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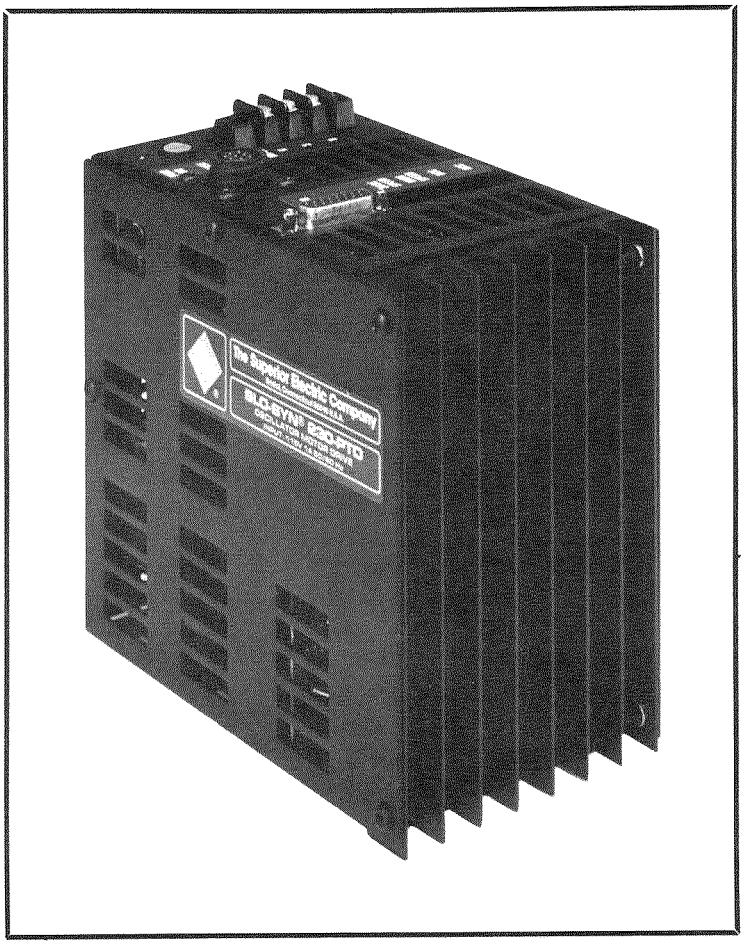
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PRICE $10.00

INSTRUCTIONS
for
SLO-SYN® MICRO-SERIES
PACKAGED TRANSLATOR OSCILLATOR
TYPES 230-PTO, 430-PTO



SUPERIOR ELECTRIC
WARNER ELECTRIC

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EXPRESS START-UP PROCEDURE
for
SLO-SYN® MICRO SERIES MOTION CONTROLS
PACKAGED TRANSLATOR/OSCILLATORS
TYPES 230-PTO, 230-PTOX, 430-PTO AND 430-PTOX

STEPS NECESSARY TO BECOME OPERATIONAL

This section outlines the minimum steps necessary for the Translator Drive to become operational. **FAILURE TO PERFORM THESE STEPS MAY RESULT IN DAMAGE TO THE DRIVE.**

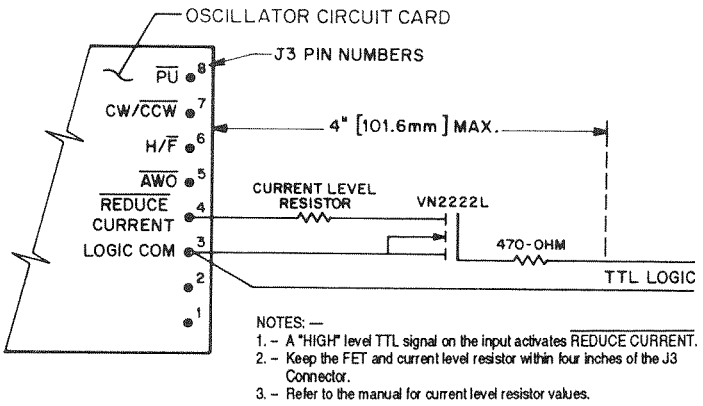
I. POWER SUPPLY

CAUTION: Never connect or disconnect anything from the unit with the power on.

1. Be sure the ac power line is within specified limits and is connected correctly (see Section 3.5 on page 5 of the manual).
2. If the unit is an "X" model, be sure the proper tap is selected on the transformer, depending on the ac mains voltage.
3. Be sure the unit is properly grounded ("G" terminal on the ac power strip).

II. DRIVE

1. Make sure the motor to be used is compatible with the drive. Refer to the manual for a list of compatible motors.
2. Use the motor connection diagrams shown in the manual (Figure 2.3 on page 4) for 4-, 6- and 8-lead motors. When using a 6-lead motor, be sure to insulate and isolate the unused wires. Be sure to insulate all motor leads to prevent inadvertent shorts to ground or to each other.
3. For Reduced Current operation, see Sections 6.71 and 6.72 on pages 6 and 7 of the manual. Install a resistor of the appropriate value between the REDUCED CURRENT pin and the LOGIC COMMON pin. Refer to the speed/torque data and the resistor versus current table included in the manual. If you desire to run the Reduce Current remotely, refer to the circuit example shown in Figure 1.
4. To connect to the logic controls, refer to Section 4, Functional Description, in the manual for the connections.
5. Caution: The motor may operate erratically at speeds below 350 steps per second due to motor resonance. Avoid this speed range if a problem exists.



TYPICAL REMOTE REDUCED CURRENT INTERFACE
FIGURE 1

III. OSCILLATOR

1. Set up a switch S1 on the oscillator properly.

   a. Select a frequency range of operation for the oscillator as shown in the following chart. The pulse output is square waves.

S1-1	S1-2	S1-5	S1-6	RANGE SELECTED
X	X	off	off	no pulses out of oscillator
on	off	off	on	0 to 10 kHz
on	off	on	off	0 to 20 kHz
off	on	off	on	0 to 50 kHz

Note: X denotes either position.

   b. High Speed adjustment select:

   If S1-3 is inthe On position, the high speed is adjustable using "R3" on the oscillator board only.

   If S1-3 is in the Off position, the high speed is adjustable using an external potentiometer connected between J1-8 and J1-15. A 500k ohm multi-turn potentiometer is suggested.

   c. Translator Pulse Source select:

   If S1-4 is in the On position, the drive translator is connected to the oscillator output.

   If S1-4 is in the Off position, the drive translator input is J1-3.

2. Adjust the base speed of the oscillator at nonresonant starting speed, preferably above the mechanical resonance speed of the motor. This is accomplished by adjusting "R4" with the "RUN" (J1-6) and the "BASE SPEED ONLY" (J1-14) inputs tied to SIGNAL COMMON (J1-7 or J1-12).
3. Adjust the high speed of the oscillator to the desired high speed. Close position 3 of switch S1, or temporarily short J1-8 to J1-15, and adjust "R3" with the "RUN" (J1-6) input tied to SIGNAL COMMON (J1-7 or J1-12). If the motor stalls, just "R3" clockwise to lower the high speed limit. Remove the "RUN" input from SIGNAL COMMON and wait for the motor to stop. Then connect the "RUN" input to SIGNAL COMMON.
4. Adjust the Acceleration and Deceleration potentiometers on the oscillator board if you desire. The procedure is described in the manual. The factory preset value is 1 second for both the acceleration and the deceleration rates.

Fuses and Connectors for 230 and 430 Series Packaged Drives

Fuse: 3 ampere, 250 volt slow-blow
Bussman part number MDA-3
Littelfuse part number 326003

Motor Connector (mates with female motor connector J2 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

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SLO-SYN® Micro Series Motion Controls

INSTALLATION GUIDELINES FOR REDUCED NOISE INTERFERENCE

I. GENERAL COMMENTS

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.

This guide is aimed toward helping users avoid such problems at the start by applying "good engineering practices" when designing their systems. Following these guidelines will usually prevent EMI noise from interfering with drive operation.

II. NOISE SOURCES

What causes electrical noise? 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).

The following are some of the more common causes of electrical interference:

- 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

III. MOUNTING LOCATION

When selecting a mounting location, it is preferable to keep the drive away from obvious noise sources, such as those listed above. 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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IV. WIRING PRACTICES - "DOS AND DON'TS"

Do the following when installing or wiring your drive or indexer:

- **Do** keep the drive and its wiring as far away from noise sources as possible.
- **Do** provide a good, solid ground connection to the ac system earth ground conductor. Bond the drive case to the system enclosure.
- **Do** use a single-point grounding scheme for all related components of a system (this looks like a "hub and spokes" arrangement).
- **Do** keep the ground connection short and direct.
- **Do** 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 or indexer.
- **Do** keep signal and drive wiring well separated. If the wires must cross, they should do so at right angles to minimize coupling. Power wiring includes ac wiring, motor wiring, etc. and signal wiring includes inputs and outputs (I/O), serial communications (RS232 lines), etc.
- **Do** use separate conduits or ducts for signal and I/O wiring. Keep all power wiring out of these signal line conduits.
- * **Do** use shielded, twisted-pair cables for Indexer I/O lines.
- **Do** ground shields only at one end, the indexer/drive end.
- **Do** use twisted-pair, shielded cable for the motor wiring.
- **Do** use solid-state relays instead of electromechanical contact types wherever possible to minimize noise generation.
- **Do** suppress all relays to prevent noise generation. Typical suppressors are capacitors or MOV's. See manufacturers literature for complete information.
- **Do** use shielded, twisted-pair cable for connections to RS232 serial port.

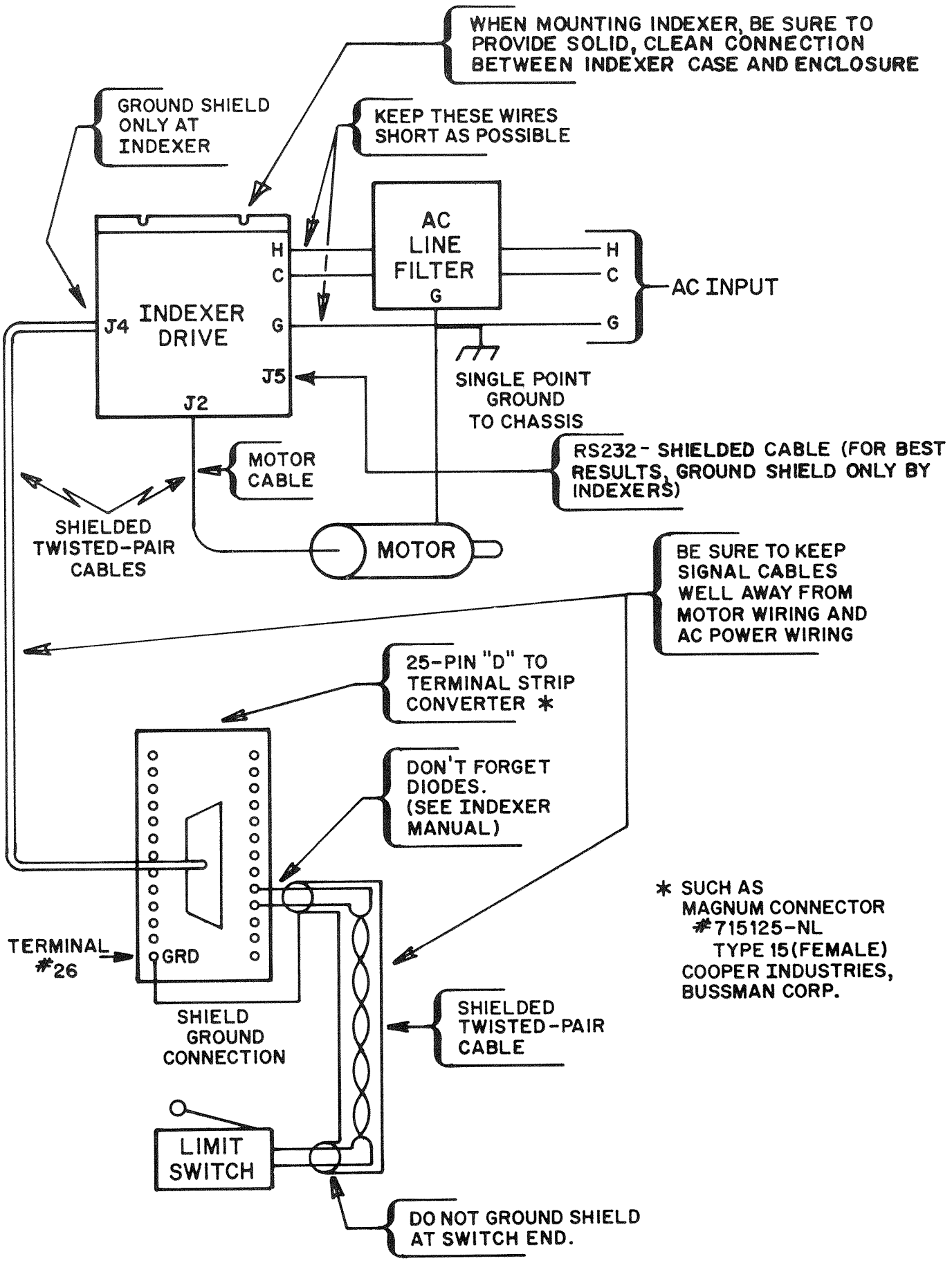
Do not do the following when installing your drive or indexer:

- **Do not** install sensitive computer-based equipment (such as an indexer/drive) near a source of electromagnetic noise.
- **Do not** bundle power and signal lines together.
- **Do not** bundle motor cables and signal lines together.
- **Do not** fail to use shielded, twisted-pair cables for signals.
- **Do not** fail to properly connect the system grounds.
- **Do not** use "Daisy-chained" grounds.
- **Do not** fail to ground signal cable shields at only one end.
- **Do not** assume that power from the ac line is adequately "clean".

V. TROUBLESHOOTING GUIDE

1. Check the quality of the ac line voltage using an oscilloscope and a line monitor, such as Superior Electric's VMS series. If line voltage problems exist, use appropriate line conditioning, such as line filters or isolation transformers.
2. Be certain all of the previous Dos and Don'ts are followed for location, grounding, wiring and relay suppression.
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.
5. Electrical interference problems are common with today's computer-based controls, and such problems are often difficult to diagnose and cure. Sometimes, finding and curing such problems involves a bit of "black magic". Keep trying various combinations of the "good wiring practices" outlined in this document.

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RECOMMENDED WIRING PRACTICE

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WARNINGS:

• Voltages present in this unit can cause serious or fatal injury. Only qualified personnel should install or perform servicing procedures on this equipment.
• Voltage is present on unprotected pins when unit is operational.
• No short circuit protection for motor outputs is provided in this unit. The AC input is fused.
• Before making changes to the motor or control wiring, turn off all power to the unit, and disconnect its AC power source.
• When power is applied, all parts of the drive circuit should be considered hazardous.
• Allow at least ten minutes for capacitors to discharge as they will remain at high voltages for several minutes after power is removed.

PRECAUTIONS:

- Assure motor compatibility before using the unit.
- Observe all cooling and temperature limitations. Heat sink temperature must be maintained between 0 and 70 degrees C. (32 and 158 degrees F). Unit must not be operated in ambient temperatures below 0°C (32°F) or above 50°C (122°F).
- All Windings Off should be used with caution, as all holding torque is lost.
- Do not connect or disconnect motor or signal cables while AC power is applied.
- Do not apply AC power until all connections have been made correctly.
- Do not exceed specified input voltage.
- Do not operate the unit without the enclosures in place as high voltages are present.

LIMITS OF USE

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

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

SECTION 1: INTRODUCTION

1.1 FEATURES OVERVIEW

The 230-PTO and 430-PTO are differentiated as follows:

	MOTOR CURRENT PER PHASE	MOTOR AS PER PHASE
230-PTO	2 Amps peak	56 VA nominal
430-PTO	3.5 Amps peak	96 VA nominal

The 230-PTO and 430-PTO are members of a family of stepping motor drives supplied in a sheet metal enclosure with a power supply, a heat sink and an appropriate control circuit card. In the case of the 230-PTO and 430-PTO, an oscillator card is provided, hence the designation "PTO" for Packaged Translator Oscillator

The translator sections are low to medium power, high efficiency units that can control wide range of 4-, 6- or 8-lead two-phase stepping motors. The units will operate the motors in full-steps or in half-steps. They allow external control of basic motor functions as well as manual adjustment of motor speed, acceleration and deceleration.

1.2 INSPECTION PARTS LIST

All components of the 230-PTO and 430-PTO are supplied completely assembled and mounted in the enclosure and have the correct model number (230-PTO or 430-PTO) on a label affixed to the enclosure.

Also provided is a plastic bag containing two mounting brackets and four screws for attaching the brackets to the unit.

1.3 USING THIS MANUAL

This manual is an installation and operating guide to the 230-PTO and 430-PTO drives. All the information provided is necessary for using these drives successfully.

We strongly recommend that the pages in this manual be read thoroughly and completely before attempting to install and operate the equipment.

1.3.1 ORGANIZATION

All entries in this manual refer to both the 230-PTO and the 430-PTO modules, unless otherwise specified.

This manual is organized for the convenience of the operator. Section 2, "mounting and Pin Assignments," provides diagrams and reminders that are necessary, even for the experienced user and installer.

Complete specifications (Section 3) will provide easily referenced information concerning all aspects of installation, power and interface requirements, as well as performance specifications.

The "Functional Description" (Section 4) provides operational information in narrative form. This presentation is useful in design, diagnostic and troubleshooting situations.

Section 5, "Pin Descriptions" provides detailed information on functions of the input connections in advance of using the equipment.

Section 6, "Operating Instructions," lists the procedures for using a remote potentiometer, setting base speed and high speed and the acceleration and deceleration potentiometers.

The following sections contain additional drawings and information useful for setting up and operating the oscillator modules.

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1.3.2 LOGIC AND VOLTAGE CONVENTIONS

Throughout this manual, the following conventions are followed:

- The designation "Vo" signifies the logic signal common terminal. "Vom" signifies the motor supply voltage common terminal. Both Vo and Vom are internally connected to the drive module's case.
- All logic functions are true logic. A logic low, or a logic 0 will activate a function and a logic high, or a logic 1 will deactivate a function. Thus,

IN THIS MANUAL THE TERMS ACTIVE OR ACTIVATE WILL IMPLY A LOGIC LOW CONDITION AND THE TERMS INACTIVE OF DEACTIVATE WILL IMPLY A LOGIC HIGH CONDITION.

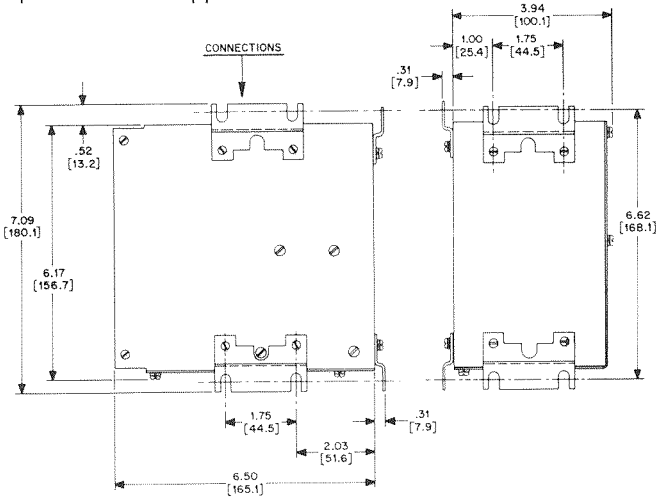
- In cases where the function changes with a change in logic state, the low true (active) will be indicated with a bar. For example, in the case of CW/$\overline{CCW}$, CW is active with no connection.
- When a control signal pin is left open, it is clamped in a logic high (inactivated) state.
- The motor drive changes state and advances the motor one step (or one half-step in the half-step mode) on a positive going (or low to high) pulse edge.
- Clockwise (CW) and counterclockwise (CCW) are oriented correctly when viewing the motor from the label end.

SECTION 2: MOUNTING AND PIN ASSIGNMENTS

2.1 MOUNTING

The units are designed for bulkhead mounting using the mounting brackets supplied. Pem nuts are provided on the end opposite the heat sink and on the side opposite the label. Use the set of holes that is best suited to your application. The mounting brackets must be attached with the screws supplied. Longer screws will project too far into the enclosure, and may damage internal components. Figure 2.1 shows mounting dimensions.

The unit must be mounted with the heat sink fins vertical for proper cooling. When two of more units are mounted side by side, provide at least 2 inches (51mm) between units on all sides for proper flow of cooling air. Be sure to observe the operating temperature limits. Forced air (fan) cooling may be required in some applications.



MOUNTING DIMENSIONS
FIGURE 2.1

2.2 MOTOR CONNECTIONS

Motor connections to the Packaged Translator Oscillator are made to the circular twist-lock receptacle on top of the unit. Cables are available in lengths of 10, 25 and 50 feet (3, 7.6 and 15.2 meters) for making the connections between the drive and the motor. The cables have the mating twist-lock plug on one end and are offered with unterminated leads on the other end or with a plug for use with motors that have receptacles.

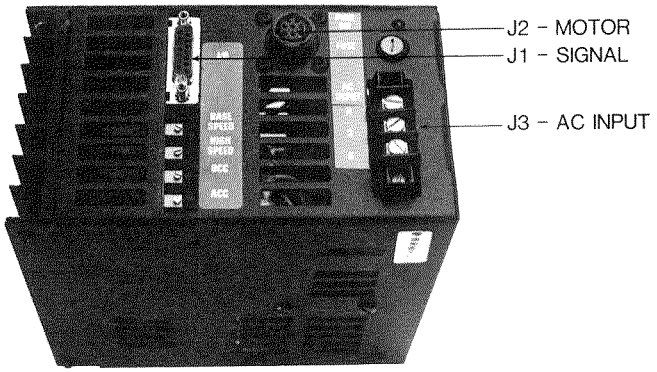
Refer to the chart for cable part numbers.

Figure 2.2 shows the pin assignments for the motor connector. 230-PTO and 430-PTO modules can be used with 4-lead, 6-lead and 8-lead SLO-SYN motors. Figure 2.3 shows the correct connection for each possible motor configuration.

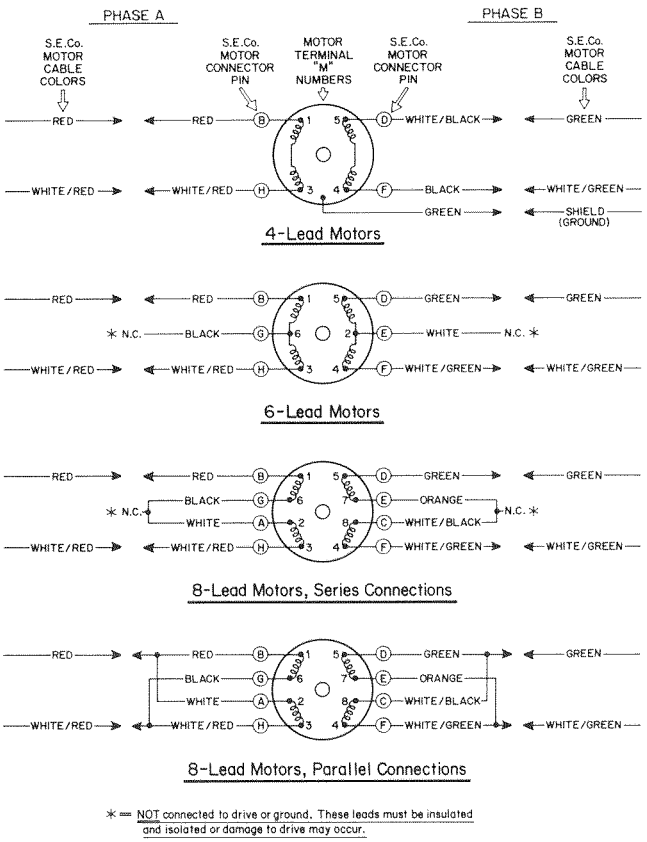
CABLE CONFIGURATION		CABLE PART NUMBER		
DRIVE END	MOTOR END	10 FEET LONG	25 FEET LONG	50 FEET LONG
TWIST-LOCK CONNECTOR	UNTERMINATED LEADS	B215801-001	B215801-002	B215801-003
TWIST-LOCK CONNECTOR	PLUG*	B216066-001	B216066-002	B216066-003

* Mates with receptacle on MO61, MO62 and MO63 motors that have receptacles (MO62-CS08, etc.).

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MOTOR, I/O AND AC POWER PIN ASSIGNMENTS FIGURE 2.2



* = NOT connected to drive or ground. These leads must be insulated and isolated or damage to drive may occur.

MOTOR CONNECTIONS FIGURE 2.3

SECTION 3: SPECIFICATIONS

3.1 PRODUCT DESCRIPTION

Bipolar, speed adjustable, 2-phase stepping motor drive with translator oscillator and power supplies

Full and half step only

Power semiconductor type: H-Bridge power IC

Translator: internal IC

Control signals optically isolated from the motor drive module (except for Reduce Current)

Power on LED lights when drive is energized.

3.2 PERFORMANCE

Resolution:Half-step or full-step

Step Rate: 0 to 10,000 full-steps/sec.;
0 to 10,000 half-steps/sec.

Oscillator base speed frequency range: 0 Hz to 2500 Hz

($\overline{\text{BASE SPEED ONLY}}$ connected to SIGNAL COMMON)

Oscillator high speed frequency range: 0 Hz to 20k Hz

Accel/Decel adjustable range: 50ms to 2 sec.

Oscillator stability: Velocity; Accel/Decel ± 5% over temperature and input power range.

Speed/Torque: All specifications use typical data.
See Section 7 for typical Speed/Torque curves.

Drive module power dissipation (worst case)

230-PTO: 40 watts
430-PTO: 65 watts

3.3 MOTOR COMPATIBILITY

	230-PTO	430-PTO
Frame Sizes:	MO61 to MO92	MO61 to M112
No. of Leads:	4, 6, 8	4, 6, 8
Min. Inductance:	0.55mH	0.55mH

Max. Resistance: 3.5 ohms including drive-to-motor cable.

CAUTION: DO NOT USE LARGER FRAME SIZE MOTOR THAN THOSE LISTED, OR THE DRIVE MAY BE DAMAGED.

MOTOR FAMILIES

MOTORS FOR USE WITH 230-PTO
WITH CONNECTOR

M061-CS08	M062—CS09	M063-CS06
M061-CE08	M062-CE09	M063-CS09
		M063-CE09

WITH LEADS

M061-LS08	M063-LE09	M092-FD09
M061-LE08	M091-FC09	M092-FD310
M062-LS09	M091-FD09	M092-FD8009
M062-LE09	M091-FD8009	M092-FD8019
M063-LS06	M091-FD8109	M092-FD8814
M063-LS09	M092-FC09	

MOTORS FOR USE WITH 430-PTO
WITH CONNECTORS

M061-CS08	M062-CE09	M063-CS09
M061-CE08	M063-CS06	M063-CE09
M061-CS09	M063-CE06	

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WITH LEADS

M061-LS08	M091-FD06	M093-FD8011
M061-LE08	M091-FD8106	M093-FD8014
M062-LS09	M092-FC09	M111-FD12
M062-LE09	M092-FD09	M111-FD16
M063-LS06	M092-FD310	M111-FD8012
M063-LE06	M092-FD8009	M112-FD327
M063-LS09	M092-FD8109	M112-FD8012
M063-LE09	M093-FC14	M112-FJ8012
M091-FC06	M093-FD14	M112-FJ8030

Table 3.1: Motor Families

3.4 MECHANICAL SPECIFICATIONS

Size: 6-1/2" (165mm)H x 6-1/2" (165mm)W x 4" (102mm)D
Weight: 230-PTO: 8-1/2 lbs (3.86 kg)
430-PTO: 9lbs (4.08 kg)

3.5 ELECTRICAL SPECIFICATIONS

3.5.1 Input Power Requirements

AC Input:
230-PTO: 102-132 VAC< 50/60 hertz, 1.0 ampere @ 115 VAC
430-PTO: 102-132 VAC, 50/60 hertz, 1.5 amperes @ 115 VAC

Fuse: 250 volt, 3 amperes

3.5.2 AC Input Connections, J3

3-screw terminal strip

Pin	Assignment
1	Hot (black)
2	Neutral (white)
3	Ground (green)

3.5.3 OUTPUT TO MOTOR

3.5.3.1 Motor Connections, J2

8-pin circular, twist-lock female connector which mates with AMP connector P/N 206434-1 (using AMP pins P/N 66506-8, and AMP cable clamp P/N 206062-1)

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

Note: Motor phase A is M1 and M3; Motor phase B is M4 and M5.

3.6 I/O (Interface)

3.6.1 I/O Connector J1: 15 pin, "D" type female. (See Figure 2.2)

Pin Assignments:

Pin	Assignment
1	$\overline{\text{ALL WINDINGS OFF (AWO)}}$
2	CW/$\overline{\text{CCW}}$
3	$\overline{\text{PULSE IN}}$
4	DO NOT USE
5	DO NOT USE
6	$\overline{\text{RUN}}$
7	SIGNAL COMMON (Vo)
8	HI SPEED POT 1
9	HALF/$\overline{\text{FULL}}$
10	$\overline{\text{PULSE OUT}}$
11	DO NOT USE
12	SIGNAL COMMON (Vo)
13	DO NOT USE
14	$\overline{\text{BASE SPEED ONLY}}$
15	HI SPEED POT 2

NOTE: The bar denotes low logic, active state

Wire size: 28 AWG minimum

Run length: 50 feet (15 meters) max.; 15 feet (4.6 meters) max. for HI SPEED POT 1 and HI SPEED POT 2. Shielded cable must be used for highest noise immunity. Be sure to ground the shield only at one end of the cable.

3.6.2 Potentiometers (see Figure 9.0 for potentiometer locations)

R1 Deceleration
R2 Acceleration
R3 High Speed
R4 Base Speed

The potentiometers are accessible from the top of the unit and a label identified the function of each potentiometer. See Section 6 for adjustment procedures.

3.6.3 Switch S1 a 6-position DIP switch, is provided for setting speed ranges and for other functions. See Section 6 for proper set up.

3.6.4 I/O Characteristics

$\overline{\text{RUN}}$, $\overline{\text{BASE SPEED ONLY}}$ input Characteristics:

high level voltage: +5, 5 VDC to + 15 VDC
high level current: 600 microamperes max.
low level voltage: 0 VDC to + 4.5 VDC
low level current: 1.8 milliamperes max.

$\overline{\text{AWO}}$, CW/$\overline{\text{CCW}}$, $\overline{\text{PULSE IN}}$, HALF/$\overline{\text{FULL}}$ input characteristics:

high level input current: less than 1 mA
low level input current: 10mA to 20 mA

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NOTE: these inputs are tied to SIGNAL COMMON for a low level and open circuited for a high level.

$\overline{\text{PULSE OUT}}$ output characteristic:

high level output voltage: + 24 VDC max.

low level output voltage: + .7 VDC at 40 mA max.

3.7 ENVIRONMENTAL REQUIREMENTS

Storage Temperature: – 40°F to + 185°F (– 40°C to + 85°C)

Operating Temperature: + 158°F (70°C) maximum heat sink temperature

Humidity: 95% relative humidity maximum, noncondensing

Altitude: 10,000 feet (3048 meters) maximum.

Cooling: Will operate up to 122°F (50°C) if maximum heat sink temperature of 158°F (70°C) is maintained; forced air (fan) cooling may be required.

NOTE: Forced-air cooling is required to operate the 430-PTO at ambients greater than 95°F (35°C).

SECTION 4: FUNCTIONAL DESCRIPTION

4.1 OVERVIEW

The 230-PTO and 430-PTO are motor drive/translator/pulse generator modules that allow for the operation of all basic motor functions.

External power to the unit is required.

The functions that the drive performs are:

- Adjustable acceleration and deceleration
- Adjustable base speed
- Clockwise/counterclockwise direction control
- Full-step/half-step control
- Run-stop control
- Remote mechanical speed adjustment

4.2. OPERATIONAL

The 230-PTO and 430-PTO modules can be functionally divided into four components:

1. Motor drive circuitry
2. Translator circuitry
3. Oscillator/pulse generator circuits
4. Logic control functions

To drive the motor, a technique called "chopping" is used. Compared to older drive techniques, chopping gives improved motor performance while allowing the drive circuitry to dissipate less power. The voltage applied to the motor windings is turned on and off very rapidly, or **chopped.** The voltage level and chopping frequency are precisely controlled so that the desired current is produced.

The instantaneous current in the drive circuit is sensed and is used to control the current to the motor.

The translator circuitry accepts a single pulse as an input and determines which windings (phases) of the motor must be turned on and off in order to advance the motor shaft one step, in the full-step mode. The translator circuit is fully self-contained and is not accessible through any of the function pins.

The pulse input to the translator is internally generated by the oscillator. **This is accomplished by setting switch S1, position 4 to the "on" (closed) state, unless an external pulse source is utilized.** The oscillator circuitry controls the frequency of the pulse train for acceleration, deceleration, high and base speeds in accordance with the settings of the appropriate potentiometers.

The logic control circuitry accepts high or low logic levels through the pins on connector J1 and adjusts the motor operational parameters as described in Section 5.

The 230-PTO and 430-PTO enable the user to remotely control the high speed rate by connecting a 500k ohm potentiometer between pins 8 & 15 on connector J1. **If no external potentiometer is required, set position 3 of switch S1 to the "on" (closed) state.**

SECTION 5: PIN DESCRIPTIONS

[Ref. Figure 2.2]

Connector J1, 15-pin "D" type connector, female

5.1 $\overline{\text{AWO}}$ ($\overline{\text{ALL WINDINGS OFF}}$) Pin 1

When connected to SIGNAL COMMON (closed), i.e., when activated, turns off all power to the motor windings. The motor shaft can now be turned by hand. No motion can occur if this signal is active.

When this pin is left open, all windings are on.

WARNING

Holding torque is eliminated when this signal is active. Ensure that the motor load, when released by this command, will not injure property or personnel.

5.2 CW/$\overline{\text{CCW}}$ (DIRECTION) – Pin 2

A logic high causes the motor shaft to step in the clockwise direction as viewed from the label end of the motor. A logic low will cause the motor to turn in a counterclockwise direction. With this pin left open, the motor will step in a CW direction.

5.3 $\overline{\text{PU}}$ ($\overline{\text{PULSE IN}}$) – Pin 3

A low to high transition (positive going edge) on this pin causes the motor to take one step in the direction selected by the CW/$\overline{\text{CCW}}$ pin.

Normally, when the oscillator board is used for control, this pin is connected to $\overline{\text{PULSE OUT}}$, pin #10, by placing position 4 of switch S1 in the "on" (closed) state.

Minimum pulse width low is 15 microseconds; minimum pulse width high is 50 microseconds. Rise and fall times are less than 2 microseconds each.

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5.4 DO NOT USE – Pin 4

This pin is not available to the operator.

5.5 DO NOT USE – Pin 5

This pin is not available to the operator.

5.6 RUN

When connected to "SIGNAL COMMON" (logic low) enables the oscillator.

If BASE SPEED ONLY is open (logic high) when RUN is activated (logic low), the motor will accelerate according to the set rate, to the predetermined high speed. When RUN is open (logic high), the motor will decelerate according to the set rate until base speed is reached, and will then stop.

If BASE SPEED ONLY is activated (logic low) when RUN is activated (logic low), the motor will run at base speed until RUN is open (logic high).

5.7 SIGNAL COMMON – Pin 7

Reference point for all inputs and outputs. Internally tied to the aluminum case of the drive module.

5.8 HI SPEED POT 1 – Pin 8

Allows for control of high speed by means of an external 500k ohm potentiometer, when used in conjunction with HI SPEED POT 2 (pin #15). This is also a test point for acceleration and deceleration.

5.9 H/$\overline{F}$ (HALF/$\overline{FULL}$) – Pin 9

When the pin H/$\overline{F}$ is connected to "SIGNAL COMMON" (logic low), the motor operates in the full-step mode.

An open pin (logic high) selects the half-step mode. When operated in the half-step mode the motor provides smoother motion with finer resolution, but at approximately 30% less torque.

NOTE: If the H/$\overline{F}$ input is switched low with the Vm power on, it is possible to get a full step, one winding on ("wave mode") condition that results in reduced motor torque. To avoid this, power to the unit must be turned off (remove Vm) whenever this input is activated.

5.10 $\overline{PULSE\ OUT}$ – Pin 10

Produces a pulse (square wave output) from oscillator. Connect to "$\overline{PULSE\ IN}$" by placing position 4 of switch S1 in the "on" (closed) state if an external source is not required.

This is also a test point for monitoring base speed and high speed. This output is an open collector output and should be connected to $\overline{PULSE\ IN}$ if used for monitoring purposes.

5.11 DO NOT USE – Pin 11

This pin is not available to the operator.

5.12 SIGNAL COMMON – Pin 12

Reference point for all logic inputs and outputs.

5.13 DO NOT USE – Pin 13

This pin is not available to the operator.

5.14 BASE SPEED ONLY – Pin 14

When connected to "SIGNAL COMMON," (logic low) permits only base speed velocity from oscillator.

Frequency Range: 0 Hz to 2500 Hz.

There is no acceleration or deceleration when operating at base speed.

If this pin is open (logic high), high speed mode is selected.

5.15 HI SPEED POT 2 - Pin 15

Allows for control of high speed by means of an external potentiometer (ten turn, audio taper is recommended) when used in conjunction with HI SPEED POT 1 (pin #8). As an alternative to using an external potentiometer, the high speed can be controlled by connecting an analog voltage (5 to 9 volts dc) to this input. It will be necessary to "ramp" the analog input to control acceleration and deceleration of the pulse train. Position 3 of switch S1 must be 'off" (open) when using analog voltage.

NOTE: 500k ohm (connected across pins #8 and #15) is recommended when external control is required and position 3 of switch S1 must be "off" (open).

SECTION 6: OPERATING INSTRUCTIONS

6.1 INTRODUCTION

This section outlines the procedures for adding an external high speed potentiometer to the 230-PTO and 430-PTO modules, for setting base speed, and for adjusting high speed, acceleration and deceleration.

6.2 OPERATION FROM EXTERNAL OR ON BOARD POTENTIOMETER

1. HI SPEED POTS 1 and 2 allow connections to a **remote potentiometer for control of HI SPEED setting.**

2. Connect a 500k ohm potentiometer between J1 pins #8 and #15 for external control.

OR:

Connect HI SPEED POT 1 to HI SPEED POT 2 by placing position 3 of switch S1 in the "on" (closed) position when no external control is required.

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6.3 BASE SPEED

Base speed is the rate at which a specific motor and load will start or stop with no acceleration or deceleration.

1. Connect $\overline{\text{BASE SPEED}}$ ONLY (J1, pin #14) to SIGNAL COMMON.
2. Connect $\overline{\text{RUN}}$ (J1, pin #6) to SIGNAL COMMON.
3. Turn "Base Speed Pot" (R4) clockwise to *increase* base speed.

Speed (pulse frequency) can be monitored at J-1 pin #10 (PULSE OUT). Position 4 of switch S1 should be "on" (closed).

Three ranges of Base Speed and High Speed can be selected with DIP switch S1 as follows.

RANGE	APPROX. BASE SPEED RANGE	APPROX. HIGH SPEED RANGE	SWITCH POSITIONS			
			S1-1	S1-2	S1-5	S1-6
1	0 – 1250 Hz	0 – 10 kHz	ON	OFF	OFF	ON
2	0 – 2500 Hz	0 – 20 kHz	ON	OFF	ON	OFF
3	0 – 5000 Hz	0 – 50 kHz	OFF	ON	OFF	ON

*The maximum speed attainable by the drive is 10kHz.

The following table lists approximate settings for Base Speed Potentiometer R4 when using range 2 (0 – 2500 Hz) and with High Speed Potentiometer R3 set for 20 kHz.

BASE SPEED (HZ)	POTENTIOMETER R4 SETTING (number of turns CW from fully CCW position)
0	0
100	4
200	6
400	10 1/2
600	14 1/4
800	16 1/2
1000	18 1/4
1250	19 1/2
1500	20 1/2
1750	21 1/4
2000	22
2500	22 3/4

6.4 HIGH SPEED

HI SPEED POTS 1 AND 2 ARE EITHER CONNECTED TOGETHER (FOR ON BOARD OPERATION) OR ARE CONNECTED TO A REMOTE POTENTIOMETER. (Potentiometer set at minimum resistance.)

1. Make sure that BASE SPEED ONLY (J1 pin #14) is *OPEN.*
2. Connect $\overline{\text{RUN}}$ (J1 pin #6) to SIGNAL COMMON.
3. Turn HIGH SPEED POT (R3) *counterclockwise* to increase velocity to desired maximum limit.

Speed (pulse frequency) can be monitored at J-1, pin #10 ($\overline{\text{PULSE OUT}}$). Position 4 of switch S1 should be "on" (closed).

The settings of "DIP" switch S1, described in 6.3, also affects the High Speed Range as noted in 6.3.

The following table lists approximate settings for High Speed Potentiometer R3 when using range 2 and with Base Speed Potentiometer R4 set for 0 Hz.

HIGH SPEED (KHZ)	POTENTIOMETER R3 SETTING (number of turns CCW from fully CW position)
0	0
0.15	1/2
0.5	3/4
1	1
2	1 1/2
3	2
4	2 1/2
5	3
7	4
9	5 1/4
10	5 3/4
12	7
14	8 1/2
16	10
18	12
20	13 1/2

NOTE: Because of the oscillator design, the high speed cannot be set lower than the speed set on the base speed potentiometer. For example, if base speed is set to 200 Hz, the high speed can be set no lower than 200 Hz.

6.5 ACCELERATION

Acceleration time to high speed, with the Accel potentiometer (R2) fully couterclockwise is approximately 50 milliseconds. Range is from 50 milliseconds to 2 seconds (approximately).

Measure acceleration with an oscilloscope connected between HI SPEED POT 1 and SIGNAL COMMON. Oscilloscope should be triggered when RUN (J1 pin #6) goes low.

Then make the following settings:

1. Make sure $\overline{\text{BASE SPEED ONLY}}$ is *Open.*
2. Set $\overline{\text{RUN}}$ to *Open.*

This signal must be open circuited long enough to allow complete deceleration.

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3. Connect $\overline{\text{RUN}}$ to SIGNAL COMMON (logic low).

4. Measure acceleration time.

5. Adjust Acceleration potentiometer (R2) clockwise to increase acceleration time.

6. Repeat steps 2-5 until acceleration is attained.

The following table gives approximate settings for the Acceleration Potentiometer (R2).

ACCELERATION TIME (milliseconds)	POTENTIOMETER R2 SETTING (number of turns CW from fully CCW position)
22	0
60	1/2
100	1
200	2
300	3
400	4
500	5
600	6
800	8
1000	10
1250	12 1/2
1500	15
1750	17 1/2
2000	20
2200	22

The acceleration times are essentially unaffected by any potentiometer or switch settings.

6.6 DECELERATION

Deceleration time from high speed to base speed, with the Deceleration potentiometer (R1) fully counterclockwise is 50 milliseconds. Range is from 50 milliseconds to 2 seconds.

Measure deceleration with an oscilloscope connected to HI SPEED POT 1 and SIGNAL COMMON. Oscilloscope should trigger when RUN (J1 pin #6) goes high.

Then make the following settings:

1. Make sure $\overline{\text{BASE SPEED ONLY}}$ is *Open*.

2. Connect $\overline{\text{RUN}}$ (J1 pin #6) to SIGNAL COMMON (low). Maintain low until high speed is achieved.

3. Remove $\overline{\text{RUN}}$ connection to SIGNAL COMMON. Maintain until measurement is complete.

[Oscilloscope will be triggered when $\overline{\text{RUN}}$ is open. This signal must be open circuited long enough to allow complete deceleration.]

4. Measure deceleration time.

5. Adjust Deceleration potentiometer (R1). Clockwise movement increases deceleration time.

6. Repeat steps 2-5 until desired deceleration is reached.

The following table gives approximate settings for the Deceleration Potentiometer (R1).

DECELERATION TIME (milliseconds)	POTENTIOMETER R1 SETTING (number of turns CW from fully CCW position)
22	0
60	1/2
100	1
200	2
300	3
400	4
500	5
600	6
800	8
1000	10
1250	13
1500	15 1/2
1750	18
2000	20

6.7 REDUCED CURRENT

WARNING:

The following procedure requires disassembly of the enclosure and skilled workmanship must be accomplished. Failure to strictly follow these procedures or entering the enclosure for any other purpose will void the warranty. ALWAYS DISCONNECT POWER AND ALL CABLES BEFORE PROCEEDING. REASSEMBLE THE ENCLOSURE BEFORE POWER IS REAPPLIED.

It is possible to reconfigure the 230-PTO and 430-PTO to supply less than rated current to the motor. To do this, a jumper or a resistor must be connected between LOGIC COMMON (Pin #3) and $\overline{\text{REDUCE CURRENT}}$ (pin #4) on the oscillator circuit card location J3. These pins protrude through holes in the oscillator circuit card.

To gain access to the pins, first remove the six screws that hold the nameplate side of the enclosure in position and remove it. Then remove the two screws that fasten the heat sink to the other side of the enclosure. Pivot the heat sink together with the attached drive module and oscillator card away from the assembly to gain access to pins #3 and #4 of J3.

Care should be taken to keep the resistor or jumper leads less than 2 inches (51mm) long and to prevent them from contacting each other or any other part of the assembly. This signal is not optically isolated.

The proper resistor values or jumper leads and their associated current values are shown in 6.7.1 for the 230-PTO and in 6.7.2 for the 430-PTO.

6.7.1 Reduced Current for 230-PTO

CURRENT (amperes)	RESISTOR (ohms)
1.00	0 (jumper)
1.25	2.49k ohms, 1/4 watt, 1%
1.50	7.50k ohms, 1/4 watt, 1%
1.75	23.7k ohms, 1/4 watt, 1%
2.00	open

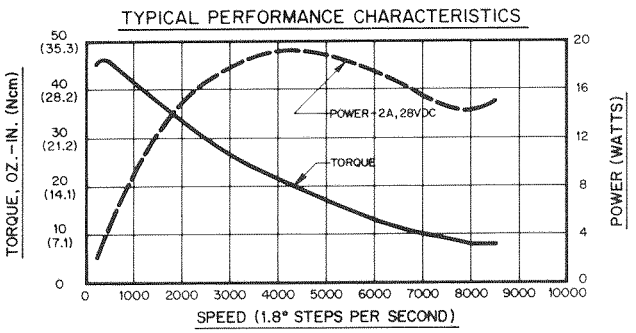
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6.7.2 Reduced Current for 430-PTO

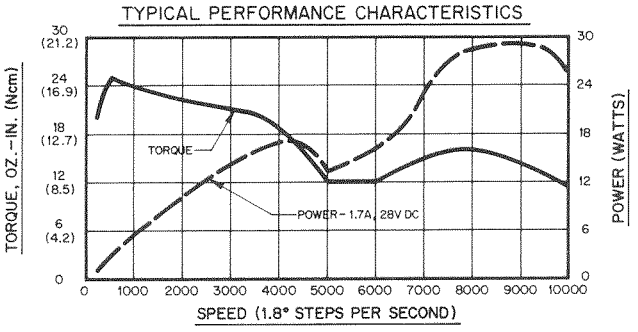
CURRENT (amperes)	RESISTOR (ohms)
1.5	0 (jumper)
2.0	1.78k ohms, 1/4 watt, 1%
2.5	5.62k ohms, 1/4 watt, 1%
3.0	16.2k ohms, 1/4 watt, 1%
3.5	open

SECTION 7: SPEED/TORQUE CURVES

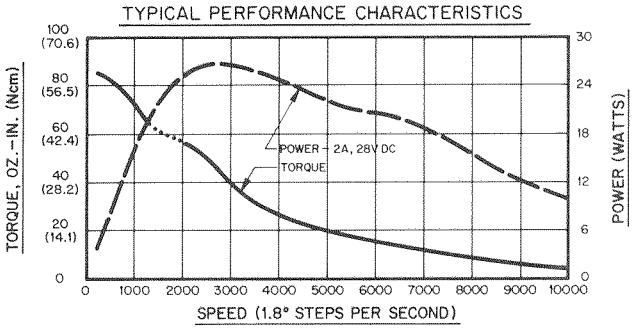
TYPICAL SPEED VS. TORQUE CHARACTERISTICS 230 SERIES MOTION CONTROLS



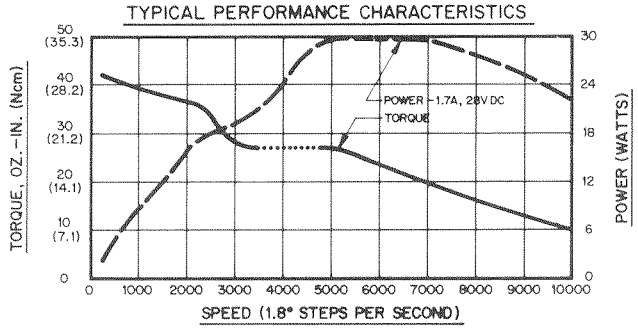
SERIES CONNECTION
M061-CS08 AND M061-LS08 MOTORS



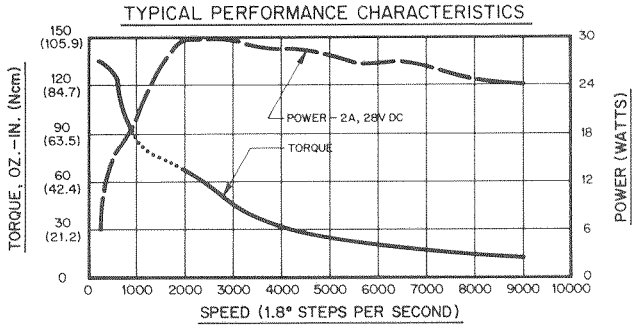
PARALLEL CONNECTION
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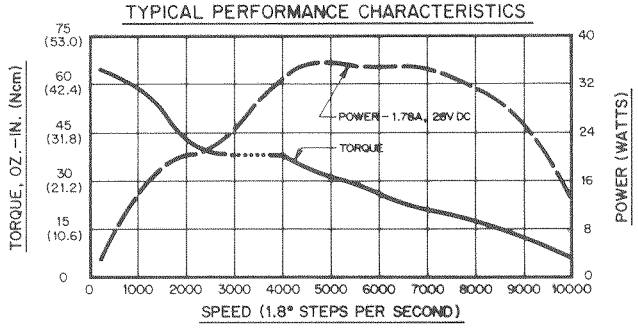
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PARALLEL CONNECTION
M062-CE09 AND M062-LE09 MOTORS

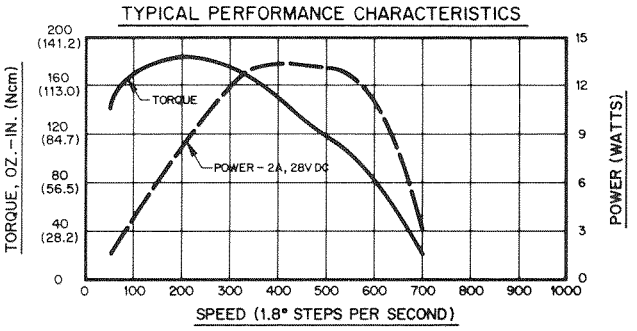


SERIES CONNECTION
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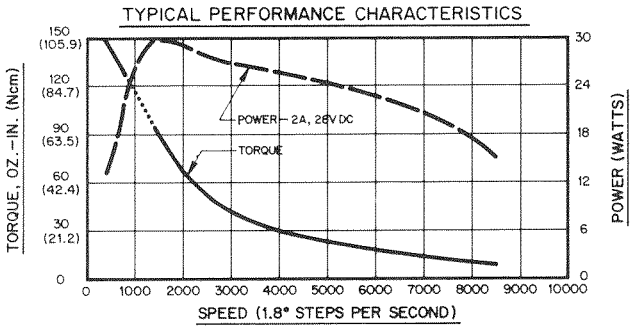


PARALLEL CONNECTION
M063-CE09 AND M063-LE09 MOTORS

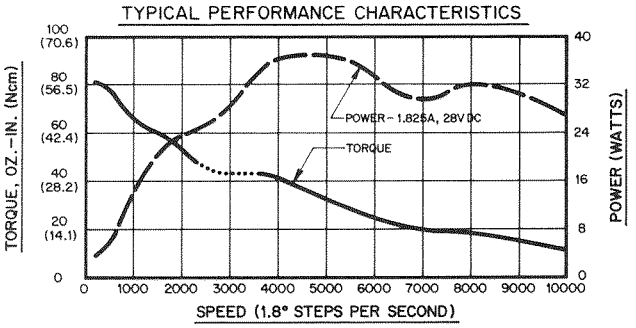
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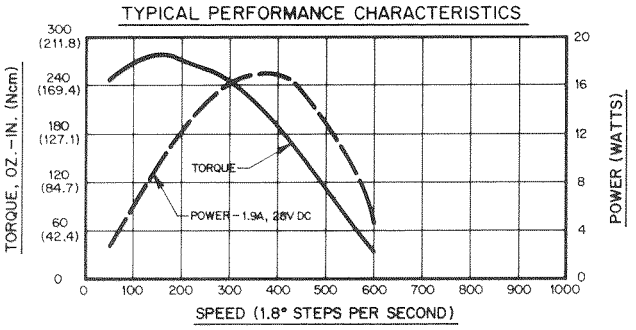
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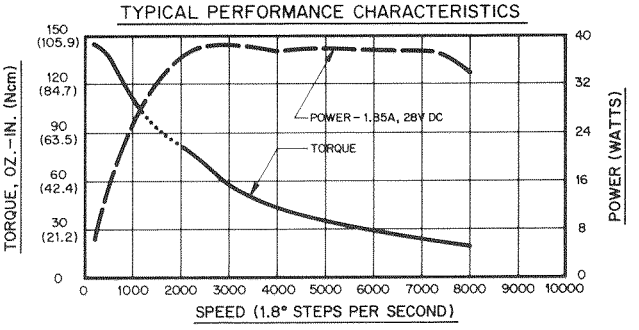
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M091-FC09 AND M091-FD09 MOTORS



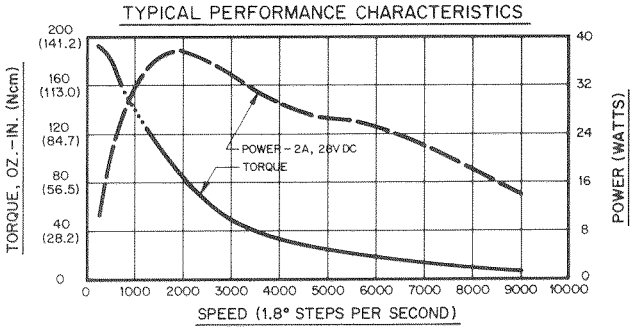
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M091-FD8009 AND M091-FD8109 MOTORS



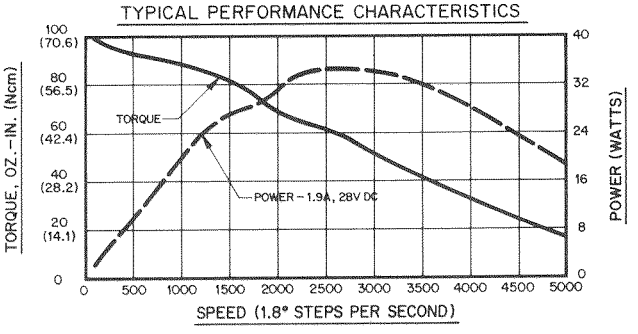
SERIES CONNECTION
M092-FC09 AND M092-FD09 MOTORS



PARALLEL CONNECTION
M092-FD8109 AND M092-FD8009 MOTORS



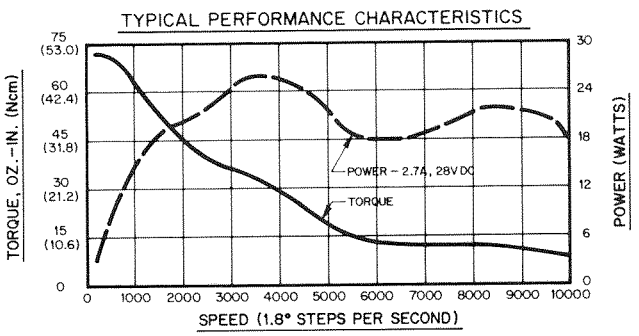
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M092-FD310 MOTOR



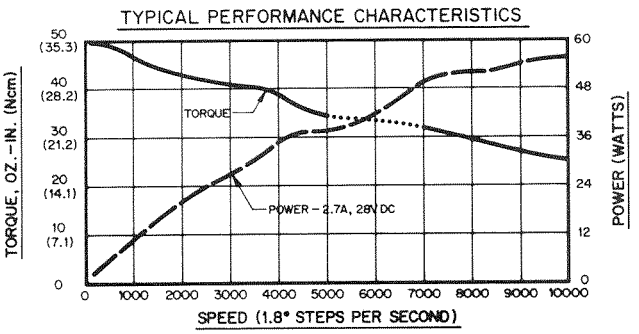
PARALLEL CONNECTION
M092-FD8814 MOTOR

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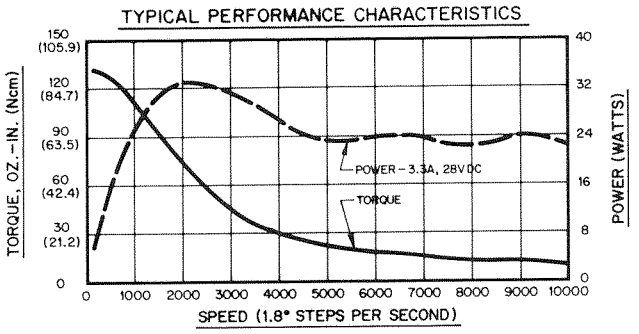
TYPICAL SPEED VS. TORQUE CHARACTERISTICS
430 SERIES MOTION CONTROLS



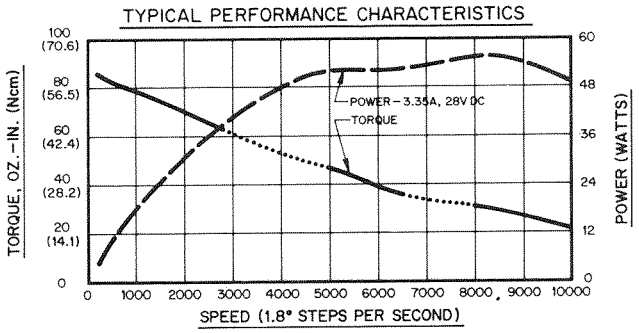
SERIES CONNECTION
M061-CS08 AND M061-LS08 MOTORS



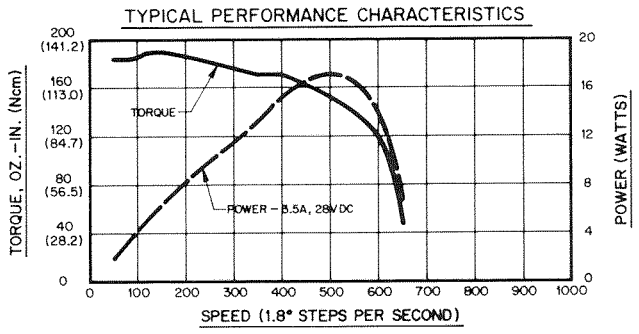
PARALLEL CONNECTION
M061-CE08 AND M061-LE08 MOTORS



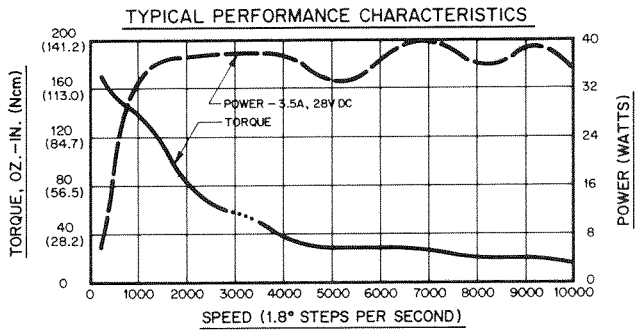
SERIES CONNECTION
M062-CS09 AND M062-LS09 MOTORS



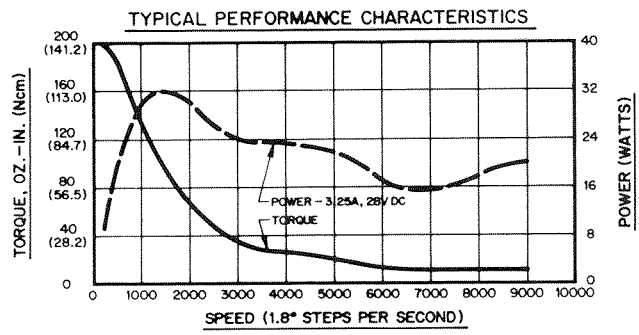
PARALLEL CONNECTION
M062-CE09 AND M062-LE09 MOTORS



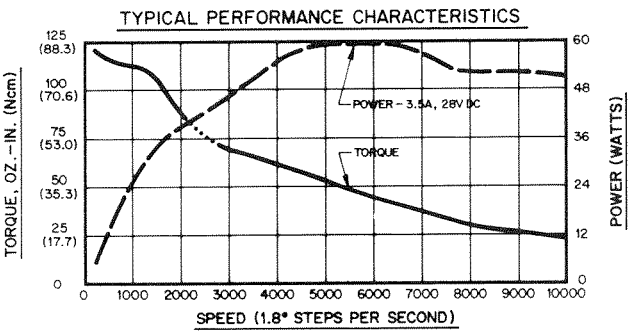
SERIES CONNECTION
M063-CS06 AND M063-LS06 MOTORS



PARALLEL CONNECTION
M063-CE06 AND M063-LE06 MOTORS

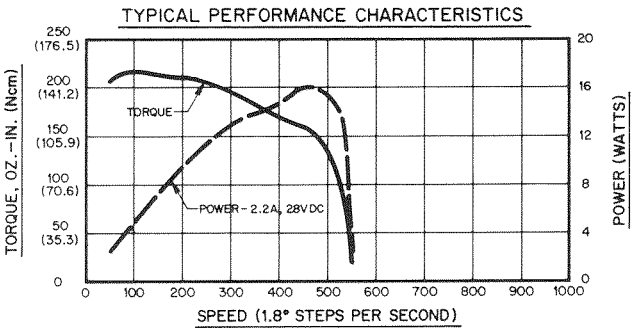


SERIES CONNECTION
M063-CS09 AND M063-LS09 MOTORS

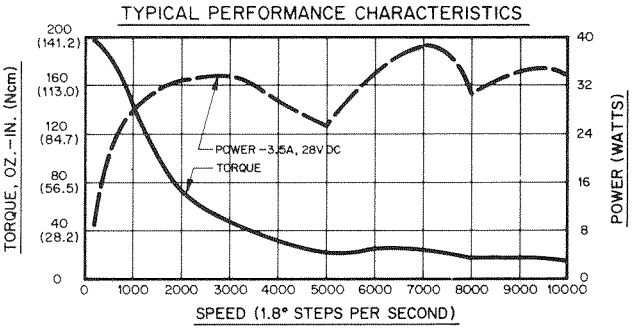


PARALLEL CONNECTION
M063-CE09 AND M063-LE09 MOTORS

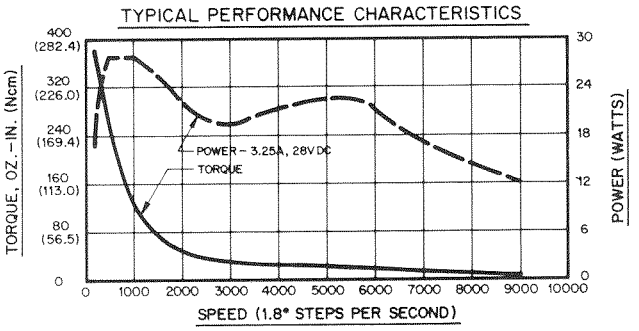
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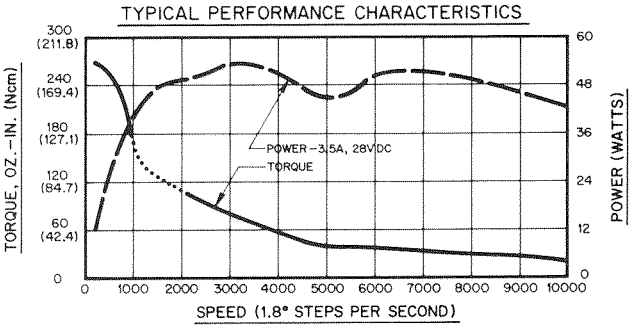
SERIES CONNECTION
M091-FC06 AND M091-FD06 MOTORS



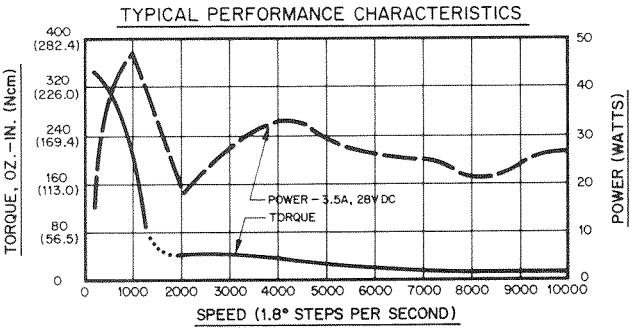
PARALLEL CONNECTION
M091-FD8106 MOTOR



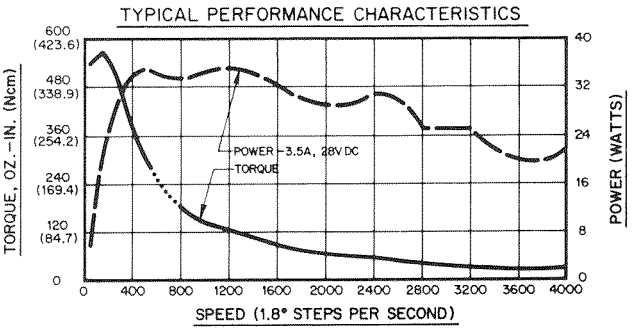
SERIES CONNECTION
M092-FC09 AND M092-FD09 MOTORS



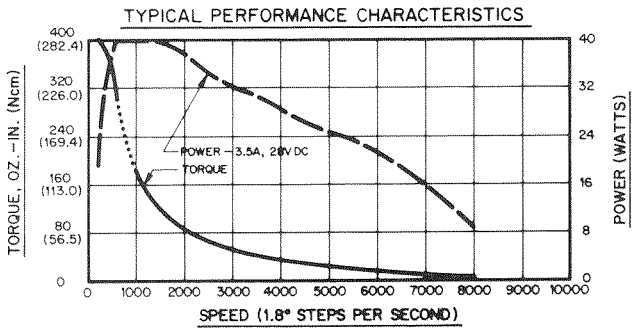
PARALLEL CONNECTION
M092-FD8109 AND M092-FD8009 MOTORS



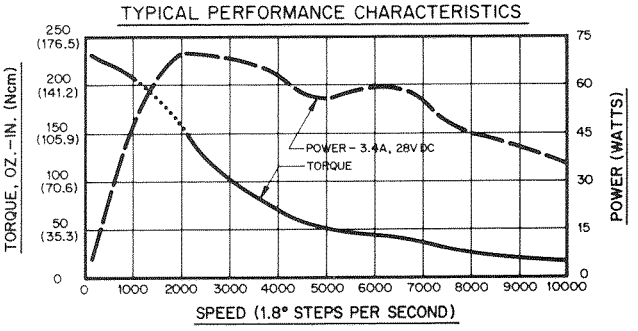
SERIES CONNECTION
M092-FD310 MOTOR



SERIES CONNECTION
M093-FD8011 MOTOR



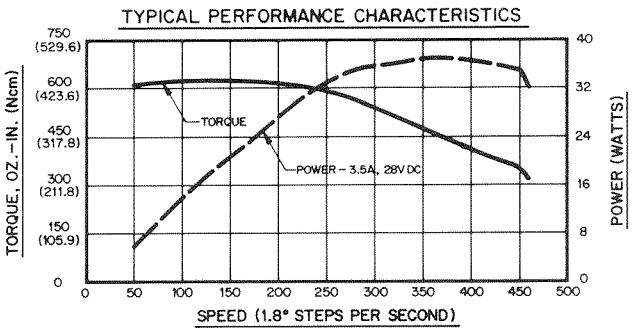
SERIES CONNECTION
M093-FC14 AND M093-FD14 MOTORS



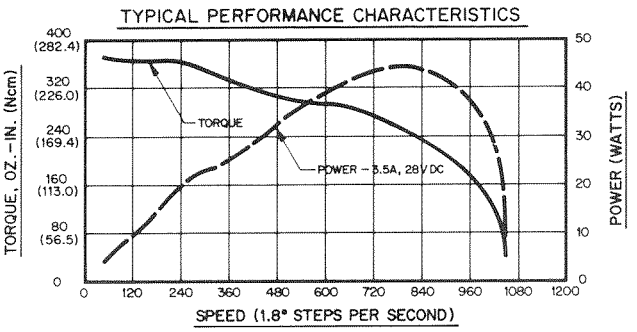
PARALLEL CONNECTION
M093-FD8014 MOTOR

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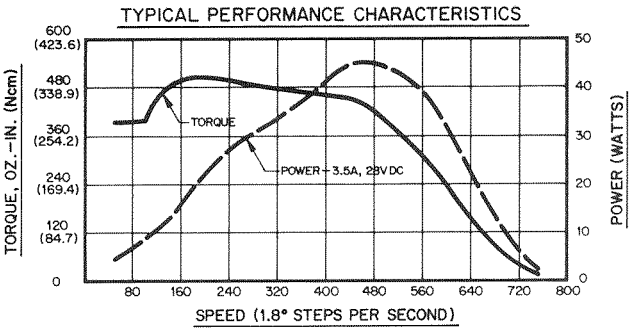
430 SERIES MOTION CONTROLS (Continued)



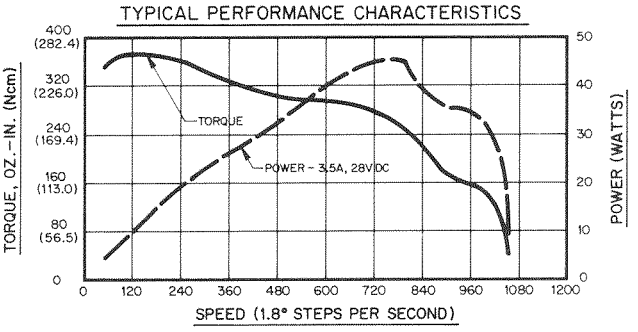
SERIES CONNECTION
M111-FD12 MOTOR



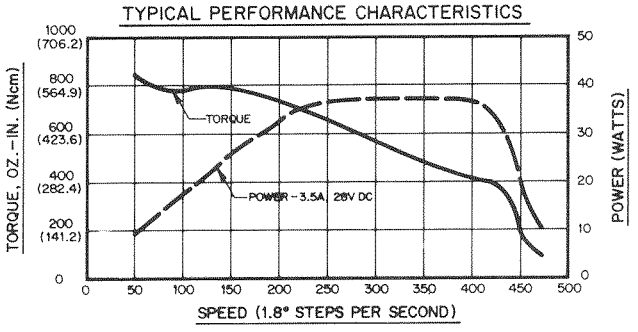
PARALLEL CONNECTION
M111-FD8012 MOTOR



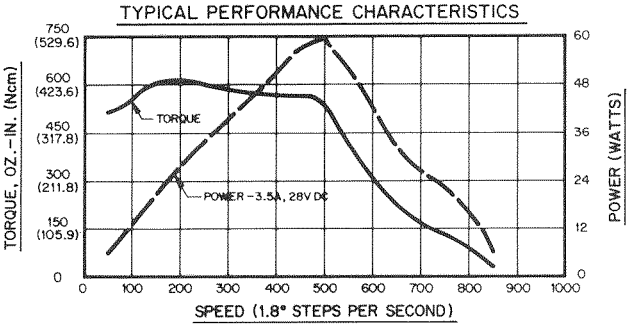
SERIES CONNECTION
M111-FD16 MOTOR



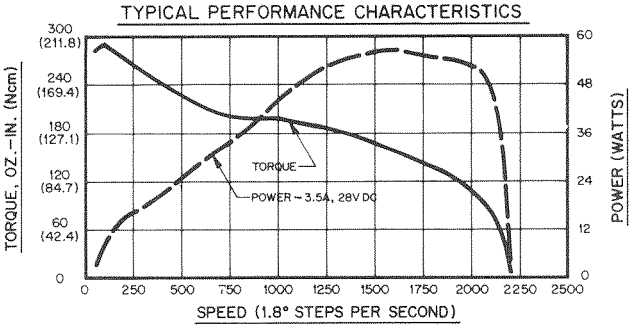
PARALLEL CONNECTION
MD112-FD8012 AND M112-FJ8012 MOTORS



SERIES CONNECTION
M112-FJ327 MOTOR



SERIES CONNECTION
M112-FJ8030 MOTOR



PARALLEL CONNECTION
M112-FJ8030 MOTOR

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SECTION 8: 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 the power to the drive before performing work on parts mechanically coupled to the motor.

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

In General:

*Check all installation wiring carefully for wiring errors or poor connections.

*Check to see that the proper AC voltage level is being supplied to the unit.

*Be sure the motor is compatible for use with this unit.

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

Connections to the J2 Motor Connector are reversed.

8.2 IF THE MOTOR MOTION IS ERRATIC, Check:

Low filter capacitor.

Input pulses not of proper level or width.

Supply voltage out of tolerance.

Motion parameters (base speed, high speed, acceleration/deceleration) may need adjustment.

8.3 IF TORQUE IS LOW, Check:

$\overline{AWO}$ ($\overline{ALL\ WINDINGS\ OFF}$) active.

Improper supply voltage.

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

SECTION 9: COMPONENT LAYOUT

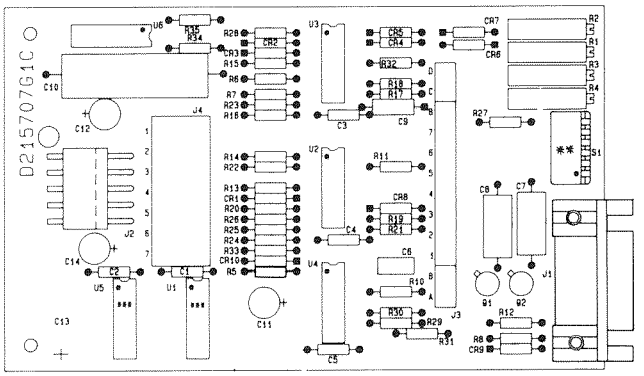


Figure 9.0 Component Layout 230-PTO or 430-PTO Circuit Card

WARRANTY AND LIMITATION OF LIABILITY

The Superior Electric Company (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.

THE COMPANY'S OBLIGATION UNDER THIS WARRANTY SHALL BE STRICTLY AND EXCLUSIVELY LIMITED TO REPAIRING OR REPLACING, AT THE FACTORY OR A SERVICE CENTER OF THE COMPANY, ANY SUCH EQUIPMENT OR PARTS THEREOF WHICH AN AUTHORIZED REPRESENTATIVE OF THE COMPANY FINDS TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP UNDER NORMAL USE AND SERVICE WITHIN SUCH PERIOD OF ONE YEAR. THE COMPANY RESERVES THE RIGHT TO SATISFY SUCH OBLIGATION IN FULL BY REFUNDING THE FULL PURCHASE PRICE OF ANY SUCH DEFECTIVE EQUIPMENT. This warranty does not apply to any equipment which has been tampered with or altered in any way, which has been improperly installed or which has been subject to misuse, neglect or accident.

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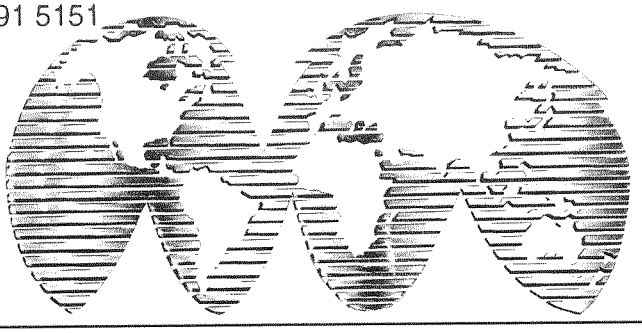
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