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INSTALLATION INSTRUCTIONS for SLO-SYN® 440 MODEL PACKAGED DRIVES

WARNER ELECTRIC
Superior Electric
DANA

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THINGS TO KNOW BEFORE USING THIS EQUIPMENT

- Only qualified personnel should install or perform servicing procedures on this equipment. Do not operate the unit without the enclosures in place as voltage present in this unit can cause serious or fatal injury.
- Before performing any work on the unit, allow at least five minutes for the capacitors to discharge fully.
- Voltage is present on unprotected pins when unit is operational.
- The "PWR ON" LED must be off for approximately 30 seconds before connecting or disconnecting the motor connector. **Failure to turn the power off may result in damage to the drive and/or motor connector.**
- Motors powered by this drive may develop extremely high torque. Be sure to disconnect ac power to this drive before doing any mechanical work.

WARRANTY RESTRICTIONS

Reconfiguration of the circuit in any fashion not shown in this manual will void the Warranty.

Failure to follow the proper wiring practices as described in Section 3.1 will void the Warranty.

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SECTION 1: INTRODUCTION

1.1 USING THIS MANUAL

It is important that you understand how the 440 Series unit is installed and operated before you attempt to use it. **We strongly recommend that you read this manual completely before proceeding with the installation of this unit.**

This manual is an installation and operating guide to the Drive section of 440 model Micro Series Motion Controls. 440 models can be supplied as Translators, Translator/Oscillators or Indexers. Instructions for the control portion (Translator, Translator/Oscillator or Indexer) of the unit are given in the attached manual.

Section 1 gives an overview of the Drive and its features. Section 2 describes the steps necessary to place the **drive** portion of the unit into operation. General wiring guidelines as well as the physical mounting of the unit and connections to the drive portion are covered in Section 3.

Complete specifications, listed in Section 4, provide easily referenced information concerning electrical, mechanical and performance specifications. The procedure for setting the motor current level is also covered in this section.

Torque versus speed characteristics with all appropriate SLO-SYN Stepper Motors are given in Section 5.

Section 6, Troubleshooting, gives procedures to follow if the 440 Series drive fails to operate properly.

Appendix A provides procedures for troubleshooting electrical interference problems.

1.2 PRODUCT FEATURES

440 model Micro Series Drives are bipolar, speed adjustable, two-phase chopper drives which use power hybrid devices. They can be purchased for step resolutions of full/half step, 1/5-1/10 microstep or 1/125 microstep. The maximum running speed is 10,000 full steps per second. To reduce the chances of electrical noise problems, the control signals are optically isolated from the drive circuit.

- Switch selectable current levels of 1, 2, 3 and 4 amperes
- Latched short circuit protection
- Unlatched undervoltage and transient overvoltage protection
- Inputs are optically isolated
- Reduced Current and Windings Off capability

440 model Micro Series Motion Controls have the capability of reducing motor current level to decrease motor heating when full power is not needed. Complete information on all control related features of the units are included in the attached manual.

SECTION 2: EXPRESS START UP PROCEDURE

The following instructions define the minimum steps necessary for the **Drive** section of your unit to become operational. If applicable, be sure to follow the Express Start Up Procedure for the Control section of the unit as given in the attached Instruction Manual.

CAUTION:

Always disconnect the ac power to the unit and be certain that the "PWR ON" LED is OFF before connecting or disconnecting the motor connector or leads. FAILURE TO DO THIS WILL RESULT IN DAMAGE TO THE DRIVE.

Always operate the Motor and the Drive GROUNDED. Be sure to twist together the wires for each motor phase. Six twists per foot is a good guideline.

1. Check to see that the motor used is compatible with the drive. Refer to Section 4.4 for a list of compatible motors.

2. Set the correct current level for the motor being used per the instructions in Section 4.5.

3. Wire the motor per the "Motor Connections" description in Section 3.4.

4. Set the AC Voltage switch to the correct level as described in Section 3.3. Connect power source to the AC input terminal strip. The terminal labeled "H" is hot, "C" is common and "G" is ground.

NOTES:

If the motor operates erratically, refer to Section 5, "Torque Versus Speed Characteristics".

Clockwise and counterclockwise directions are properly oriented when viewing the motor from the label end.

MOTOR CONNECTOR PART NUMBERS FOR 440 SERIES PACKAGED DRIVES

(This connector mates with the motor connector on drive)
Phoenix Part Number: 1777824

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SECTION 3: INSTALLATION GUIDELINES

3.1 GENERAL WIRING GUIDELINES

SLO-SYN Micro Series drives use modern solid-state electronics such as microprocessors to provide the features needed for advanced motion control applications. In some cases, these applications produce electromagnetic interference (EMI, or electrical "noise") that may cause inappropriate operation of the microprocessor logic used in the Micro Series product, or in any other computer-type equipment in the user's system.

In general, any equipment that causes arcs or sparks or that switches voltage or current at high frequencies can cause interference. In addition, ac utility lines are often "polluted" with electrical noise from sources outside a user's control (such as equipment in the factory next door). Some of the more common causes of electrical interference are:

- power from the utility ac line
- relays, contactors and solenoids
- light dimmers
- arc welders
- motors and motor starters
- induction heaters
- radio controls or transmitters
- switch-mode power supplies
- computer-based equipment
- high frequency lighting equipment
- dc servo and stepper motors and drives

The following wiring practices should be used to reduce noise interference.

Failure to properly wire the system will void the Warranty.

- **Solid grounding of the system is essential.** Be sure that there is a solid connection to the ac system earth ground. Bond the drive case to the system enclosure. Use a single-point grounding system for all related components of a system (a "hub and spokes" arrangement). Keep the ground connection short and direct.

- **Keep signal and power wiring well separated.** If possible, use separate conduit or ducts for each. If the wires must cross, they should do so at right angles to minimize coupling.

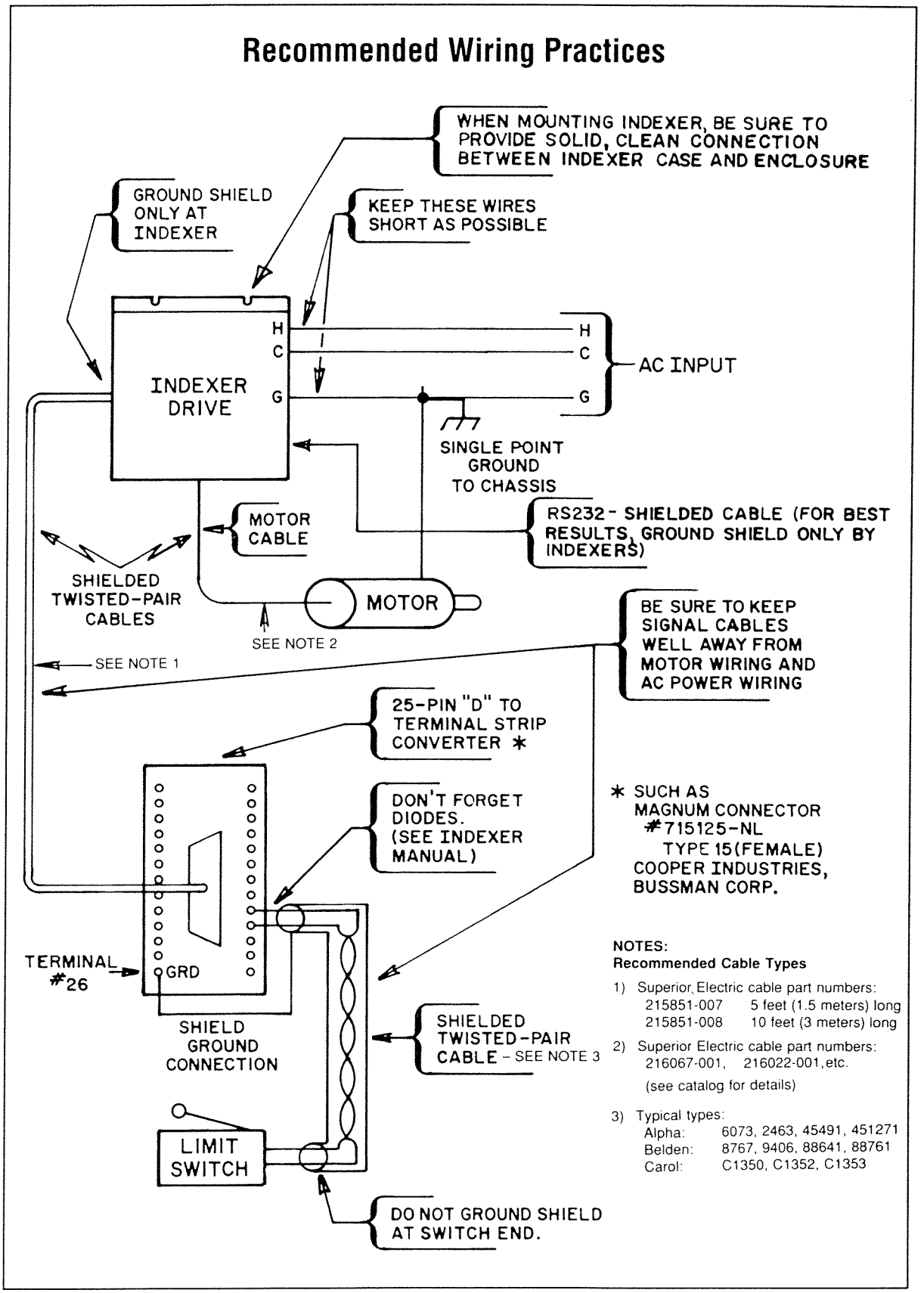
  Note: Power wiring includes ac wiring, motor wiring, etc. and signal wiring includes inputs and outputs (I/O), serial communications (RS232 lines), etc.

- **Use shielded, twisted-pair cables for Indexer I/O lines. BE SURE TO GROUND SHIELDS ONLY AT ONE END, THE INDEXER/DRIVE END.**

- **Suppress all relays to prevent noise generation.** Typical suppressors are capacitors or MOV's. (See manufacturer's literature for complete information). Whenever possible, use solid-state relays instead of mechanical contact types to minimize noise generation.

If you are experiencing problems with drive operation which might be related to EMI, refer to Appendix A for Troubleshooting pointers.

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Recommended Wiring Practices
Figure 3.1

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3.2 MOUNTING

The 440 Series Motion Control is mounted by fastening its mounting brackets to a flat surface as shown in Figure 3.2.

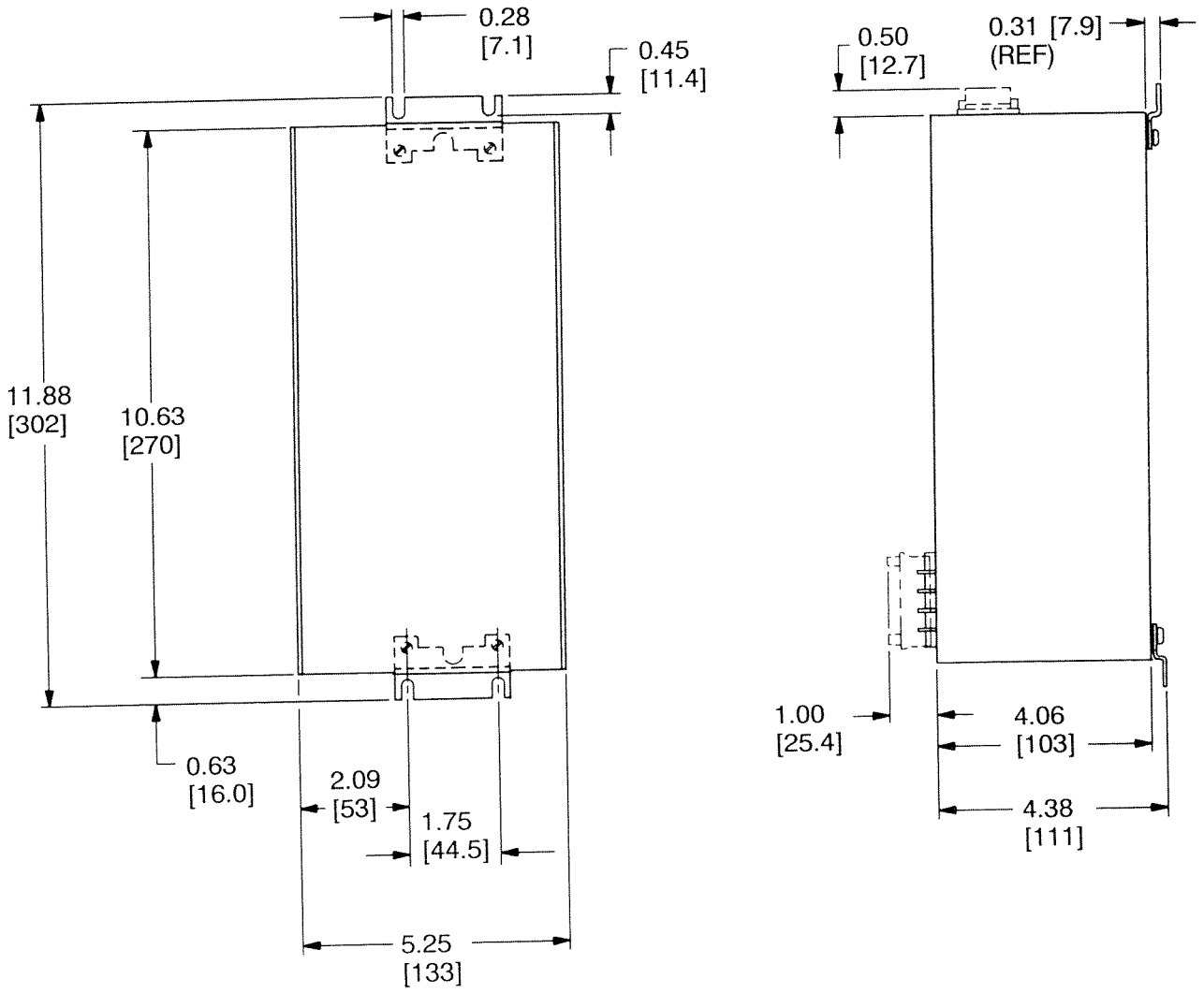


Figure 3.2, Mounting Diagram

NOTE: The unit should be mounted upright with the I/O and Motor connectors on top, or proper cooling will not occur. Air flow should not be obstructed. Case temperature should not exceed +70° C (+158° F). Forced air cooling may be required to maintain temperature within the stated limits.

When selecting a mounting location, it is important to leave at least two inches (51mm) of space around the top, bottom and sides of the unit to allow proper airflow for cooling.

It is also important to keep the drive away from obvious noise sources. If possible, locate the drive in its own metal enclosure to shield it and its wiring from noise sources. If this cannot be done, keep the drive at least three feet from any noise sources.

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3.3 SELECTING INPUT VOLTAGE RANGE

The 440 Series Drives can be operated from 115 Vac or from 230 Vaç, 50/60 hertz power sources. The selector switch located next to the ac input terminals must be set to the appropriate level. The factory default is 230 Vac. To use 115 Vac, slide the switch to the 115 V position. See Figure 3.3 for the location of the switch.

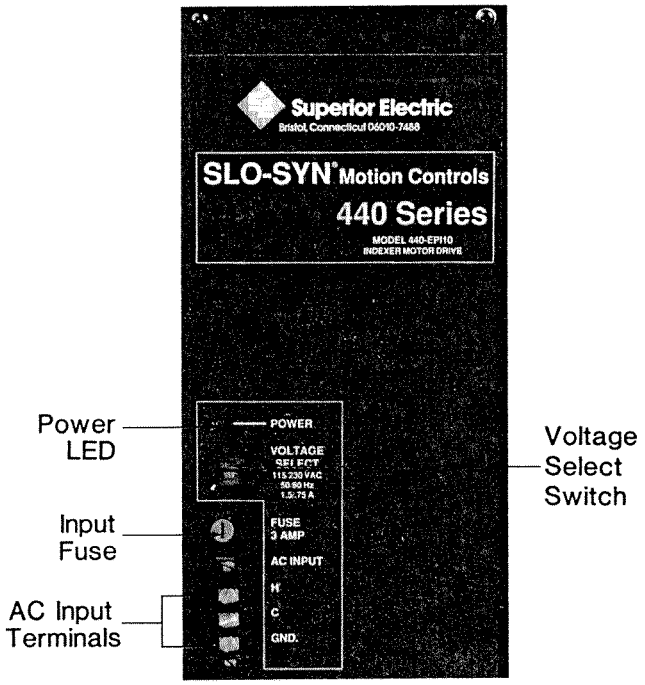


Figure 3.3, Connector And AC Voltage Selector Switch Locations

3.4 CONNECTOR LOCATIONS AND PIN ASSIGNMENTS

Figure 3.3 shows the connector locations for the 440 Drive.

MOTOR CONNECTIONS

All motor connections are made via the 4-pin Phoenix connector. Pin assignments for this connector are:

Pin	Assignment
1	M1
2	M3
3	M5
4	M4

NOTE: Motor phase A is M1 and M3 and motor phase B is M4 and M5.

Connector: Phoenix part number 1777824

Cabling from the drive to the motor should be done with a shielded, twisted pair cable. As a guideline, the wires for each motor phase should be twisted about six times per foot.

Superior Electric offers the following motor cable configurations:

Length	Unterminated Leads On Motor End Part Number	(Plug On Motor End)* Part Number
10 ft (3 m)	B216022-001	B216067-001
25 ft (7.6 m)	B216022-002	B216067-002
50 ft (15.2 m)	B216022-003	B216067-003

* Mates with receptacle on M061, M062 and M063 motors equipped with connectors (M061-CS08, etc.).

Figure 3.4 shows the possible motor wiring configurations.

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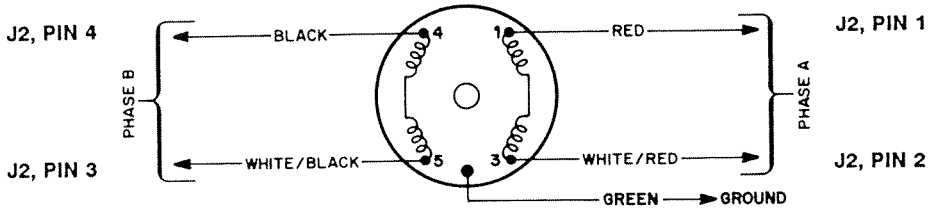


Figure 3.4, Motor Wiring Configurations

POWER INPUT

The ac input power is connected to a 3-screw terminal strip. The terminals are labeled as follows:

Terminal	Lead Color, North American Standard	Lead Color, European Standard (CEE)
"H" for Hot	Black	Brown
"C" for Common or Neutral	White	Blue
"G" for Ground	Green	Green with Yellow stripe

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SECTION 4: SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

440 SERIES PACKAGED UNITS

Size	
(Inches)	5.25 W x 4.5 D x 10.75 H (height over connectors, excluding mounting flanges. Height with flanges is 12 inches)
(mm)	134 W x 115 D x 273 H
Weight	8.2 pounds (3.72 kg)

4.2 ELECTRICAL SPECIFICATIONS

AC Input Range	90 to 132 Vac, 50/60 Hz or 180 to 264 Vac, 50/60 Hz, switch selectable
AC Current	1.5 ampere at 115 Vac input 0.75 ampere at 230 Vac input
Fuse Rating*	250 volts, 3 amperes
Fuse Type*	Littelfuse part number 312003 or Bussman part number MTH-3
Drive Power Dissipation	
(Worst Case)	40 watts (drive only) 45 watts (drive plus control)

* If this fuse blows, the power supply will be prevented from energizing any of its outputs, hence, the unit will not operate. Usually, this fuse will only blow if an internal failure occurs.

4.3 ENVIRONMENTAL SPECIFICATIONS

Temperature	
Operating	+32° F to +122° F (0° C to +50° C) free air ambient
Storage	-40° F to +167° F (-40° C to +75° C)
Humidity	95% max. noncondensing
Altitude	10,000 feet (3048 m) max.
Cooling	will operate up to 122° F (50° C) as long as maximum case temperature of 158° F (70° C) is maintained; forced-air (fan) cooling may be required.

4.4 MOTOR COMPATIBILITY

Motor Types	Superior Electric M Series
Frame Sizes	M061 through M091*
Number of Connections	4, 6, 8
Minimum Inductance	0.6 millihenrys
Maximum Inductance	40 millihenrys
Maximum Resistance	8 ohms at 1 amp. setting 4 ohms at 2 amp. setting 2.5 ohms at 3 amp. setting 2 ohms at 4 amp. setting

NOTE: Maximum resistance is total of motor plus cable.

CAUTION: Do not use larger frame size motor than those listed, or the drive may be damaged.

MOTORS FOR USE WITH 440 DRIVES

WITH CONNECTOR

M061-CS08	M062-CS09	M063-CS09
M061-CE08	M062-CE09	M063-CE09

WITH LEADS

M061-LS08	M063-LS09	M091-FD09
M061-LE08	M063-LE09	M091-FD8009
M062-LS09	M091-FC09	
M062-LE09		

* Operation at low speeds (less than 600 pulses per second) is possible with larger frame size motors than those listed here.

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4.5 CURRENT SETTINGS

The proper current setting for each motor is shown on the individual torque vs. speed curves. Use this current level to obtain the torque shown. The access hole for the switch for setting motor current level is located on the back of the unit (see Figure 4.1).

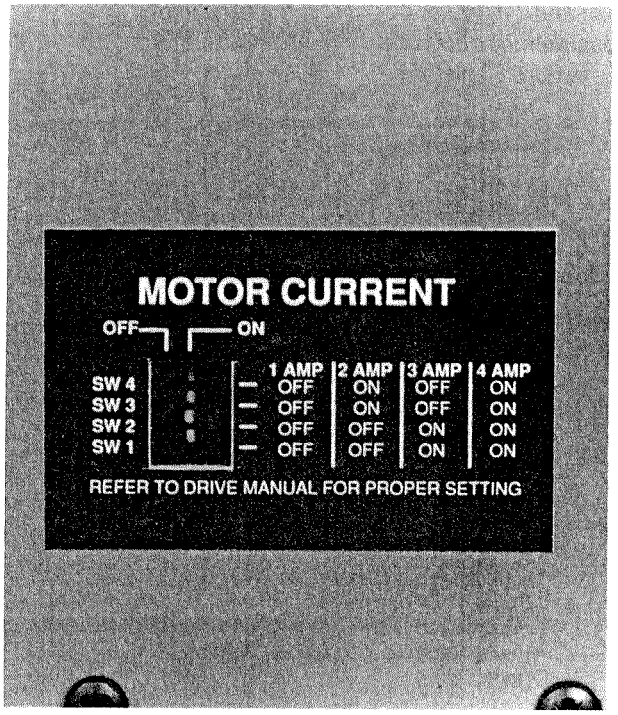


Figure 4.1
DIP Switch For Setting Motor Current Level

CURRENT	SW1	SW2	SW3	SW4
1 Ampere	OFF	OFF	OFF	OFF
2 Amperes	OFF	OFF	ON	ON
3 Amperes	ON	ON	OFF	OFF
4 Amperes	ON	ON	ON	ON

4.6 INDICATOR LIGHTS

"POWER" LED, Red

Lights when the +5V drive logic power supply is present, indicating that the drive is energized.

"FAULT" LED, Red

Lights to indicate a drive overcurrent condition. During this condition, power is removed from the motor windings so that no holding torque is being applied. Recovery from this condition requires removing and then reapplying the ac power.

SECTION 5: TORQUE VERSUS SPEED CHARACTERISTICS

5.1 MOTOR PERFORMANCE

All stepper motors exhibit instability at their natural frequency and harmonics of that frequency. Typically, this instability will occur at speeds between 50 and 500 full steps per second and, depending on the dynamic motor load parameters, can cause excessive velocity modulation or improper positioning. This type of instability is represented by the open area at the low end of each Torque vs. Speed curve.

There are also other instabilities which may cause a loss of torque at stepping rates outside the range of natural resonance frequencies. One such instability is broadly defined as mid-range instability. Usually, the damping of the system and acceleration/deceleration through the resonance areas aid in reducing instability to a level that provides smooth shaft velocity and accurate positioning. If instability does cause unacceptable performance under actual operating conditions, the following techniques can be used to reduce velocity modulation.

1) Avoid constant speed operation at the motors unstable frequencies. Select a base speed that is above the motors resonant frequencies and adjust acceleration and deceleration to move the motor through unstable regions quickly.

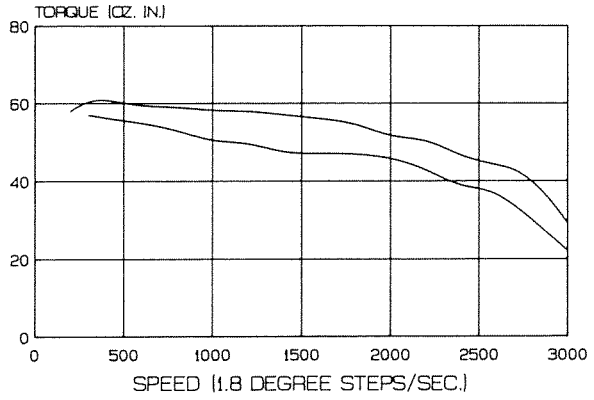
2) The motor winding current can be reduced as discussed in Section 4.5. Lowering the current will reduce torque proportionally. The reduced energy delivered to the motor can decrease velocity modulation.

3) Use the half-step mode of operation on full/half step models or use microstepping (microstepping models only) to provide smoother operation and reduce the effects of mid range instability. Note that microstepping reduces the shaft speed for a given pulse rate.

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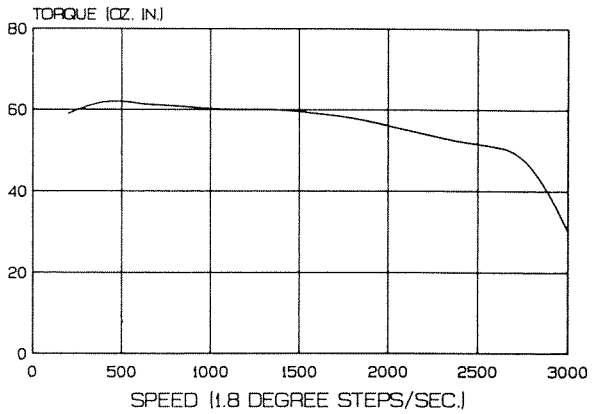
5.2 TYPICAL TORQUE VERSUS SPEED CURVES

FULL AND HALF STEP WITH A 3 AMP SETTING



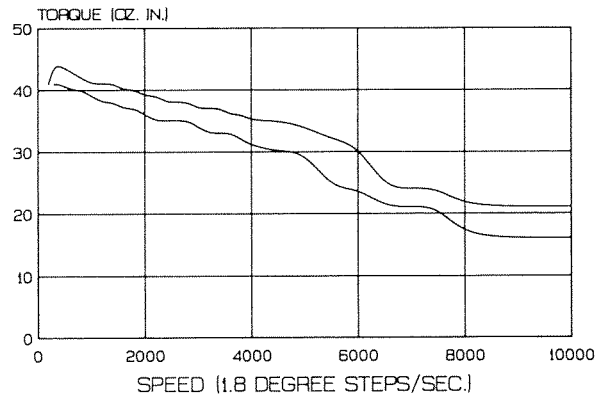
HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 3 AMP SETTING



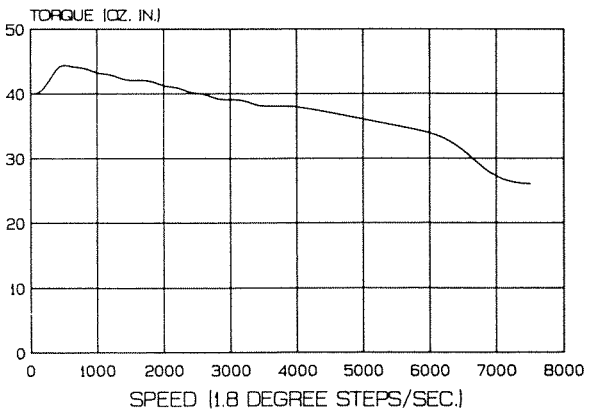
M061-CS08, M061-CE08, M061-LS08, M061-LE08 MOTORS
SERIES CONNECTED

FULL AND HALF STEP WITH A 4 AMP SETTING



HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 4 AMP SETTING



M061-CE08, M061-LE08 MOTORS
PARALLEL CONNECTED

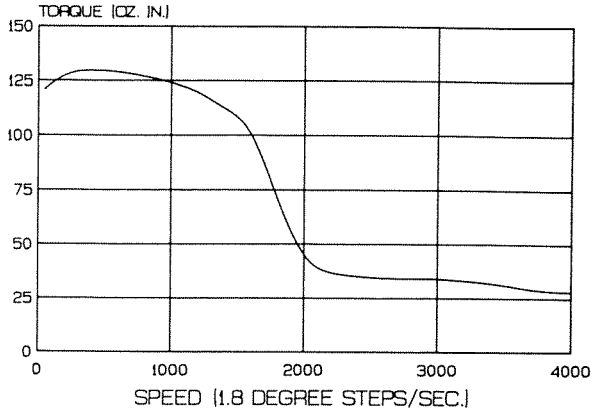
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FULL AND HALF STEP WITH A 4 AMP SETTING



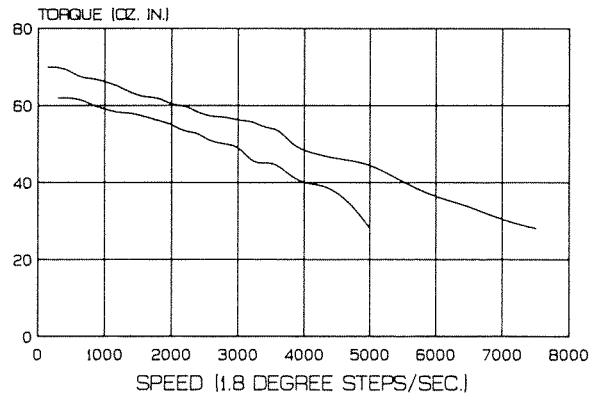
HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 4 AMP SETTING



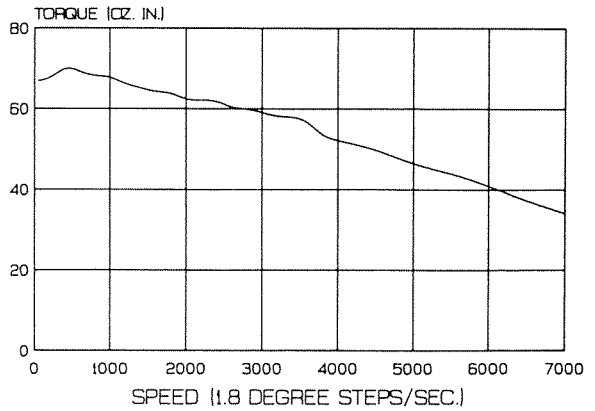
M062-CS09, M062-CE09, M062-LS09, M062-LE09 MOTORS
SERIES CONNECTED

FULL AND HALF STEP WITH A 4 AMP SETTING



HALF STEP TORQUE HIGHER THAN FULL STEP

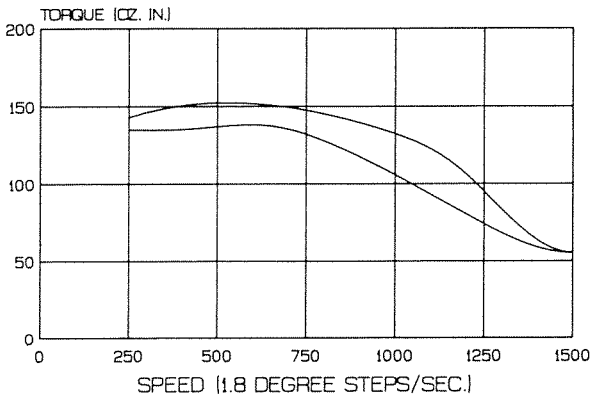
MICROSTEP WITH A 4 AMP SETTING



M062-CE09, M062-LE09 MOTORS
PARALLEL CONNECTED

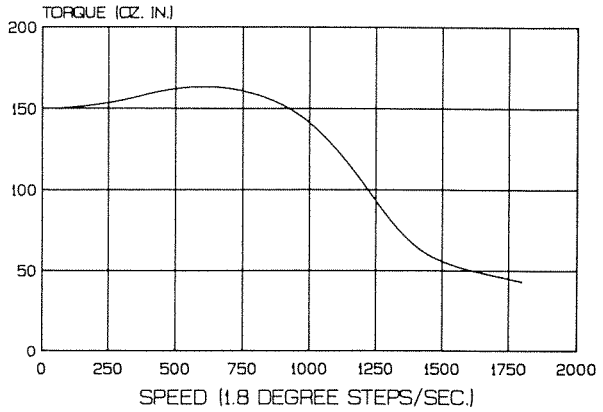
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FULL AND HALF STEP WITH A 4 AMP SETTING



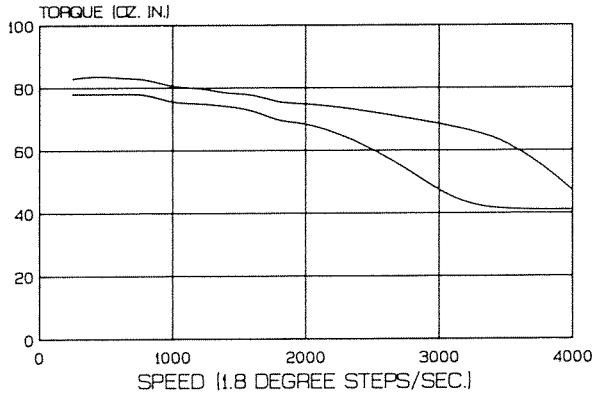
HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 4 AMP SETTING



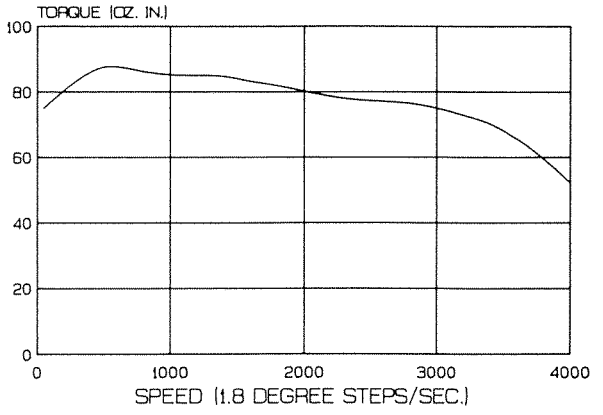
M063-CS09, M063-CE09, M063-LS09, M063-LE09 MOTORS
SERIES CONNECTED

FULL AND HALF STEP WITH A 4 AMP SETTING



HALF STEP TORQUE HIGHER THAN FULL STEP

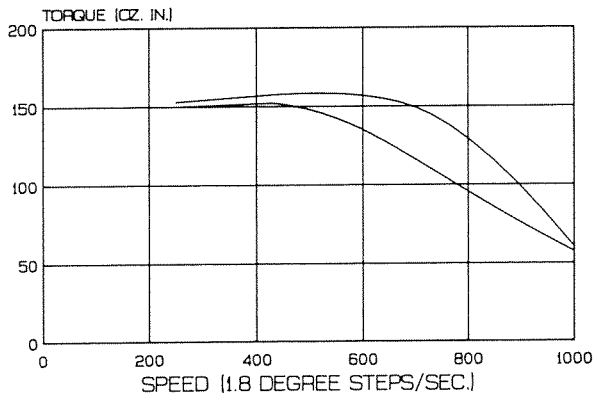
MICROSTEP WITH A 4 AMP SETTING



M063-CE09, M063-LE09 MOTORS
PARALLEL CONNECTED

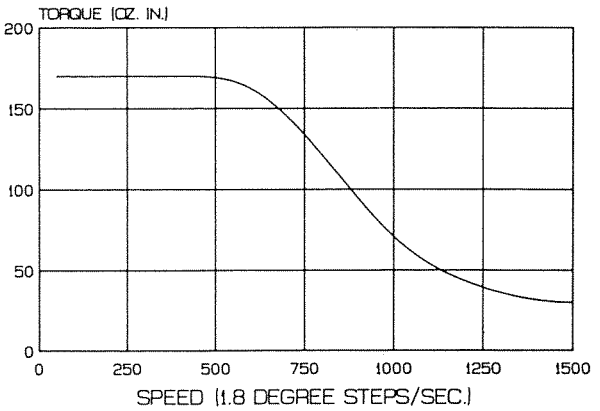
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FULL AND HALF STEP WITH A 4 AMP SETTING



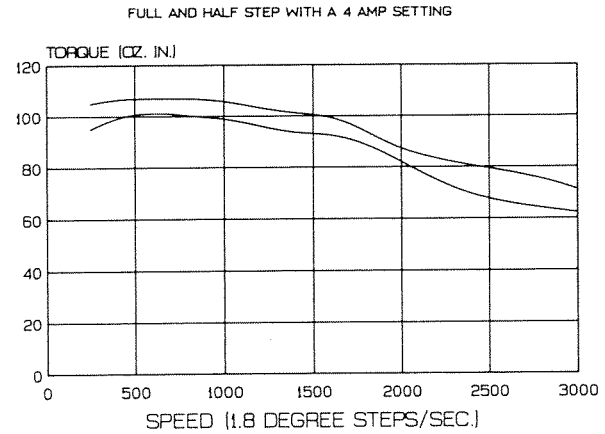
HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 4 AMP SETTING



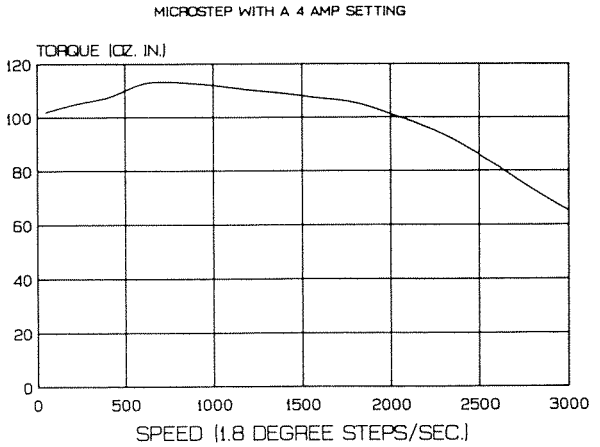
M091-FC09, M091-FD09, M091-FD8009 MOTORS
SERIES CONNECTED

FULL AND HALF STEP WITH A 4 AMP SETTING



HALF STEP TORQUE HIGHER THAN FULL STEP

MICROSTEP WITH A 4 AMP SETTING



M091-FD8009 MOTORS
PARALLEL CONNECTED

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SECTION 6: TROUBLESHOOTING

WARNING:

Motors connected to this drive can develop high torque and large amounts of mechanical energy.

Keep clear of the motor shaft and all parts mechanically linked to the motor shaft.

Turn off all power to the drive before performing work on parts mechanically coupled to the motor.

If installation and operating instructions have been followed carefully, this unit should perform correctly. If the motor fails to step properly, the following checklist will be helpful in locating and correcting the problem.

In General:

- Check all installation wiring carefully for wiring errors or poor connections.
- Check to see that the proper voltage levels are being supplied to the unit.
- Be sure that the motor is a correct model for use with this unit.

Specifically:

IF MOTOR DIRECTION (CW, CCW) IS REVERSED, Check For:

Reversed connections to the Motor Connector.

IF THE MOTOR MOTION IS ERRATIC, Check For:

Supply voltage out of tolerance or incorrect switch setting.

Proper motion parameters (low speed, acceleration/deceleration, jog speed, home speed and feed rate).

IF TORQUE IS LOW, Check For:

All Windings Off active or Reduced Current active.

Improper supply voltage.

If a malfunction occurs that cannot be corrected by making the preceding checks, contact The Superior Electric Company.

APPENDIX A: TROUBLESHOOTING ELECTRICAL INTERFERENCE PROBLEMS

Electrical interference problems are common with today's computer-based controls, and such problems are often difficult to diagnose and cure. If such a problem occurs with your system, it is recommended that the following checks be made to locate the cause of the problem.

1. Check the quality of the ac line voltage using an oscilloscope and a line monitor, such as the Superior Electric VMS series. If line voltage problems exist, use appropriate line conditioning, such as line filters or isolation transformers.

2. Be certain all of the recommended wiring practices are followed for location, grounding, wiring and relay suppression (see Section 3.1).

3. Double check the grounding connections to be sure they are good electrical connections and are as short and direct as possible.

4. Try operating the drive with all suspected noise sources switched off. If the drive functions properly, switch the noise sources on again, one at a time, and try to isolate which ones are causing the interference problems. When a noise source is located, try rerouting wiring, suppressing relays or other measures to eliminate the problem.

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Product Application: 1 800 227-6471
Product Literature Request: 1 800 447-7171
Fax: 1 800 766-6366

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TEL: (203) 585-4500 TELEX: 96-2446 TWX: 710-454-0682
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