Precision Motion Controls

HVS Series Motors and Drives

Operator's Manual
PN 04-01820 Rev. A

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The HVS drive is not line isolated. Use a 3 pin power plug only. The terminals of motor connector contains fatal voltage, Do not probe the connector with power on, this could damage the drive or result in body injury.

The drive can produce very high power to the load. Make sure there is no load on the motor shaft before turning on the drive.

Warranty

PMC's HVS drives have a one year warranty against manufacturing defects from the date of purchase. If your unit should ever fail, and you wish to send it back for repair, you should first obtain the following information :

1. Get the serial number from the defective unit.
2. Check purchase date to see if the unit is under warranty. If not, obtain a purchase order number for repair costs.
3. Call Precision Motion Controls for a return authorization (408) 298-0898.
4. Ship to :

Precision Motion Controls
160 E. Virginia St. #264
San Jose, CA. 95112

Attention RMA #_____

Limitation Of warranty

Sellers liability arising from or connected with item purchased shall be limited exclusively to repair, replacement or refund of the buyers purchase price, at the sellers sole option. In no event shall seller be liable for any incidental, consequential of special damages of any kind, Including but not limited to lost profits arising from or in any way connected with this agreement or items sold hereunder. Including with limitation, negligence, failure, to warn, or strict liability.

Terms and Conditions

All acknowledgment, acceptances, and sales of sellers products are subject to and shall be governed exclusively by the terms and conditions stated herein.

Introduction

Description

The HVS series microstepping drive is a 12 amp 330 volt device, made of a reliable IGBT H bridge drive construction. This bipolar drive contains a variable supply in the front end and H bridge amplifier with a recirculating current scheme on the motor driver side. The voltage to the motor driver is adjusted to compensate for the motor back EMF voltage loss and the current charging requirement, based on the speed, motor size, and the current of the winding. The HVS series drive reduces the motor heating due to the hysteresis and eddy current losses while increasing the speed-torque curve when compared to conventional motor drivers. The drive has its own self contained power supply, relieving the customer of the responsibility and cost of supplying one. This drive is intended to be used with NEMA 42 and 65 size motors. The drive can be ordered with a variety of motors ranging from 1000 to 8000 in-oz. of torque.

Dip switch selectable features include steps per revolution selections, 3rd. harmonic waveform selection to provide smooth movement with a wide selection of motors as well as the test mode, auto-shutdown (motor current reduces to 1/2 when not running) and motor currents up to 12 amps.

The drive responds to three input signals; a step pulse, direction, and remote disable. The remote disable input removes power from the drive so that the motor can be turned by hand. The remote disable may also be used as a safety limit since it overrides any of the other drive signals. All inputs are optically isolated to prevent ground loops to connecting equipment.

The Fault+, Fault- output is the collector and emitter of a opto transistor . The Fault' transistor will be turned on when an undervoltage, over-current, or over-temperature condition occur. When the Fault is activated, the power needs to be recycled. This allows the user to correct the fault condition before continuing.

Pin outs for the connectors and box dimensions are described in appendix.

Features

* Multiple step/rev combinations. (25600; 12800; 6400; 400; 25000; 10000; and 2000).
* +- 2% third harmonic current waveform selection
* Over-current, over-temperature, and undervoltage protection.
* Built in energy absorber for energy dump condition.
* Motor interlock signal to protect the drive.
* Indicators for power, step, over-temperature, over-current, undervoltage condition.
* Remote disable input and fault output.
* Autostandby current reduction.

The drive has a dip switch selectable auto-standby mode, that reduces the current to half after 2 seconds of no motor movement. Due to the motor detent torque and other nonlinear properties a shift in position of up to 3 usteps on the 25000 step /revolution setting may occur. If this can be tolerated we recommend to select this feature, this will reduce heat generated by the motor, and also reduce the stress to the capacitor due to the ripple current , which will prolong the capacitor's life.

LED indicator

Power- The Power LED indicates that the internal 5 volts supply of the drive is operational. This LED should always be illuminated if the drive has AC power applied to it.

Step- The step indicator LED is turned on when pulses are received by the drive. The LED will turn off if pulses are not received for 2 seconds. This will also correspond to the time when the auto-standby is energized (if enabled). This LED and Overtemp LED will light up if the motor connection terminal T+ and T- aren't shorted together. The drive needs to recycle the power to recover.

Overtemp- the heat sink temperature rises above 80 degrees centigrade the drive goes to a shut-down mode. The over-temperature LED will be illuminated. The power must be recycled to recover. Check if the fan is working and the surroundings temperature. This LED is also used in conjunction with the step LED as indicator for motor connector interlock signal.

Over-current- means that too much current was being drawn through the motor transistors. Check your motor for a short or for a short across the motor terminals. The short could be winding to winding and winding to shield. The drive must be turned off to make these checks. If the checks is okay, the drive is damaged. Send the drive to factory to have it repaired.

Undervoltage- indicate the line voltage drops below 95 VAC. If this condition is detected then the current to the motor is set to zero and the drive goes to a shutdown mode. The power to the drive must be turned off and then back on to recover.

Energy dumping

The motor will behave like a generator when the system tries to stop abruptly. The energy on the load will then convert to electrical power and return to the system which will cause the motor supply to rise. The drive facilitate energy absorber circuitry when this condition occurs. The circuit can absorbs about 30 joules for every 5 second. If your system has a large inertia load or need to absorb energy more frequently (many fast deceleration) you may have to consult the factory.

Motor interlock

The system upon power up tests to see if a motor is connected The drive will be shut off if T+ and T- aren't shorted . Both Step and Over-temperature LED will illuminate. Correct the problem and recycle the power to recover the drive.

Note: The drive may take few minutes to deplete the energy. Make sure the power LED is off before turning the driver back on.

Installation

Unpacking

When unpacking your unit verify that the unit was not damaged during shipping. Report any damage found to the shipper. Check the box contents against the packing slip. The box will contain the driver, mounting brackets and a motor (if one was ordered with the drive).
Connect the motor to the driver box, check the dip switch selection for current setting then plug in the AC line cord to a 208/230 VAC outlet. Verify the power LED is illuminated and all the LEDs are off. Feel the shaft of the motor and verify that the motor is producing torque. If you are able to move the motor shaft the motor does not have torque; unplug the line cord. Check if any of the motor wires have come out of the connector. Contact the factory for a return authorization if the above check proves negative.

Remove power from the drive; Place the dip switch in the test position (see table 2) and plug the drive in. The motor will rotate in the CCW direction continuously. Remove power and put the test switch to the normal position.

CAUTION, always disconnect the AC power prior to connecting or disconnecting the motor to the box.

Mounting

The HVS Drive comes with mounting brackets to facilitate mounting. The unit may be mounted in any direction. A minimum 3 inch clearance is required for the air inflow and outflow around the box. See appendix C for a detailed drawing of the motors and the box.

Warning : Only use 1/4" long 4/40 screws to mount the bracket to the drive. Using longer screw can damage the drive.

Cooling

The surrounding temperature of the environment should not exceed 40 degrees centigrade. If the driver needs to be in a warmer environment, consult the factory for recommendations.

Wiring

Motor Connections

The drive, if purchased with a motor, comes with a connector attached to the motor; otherwise a connector with screw mounting will be supplied. The center pin is for connection of the motor cable shield. The center pin is connected to earth ground and the shield is connected to the motor case. A wire needs to make connection between T+ and T- on the screw mount terminal to signal the motor is connected.

Always route the motor cable far from the indexer cable and electrical noise sensitive signal.

T+	
A+	(Green)
A-	(White)
Shield	(Earth gnd)
B+	(Black)
B-	(Red)
T-	

Line Power

The HVS drive incorporates a standard IEC320 power inlet. The power cable for this drive needs to be able to handle a minimum current of 10 amps. Although the drive works with line voltages from 95 VAC to 260 VAC, it is intended for 208/240 VAC line voltage. The drive rectifies the input AC voltage to the DC voltage which drives the motor. The higher input voltage will be able to run motor faster. You must force air into the box to cool the drive if you use 115 VAC power source. The 230 VAC's fan inside the box may not be able to cool the drive when used at the 115 VAC.

Warning : Always use a 3 pin plug . Failure to do so could result in bodily injury.

Warning: The drive is not a line isolated device. The motor connector contains fatal voltage. Do not probe the terminal screw.

Indexer Connections

The STEP+, STEP-, DIRECTION+, DIRECTION-, SHUTDOWN+, SHUTDOWN-, signals are inputs to the drive. Each signal is connected to a optocoupler with a 470 ohm resistor in series. A 5-10 ma. current should be applied to the optocoupler input. A 5 volt driving source will meet the requirement. The FAULT+, FAULT-, signals are the outputs from the drive. They are connected to the collector and emitter of the optocoupler respectively. A maximum 5 ma. will conduct through the transistor when the FAULT condition occurs. See appendix A for a typical indexer connection.

Always use a shielded cable for the indexer signals, and route them far from the motor cable.

The STEP+, STEP-, DIRECTION+, DIRECTION-, signals are required for operation of the motor. The signals are photo-coupled to eliminate ground loops. The direction signal must not change 50 usec prior to the step going positive. A remote shutdown is provided to remove power from the drive without removing power from the box . The FAULT output is turned on when an over-temperature, over-current, undervoltage or motor interlock check failure conditions occur. This can be used as an status input to the controller.

25 pin “D” connector

1 Step +
14 Step -
2 Direction +
15 Direction -
16 Shutdown +
17 Shutdown -
9 Fault+
21 Fault-

A typical wiring connection of the drive is in appendix A for your reference..

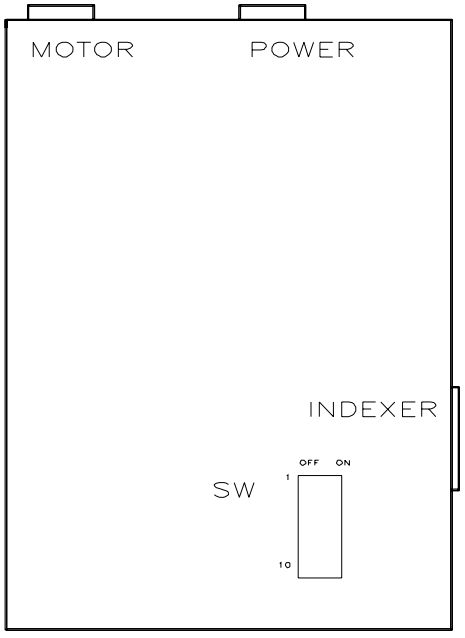
Switch Settings

The switches are only read once after power-up. Disconnect AC power from the unit prior to attempting to change any switch settings.

There is one 10 position dip switches accessible from under the box. The switches control the following functions.

* Step size selection
* 3rd. harmonic selection
* Test mode
* Auto-standby current reduction
* The current selection

The following drawing shows the location of the dip switch in the bottom view of the box.



Step size selection

Table1: step size selection

Steps/rev	Switch 1	Switch 2	Switch 3
reserve	off	off	off
25000	on	off	off
10000	off	on	off
2000	on	on	off
25600	off	off	on
12800	on	off	on
6400	off	on	on
400	on	on	on

Refer to table 1 for the step size selections, which are selected with dip switch 1 through 3. The steps/rev figure is based on a 200 steps per revolution stepping motor. There are 7 different step size selections in the drive. The finer steps will give you less vibration and finer positioning, but you need to generate a higher pulse rate to make the motor move the same speed. The maximum step rate is 2 MHz.

3rd. harmonic selection

Table 2

Waveshape	Switch 4	Switch 5
sine	on	on
+2% harmonic	off	on
-2% harmonic	on	off
test	off	off

Refer to table 2 for 3rd. harmonic selection. The 3rd. harmonic correction is selected with dip switches 4 through 5. The 3rd. harmonic will help provide even steps and minimize motor vibration for various motor. If you use motors that have a large detent torque compared to the motor torque, you may need to select a waveform other than sine. The wave shape corrections are based on a percentage of third harmonic distortion.

Test mode

This mode is entered upon power up if switches 4 and 5 are in the off position. The motor will rotate in the CCW direction at 0.5 rev/sec. Power must be turned off and the switches put in the waveshape position to leave this mode. Refer to table 2 for the switch setting.

Auto-standby

In the auto-standby mode the drive reduces the current to 1/2 the rated current after approximately 2

seconds if no input pulses are received. This can be used to minimize motor heating and heat dissipation by the drive. This will have some effect on the motor position and should not be used if a slight change in your stop position cannot be tolerated. The position shift due to current reduction is about 5% of a motor cardinal step (4 usteps for a system with 25000 step resolution). This mode is activated by putting switch 9 in the off position. Refer to table 4.

Current setting

Table 4					
S6	S7	S8	S9	S10	Current
on	on	on	x	x	5A
off	on	on	x	x	6A
on	off	on	x	x	7A
off	off	on	x	x	8A
on	on	off	x	x	9A
off	on	off	x	x	10A
on	off	off	x	x	11A
off	off	off	x	x	12A
x	x	x	off	x	auto-standby
x	x	x	x	off	spare

Disconnect AC power from the unit prior to attempting to change any switch settings.
The switches 6-8 are for the current setting and are approximately 1 amp per bit started with 5 amp . The maximum current is 12 amp. The off position of the switch selects the current; switch 8 is the most significant bit.

PMC's motor Current Setting

For PMC supplied motors the current setting is as below. For the non PMC motors, use the motor companies specification to set the current. Each motor company rates their motors differently, hou may have to consult them. You could damage the drive or motor if you set too much current for a motor.

Table 5				
Model	sw6	sw7	sw8	current
HVS-1000	off	off	off	12 amp
HVS-1400	off	off	on	8
HVS-1200	off	off	off	12
HVS-2000	off	on	off	10

Operation

Electrical

Input Power: 95 to 260 VAC 50/60 Hz

Fuse : 8 amp (located on PC board).

Output Power: 5 amp to 12 amp at 300 VDC through an H bridge driver (supply takes 5 minutes to discharge after power is removed).

Safety Features:

Short circuit protection is provided by a current monitoring circuit in the power supply line. The instantaneous supply current is monitored and if current in excess of 24 amps is detected the output drivers are disabled. Power to the unit must be turned off and back on if an over current condition is detected. Check motor connector to verify the connector pins are not shorted.

Motor Heating

There are 2 major causes of power losses due to the motor. They are ripple current losses and the I^2R loss. Since the HVS drives only produce the voltage required for the present speed, the ripple current loss is minimized, the I^2R loss is the major loss when the motor is standing still. When the motor is running, the ripple current and eddy current loss increase. We recommend that the motor temperature should not exceed 100 degree C at the case. Carefully monitor the case temperature of the motor if your application requires the motor to frequently run at high speeds.

Warning!
It is your responsibility to check the case temperature of the motor. Precision Motion Controls is not liable to the damage of the motor due to overheating.

Indexer Inputs

Input signals: Step signals have a 2 MHz rate maximum and a 250 nsec. minimum width, high and low.

Direction signals should not be changed 50 usec prior to a step pulse. This may cause the drive to interpret the step as the wrong direction.

Shutdown: Shutdown requires 1 msec. to respond (the application of this signal will cause the motor to lose sync if the step signal is applied while it is on).

All input signal are optically isolated and have a 330 ohm current limiting resistor in series. A current of 8 to 15 ma. should be applied to the optocouplers. A driving source of 5 volts will meet this requirement.

Output

Fault output : The maximum voltage between FAULT+, FAULT- is 35 V. The maximum sinking current is 5 ma.

PMC drives come pretested and adjusted for the motor that is supplied with the unit. No further adjustments are necessary.

“DO Not” connect or disconnect the motor with power applied to the box.

Resonance

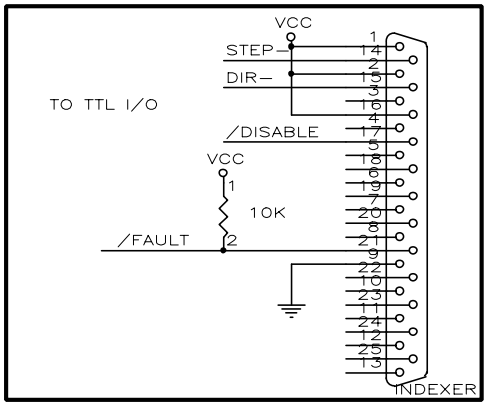
All stepper motor drives are subject to two oscillation regions; low speed (approximately 1 rev/sec) and mid range (approximately 10 to 15 rev/sec).

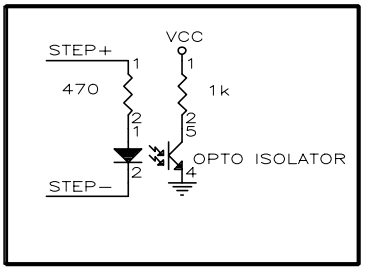
Microstepping minimizes low speed oscillation and this should not occur with PMC supplied motors. If your load has a high Q and resonates around 200 Hz, adding extra inertia to the motor shaft may eliminate the problem.

PMC motors and drives have been matched to eliminate most mid-range instability problems.

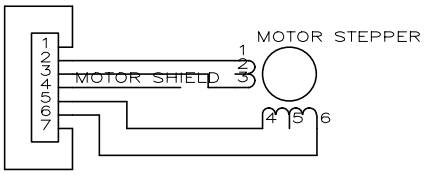
Appendix A

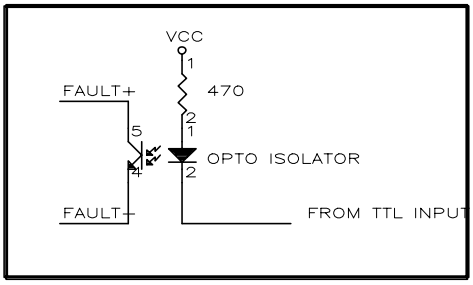
TYPICAL I/O CONNECTION





THE INPUTS CIRCUITRY





OUTPUT CIRCUITRY

Appendix B

Dip switch function

1-3 Step size selection. Step/rev are 25600, 12800, 6400, 400, 25000, 10000, 2000.
4-5 0%, +-2%, test mode.
6-8 Current selection.
9 Autostandby.
10 Spare.

LED Status

Power	The drive receives power.
Step	The drive receives step's signal.
Overtemp	Heat sink temperature exceeds 80 degree C.
Overcurrent	The current in the motor exceeds 35 A.
Undervoltage	The AC voltage is below 95 volt.

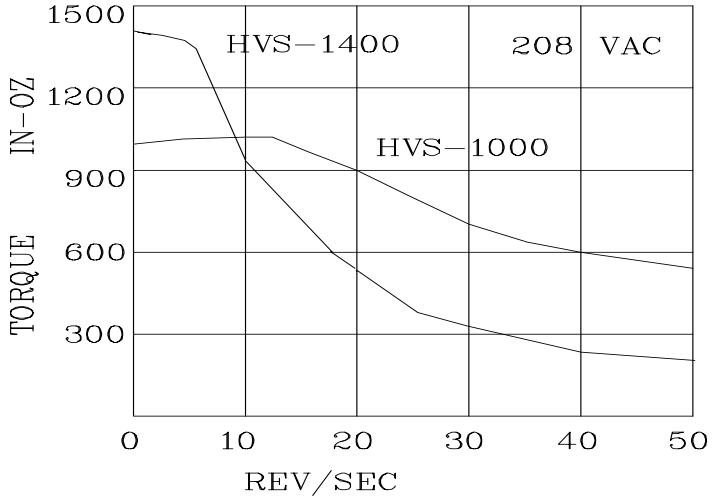
Indexer connector: 25 pin D

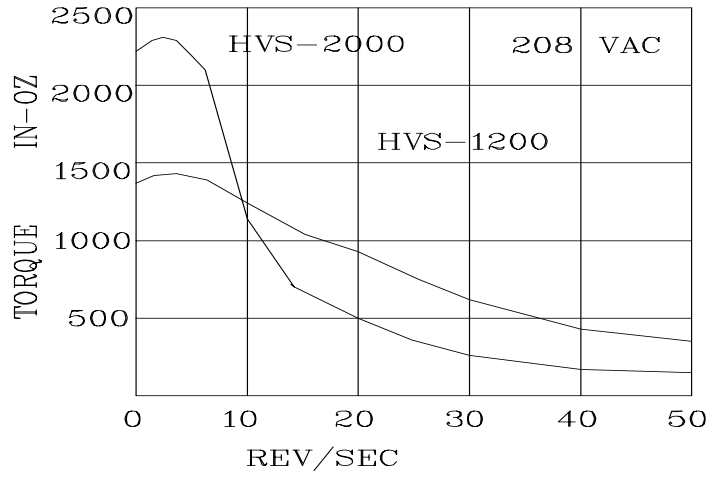
1. Step+
2. Direction+
9. Fault+
14. Step-
15. Direction-
16. Shutdown+
17. Shutdown-
21. Fault-

Motor connector: 7 pin terminal block

T+ Interlock+
A+ Motor winding A
A-
Motor Shield
B+ Motor winding B
B-
T- Interlock-

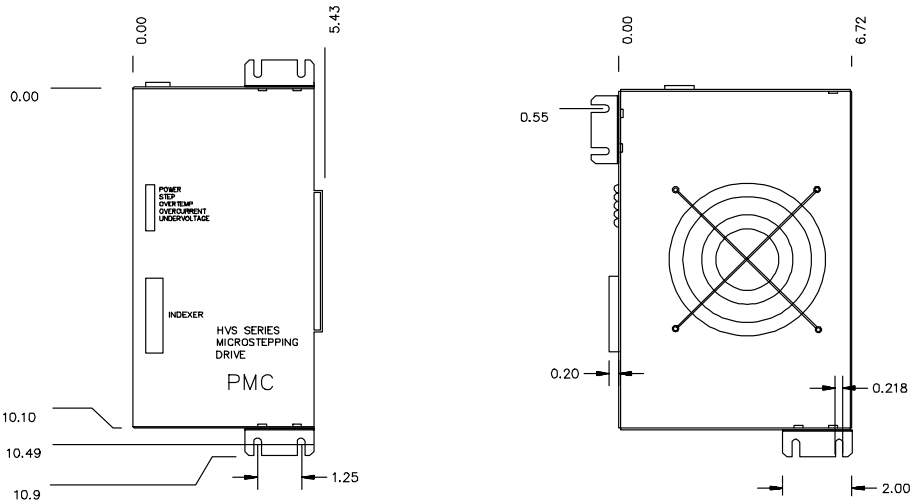
Speed versus Torque Curve





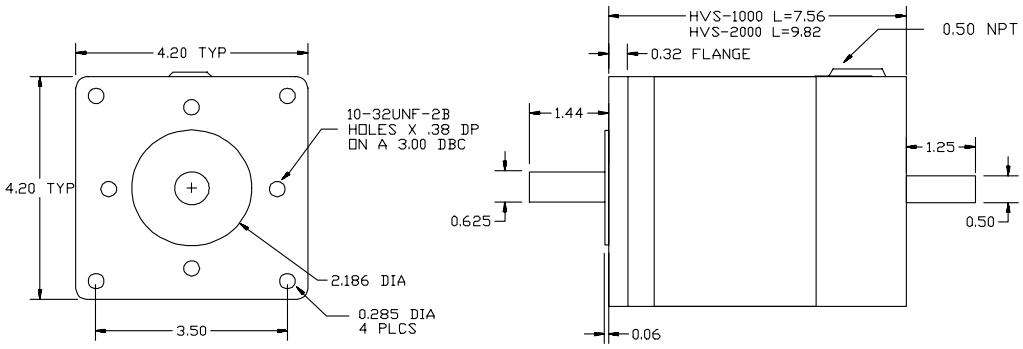
Appendix C

Dimension of the drive

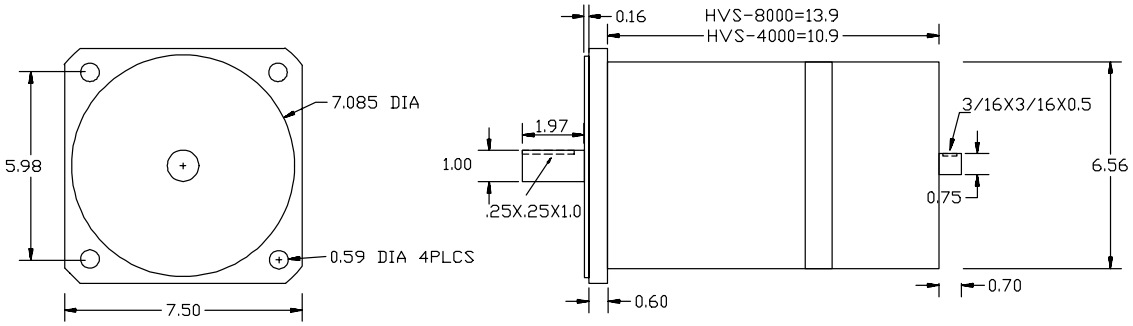


Motors dimension

NEMA 42



NEMA 65



Precision Motion Controls

2530 Berryessa Rd. #209 San Jose, CA 95112 Tel : (408) 298-0898 Fax: (408) 298-0899