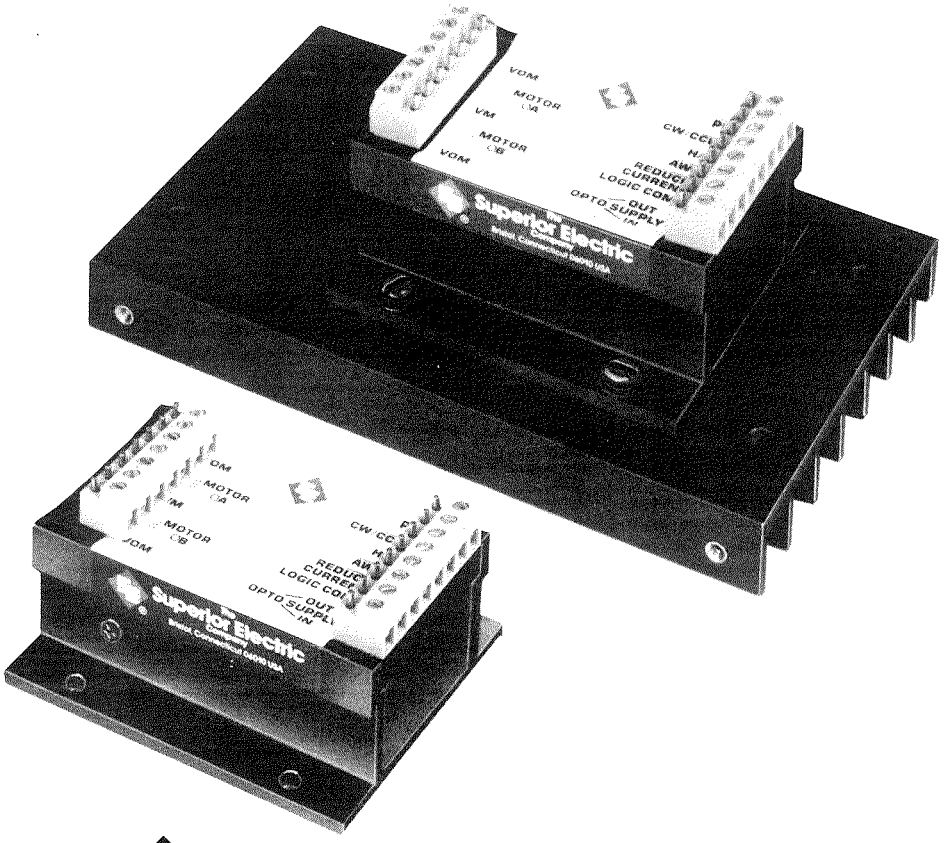
INSTRUCTION MANUAL for SLO-SYN® MICRO SERIES MOTION CONTROLS

TRANSLATOR MODULES TYPES 230-T, 430-T, 230-TH and 430-TH



Superior Electric®

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WARNINGS:

In general, 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.**
- **Assure motor compatibility before using the unit.**
- **Case temperature must be maintained between 0 and 75 degrees C.**
- **No short circuit protection is provided.**
- **Logic signal common and motor supply common are connected internally to the case.**
- **$\overline{\text{All Windings Off}}$ should be used with caution, as all holding torque is lost.**

LIMITS OF USE

- Re-configuration of the circuit in any fashion not shown in this manual will void the warranty.
- The Superior Electric Company disclaims any liability for operating this unit without the correct filter capacitor.

NOTES:

1. Clockwise and counterclockwise directions are properly oriented when viewing the motor from the *label end.*
2. The motor connector consists of 7 pins arranged symetrically around the center pin. If this connector is inadvertantly rotated 180 degrees, motor direction (CW, CCW) will be reversed. Motor direction can also be reversed by swapping the two motor connections of the **same phase** (for example, swap m1 and m3).

SECTION 1: INTRODUCTION

1.1 FEATURES OVERVIEW

The 230 and 430 drive modules are differentiated as follows:

	CURRENT PER PHASE	VA PER PHASE
230-T or TH	2 Amps peak	56 VA nominal
430-T or TH	3.5 Amps peak	96 VA nominal

"T" designates the translator module.

"TH" designates the translator module equipped with the heat sink.

The 230-T(H) and 430-T(H) are high efficiency bipolar chopper translator modules, designed in small, easily mounted packages. They can be used with a wide range of Superior Electric SLO-SYN 2-phase stepping motors, 4, 6 or 8 lead types.

The 230-T(H) and 430-T(H) use resistive current sensing and provide for full and half-step operation. Inputs are optically isolated, with choice of using internal or external opto power supplies. All units feature reduced current and all windings off capabilities.

1.2 INSPECTION PARTS LIST

Translator Module	230-T(H) or 430-T(H)
7-Pin Connector	B215744-007
8-Pin Terminal Strip	B215744-008

1.3 USING THIS MANUAL

This manual is an installation and operating guide to the 230-T(H) and 430-T(H) motor drive modules. All the information provided is necessary for using these modules successfully.

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

1.3.1 Organization

This manual is organized for the convenience of the operator. Section 2, "Mounting and Pin Assignments," provides the diagrams and reminders most necessary 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 useful in design, diagnostic, and troubleshooting situations.

Section 5, "Pin Configuration and Operations" provides detailed information for use of the equipment.

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 module's aluminum case.
- All logic functions are *low true logic.* A logic low or 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 OR 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/$\overline{\text{CCW}}$, CW is active with no connection.

- All logic control pins are optically isolated internally. When a pin is left *open*, it is clamped in a *logic high* (inactivated) state by the optical isolator.
- The motor drive changes state and advances the motor one step (or one-half step in the half-step mode) on a positive going (low to high) pulse edge.
- Clockwise (CW) and counterclockwise (CCW) are oriented correctly when viewing the motor from the nameplate (Label) end.

SECTION 2: MOUNTING AND PIN ASSIGNMENTS

The figures included here will be referenced in later sections.

2.1 MOUNTING

The 230-T(H) and 430-T(H) modules are epoxy encapsulated within an aluminum frame. The back surface of this frame has flanges and mounting holes. See Figure 2.1 below for the mounting hole diameters and locations.

It is recommended that 6-32 or 8-32 screws be used for mounting.

The major mounting consideration is that the case temperature be maintained below 167 degrees F (75 degrees C). For operation at or near full load, or at a higher temperature than 75 degrees F (25 degrees C) mounting to a heat sink is required.

A correctly configured heat sink is supplied by Superior Electric: Part #C215737-001-DB.

Also, the motor drive module can be ordered with the heat sink attached by specifying model #230-TH or 430-TH.

If no heat sink or an alternate heat sink is used, silicone heat sink compound (such as Dow-Corning number 340) must be used on the mounting surface.

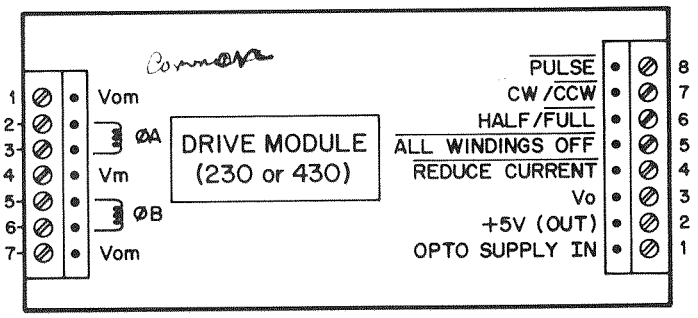
NOTE: A very thin coating is sufficient; too much is worse than none at all.

When a heat sink is used, the heat sink fins should be mounted in a **vertical position**, unless forced-air cooling is used.

Figure 2.1 shows the mounting hole locations and diameters for the Superior Electric supplied heat sink.

2.2 MOTOR CONNECTIONS

All motor connections are made via the 7 pins or a 7 pin connector (Superior Electric part number B215744-007) on the motor drives. Figure 2.2 shows the location and function of the motor drive pins. Sections 3 (3.5.2.2) and 5 (5.9-5.12) give details of how to make the motor connections.



ELECTRICAL CONNECTIONS

Figure 2.2: Output Pin Assignments

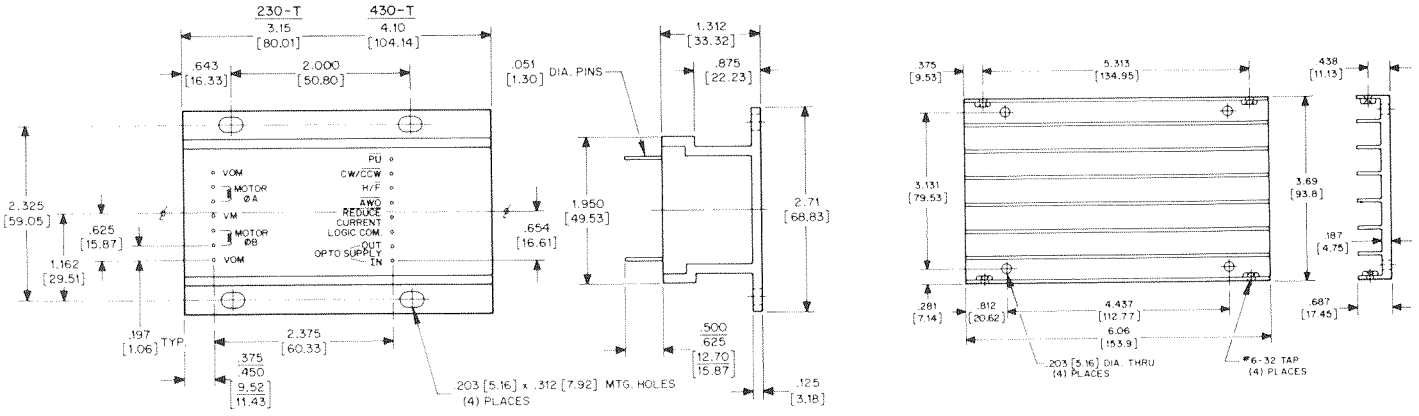


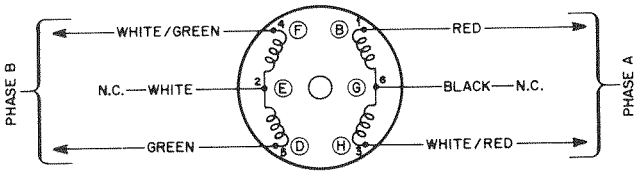
Figure 2.1: Mounting Diagram

It is suggested that a Superior Electric motor cable be used. They are available as follows:

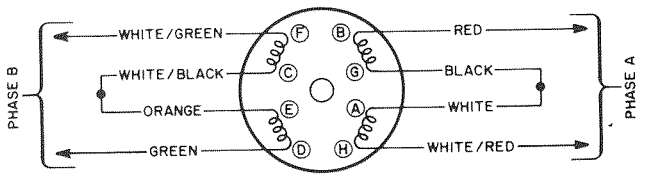
LENGTH	PART NO.
10 ft. (3m)	B215801-001
25 ft. (7.6m)	B215801-002
50 ft. (15m)	B215801-003

PLEASE NOTE: The motor drive pins are arranged symetrically about the center Vm pin. If the motor connector is inadvertently rotated 180 degrees when connecting the motor, then the CW and CCW directions will be reversed.

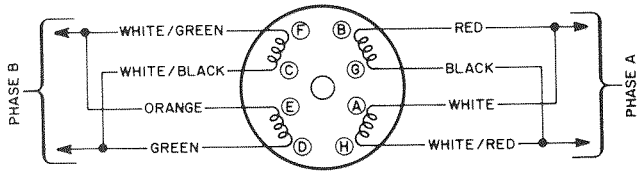
The 230 and 430 Series Translator Modules can be used with 6-lead and 8-lead SLO-SYN® motors. Figure 2.3 shows the correct connections for each possible motor configuration.



6-LEAD MOTORS, SERIES CONNECTION



8-LEAD MOTORS, SERIES CONNECTION



8-LEAD MOTORS, PARALLEL CONNECTION

MOTOR CONNECTIONS
FIGURE 2.3

2.3 CONTROL INTERFACE

All connections are made via 8 pins or terminal strip, Superior Electric part number B215744-008.

SECTION 3: SPECIFICATIONS

3.1 PRODUCT DESCRIPTION

Bipolar, 2-phase stepping motor drive with translator.
Power semiconductor type: H-bridge power IC
Translator: internal IC
Control signals optically isolated from the motor drive module (except for Reduce Current)

3.2 PERFORMANCE

Resolution	Half-step or full-step
Step Rate	0 to 10,000 full-steps/sec.
Chopping Freq.	20 kHz nominal
Speed/torque:	All specifications use typical data.

MOTOR FAMILIES

MOTORS FOR USE WITH 230-T(H)

WITH CONNECTORS

M061-CS08	M063-CS06
M061-CE08	M063-CS09
M062-CS09	M063-CE09
M062-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-FD8109
M063-LS06	M091-FD8109	M092-FD8814
M063-LS09	M092-FC09	

MOTORS FOR USE WITH 430-T(H)

WITH CONNECTORS

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

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

Power Supply Necessary (See Section 3.5.1.1)

Drive power dissipation (worst case)

230-T(H):	25 watts
430-T(H):	40 watts

3.3 MOTOR COMPATIBILITY

	230-T(H)	430-T(H)
Frame Sizes	M061 to M092	M061 to M112
No. of Leads	4, 6, 8	4, 6, 8
Min. inductance:	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.

3.4 MECHANICAL SPECIFICATIONS

	230-T(H)	430-T(H)
Type:	Potted module; Aluminum case	Potted module; Aluminum case
	"H" Unit supplied with Al. heat sink	
Size (inches):	3.15"(80mm)L 2.70"(68.6mm)W 1.31"(33.3mm)H	4.05"(103mm)L 2.70"(68.6mm)W 1.31"(33.3mm)H
	(add approx. 0.500" (12.7mm) to height for pins)	
Weight (lbs.)	1(0.45 kg)	1.5 (0.7 kg)

3.5 ELECTRICAL SPECIFICATIONS

3.5.1 Input Power Supply

3.5.1.1 Power and Voltages

	230-T(H)	430-T(H)
Supply Voltage:	28 VDC, nominal; 24 min to 36 max including ripple	28 VDC, nominal; 24 min to 36 max including ripple
Supply Current:	2.5 Amperes	4.0 Amperes
Logic Voltage:	Internally derived from motor supply. No external supply required.	

NOTE: Operation from a 28-30 VDC supply gives the best overall performance, considering tradeoffs of motor and drive heating, power supply current and torque vs. speed.

3.5.1.2 Connections

Method: Pins or terminal block (Part #B215744-007).

Assignment: Vm = + Vom = Common

Vom and Vo are internally connected to the module's aluminum case.

Cable Size: 14 gauge max., when using terminal block.

Superior Electric cables are recommended; see Section 2.2 for part numbers.

WARNING: DO NOT OPERATE THIS UNIT WITHOUT EXTERNAL FILTER CAPACITOR!!!!!

3.5.1.3 Filter Capacitor Requirement:

Minimum of 250 mfd. 50 VDC needed across Vm — Vom at drive terminals, or within 6 inches (150mm) of them.

Total filter capacitance on the motor power supply must be greater than or equal to 4700 microfarads; a 63-volt working voltage, and 3.3 amps ripple current rating are required. If the power supply does not contain sufficient filtering, then additional filtering must be added between the Vm and Vom terminals.

For example, a Sprague 53D472G063JP6 capacitor is suitable for this purpose.

3.5.2 OUTPUT TO MOTOR

3.5.2.1 Voltages and Current

	230-T(H)	430-T(H)
Output Voltage: to motor	24-36 Volts nominal, depending on power supply voltage. 36 Volts max.	36 Volts max.
Motor Current per phase:	2 Amperes peak 1 Ampere peak in reduced current mode	3.5 Amperes peak 1.5 Amperes peak in reduced current mode
Motor VA per phase:	56 VA nominal (at 28 VDC, 2A)	98 VA nominal (at 28 VDC, 3.5A)

3.5.2.2 Connections

Terminals:	At drive: Phase A and Phase B pairs
Max/Min cable length:	Total maximum resistance of motor and cable: 3.5 ohms
Cable size, type:	14 gauge maximum when using terminal block part #B215744-007.
Special Requirements:	Twist motor phase pairs: 6 twists/ft. to minimize radiated EMI/RFI and help provide maximum motor performance.

3.6 CONTROL INTERFACE REQUIREMENTS

All connections via 8 pins or terminal block part #B215744-008.

Min pulse width low:	15 microseconds
Min pulse width high:	50 microseconds

3.7 Opto-isolation

Power required for opto-isolators: 4.5-7 VDC, 60 mA typical.

To use internal opto-isolator power supply: connect OPTO OUT and OPTO IN pins together.

Logic "sinking" is required to activate optically-isolated signals (see sections 5.9 and 5.10) 20 mA

3.8 ENVIRONMENTAL REQUIREMENTS

Storage Temp:	−40°F to +185°F (−40°C to +85°C)
Operating Temp:	+32°F to +167°F (0°C to +75°C) case
Humidity:	95% max., noncondensing
Altitude:	10,000 feet (3048 meters) max.
Heat sinking:	Maintain case temperature below 167 degrees F (75 degrees C)

No heat sink needed for Reduced Current operation at 77 degrees F (25 degrees C) ambient temperatures (1 A for 230-T; 1.5 A for 430-T).

Use heat sink part #C215737-001-CB for operation at higher currents or higher ambient temperatures

SECTION 4: FUNCTIONAL DESCRIPTION

4.1 OVERVIEW

In general, the 230-T(H) and 430-T(H) electronically convert input pulses into drive signals of the proper sequence and power required to operate a stepping motor: one input pulse being "translated" into one motor step.

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 at a time 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. The translator circuit is fully self-contained and is not accessible through any of the function pins.

4.2. SIGNAL DESCRIPTION

The 230-T(H) and 430-T(H) are configured for operation by the means of the pin assignments. How these functions are treated by the motor drive module is explained in Section 6.

Input pulses, one for each desired motor step, are received by the translator circuit on the PULSE IN ($\overline{PU}$) pin.

Two input control signals alter the sequence of motor windings which will be energized. The CW/$\overline{CCW}$ pin controls which direction the motor will move and the HALF/$\overline{FULL}$ (H/F) pin determines whether a half or full step is taken.

Even when the motor is stationary, current is flowing through one or two of the windings. The magnetic field produced by this current holds the shaft firmly with a force specified as the "holding torque." The input control signal, ALL $\overline{WINDINGS\ OFF}$ ($\overline{AWO}$), turns off all current to the motor, thus allowing the shaft to be turned manually.

SECTION 5: PIN CONFIGURATION AND OPERATIONS (Ref. Figure 2.2, Section 2.2)

NOTE: The following discussion assumes the internal opto power supply is being used when describing signal functions.

5.1 $\overline{PU}$ ($\overline{PULSE\ IN}$)

A low to high (positive going edge) transition on this pin causes the motor to take one step. Maximum frequency is 15kHZ

5.2 CW/$\overline{CCW}$ (DIRECTION)

A logical high or an open connection causes the motor shaft to step in the clockwise direction as viewed from the *label* end of the motor. A logical low, or connection to LOGIC COMMON results in counterclockwise rotation.

5.3 H/$\overline{F}$ (HALF/$\overline{FULL}$)

A logical low or connection of LOGIC COMMON, causes the motor to step the full step angle indicated in its specifications. A logical high (open) causes the motor to take a "half step" equal to half of its specified step angle. When operated in 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.

5.4 $\overline{AWO}$ ($\overline{ALL\ WINDINGS\ OFF}$)

A logical low or connection to LOGIC COMMON turns off all power to the motor windings.

WARNING

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

5.5 $\overline{REDUCED\ CURRENT}$

There are two ways to use this pin:

1. Connect it directly to LOGIC COMMON (Pin#3). This reduces motor current to 1.0A for the 230 T(H) and to 1.5A for the 430 T(H).
2. Connect it through a resistor (see Table below) to LOGIC COMMON (Pin #3) for other values of reduced current.

NOTE: Connections to this pin must be kept short (2 inches or less) to avoid malfunction. Also, this signal is not optically isolated.

For the 230-T(H), typical values for resistors and the associated current are:

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

For the 430-T(H), typical resistor values and the associated currents are:

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

5.6 LOGIC COMMON

Reference point for inputs and outputs; connected internally to Vom and to the module's aluminum case.

5.7 OPTO SUPPLY OUT

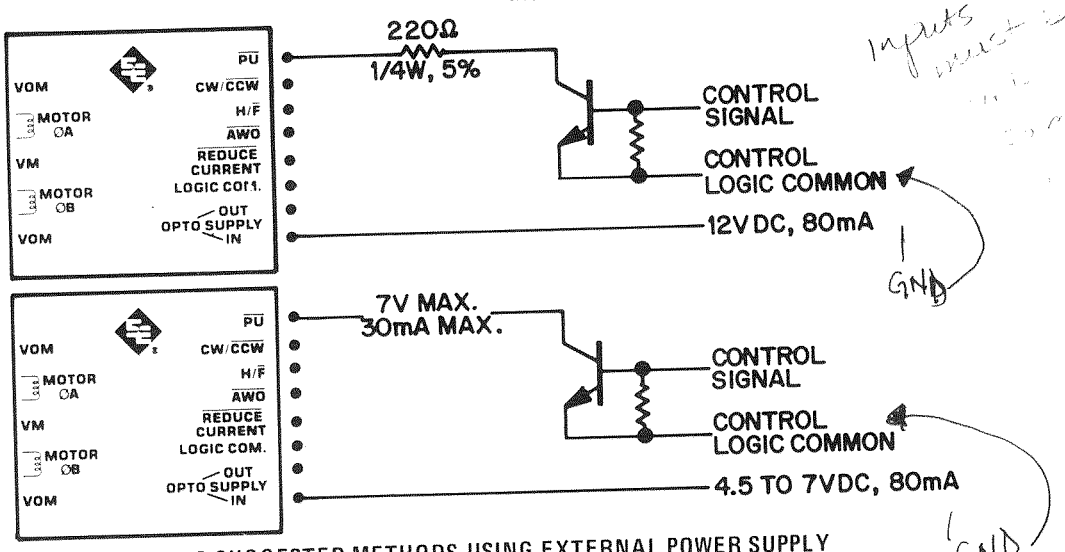
Supplies proper voltage for opto inputs from an internal source. By connecting OPTO SUPPLY OUT to OPTO SUPPLY IN, the user can use 230-T(H), 430-T(H) internal power supply. This allows logic functions to be activated by "sinking" (pulling them low; i.e., connecting them to LOGIC COMMON via an external switch or logic gate.)

In this case, the user's circuitry is not isolated from the translator.

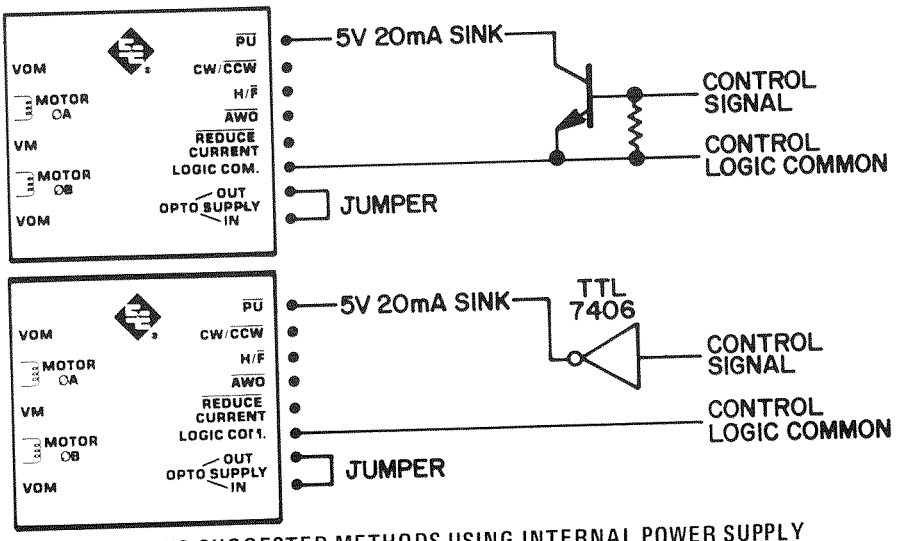
5.8 OPTO SUPPLY IN

Connection for opto-isolator power supply.

May be connected as described in 5.7, or user may provide a separate source for opto-isolators and "sink" to activate, as shown in Figure 5.1. This method may provide the best noise immunity since the user's circuitry is optically isolated from the translator.



TWO SUGGESTED METHODS USING EXTERNAL POWER SUPPLY



TWO SUGGESTED METHODS USING INTERNAL POWER SUPPLY

FIGURE 5.1 OPTO CONNECTIONS

5.9 Vm

Motor power supply input.

5.10 Vom

Common for motor supply; connected internally to Vo and to the module's aluminum case.

5.11 MOTOR Phase A (ØA)

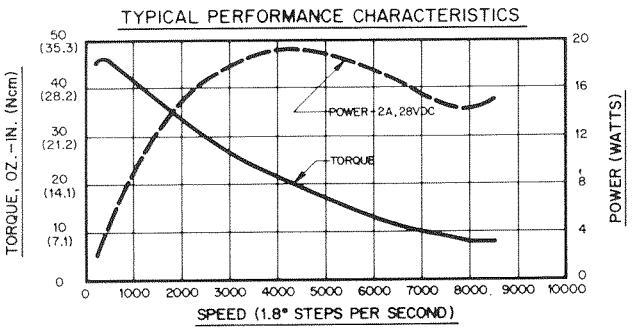
Connect the pair of wires for one motor phase here. For example, M1, M3 on Superior Electric Motors.

5.12 MOTOR Phase B (ØB)

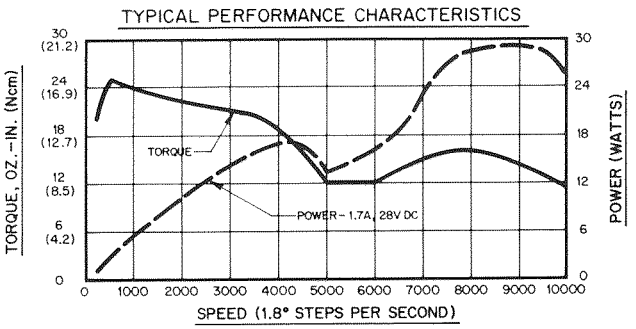
Connect the pair of wires for the other motor phase here. For example, M4, M5 on Superior Electric Motors.

SECTION 6: SPEED/TORQUE CURVES

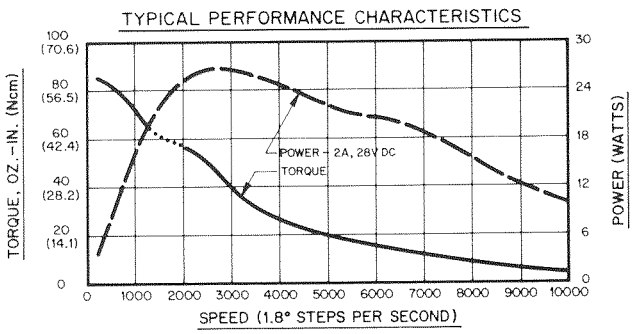
TYPICAL SPEED VS. TORQUE CHARACTERISTICS 230 SERIES MOTION CONTROLS



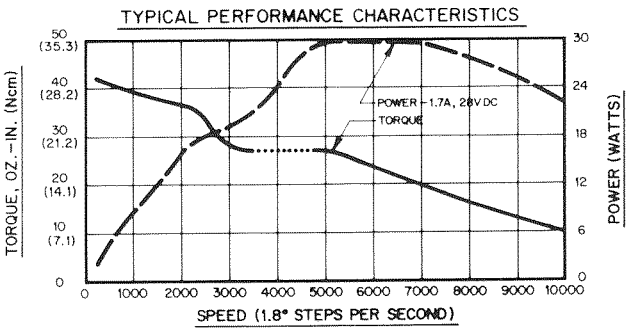
SERIES CONNECTION
MO61-CS08 AND MO61-LS08 MOTORS



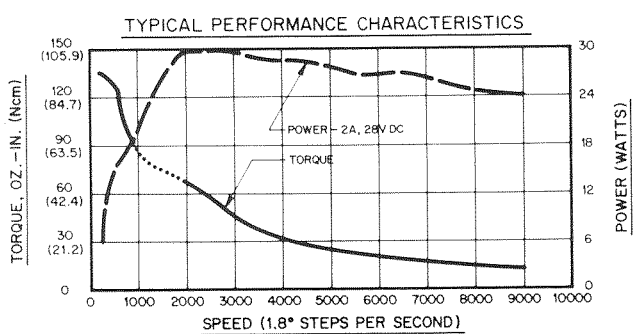
PARALLEL CONNECTION
MO61-CE08 AND MO61-LE08 MOTORS



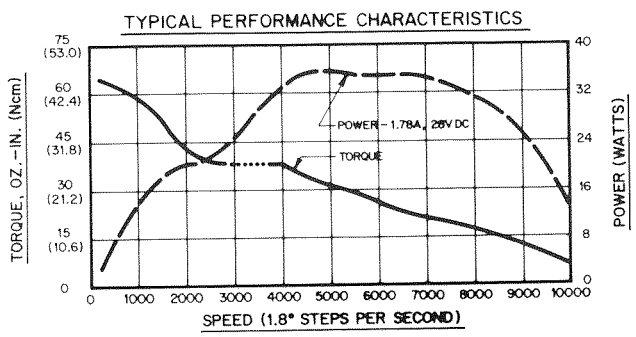
SERIES CONNECTION
MO62-CS09 AND MO62-LS09 MOTORS



PARALLEL CONNECTION
MO62-CE09 AND MO62-LE09 MOTORS



SERIES CONNECTION
MO63-CS09 AND MO63-LS09 MOTORS



PARALLEL CONNECTION
MO63-CE09 AND MO63-LE09 MOTORS