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INSTALLATION INSTRUCTIONS for SLO-SYN® MICRO SERIES 3180 MODEL DRIVES

Superior Electric

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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.

SECTION 1: INTRODUCTION

1.1 USING THIS MANUAL

It is important that you understand how the 3180 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 3180 model Micro Series Motion Controls. 3180 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 3180 Series drive fails to operate properly.

Appendix A tells how to install the ac line filter and Appendix B provides procedures for troubleshooting electrical interference problems.

1.2 PRODUCT FEATURES

3180 model Micro Series Drives are bipolar, speed adjustable, two-phase, line operated chopper drives which use power MOSFET switches. They can be purchased for step resolutions of full/half step, 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.

3180 model Micro Series Motion Controls have the capability to Boost the current level to the motor windings for increased power, or to Reduce it 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. 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 3.3.

4. Connect 120 volts ac, 50/60 hertz to the AC input terminal strip. The terminal labeled "H" is hot, "C" is common and "G" is ground.

NOTE: If 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 3180 SERIES PACKAGED DRIVES

(This connector mates with the female motor connector on drive)
Male Connector Body: AMP part number 206434-1
Pins (5 required): AMP part number 66506-8
Cable Clamp: AMP part number 206062-1

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.

- **Use a line filter on the ac input (Corcom type 10B1, 10S1 or 10K1 or equivalent) for noisy ac lines.** Particularly bad ac lines may need to be conditioned with a ferroresonant type isolation transformer to provide "clean" power to the drive. Refer to Appendix A for line filter installation instructions.

- **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.

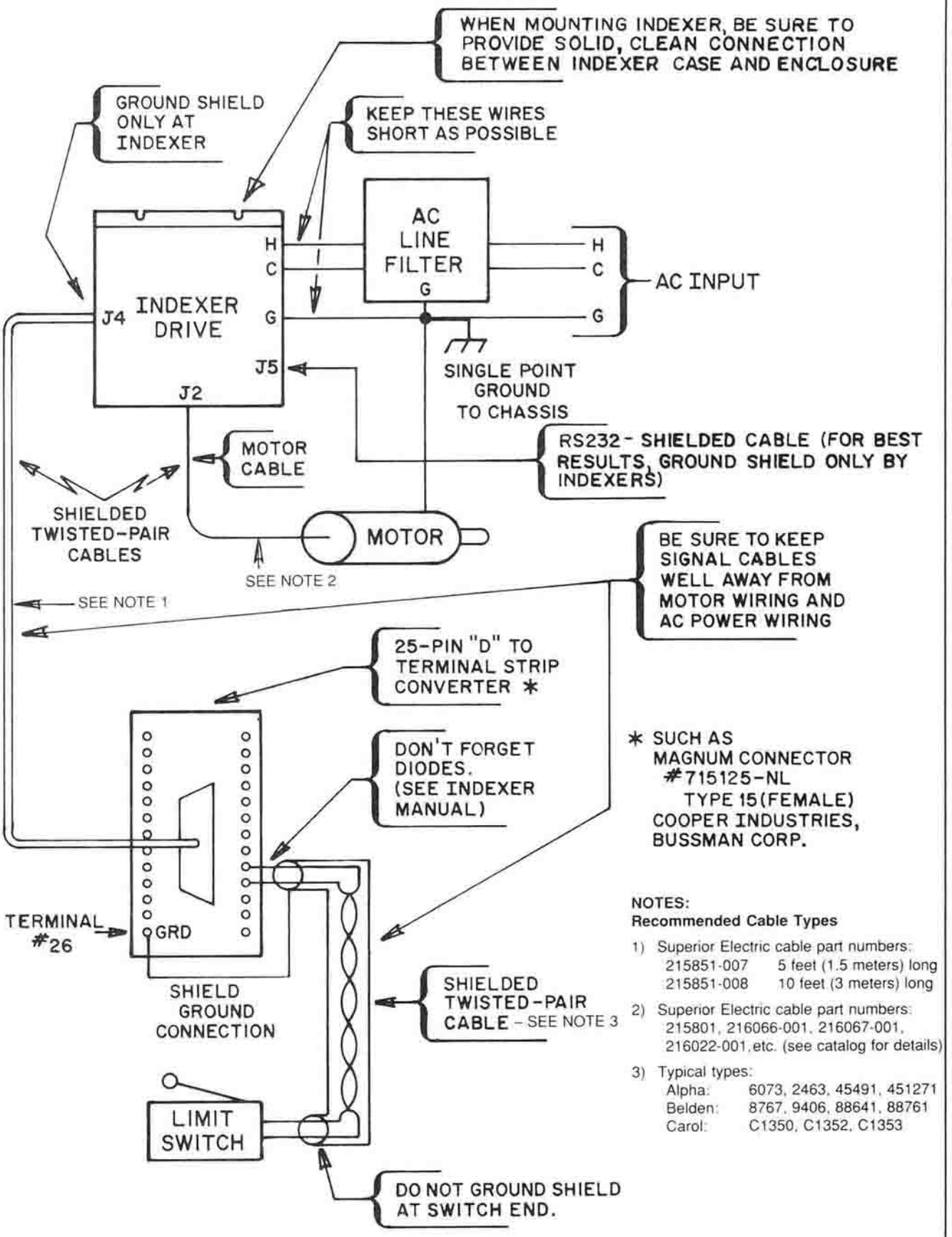
Note: Power wiring includes ac wiring, motor wiring, etc. and signal wiring includes inputs and outputs (I/O), serial communications (RS232 lines), etc.

- **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 B for troubleshooting pointers.

Recommended Wiring Practices

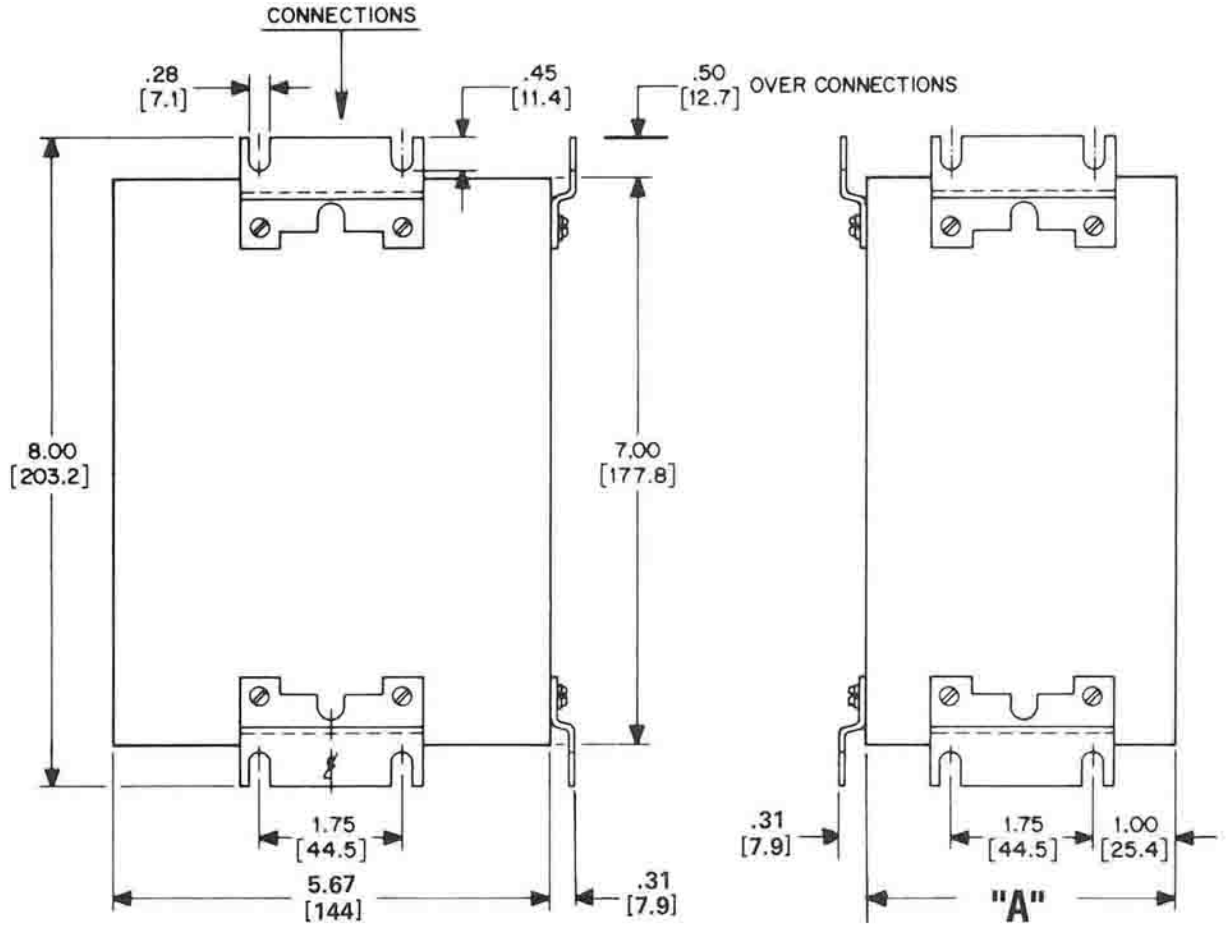


NOTES:
Recommended Cable Types

1) Superior Electric cable part numbers:
   215851-007 5 feet (1.5 meters) long
   215851-008 10 feet (3 meters) long
2) Superior Electric cable part numbers:
   215801, 216066-001, 216067-001, 216022-001, etc. (see catalog for details)
3) Typical types:
   Alpha: 6073, 2463, 45491, 451271
   Belden: 8767, 9406, 88641, 88761
   Carol: C1350, C1352, C1353

3.2 MOUNTING

The 3180 Series Motion Control is mounted by fastening its mounting brackets to a flat surface. The mounting brackets can be located in either of two positions. Figure 3.2 shows the locations and diameters of the mounting holes and indicates the possible locations of the brackets.



CONTROL TYPE	"A" DIMENSION
TRANSLATOR	4.00 (101.6)
TRANSLATOR/OSCILLATOR	6.29 (159.8)
INDEXER	6.29 (159.8)

Figure 3.2, Mounting Diagram

NOTE: The heat sink should always be mounted with the fins oriented vertically, or proper cooling will not occur. Air flow should not be obstructed. Heat sink temperature should not exceed +80° C (+176° 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.

3.3 CONNECTOR LOCATIONS AND PIN ASSIGNMENTS

Figure 3.3 shows the connector locations for the 3180 Drive.

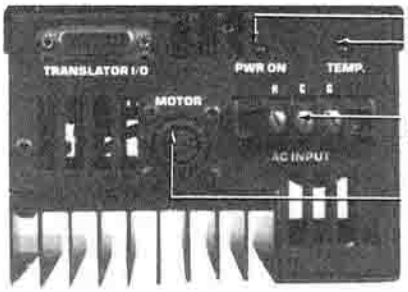


Figure 3.3, Connector Locations

MOTOR CONNECTIONS

All motor connections are made via the 8-pin circular AMP connector. Pin assignments for this connector are:

Pin	Assignment
1	M3
2	M5
3	No Connection
4	Ground
5	No Connection
6	M1
7	No Connection
8	M4

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

AMP male connector 206434-1 (AMP pin part number 66506-8 and cable clamp part number 20606-1) will mate with this connector.

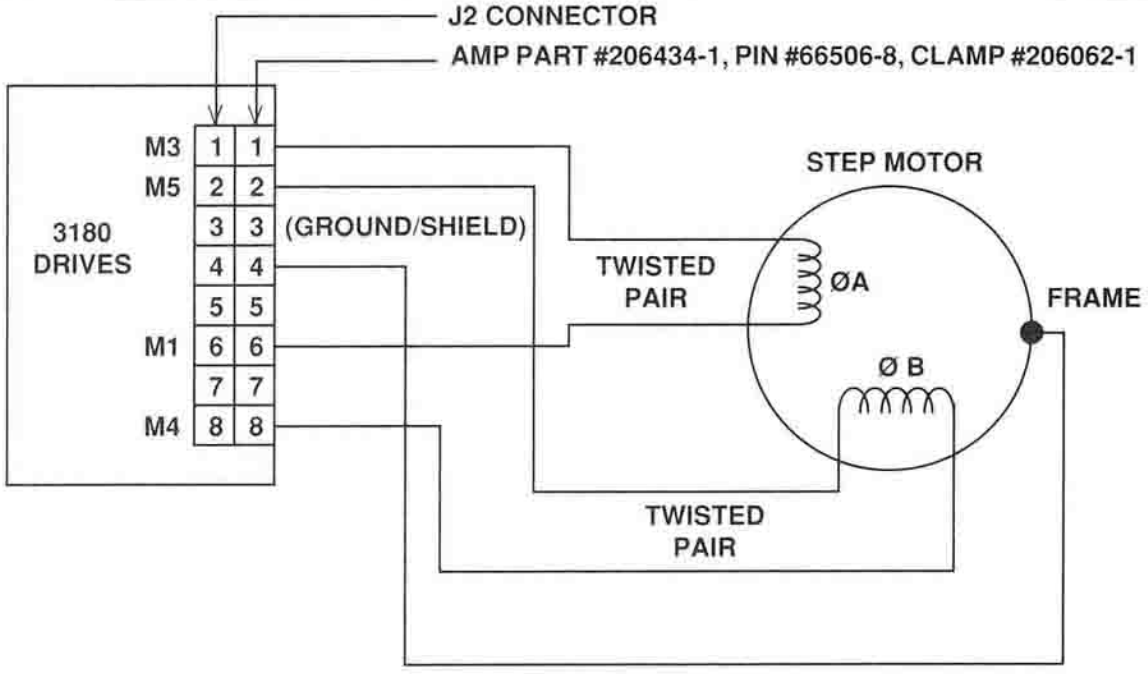
Cabling from the drive to the motor should be done with a shielded, twisted pair cable. As a guideline, the wires for each motor phase should be twisted about six times per foot.

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)	B215801-001	B216066-001
25 ft. (7.6 m)	B215801-002	B216066-002
50 ft. (15.2 m)	B215801-003	B216066-003

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

Figure 3.4 shows the proper motor wiring configuration.



NOTE: Wires connected to Pins 1 and 6 should be twisted, as well as those connected to Pins 2 and 8, Approximately 6 twists per foot. The two pairs should then be shielded to minimize radiated EMI.

Figure 3.4, Motor Wiring Configuration

The diagrams in Figures 3.5 through 3.10 show connections for each combination of cable and motor type.

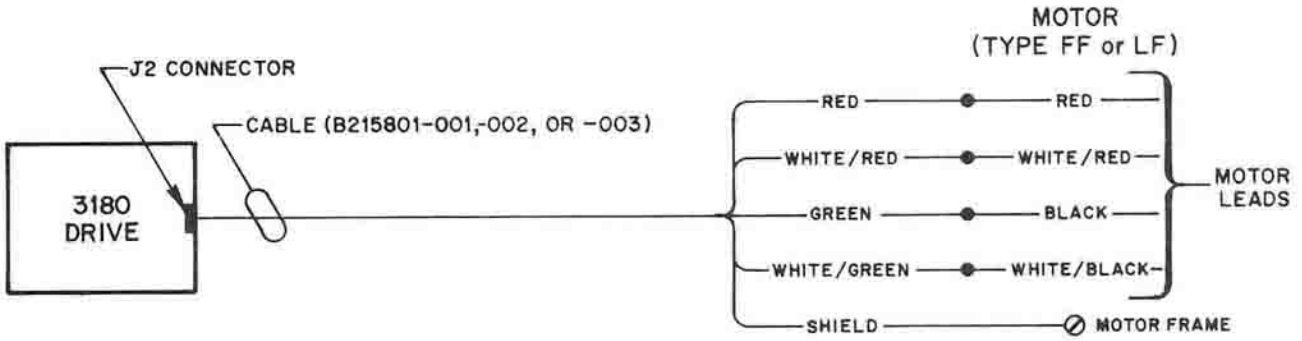


Figure 3.5, Connections Using LF Or FF Type Motors (With Leads) And Superior Electric B215801-001, -002 Or -003 Cables

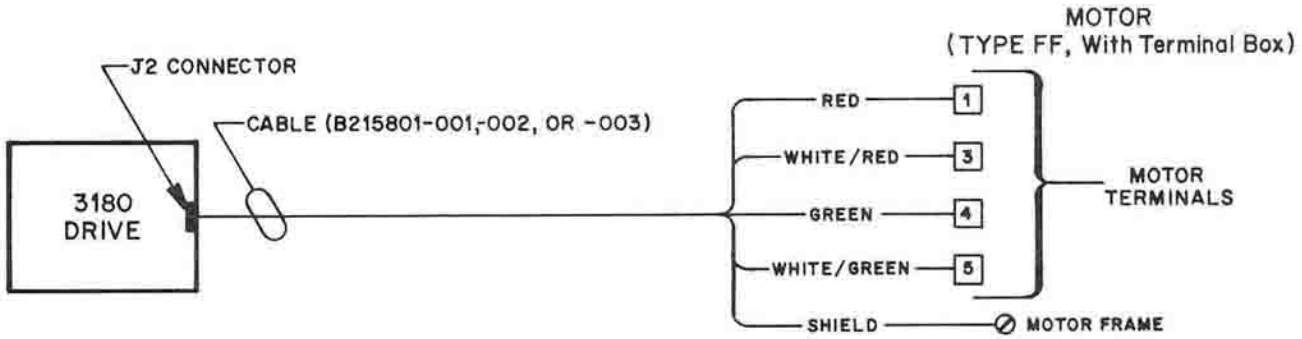


Figure 3.6, Connections Using FF Type Motors (With Terminal Enclosures) And Superior Electric B215801-001, -002 Or -003 Cables

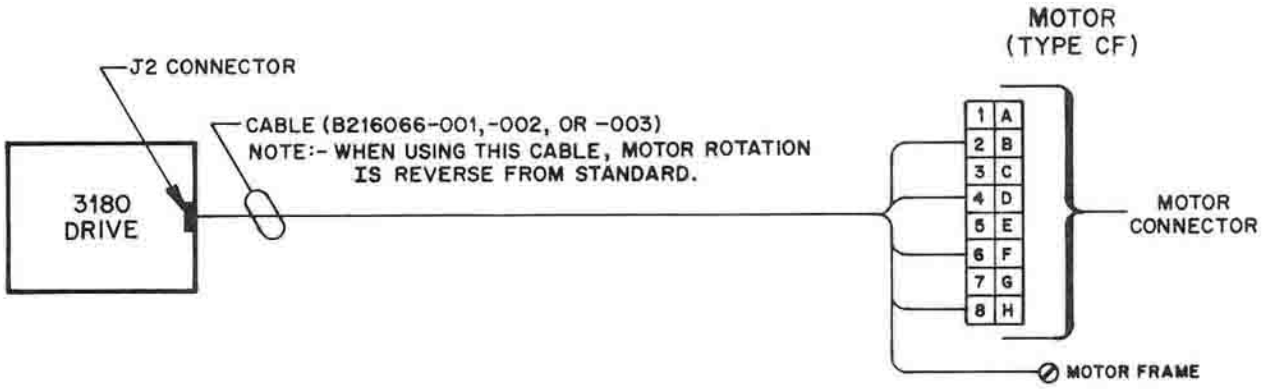


Figure 3.7, Connections Using CF Type Motors (With Connectors) And Superior Electric B216066-001, -002 Or -003 Cables

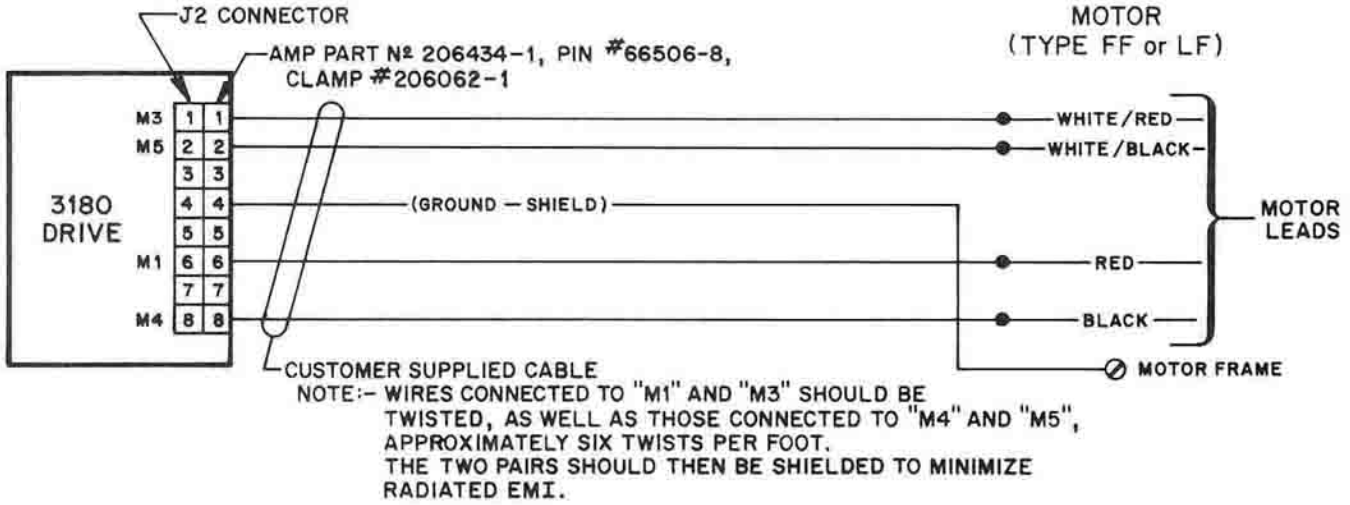


Figure 3.8, Connections Using LF Or FF Type Motors (With Leads) And Customer Supplied Cables

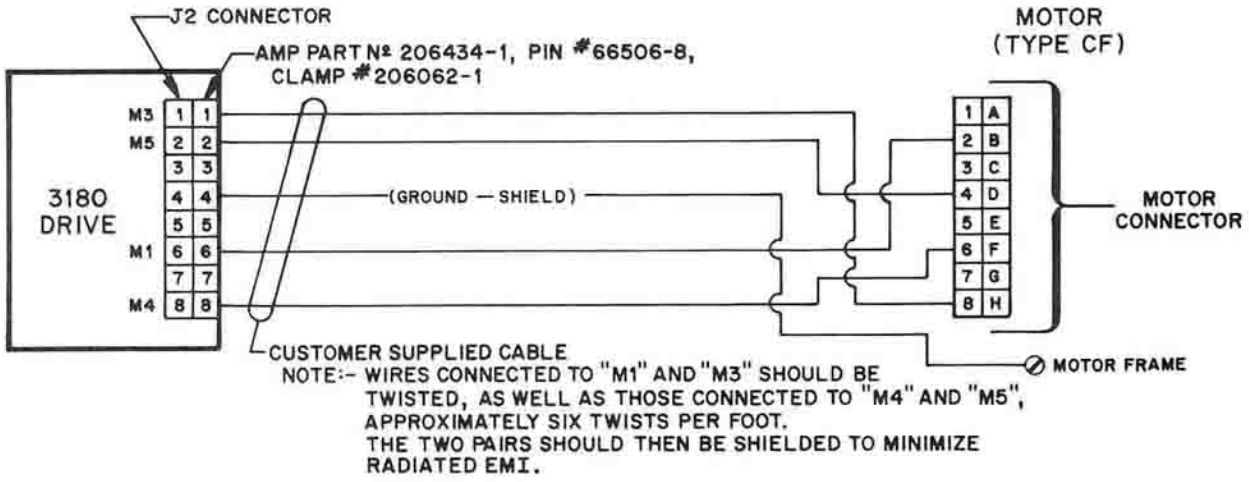


Figure 3.9, Connections Using CF Type Motors (With Connectors) And Customer Supplied Cables

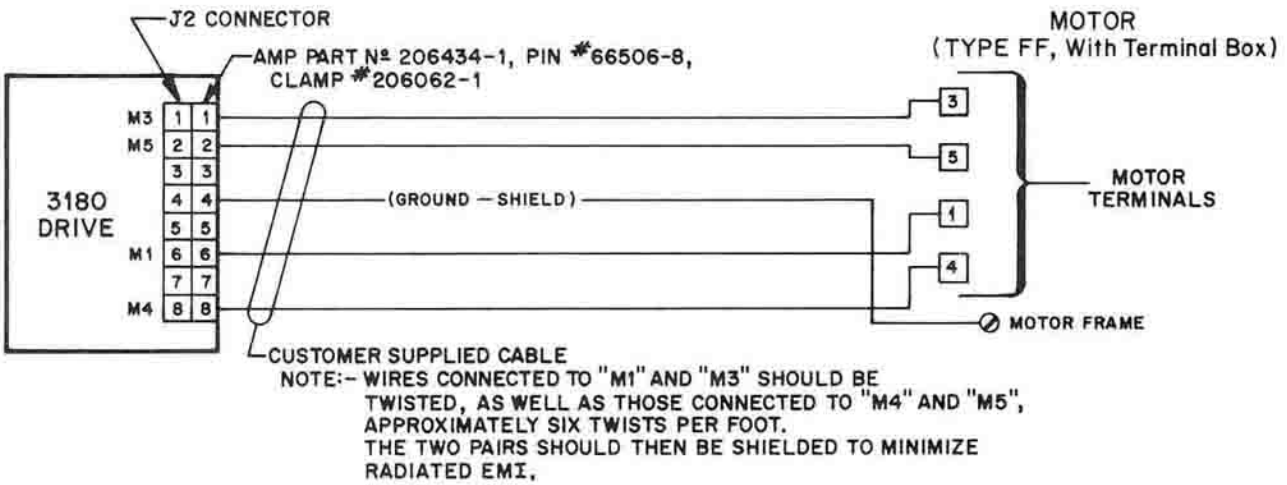


Figure 3.10, Connections Using FF Type Motors (With Terminal Enclosures) And Customer Supplied Cables

POWER INPUT

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

"H" for Hot (black) "C" for Common or Neutral (white) "G" for Ground (green)

SECTION 4: SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

TRANSLATOR DRIVES

Size	
(Inches)	5.67 W x 4.0 D x 7.69 H (height over connectors, excluding mounting flanges. Height with flanges is 8.0 inches)
(mm)	144 W x 102 D x 195 H
Weight	5 pounds (2.3kg)

TRANSLATOR/OSCILLATORS, PRESET INDEXERS, PROGRAMMABLE INDEXERS

Size	
(Inches)	5.67 W x 6.29 D x 7.69 H (height over connectors, excluding mounting flanges. Height with flanges is 8.0 inches)
(mm)	144 W x 160 D x 195 H
Weight	7 lbs (3.2 kg)

4.2 ELECTRICAL SPECIFICATIONS

AC Input Range	102 to 132 Vac, 50/60 Hz
Fuse Rating	125 volts, 5 amperes (2AG, fast acting)
Fuse Type	Littelfuse part number 225005*
Drive Power Dissipation (Worst Case)	80 watts (drive only) 85 watts (drive plus control section)
Chopping Frequency	20 kHz

* 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. Therefore, if an open fuse condition occurs, the unit must be returned to the factory for service. **DO NOT REPLACE THE FUSE OR THE UNIT MAY BE FURTHER DAMAGED.**

4.3 ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	+32° F to +122° F (0° C to +50° C) free air ambient
Storage Temperature	-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 heat sink temperature of 176° F (80° C) is maintained; forced-air (fan) cooling may be required.

4.4 MOTOR COMPATIBILITY

Motor Types	Superior Electric motors are recommended
Frame Sizes	61 mm through 112 mm
Number of Connections	4
Minimum Inductance	8.0 millihenries
Maximum Inductance	64 millihenries
Voltage To Motor	170-190 volts
Max. Motor Cable Length	100 feet (30.5 meters)

MOTORS FOR USE WITH 3180 DRIVES

SUPERIOR ELECTRIC MOTOR MODEL	3180 DRIVE CURRENT SETTING (AMPERES)*
M061-CF-408, M061-LF-408	0.5
M062-CF-402, M062-LF-402	1.0
M063-CF-401, M063-LF-401	1.0
M091-FF-401	1.0
M092-FF-402	2.0
M093-FF-402	3.0
M111-FF401	3.0
MX111-FF401	3.0
M112-FF-401	3.0
MH112-FJ-4201	3.0

* Use this value for setting the "nominal" current on the drive as described in Section 4.5.

4.5 CURRENT SETTINGS

The current applied to each motor phase is selectable via a "DIP" switch that is accessible through an opening on the side of the unit (see Figure 4.1).

NOTE: Before making this adjustment, be sure to disconnect the 120 volt ac power to the unit and wait 5 minutes for the power supply capacitors to discharge. Set the switch as follows for the appropriate current, based on the rating of the motor.

CURRENT (AMPERES)			SWITCH POSITION			
NOMINAL	REDUCE	BOOST	S1	S2	S3	S4
2.0	1.0	3.0	OFF	OFF	OFF	OFF
1.5	0.75	2.25	ON	OFF	OFF	OFF
1.0	0.5	1.5	OFF	ON	OFF	OFF
0.5	0.25	0.75	OFF	OFF	ON	OFF
3.0	1.5	3.0	OFF	OFF	OFF	ON

The Boost and Reduce functions are described in the attached control manual.

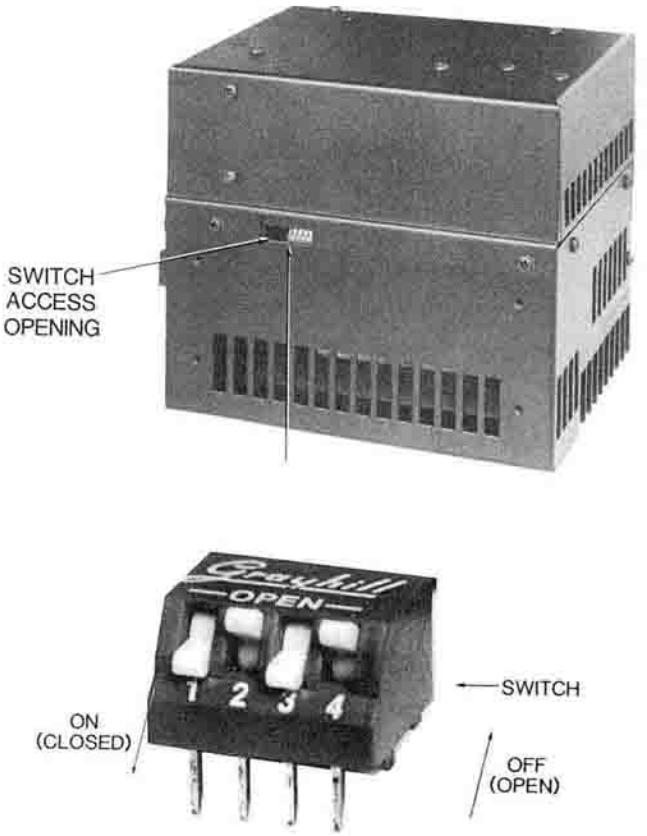


Figure 4.1, DIP Switch For Setting Current Per Phase

4.6 INDICATOR LIGHTS

"PWR ON" LED, Red — Lights when the +5V drive logic power supply is present, indicating that the drive is energized.

"TEMP" LED, Red — Lights to indicate a drive over-temperature 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 source.

SECTION 5: TORQUE VERSUS SPEED CHARACTERISTICS

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.

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. This is identified by the dotted area (....) on the torque versus speed curves.

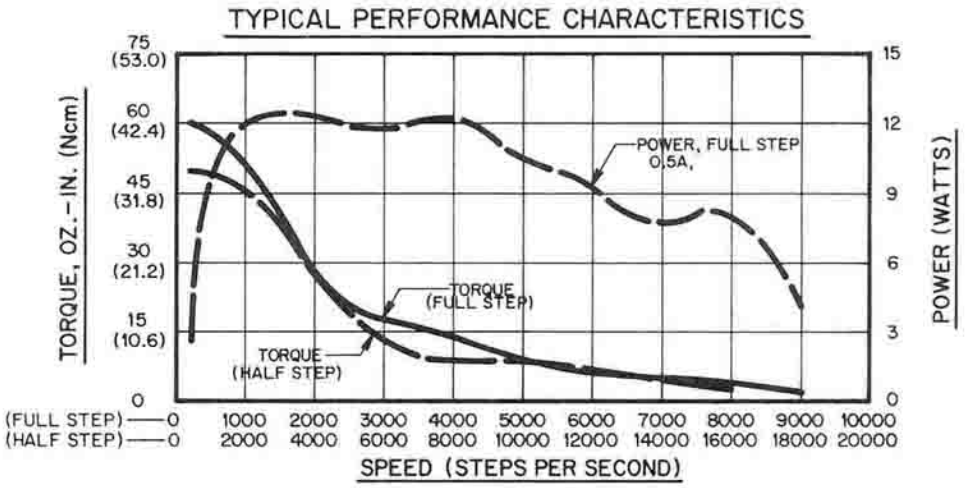
Usually, the dampening of the system and acceleration/deceleration through the resonance areas aid in reducing instability to a level that provides smooth shaft velocity and accurate positioning. If instability does cause unacceptable performance under actual operating conditions, the following techniques 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.

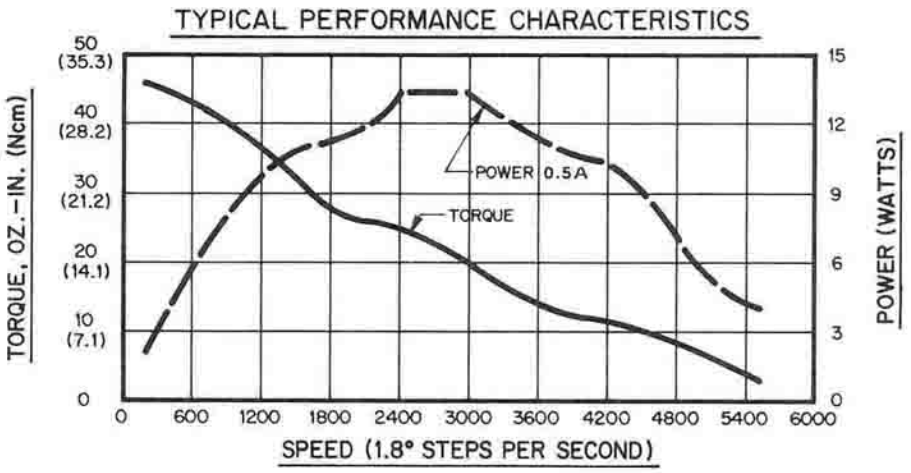
2) The motor winding current can be reduced as discussed in Section 4.5. Lowering the current will reduce torque proportionally. The reduced energy delivered to the motor can decrease velocity modulation.

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 half stepping and microstepping reduce the shaft speed for a given pulse rate.

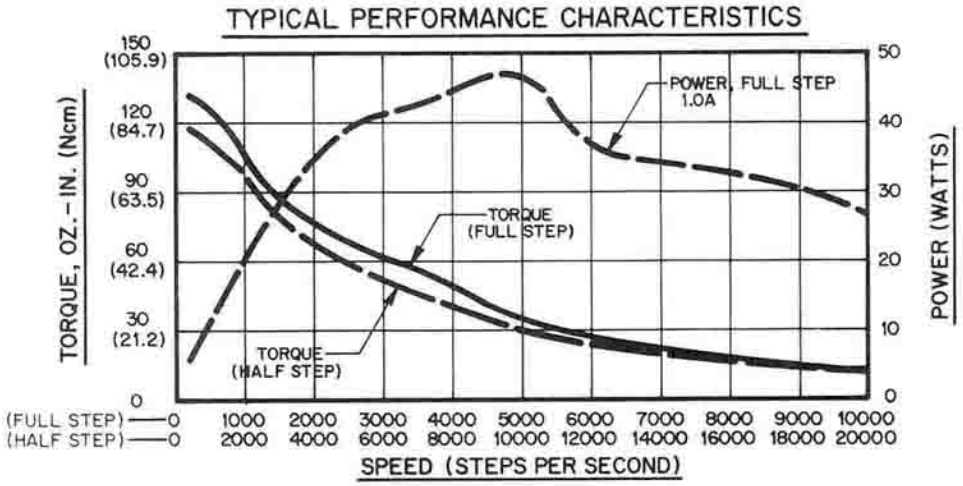
TYPICAL TORQUE VERSUS SPEED CURVES



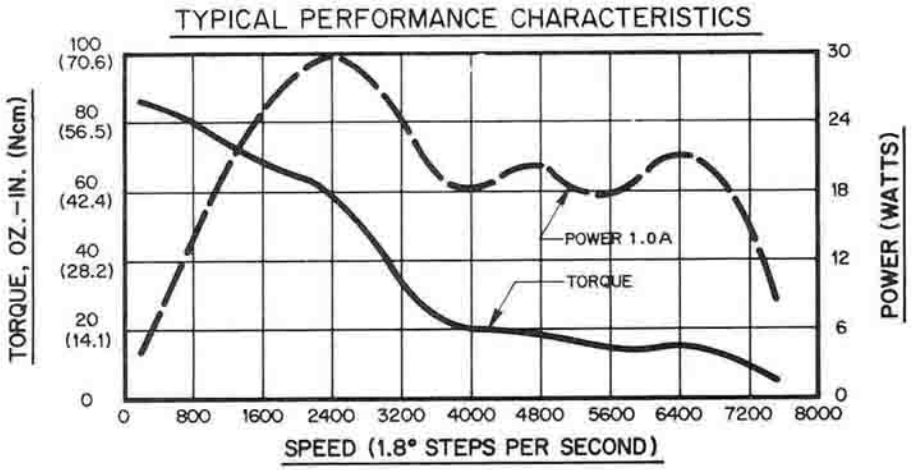
FULL/HALF STEP
M061-CF408 AND M061-LF408 MOTORS



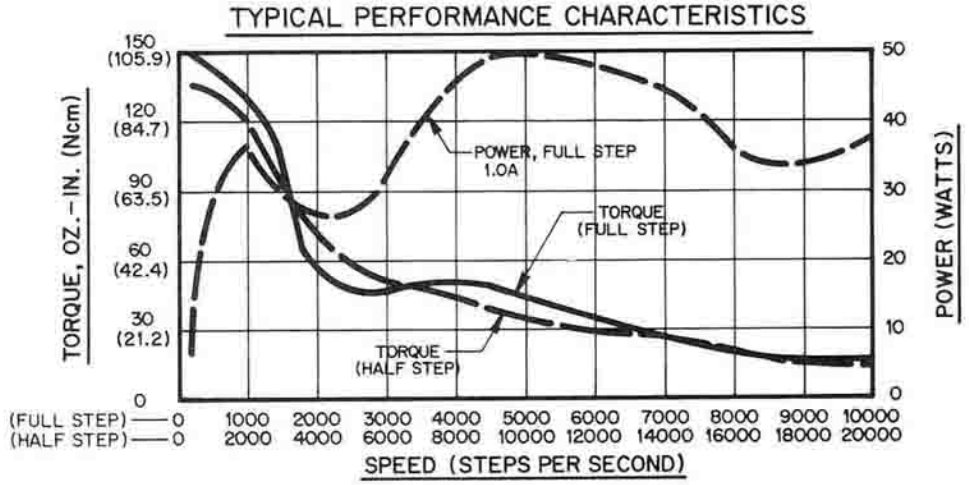
MICROSTEP
M061-CF408 AND M061-LF408 MOTORS



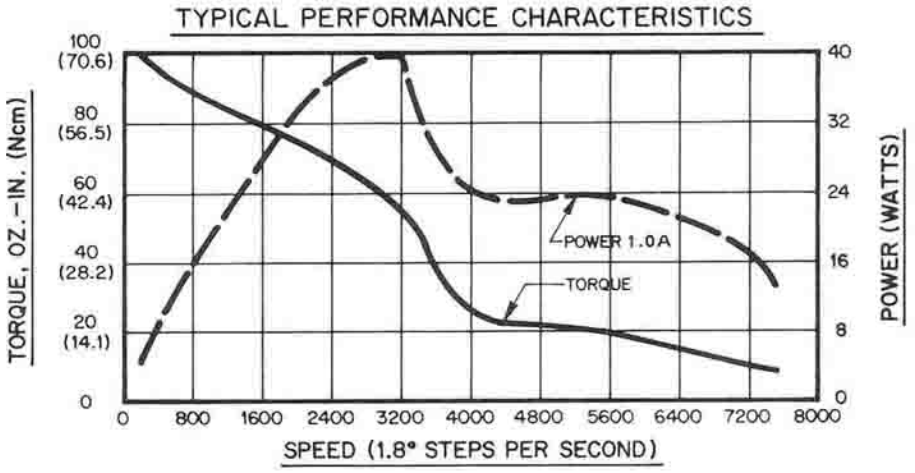
FULL/HALF STEP
M062-CF402 AND M062-LF402 MOTORS



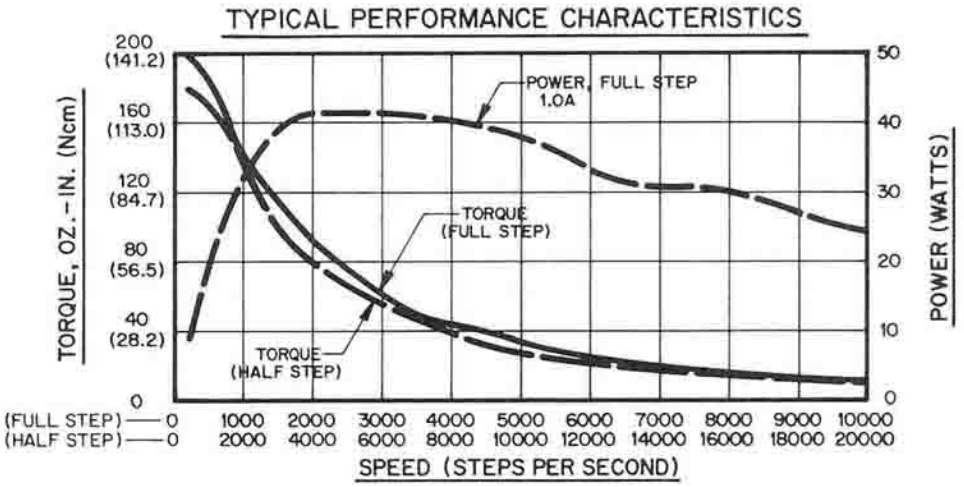
MICROSTEP
M062-CF402 AND M062-LF402 MOTORS



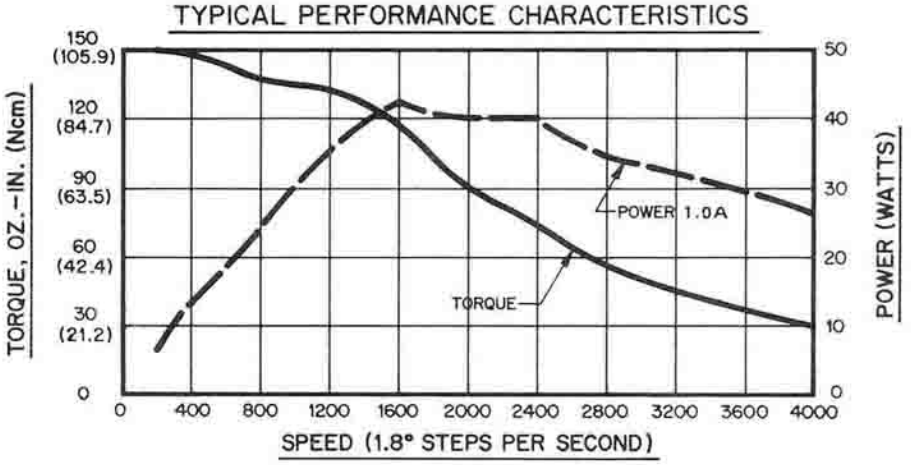
FULL/HALF STEP
M063-CF401 AND M063-LF401 MOTORS



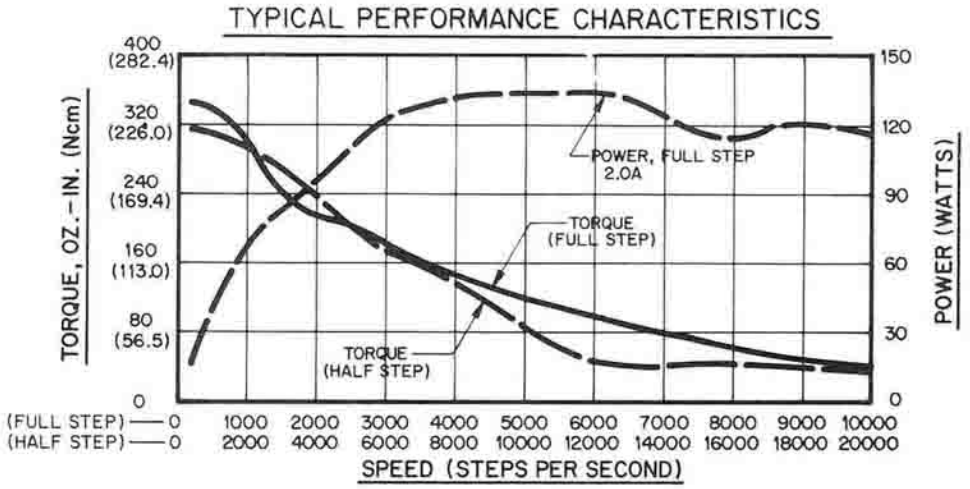
MICROSTEP
M063-CF401 AND M063-LF401 MOTORS



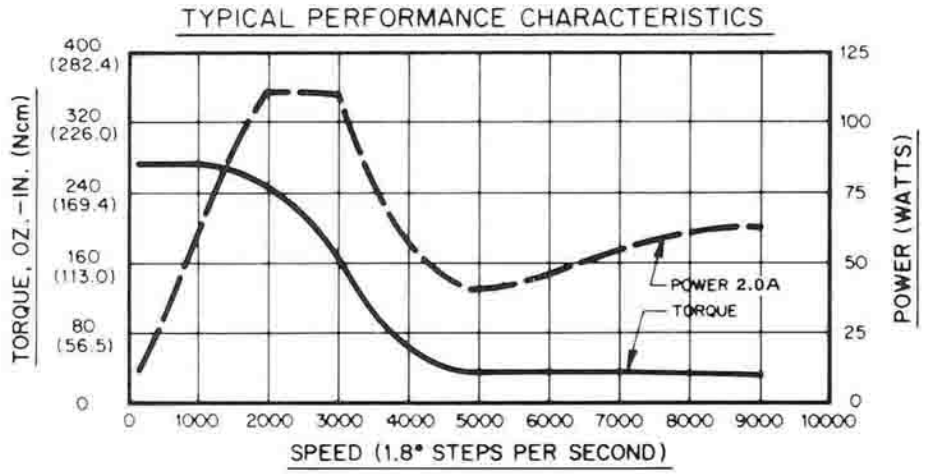
FULL/HALF STEP
M091-FF401 MOTOR



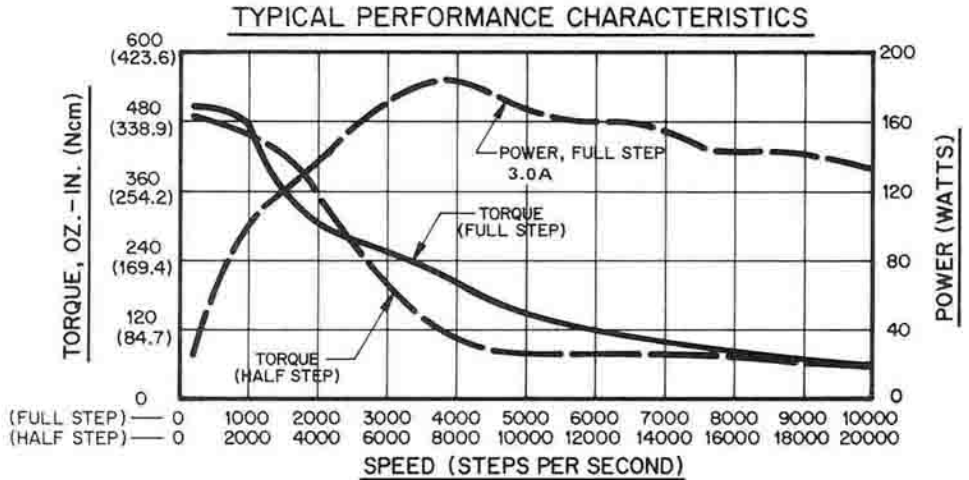
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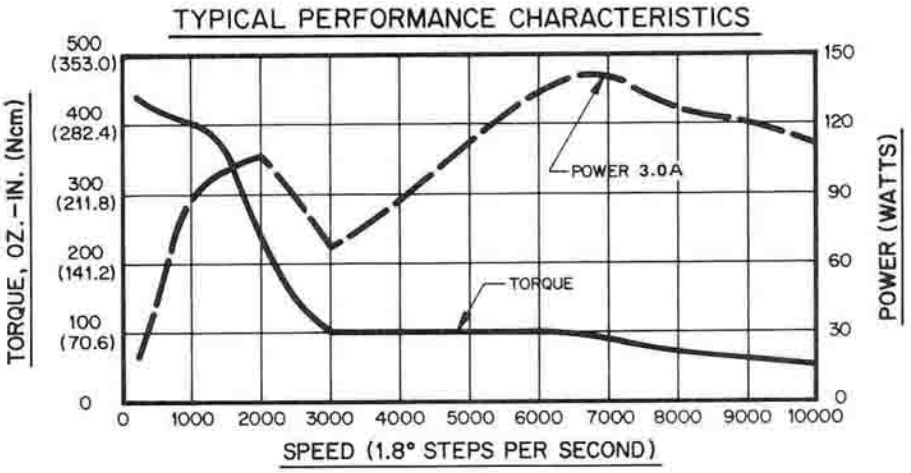
FULL/HALF STEP
M092-FF402 MOTOR



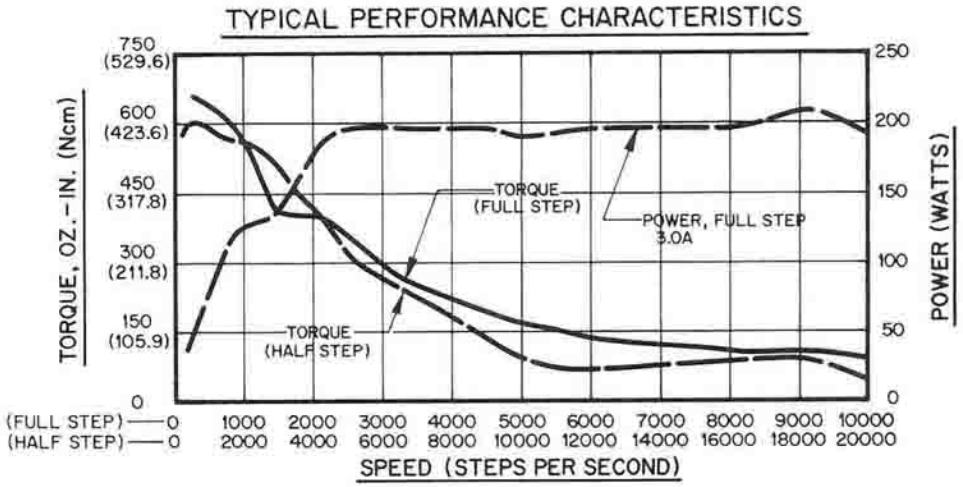
MICROSTEP
M092-FF402 MOTOR



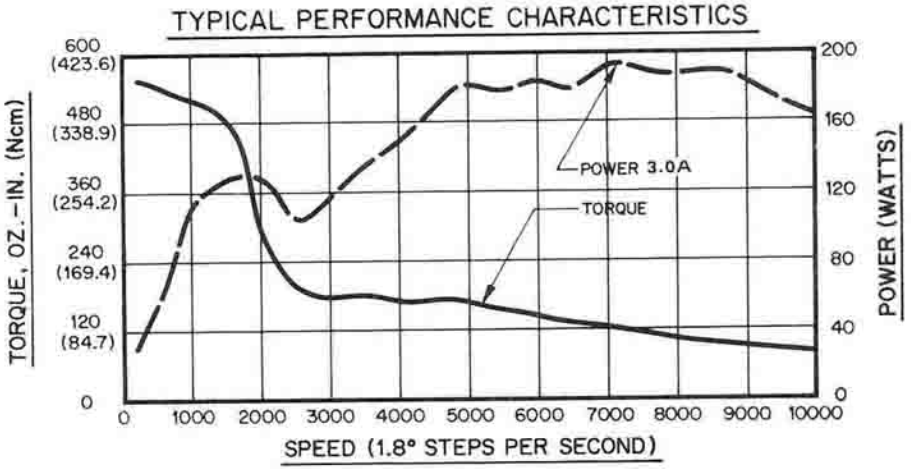
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M093-FF402 MOTOR



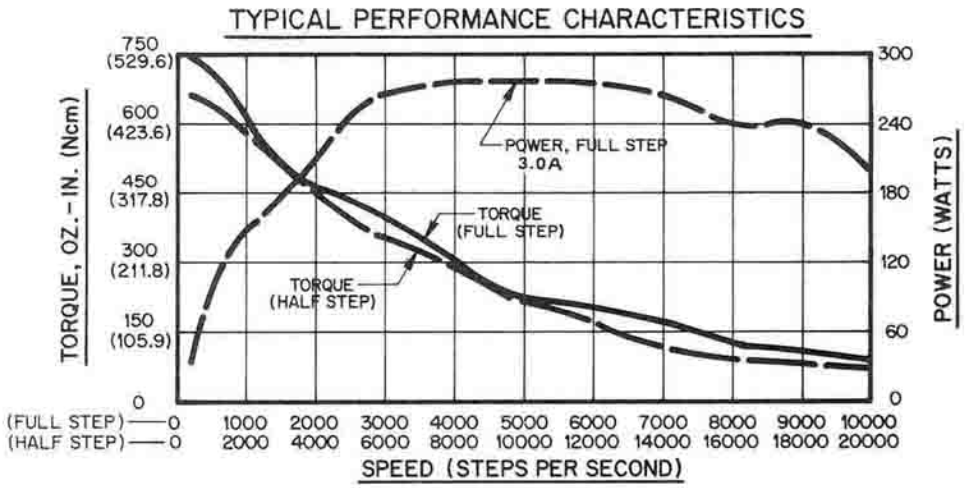
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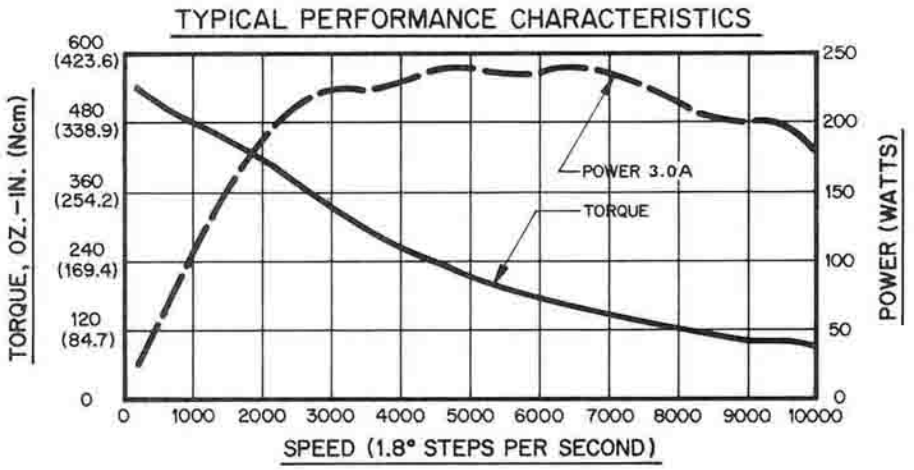
FULL/HALF STEP
M111-FF401 AND MX111-FF401 MOTORS



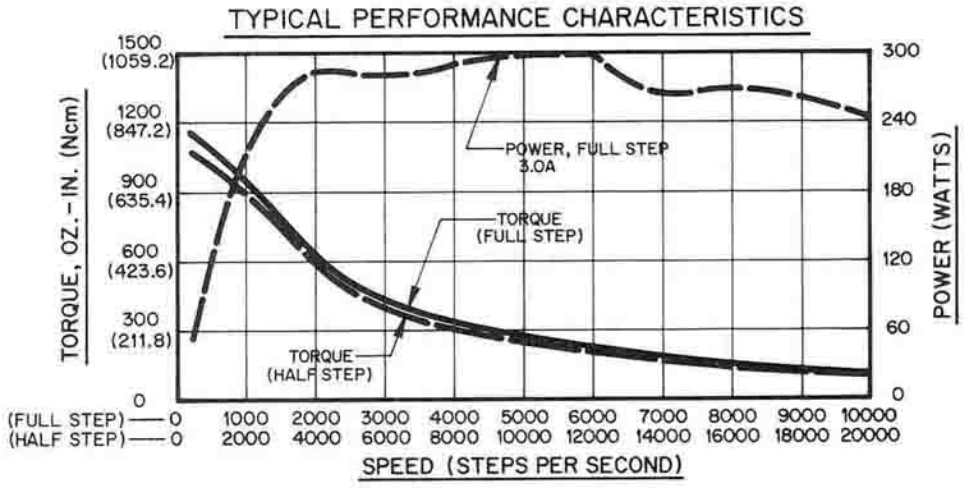
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M111-FF401 AND MX111-FF401 MOTORS



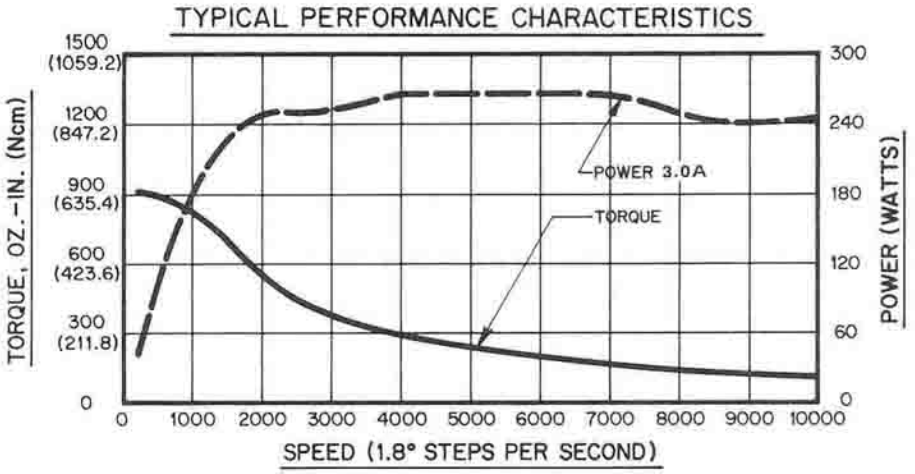
FULL/HALF STEP
M112-FF401 MOTOR



MICROSTEP
M112-FF401 MOTOR



FULL/HALF STEP
MH112-FJ4201 MOTOR



MICROSTEP
MH112-FJ4201 MOTOR

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.
Proper motion parameters (low speed, acceleration/deceleration, jog speed, home speed and feed rate).
Operation in dotted area of speed-torque curve.

IF TORQUE IS LOW, Check For:

All Windings Off active or Reduced Current active
Improper supply voltage.
Operation in dotted area of speed-torque curve.

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

APPENDIX A: AC LINE FILTER

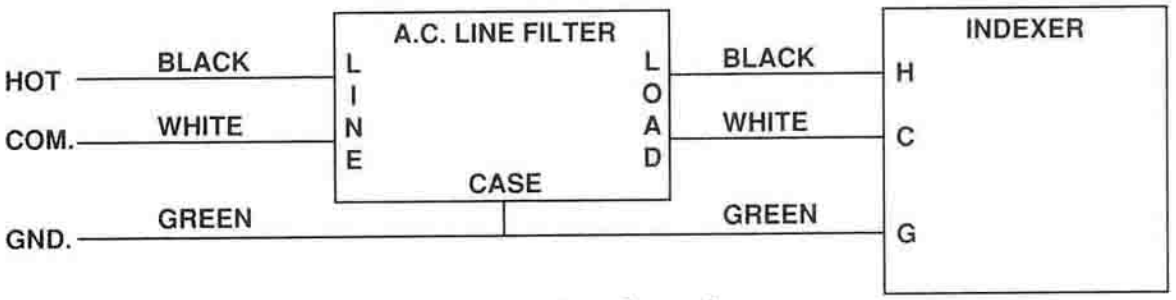
Use of an AC line filter on 3180 and 6180 Series drives is recommended. A suitable filter is included with each Indexer supplied for sale in North America.

WARNING:
IMPROPER INSTALLATION OF THE AC LINE FILTER MAY CAUSE ELECTRICAL SHOCK, WHICH COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE. TO AVOID ELECTRICAL SHOCK:

- **The ac line filter must be installed by qualified personnel. Figure A1 shows the AC Line Filter connections. Typical methods of locating and installing the line filter are shown in Figures A2 and A3.**
- **The ac line filter must be firmly fastened near the Indexer. Failure to do so may result in damage to the filter and system.**
- **The installer must properly insulate and protect the ac connections to assure that the wires are not exposed. Exposed wires could cause electrical shock, resulting in death, bodily injury or property damage.**

If you have any questions regarding installation of the line filter, contact an electrician before installing the device.

For best performance, the wire between the Filter and the Drive should be less than two feet (0.61 meter) long.



Proper AC Line Filter Connections
Figure A1

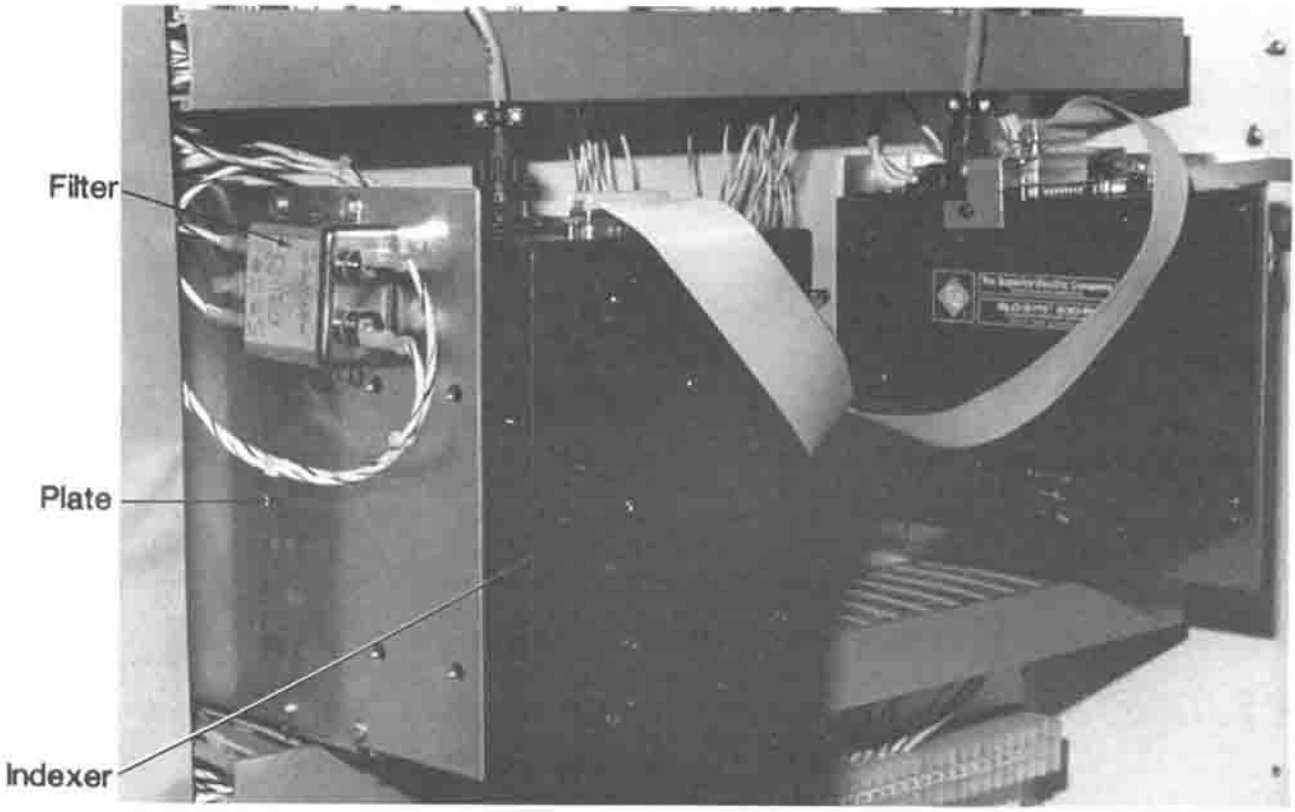


Figure A2 – Filter Installed On Fabricated Plate Mounted On Indexer

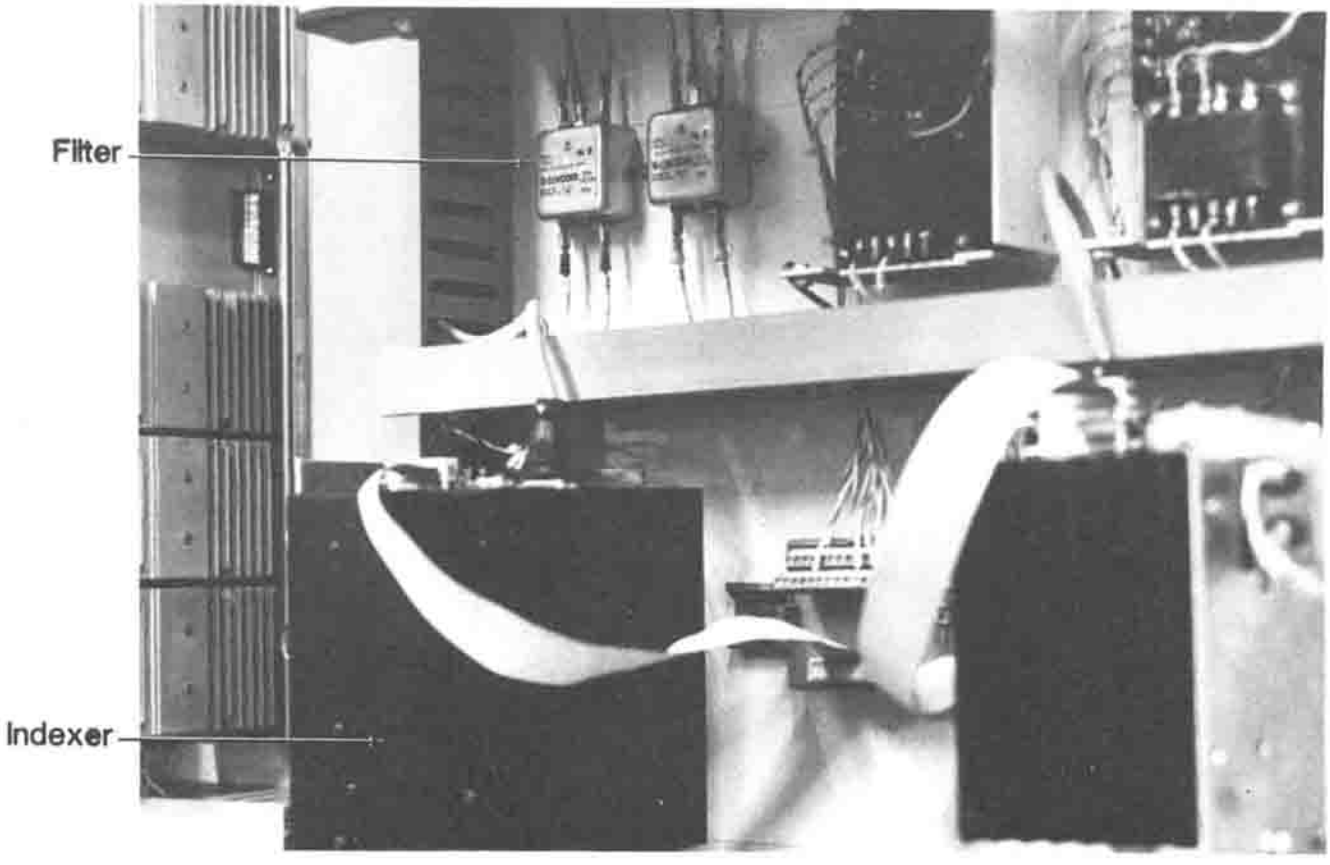


Figure A3 – Filter Mounted Adjacent To Indexer

APPENDIX B: TROUBLESHOOTING ELECTRICAL INTERFERENCE

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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Superior Electric (the "Company"), Bristol, Connecticut, warrants to the first end user purchaser (the "purchaser") of equipment manufactured by the Company that such equipment, if new, unused and in original unopened cartons at the time of purchase, will be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from the Company's factory or a warehouse of the Company in the event that the equipment is purchased from the Company or for a period of one year from the date of shipment from the business establishment of an authorized distributor of the Company in the event that the equipment is purchased from an authorized distributor.

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