INSTALLATION INSTRUCTIONS for OREGON MICRO SYSTEMS, INC. MODELS PMD8m & PMD8h MICROSTEP DRIVE MODULE

400030-153 Rev. A

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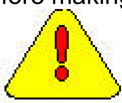
RECORD OF REVISIONS		
Revision	**Date**	**Description**
A	8/25/99	Initial Release

TABLE OF CONTENTS

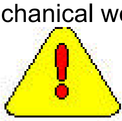
THINGS TO KNOW BEFORE USING THIS EQUIPMENT

- 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 making or breaking the motor connections.



Serious damage may occur to the motor or the drive if the motor is disconnected while the "PWRON" LED is still lit.

- Motors powered by this drive may develop extremely high torque. Be sure to disconnect power to this drive before doing any mechanical work.



This unit is designed for 20 to 80 VDC input only (see Section 4.2, Electrical Specifications).

WARRANTY RESTRICTIONS

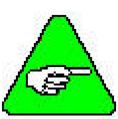
Reconfiguration of the circuit in any fashion not shown in this manual will void the Warranty.

Failure to follow the installation guidelines as described in Section 3 voids the Warranty.

SECTION 1: INTRODUCTION

1.1 USING THIS MANUAL

It is important that you understand how this Oregon Micro Systems' PMD8 series Microstep Drive Module is installed and operated before you attempt to use it.



Read this manual completely before proceeding with the installation of this unit.

This manual is an installation and operating guide to the Oregon Micro Systems' PMD8m and PMD8h Microstep Drive Modules. Section 1 gives an overview of the drives and their features. Section 2 describes the steps necessary to place the drive 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 environmental specifications. The procedure for setting the motor current level is also covered in this section.

Torque versus speed characteristics for the preferred Oregon Micro Systems' Stepper Motors are given in Section 5. Section 6, Troubleshooting, gives procedures to follow if the Microstep Drive Module fails to operate properly.

Appendix A provides procedures for troubleshooting electrical interference problems.

1.2 PRODUCT FEATURES

The Oregon Micro Systems' PMD8m (PMD8h) is a bipolar, speed adjustable, two-phase PWM drive which uses power MOSFET devices. The PMD8m can be set to operate a stepper motor in 8 step resolutions from full step to 1/100 microstep. The PMD8h can be set to operate a stepper motor in 8 step resolutions from full step to 1/128 microsteps. The maximum running speed is 3,000 rpm. To reduce the possibility of electrical noise problems, the control signals are optically isolated from the drive circuit. Additional features include:

- Active mid range stabilization control
- Switch selectable current levels of 3 through 8 amperes
- Full short circuit protection (phase-to-phase and phase-to-ground)
- Undervoltage and transient overvoltage protection
- Thermal protection
- Efficient thermal design
- Optically- isolated inputs
- Reduce Current input
- Switch selectable automatic current reduction or externally-activated current reduction
- Windings Off input
- Switch selectable step resolution
- Compact size
- Sturdy all-aluminum case

SECTION 2: EXPRESS START UP PROCEDURE

The following instructions define the minimum steps necessary to make your Oregon Micro Systems Drive operational.

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

Always operate the unit with the Motor and the Drive enclosure GROUNDED. Be sure to twist together the wires for each motor phase as well as those for the DC input. 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 preferred motors.

2. Set the correct current level for the motor being used per the instructions in Section 4.5. **Heat sinking is required if a current of 4 amperes or higher is used**.

3. Select the appropriate step resolution and set the switches as described in Section 4.5.
4. Wire the motor per the "Motor Connections" description in Section 3.2.

5. Connect the power source to the DC input terminal strip. Be sure to follow the instructions for connecting the filter capacitor as described in Section 3.2, under "Power Input."

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

Clockwise and counter-clockwise directions are properly oriented when viewing the motor from the end opposite the mounting flange.

SECTION 3: INSTALLATION GUIDELINES

3.1 MOUNTING

The Oregon Micro Systems' Drive is mounted by fastening its mounting brackets to a flat surface as shown in Figure 3.1. If the Heat Sink Assembly, HS8, is mounted against a bulkhead, be sure to apply a thin coating of thermal compound between the heat sink and the mounting surface before fastening the unit in place. Do not use too much thermal compound. It is better to use too little than too much.

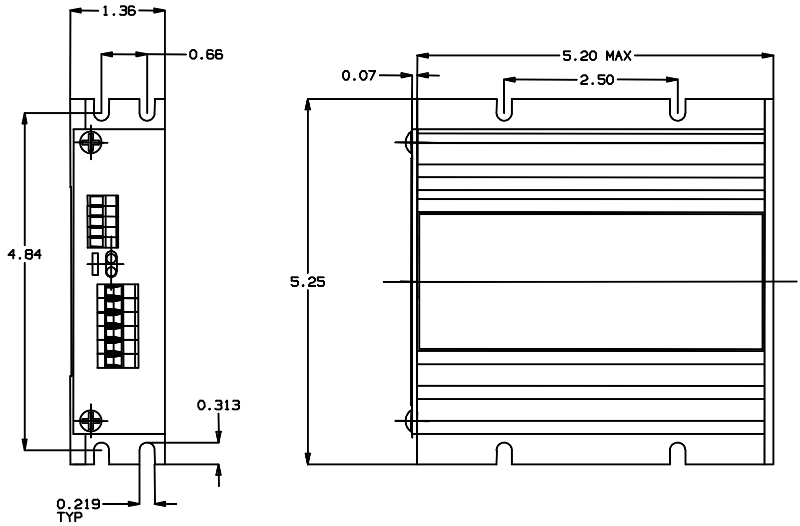
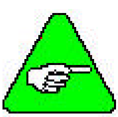


Figure 3.1, Mounting Diagram



Case temperature should not exceed +70° C (+158° F). A heat sink, such as Oregon Micro Systems' Heat Sink Assembly HS8 must be used when the drive is operated at a current setting of 4 amperes or more. In this case the unit should be mounted upright (with the cooling fins vertical) , or proper cooling will not occur. Air flow should not be obstructed. 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 sources of electrical noise. If possible, locate the drive in its own metal enclosure to shield it and its wiring from electrical noise sources. If this cannot be done, keep the drive at least three feet from any noise sources.

3.2 CONNECTOR LOCATIONS AND PIN ASSIGNMENTS

Figure 3.2 shows the connector locations for the Oregon Micro Systems' PMD8 Microstep Drive Module.

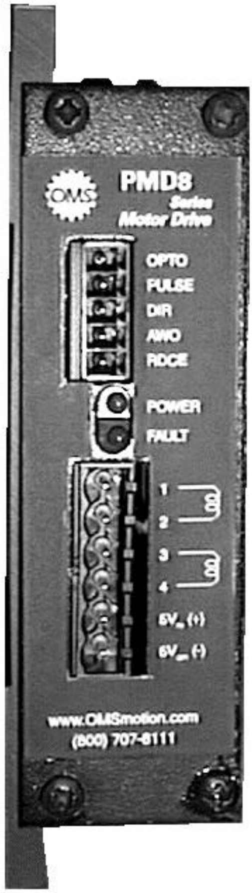
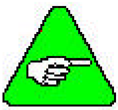


Figure 3.2, Connector Locations

MOTOR CONNECTIONS

All motor connections are made via the 6-pin connector (included). Pin assignments for this connector are given below. Motor connections are shown in Figure 3.3.

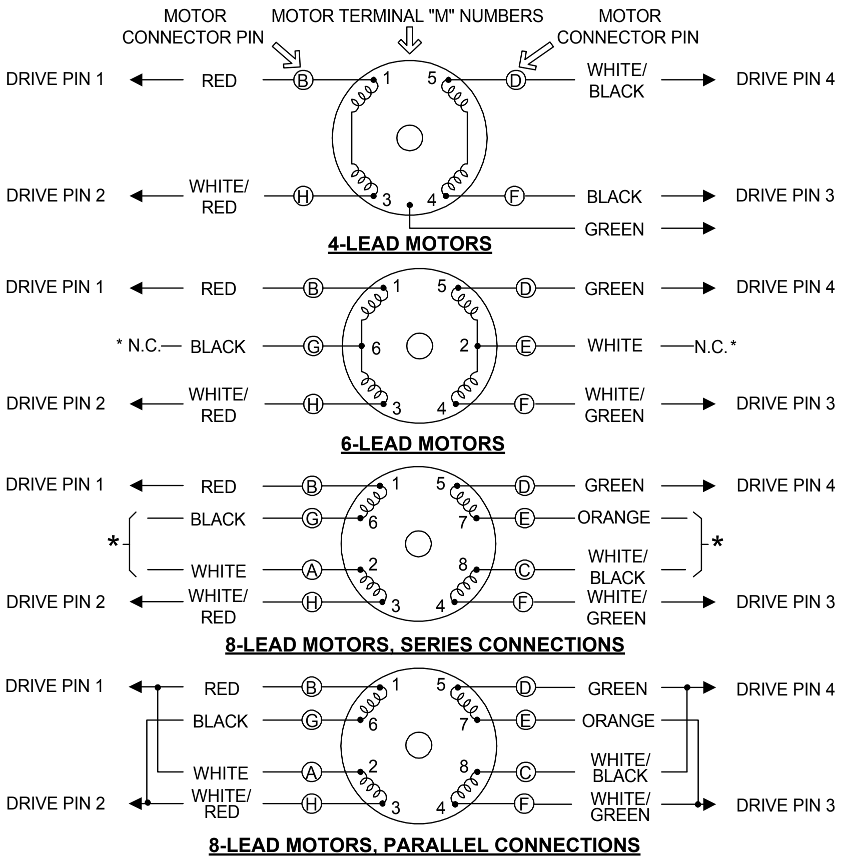
Pin	Assignment
1	M1 (Phase A)
2	M3 (Phase A)
3	M4 (Phase B)
4	M5 (Phase B)



Motor phase A is M1 and M3 and motor phase B is M4 and M5. The motor frame must be grounded.

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.

Figure 3.3 shows the possible motor wiring configurations.



*** These leads must be insulated and isolated from other leads or ground.**

Figure 3.3, Motor Wiring Configurations

Circled letters identify terminals for connector motors, numbers identify those for terminal box motors.

POWER INPUT

The DC input power is connected to pins 5 and 6 of the power connector. Pin 5 [Vm(+)] is the power supply plus (+) connection and pin 6 [Vom(-)] is the power supply minus (-) connection.

An unregulated supply similar to that shown in Figure 3.4 is preferable. If a regulated supply is used, it must be a linear regulated supply and must be capable of operating with the added filter capacitor. A switching regulated supply is not recommended for use with this drive. It is important that capacitor (C1) be connected within three feet (0.9 meter) of the input terminals. The capacitor must be of the correct value and have the proper current and voltage parameters (see list of components on page 11).

It is recommended that the power supply leads be twisted together (6 twists per foot).

If the power supply is grounded, it must only be grounded on the negative side or the short circuit protection will not operate properly.

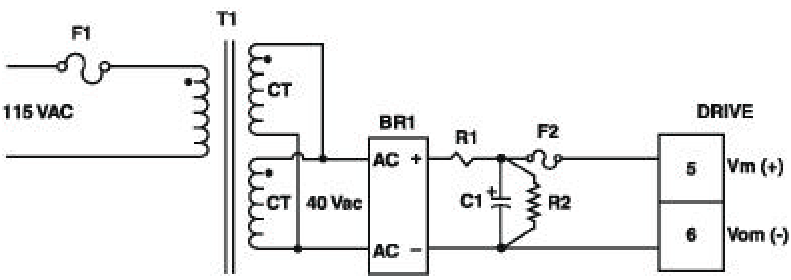


Figure 3.4, Typical Power Supply For A Single Drive Application

The cable between the filter capacitor (C1) and the drive should be twisted (six twists per foot). Maximum wire length is three feet.

Use #16 AWG or larger wire.

Components for circuit shown in Figure 3.4:

5 ampere or lower setting

F1	3 amp., time delay, Bussman MDA-3 or equivalent
F2	15 amp. very fast acting , Bussman GBB-15 or equivalent
R1	5 ohm surge limiter, Phillips 2322-654-61508 or equivalent
R2	4.7k ohm, 2 watts, ±5%
T1	160 VA, Bicron Electronics BU216AS040D, Signal Transformer 80-2 or equivalent
BR1	General Instrument GBPC3502 or equivalent
C1	**4700 mf, 6.9 amp. ripple current, 100 VDC, United Chemi-Con 36DA472F100AL2A or equivalent**

6 thru 8 ampere settings

F1	6 amp. time delay, Bussman MDA-6 or equivalent
F2	15 amp. very fast acting, Bussman GBB-15 or equivalent
R1	4 ohm surge limiter, Phillips 2322-654-61408 or equivalent
R2	4.7k ohm, 2 watts, ±5%
T1	320 VA, Bicron Electronics BU233AS040D, Signal Transformer 80-4 or equivalent
BR1	General Instrument GBPC3502 or equivalent
C1	**6800mf, 9.4 amp. ripple current, 100 VDC, United Chemi-Con 36DA682F100AD2A or equivalent**

SECTION 4: SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Size
(Inches) .... 5.25 H x 1.36 W x 5.6 D
(mm) .... 133 H x 35 W x 142 D
Weight .... 1.5 pounds (680 grams)

4.2 ELECTRICAL SPECIFICATIONS

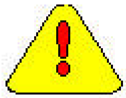
DC Input Range .... 20 VDC min., 80 VDC max.
DC Current................. see Motor Table
Drive Power Dissipation
(Worst Case)...... 40 watts

4.3 ENVIRONMENTAL SPECIFICATIONS

Temperature
Operating .... +32° F to +122° F
(0° C to +50° C) free air ambient, Natural Convection. Maximum heat sink temperature of 158° F (70° C) must be maintained. Forced-air cooling may be required.
Storage............... -40° F to +167° F
.... (-40° C to +75° C)
Humidity..................... 95% max. noncondensing
Altitude....................... 6,562 feet (2000 m) max.

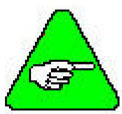
4.4 MOTOR COMPATIBILITY

Motor Types.................... Oregon Micro Systems HT Series
Frame Sizes
HT Series .... HT60 (NEMA 23) through HT93 (NEMA 34)
Number of
Connections 4, 6, 8
Minimum Inductance....... 1 millihenry
Maximum Resistance ..... = 0.25 x VDC Supply/I Setting
Example:
VDC = 60 I Setting = 7 R max. = 0.25 x 60/7 = 2.1 ohms



Duty cycle limiting or external motor cooling may be required to keep the motor shell temperature below its rating.

Do not use larger frame size motor than those listed, or the drive may be damaged. If a larger frame size motor must be used, consult the factory for recommendations.



Maximum resistance is total of motor plus cable.

PREFERRED MOTORS FOR USE WITH THE PMD8 MICROSTEP DRIVE MODULE

Motor	Control Filter Switch Settings			Current Setting (Amperes)	Power Supply Current	
	4	3	2		Standstill (Amps. DC)	Maximum (Amps. DC)
HT60F05	DOWN	UP	UP	3	1.0	2.0
HT61F05	DOWN	UP	UP	3	1.0	2.0
HT62F07	DOWN	UP	UP	4	1.0	3.5
HT62F13	UP	DOWN	DOWN	8	1.5	4.5
HT63F07	DOWN	UP	UP	4	1.0	2.0
HT63F13*	DOWN	UP	UP	8	2.0	4.5
HT91F07	DOWN	UP	UP	4	1.5	2.5
HT91F13*	DOWN	UP	UP	8	1.5	4.0
HT92F13*	DOWN	UP	UP	8	2.0	4.5
HT93F10	UP	DOWN	DOWN	7	2.0	4.5
HT93F14*	UP	DOWN	DOWN	8	2.0	4.5

* Recommended motor

Power supply currents shown are measured at the output of the rectifier bridge in Figure 3.4.

Motors with windings other than those listed can be used as long as the current ratings listed on the motors are not exceeded.

4.5 CURRENT AND STEP RESOLUTION SETTINGS

4.5.1 Current Settings (Switch Positions 1 - 5)

The proper current setting for each motor is shown on the torque vs. speed curves. Use this current level to obtain the torque shown. The access hole for the switches which set the motor current level is located on the back of the unit (see Figure 4.1). Switches 1 through 5 are used to select a current level. Select the desired operating current by setting the appropriate switch. Only one switch should be Down at a time. If two or more switches are Down, the higher current level will be the active level. The switch settings are as follows:

Switch	Position	Peak Current (Amps)	RMS Current (Amps)
All	Up	3.0	2.1
1	Down	4.0*	2.8
2	Down	5.0*	3.5
3	Down	6.0*	4.2*
4	Down	7.0*	5.0*
5	Down	8.0*	5.6*

*Heat sinking is recommended at current settings of 4 amperes or higher. The drive case temperature MUST NOT exceed 70°C.

4.5.2 Step Resolution (Switch Positions 6 - 8)

The number of pulses per revolution is selected using positions 6 through 8 of the switch described in Section 4.5. The following chart shows the correct switch settings for each available step resolution.

Switch*	Position*	PMD8m		PMD8h	
		Resolution	Pulses/Rev	Resolution	Pulses/Rev
All	Up	Full	200	Full	200
7	Down	1/2	400	1/2	400
8	Down	1/5	1,000	1/4	800
7 & 8	Down	1/10	2,000	1/8	1600
6	Down	1/20	4,000	1/16	3200
6 & 7	Down	1/25	5,000	1/32	6400
6 & 8	Down	1/50	10,000	1/64	12,800
6, 7 & 8	Down	1/100	20,000	1/128	25,600

* Switches not listed must be in the Up position

4.6 AUTO REDUCE AND CONTROL FILTER SETTINGS

4.6.1 Auto Reduce (Switch Position 1)

Refer to Figure 4.1 for the location of the Auto reduce switch

Up - 50% Standstill current activated after 0.5 to 1.5 seconds.

Down - Auto reduce not active. **Reduce can be controlled by an external signal.**

4.6.2 Control Filter (Switch Positions 2 - 4)

Switch positions 2 - 4, Figure 4.1, are used to set the control filter as follows:

	SWITCH			**FILTER FREQUENCY (Hz)**
	4	**3**	**2**	
POSITION	Down	Down	Down	1700
	Down	Down	Up	850
	Down	Up	Down	540
	Down	Up	Up	420
	Up	Down	Down	330
	Up	Down	Up	270
	Up	Up	Down	230
	Up	Up	Up	200

Filter selection depends on the motor selected. See the list of recommended motors in Section 4.4.

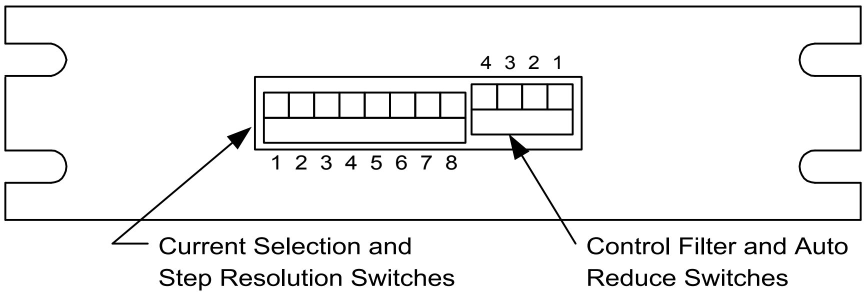


Figure 4.1, Current Level, Step Resolution, Auto Reduce & Control Filter Switches

4.7 SIGNAL SPECIFICATIONS

4.7.1 Connector Pin Assignments

All connections are made via the 5-pin connector.

Pin	**Assignment**
1	OPTO
2	PULSE
3	DIR
4	AWO
5	RDCE

4.7.2 Signal Descriptions

OPTO Opto-Isolator Supply; User supplied power for the opto-isolators.

PULSE Pulse Input; A low to high transition on this pin advances the motor one step. Step size is determined by the Step Resolution switch setting.

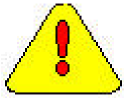
DIR Direction Input

When this signal is high, motor rotation will be clockwise. Rotation is counter-clockwise when this signal is low.

Clockwise and counterclockwise directions are properly oriented when viewing the motor from the end opposite the mounting flange.

AWO All Windings Off Input

When this signal is low, AC and DC current to the motor will be zero.



There is no holding torque when the AWO signal is low.

RDCE Reduce Current Input

The motor current will be 50% of the selected value when this signal is low.

Holding torque is also reduced when this signal is low.

4.7.3 Level Requirements

OPTO

Voltage .... 4.5 to 6.0 VDC

Current................... 16 mA per signal used

Other Signals

Voltage

Low .... ≤0.8 VDC

≥0.0 VDC

High .... ≤OPTO

≥OPTO - 1 volt

Current

Low .... ≤16 mA

High .... ≤0.2 mA

4.7.4 Timing Requirements

PULSE

Max. Frequency..... 500 kHz

Max. Rise And

Fall Times .... 1 microsecond

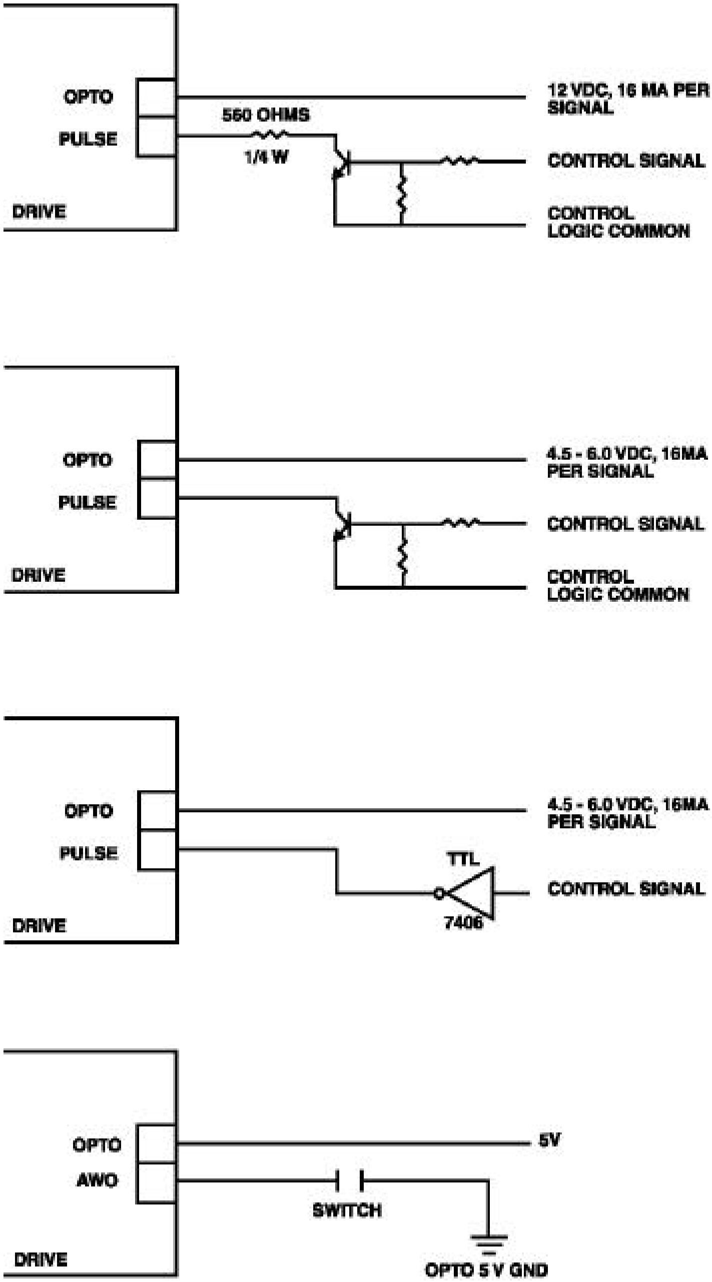
Min. Pulse Width ... 1 microsecond

Dir

Response Time ..... ≤5 microseconds

Other Signals

Response Time ..... ≤50 microseconds



Suggested Methods For Control Interface
Figure 4.2

4.8 INDICATOR LIGHTS

"POWER" LED, Red

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

"FAULT" LED, Red

Lights to indicate over current condition. This condition is a result of motor wiring errors or a ground fault.

Also lights to indicate the heat sink temperature has exceeded a safe level for reliable operation.

Recovery from over current or over temperature condition requires removing and then reapplying the power.

SECTION 5: TORQUE VERSUS SPEED CHARACTERISTICS

5.1 MOTOR PERFORMANCE

All stepper motors exhibit instability at their natural frequency and harmonics of that frequency. Typically, this instability will occur at speeds between 50 and 1000 full steps per second and, depending on the dynamic motor load parameters, can cause excessive velocity modulation or improper positioning. This type of instability is represented by the open area at the low end of each Torque vs. Speed curve.

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

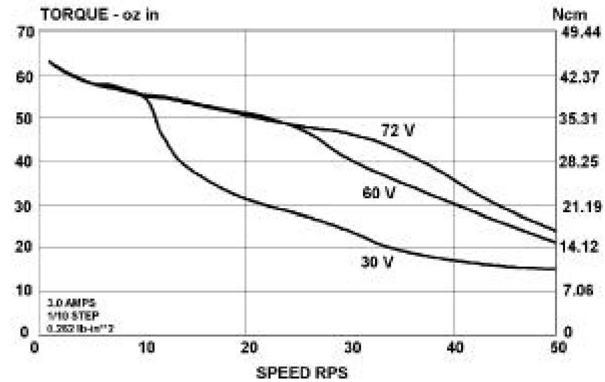
1) Ensure that the control filter is set as shown in the motor table in Section 4.4. If so, try changing the filter setting one or two frequency settings lower. See Section 4.6.2. If the results are worse try setting the filter one or two frequency settings higher.
2) Avoid constant speed operation at the motor's unstable frequencies. Select a base speed that is above the motor's resonant frequencies and adjust acceleration and deceleration to move the motor through unstable regions quickly.

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

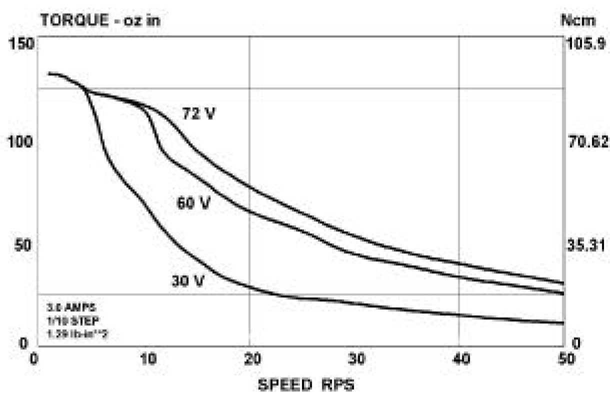
3) Use microstepping to provide smoother operation and reduce the effects of mid range instability. **Microstepping reduces the shaft speed for a given pulse input rate.**

5.2 TYPICAL TORQUE VERSUS SPEED CURVES

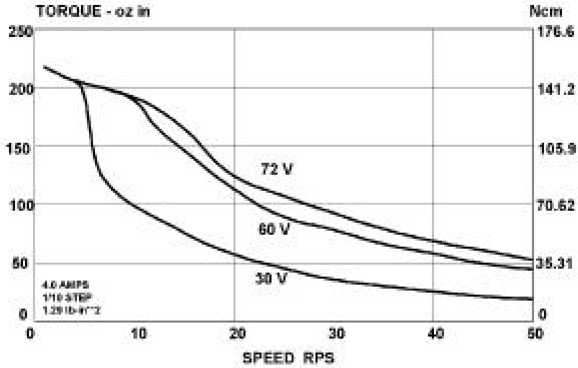
The test conditions used when obtaining the torque versus speed data are listed in the lower left-hand corner of each curve.



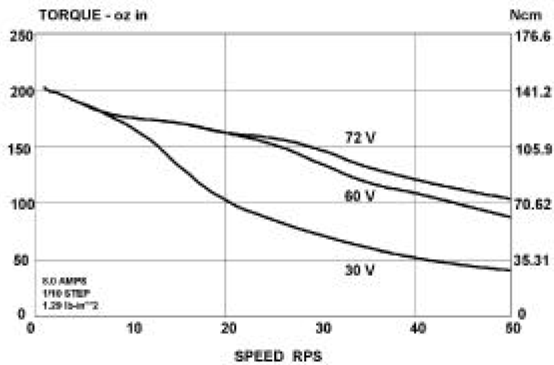
HT60F05 MOTOR, 3.0 Amp



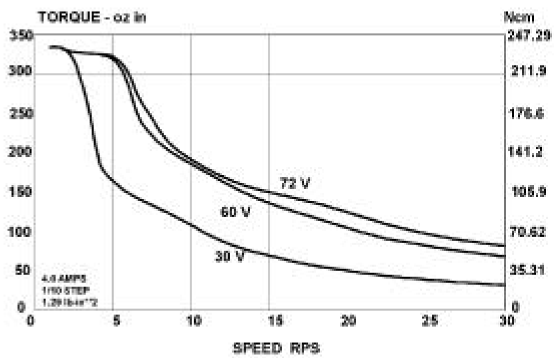
HT61F05 MOTOR, 3.0 Amp



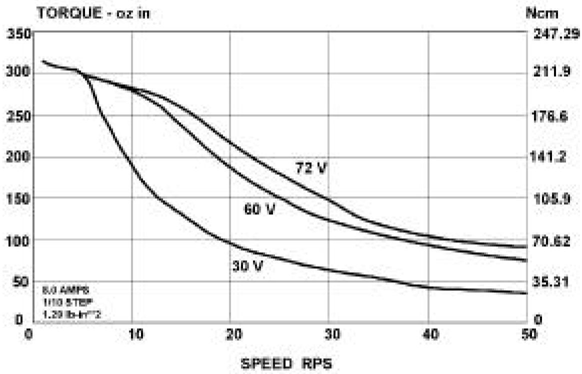
HT62F07 MOTOR, 4.0 Amp



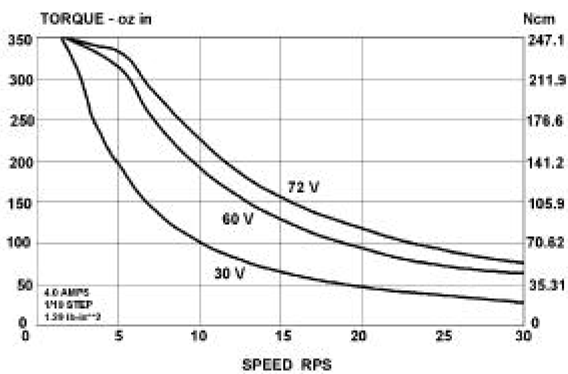
HT62F13 MOTOR, 8.0 Amp



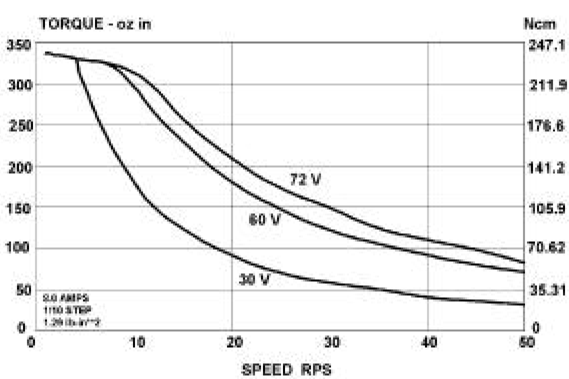
HT63F07 MOTOR, 4.0 Amp



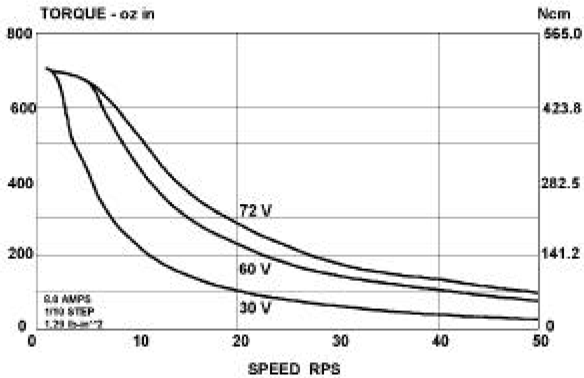
HT63F13 MOTOR, 8.0 Amp



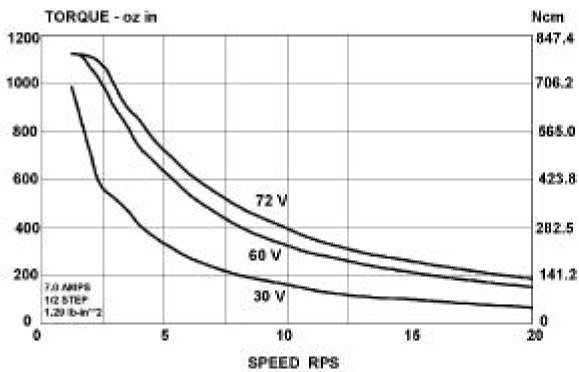
HT91F07 MOTOR, 4.0 Amp



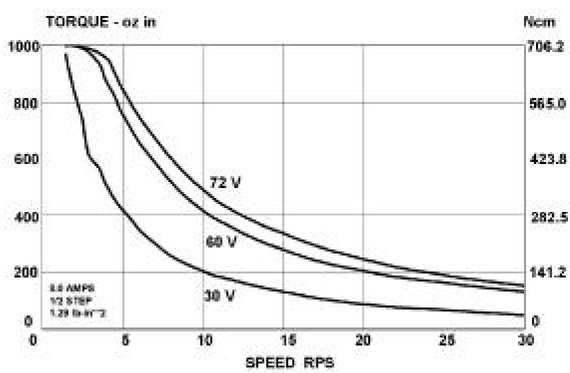
HT91F13 MOTOR, 8.0 Amp



HT92F13 MOTOR, 8.0 Amp



HT93F10 MOTOR, 7.0 Amp



HT93F14 MOTOR, 8.0 Amp

SECTION 6: TROUBLESHOOTING

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 help locate and correct 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 "POWER" LED lights when power is applied.
- 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. Reversing the phase A **or** the phase B connections will reverse the direction of motor rotation.

IF THE MOTOR MOTION IS ERRATIC, Check For:
Supply voltage out of tolerance.

Improper motion parameters (low speed, acceleration/deceleration, jog speed, home speed and feed rate). Set parameters on controller supplying pulse input to drive.

Filter capacitor missing or too low in value.

IF TORQUE IS LOW, Check For:
All Windings Off active or Reduced Current active.

Improper supply voltage.

IF "POWER" INDICATOR IS NOT LIT, Check For:
Improper input wiring and voltage levels

Blown supply circuit fuse or tripped input circuit breaker

IF "FAULT" INDICATOR IS LIT, Check For:
Improper motor wiring

Grounded or shorted wiring to the motor or shorted motor

Improper motor type or incorrect Current Select switch setting

Ambient temperature around drive above 50°C (122°F)

Heat sink temperature above 70° C (158° F)

Restricted airflow around drive

If a malfunction occurs that cannot be corrected by making the preceding checks, contact Oregon Micro Systems.

APPENDIX A: TROUBLESHOOTING ELECTRICAL INTERFERENCE PROBLEMS

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

1. Check the quality of the AC line voltage to the power supply using an oscilloscope and a line monitor. If line voltage problems exist, use appropriate line conditioning, such as line filters or isolation transformers.
2. Be certain proper wiring practices 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.

LIMITED WARRANTY

The Seller warrants that the articles furnished are free from defect in material and workmanship and perform to applicable, published Oregon Micro Systems, Inc., specifications for one year from date of shipment. This warranty is in lieu of any other warranty express or implied. In no event will Seller be liable for incidental or consequential damages as a result of an alleged breach of the warranty. The liability of Seller hereunder shall be limited to replacing or repairing, at its option, any defective units which are returned f.o.b. Seller's plant. Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect or unauthorized repair are not covered by warranty. Seller shall have the right of final determination as to the existence and cause of defect. As to items repaired or replaced, the warranty shall continue in effect for the remainder of the warranty period, or for 90 days following date of shipment by Seller of the repaired or replaced part whichever period is longer. No liability is assumed for expendable items such as lamps and fuses. No warranty is made with respect to custom equipment or products produced to Buyer's specifications except as specifically stated in writing by Seller and contained in the contract.

OMS Oregon Micro Systems, Inc.™
A Pro-Dex Company
1800 NW 169th Place • Suite C100
Beaverton, Oregon 97006
(503) 629-8081
Fax (503) 629-0688
Email: sales@OMSmotion.com
Web Site: http://www.OMSmotion.com