DC voltage supply, in the range from 12 to 48V. Both the motor and the logic power supplies are derived internally from it. Maximum allowable ripple is ± 0.5V @ 12VDC, ±1V @ 24VDC.

CURRENT

Since the stepping motor, when stepped, circulates current in and out of the drive, the phase currents are relatively large compared with the average current actually drawn through the supply. A power supply rating of 50 watts will normally provide sufficient current to develop maximum performance of the DB Drive.

POWER WIRING

The power supply wires should be at least 18 gauge for most applications. Power supply wires should be shielded at all times.

GROUNDING

The DB Drive chassis should be connected to a reliable earth ground for safety reasons. To obtain a gas-tight connection, install a star washer between the case and one of the mounting screw heads, using a screw which will displace metal in the receiving mounting surface, such as a thread-rolling screw.

Verifying Operation

Double check all wiring connections to make sure no errors have been made. If a Compumotor indexer is being used, please refer to its manual to perform the following test move.

Acceleration = 10 rps^2

Velocity = 1 rps

Distance = +25000 steps (1 revolution)*

*If a resolution other than 25000 steps/rev is being used, set the distance parameter to match that of the DB drive's resolution.

Initiate a move with the above parameters. The motor should move 1 revolution in the clockwise direction. In the event the motor does not move, do the following.

1. Double check all connections to the DB drive.
2. Verify that the proper DC voltage is present at the Drive.
3. If an oscilloscope is handy, verify that step pulses are present at the Step+ Input of the drive (these steps will only be present while the motor is moving).
4. Verify that there is holding torque on the motor shaft when it is powered on.

CHAPTER ③

Specifications

Chapter Objectives

The information in this chapter will enable you to:

❑ Verify and identify product specifications

Electrical Specifications

AMPLIFIERS

Type:	20Khz fixed frequency, variable duty cycle pulse width modulated.
Current rating:	0.00 to 4 amps per phase, resistor selectable.

INPUTS

Power Input:	12 - 48VDC, 50 watts maximum.
Step Input:	(0 to +5VDC @ 20ma) High going pulse, 1 microsecond minimum width, pulse must remain low for a minimum of 2 microseconds.

COMMAND INTERFACE

Type:	Step and Direction. Compatible with most Compumotor indexers
Pulse rate:	330 Khz. max. This input is fully optically isolated and requires a TTL type signal to operate (>3.5 VDC high, <0.8 VDC low. User's drive must be capable of providing 20 milliamps max.
Direction:	Logic High = CW rotation Logic Low = CCW. This input is fully optically isolated and requires a TTL type signal to operate (>3.5VDC high, <0.8VDC low). User's drive must be capable of providing 20ma max.

Environmental Specifications

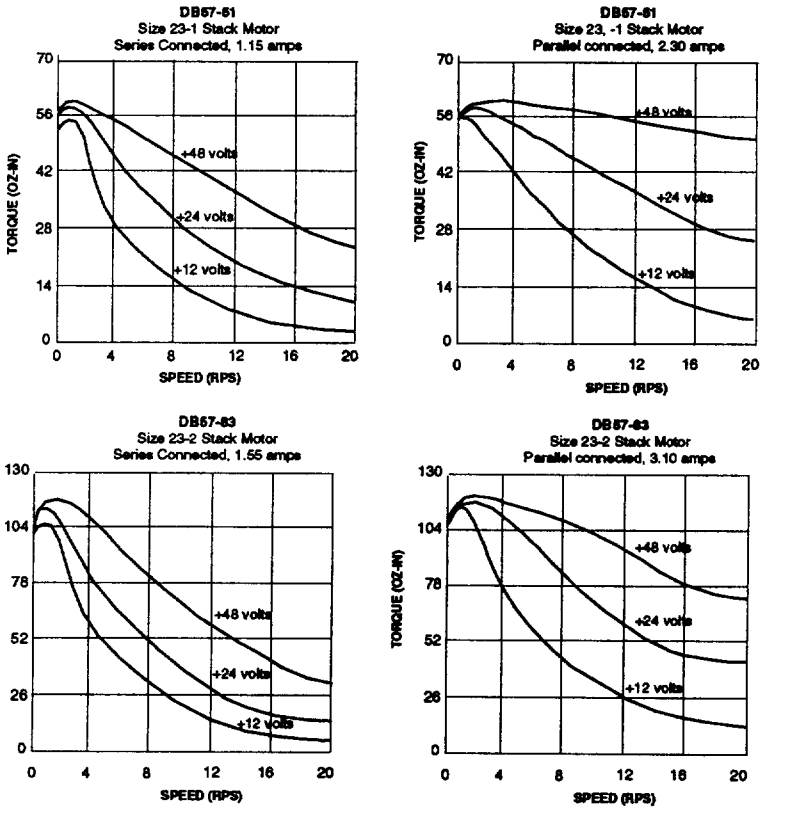
TEMPERATURE—OPERATING

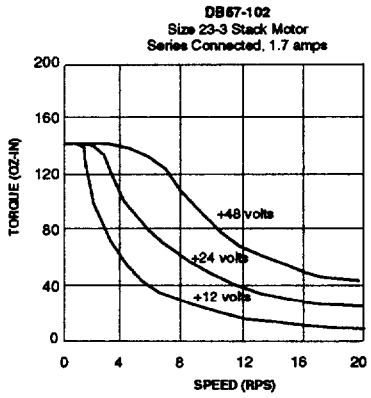
Drive	0 - 50°C -Maximum allowable heatsink fin temp. is 65°C. Fan cooling may be required in hostile environment, such as high ambient temperature and/or no moving air.
Motor	#100°C maximum motor case temperature. Actual temperature rise duty cycle dependent.
Storage	-40 to 85°C
Humidity	0 - 95%, non-condensing

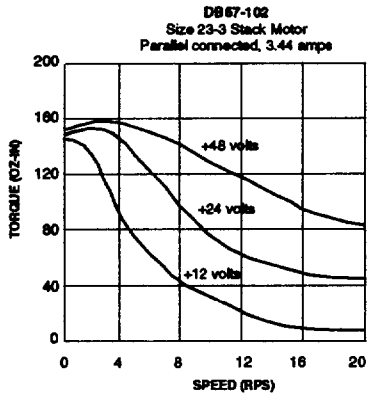
Motor Requirements

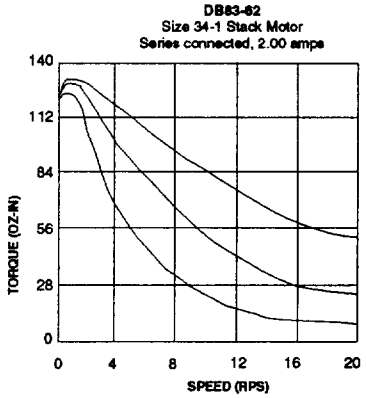
Breakdown voltage	250VDC minimum.
Number of leads	4 (Typically, however, 6 and 8 leaded motors will work. If a 6 leaded motor is used, the center tap should be left unconnected. 8 leaded motors should be wired in series or parallel.

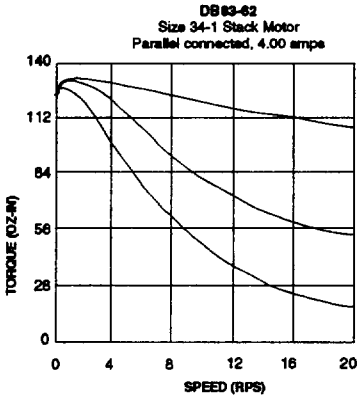
Speed Torque Curves

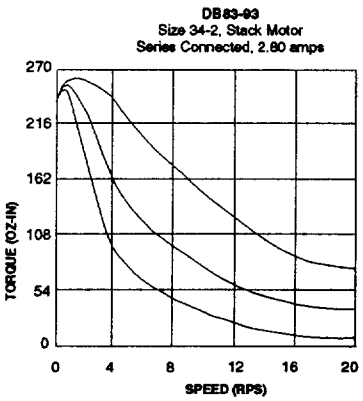


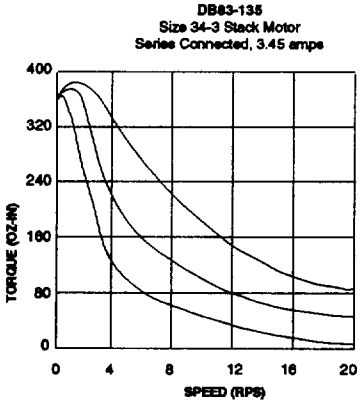

DB67-102
Size 23-3 Stack Motor
Series Connected, 1.7 amps
TORQUE (OZ-IN)
200
160
120
80
40
0
+48 volts
+24 volts
+12 volts
0 4 8 12 16 20
SPEED (RPS)


DB67-102
Size 23-3 Stack Motor
Parallel connected, 3.44 amps
TORQUE (OZ-IN)
200
160
120
80
40
0
+48 volts
+24 volts
+12 volts
0 4 8 12 16 20
SPEED (RPS)


DB83-62
Size 34-1 Stack Motor
Series connected, 2.00 amps
TORQUE (OZ-IN)
140
112
84
56
28
0
0 4 8 12 16 20
SPEED (RPS)


DB83-62
Size 34-1 Stack Motor
Parallel connected, 4.00 amps
TORQUE (OZ-IN)
140
112
84
56
28
0
0 4 8 12 16 20
SPEED (RPS)


DB83-93
Size 34-2, Stack Motor
Series Connected, 2.80 amps
TORQUE (OZ-IN)
270
216
162
108
54
0
0 4 8 12 16 20
SPEED (RPS)


DB83-135
Size 34-3 Stack Motor
Series Connected, 3.45 amps
TORQUE (OZ-IN)
400
320
240
160
80
0
0 4 8 12 16 20
SPEED (RPS)

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