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Find the *Aerotech Unidex U14R-2-A-40* at our website: *Click HERE*

Recommended standard RCN1 modules for the DM4000 Series are:

Aerotech Translator	Motor	Phase Current (amps)	Torque (oz-in)	Recommended Personality Module (RCN1)
DM4001	50SM	1	38	RCN1 - 1.0 - xxxx
DM4005	101SM	4.6	90	RCN1 - 5.0 - xxxx

Contact Aerotech Inc. for Customized Personality Modules

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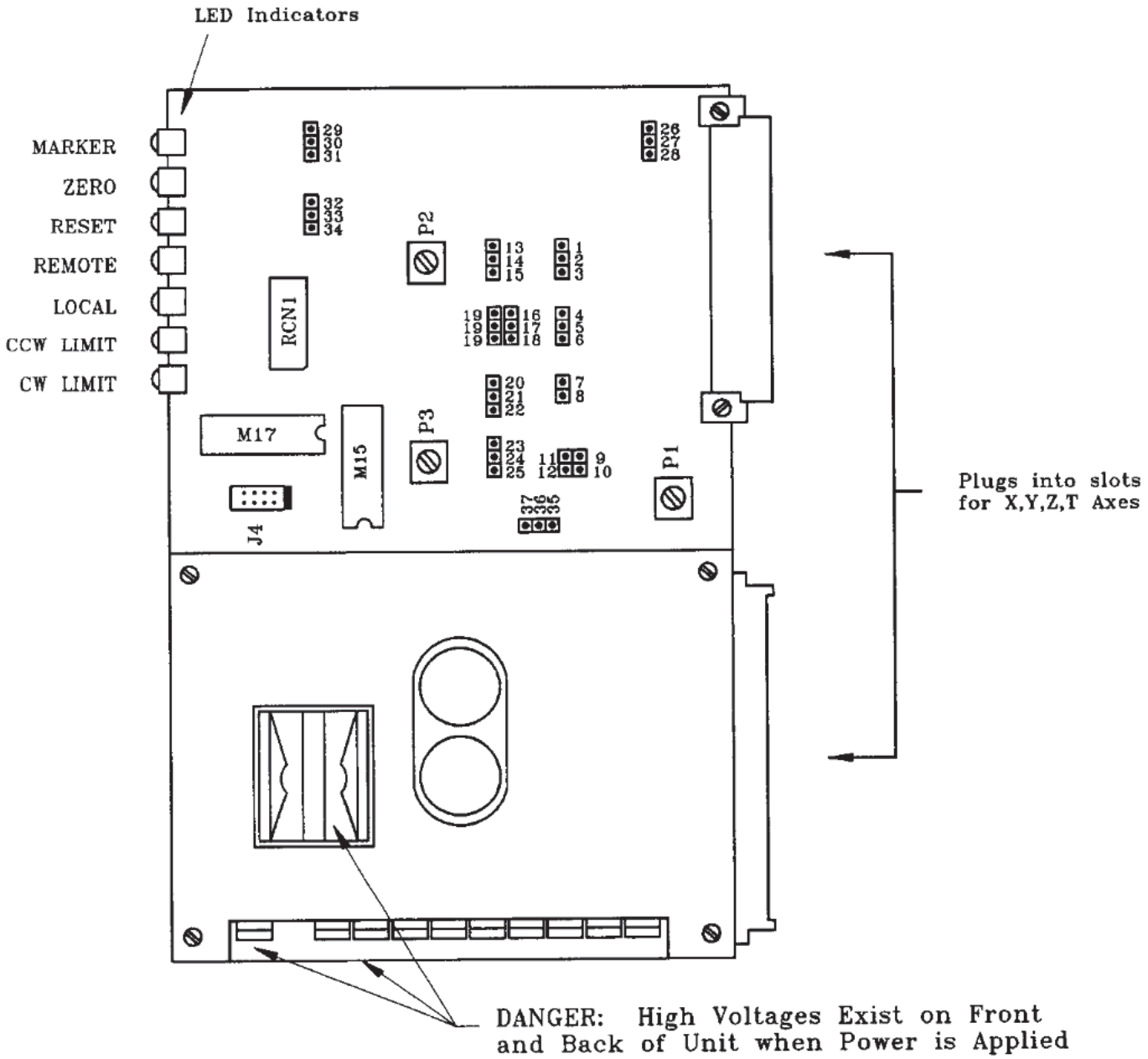


Figure 6-1: Outline of DM4005 and DM4001 Stepping Drive Module

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STEPPING DRIVE P/N	DM4001	DM4005
STEPPING MOTOR P/N	50SM	101SM
STATIC TORQUE OZ.-IN.	38	90
MOTOR SPEED MAX. RPM	1000	1875
MAXIMUM MOTOR OUTPUT POWER WATTS	12	53
MOTOR ROTOR INERTIA OZ.-IN.-SEC.^{2} Kg-M^2	.166 0,0118 x 10^{-3}	.5 0,035x10^{-3}
MOTOR FRAME NEMA 2	23	23
MOTOR TYPE (AMPS/PHASE)		
STEPPING DRIVE VOLTS DC AMPS TYPE	40 1 UNIPOLAR	40 5 UNIPOLAR
WEIGHTS MOTOR (LBS.) (KG) MOTOR/DRIVE (LBS.) (KG)	 2.3 1.05 12.00 5.45	 3.6 1.64 14.00 6.36
INPUT POWER VOLTS (50/60 HZ) AMPS Allowable voltage tolerance (+/- 10% Max.)	 115/230 .5	 115/230 1

Table 6-1: Stepping Drive Specifications

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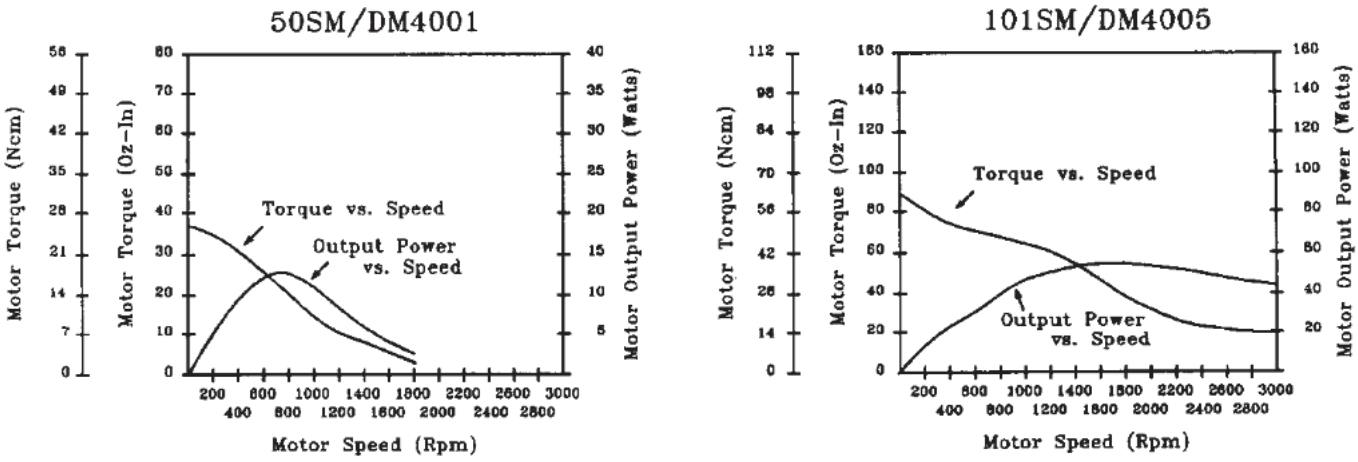


Figure 6-2: DM4001, DM4005, DM1501 Torque/Speed Curves

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6-1-2: DMV8008 AND DMV16008 (Model U14H only) DRIVE MODULES

6-1-2-1: CIRCUIT DESCRIPTION

The DMV8008 and DMV16008 are designed to accurately control a standard bipolar Stepping motor by utilizing a unique sin/cos translator control. This control is capable of dividing a full-step size into 250, evenly spaced micro steps. For a 50 pole (200 full step) (standard) Stepping motor, this subdivision of a full step provides electrical resolutions of up to 50,000 steps per revolution. This sin/cos translator control, as mentioned in the introduction, can be easily altered to provide other step sizes. By simply programming two IC chips, a host of other incremental step sizes can be chosen, ranging from 200 steps/rev (full step) up to 50,000 steps/rev in 200 step intervals. In other words, there are 250 choices of stepping resolutions.

The DMV Series Stepping drive modules require a DC bus power supply and +5, ±12VDC control supply for operation. The external DC bus power supply, made up mainly of Transformer T1 and/or T2 and capacitors C1 through C4 are shown in Figures 5-2 and 5-3. A separate power supply board module (explained later in this Chapter) is required for +5, ±12VDC control power to the DMV Series module.

The DMV8008 can be used in Unidex 14 chassis U14S and U14R and U14H. The DMV 16008 is limited to use in the U14H chassis only. Note that in the case of the DMV16008, Transformers T1 and T2 are not required if the incoming supply to the U14H chassis is 115VAC. The DMV16008 is operating "off line" in this particular case.

An outline of the DMV8008 and DMV16008 drive modules is shown in Figure 6-3. Table 6-2 provides Specifications for the DMV8008 and the DMV16008. Speed/Torque Curves are provided in Figure 6-4.

6-1-2-2: "HOME" REFERENCE DEFINITION & OPTIONS

All Unidex 14 Controllers are capable of generating a cold start reference position, which is the "Home" position. The basic Home cycle involves the following series of events. When the "Go Home" command has been issued, the motor will turn CCW (standard) or CW (optional) until a "Home Limit Switch" activation occurs.

NOTE: The CCW and CW rotational references are viewed "looking into" the motor mounting flange.

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Upon "Home Limit Switch" activation, the motor will reverse and rotate in the opposite direction until the switch deactivates. If no "Marker" pulse option exists, upon switch deactivation, the motor will reverse and stop. If a "Marker" pulse option does exist (see Section 6-1-2-3), the motor will reverse and continue to rotate until the "Marker" pulse is located and then stops.

The speed at which the Home cycle occurs is factory set at 120 RPM. A low home speed is used for achieving an accurate home reference position. If a different speed is required, see Section 6-1-2-7 for appropriate Personality module changes.

For most rotary motion stages, the "Home Limit Switch" referenced above is an independent switch incorporated specifically for the "Home" cycle. For linear motion stages, the "Home Limit Switch" could be an independent switch as well. However, in most cases, the CCW or CW limit switches perform "double duty" and act as the "Home Limit Switch". The "Home Limit Switch" wiring either to the CW or CCW limit switch is done at the motor/stage external to the Unidex 14.

If it is not possible to use the "Home Limit" input at J13, 14, 19 or 20 such as when Opto 22 coupled limits are being used, the "CCW" or "CW limit" input may be paralleled to the "Home Limit" input by reconfiguring jumpers JP2-1 through 6 on the DMV16008/DMV8008 PC board. Note that this scheme is possible only with linear stages and not with rotary stages.

The jumper definition follows:

HOME LIMIT SOURCE:

(Standard) From Home Limit Input: Jumper JP2-3 to 4 , Remove JP2- 1 to 2, JP2-5 to 6.
(Optional) From CCW Limit Input: Jumper JP2-1 to 2, Remove JP2-3 to 4, JP2-5 to 6.
(Optional) From CW Limit Input: Jumper JP2-5 to 6, Remove JP2-1 to 2, JP2-3 to 4.

See Figure 6-3 for jumper locations.

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When the Home command is issued, the standard direction of motor rotation is CCW. If CW rotation is required, jumpers JP8-1 through 3 on the DMV16008/DMV8008 board must be reconfigured.

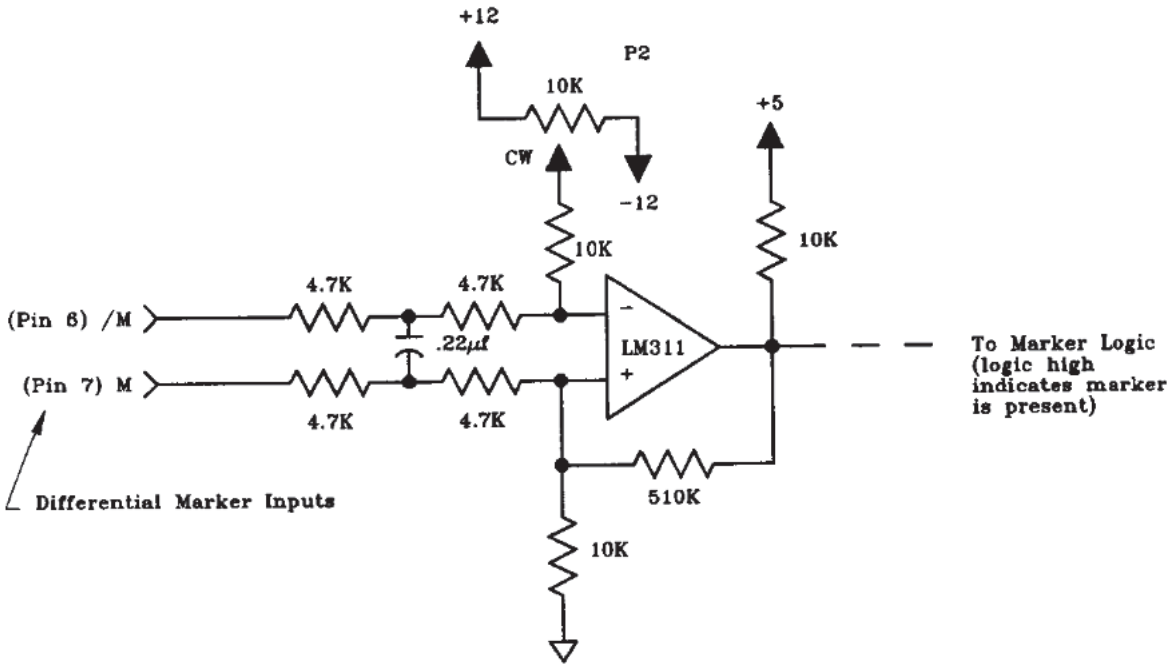
The jumper definition follows:

(Standard) CCW Home - Jumper JP8-1 to 2, Remove JP8-2 to 3.
(Optional) CW Home - Jumper JP8-2 to 3, Remove JP8-1 to 2.

See Figure 6-3 for jumper locations.

6-1-2-3: OUTLINE OF MARKER BUFFER CIRCUIT

Shown below is a circuit diagram of the differential input marker circuit:



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Potentiometer P2 (see Figure 6-3) in the previous circuit diagram, allows the threshold of the Marker input signal to be adjusted. The threshold level is increased by turning P2 CW. To activate the Marker logic, the voltage signal at "M" must rise slightly higher than the voltage signal at "/M", plus the threshold setting at P2. In other words:

M > /M + P2 (threshold)

For a TTL Marker connection, the signal common of the TTL circuit should be tied to signal common with the Marker tied to "M". P2 should be adjusted to approximately +1VDC at the P2 wiper.

NOTE: P2 will be factory set so that proper "Home Cycle" operation will occur when the marker option is absent, or when interfacing to an Aerotech stage/motor with a "Home Marker" (HM) option. This setting is approximately -1VDC at the P2 wiper.

6-1-2-4: LIMIT SWITCH POLARITY SELECTION

As a standard, Unidex 14 controllers are configured to interface to normally open (active low) limit switches (CCW, CW and Home). If use of normally closed (active high) limit switches is required, jumpers JP3-1 through 3, JP4-1 through 3, and JP5-1 through 3 on the DMV16008/DMV8008 board must be reconfigured.

The jumper definitions follow:

(Standard) CCW Limit, Normally Open - Jumper JP3-1 to 2, Remove JP3-2 to 3.
(Optional) CCW Limit, Normally Closed - Jumper JP3-2 to 3, Remove JP3-1 to 2.
(Standard) CW Limit, Normally Open - Jumper JP4-1 to 2, Remove JP4-2 to 3.
(Optional) CW Limit, Normally Closed - Jumper JP4-2 to 3, Remove JP4-1 to 2.
(Standard) Home Limit, Normally Open - Jumper JP5-1 to 2, Remove JP5-2 to 3.
(Optional) Home Limit, Normally Closed - Jumper JP5-2 to 3, Remove JP5-1 to 2.

See Figure 6-3 for jumper locations.

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6-1-2-5: +/- DIRECTION DEFINITION & OPTIONS

When a "+" direction is programmed into a Unidex 14, the motor will rotate in the CCW direction.

NOTE: CCW rotation is viewed as "looking into" the motor mounting flange.

When a "-" direction is programmed, the motor will rotate in the CW direction. If the opposite convention is required, jumpers JP7-1 through 3 may be reconfigured.

The jumper definition follows:

(Standard) "+" = CCW, "-" = CW - Jumper JP7-2 to 3, Remove JP7-1 to 2.
(Optional) "-" = CCW, "+" = CW - Jumper JP7-1 to 2, Remove JP7-2 to 3.

See Figure 6-3 for jumper locations.

6-1-2-6: SELECTING STEPPING MOTOR RESOLUTION

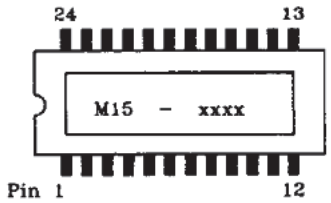
The DMV Series modules can be programmed to drive a Stepping motor at 250 different stepping resolutions. As was described in Item 6-1-2-1 (*Circuit Description*), a stepping resolution range can be selected between 200 steps/rev and 50,000 steps/rev inclusive, in increments of 200 steps (i.e., 200, 400, 600, ..., 49600, 49800 and 50000 steps/rev).

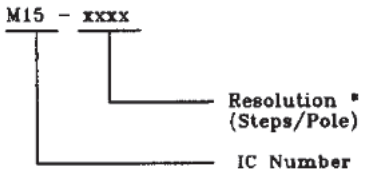
The changing of resolution on the DMV Series involves the programming to two IC chips, M15 and M17 (see Figure 6-3). This programming cannot be done in the field. However, M15 and M17 can be changed very easily in the field since both ICs are mounted on IC sockets.

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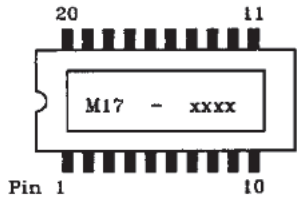
The part numbering system for M15 and M17 is shown below. These part numbers must be used when ordering different control resolutions.

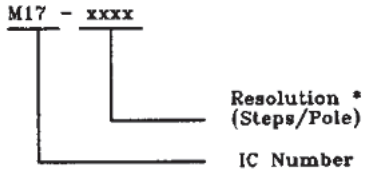
For IC M15:





For IC M17:





*** NOTE:** This number defines the resolution (in steps/pole).

For example:

POLE RESOLUTIONS
(STEPS/POLE)

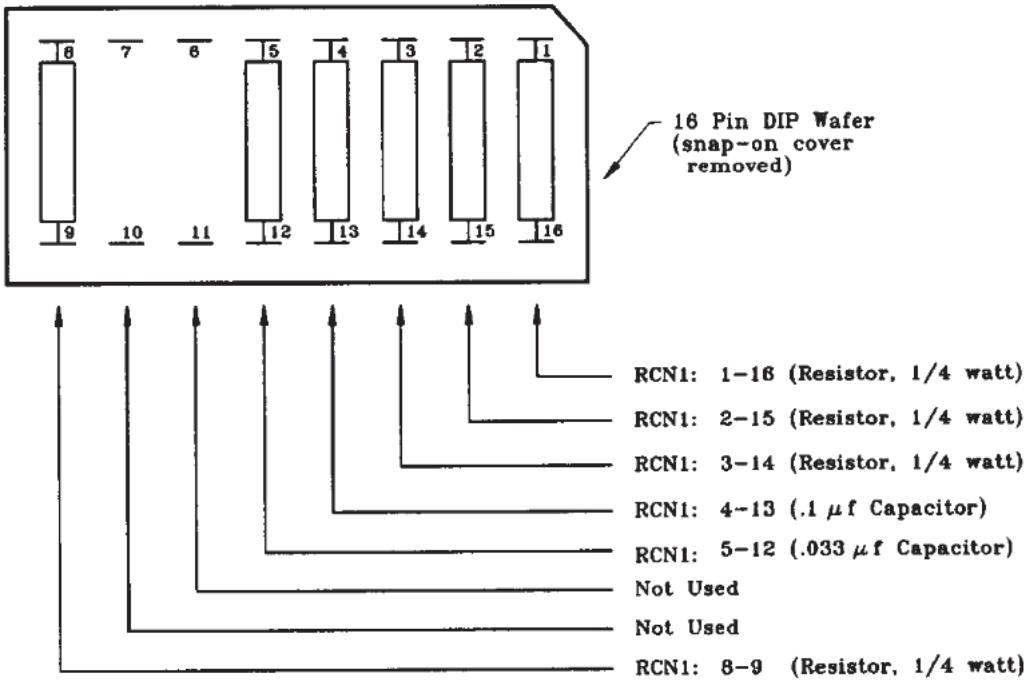
1000	→	50000 Steps/Rev	For standard
720	→	36000 Steps/Rev	motors
80	→	4000 Steps/Rev	(1.8°/full step)
16	→	800 Steps/Rev	

As was mentioned in the introduction to this manual, the step/rev numbers listed above apply to a 50-pole 1.8 degree per full step Stepping motor. When determining step/rev for other multiple pole motors, multiply the given steps/pole resolution by the number of poles for the given Stepping motor. The resulting number will then be the step/rev resolution for that motor.

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6-1-2-7: PERSONALITY MODULE (RCN1)

The Personality module is a 16-pin DIP wafer consisting of 4 resistors and 2 capacitors. This module contains all of the parameters used to match a given Stepping motor with a given resolution for the DMV Series. A representation of a Personality module is shown below (see also Figure 6-3):



The parameter settings of RCN1 are explained in the following subsections.

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6-1-2-8: RCN1: 8-9, HOME CLOCK OSCILLATOR ADJUSTMENT

The adjustment for the oscillator which sends the Stepping motor into a limit involves RCN1: 8-9. This value can be determined as follows:

$$\text{Home Clock Frequency (Hz)} \sim \frac{1}{.75(.033\text{x}10^{-6})\ (\text{RCN1: 8-9})}$$

Where RCN1: 8-9 is in ohms

6-1-2-9: RCN1: 3-14 & 2-15, LO/HI CURRENT LEVEL ADJUSTMENT

The RCN1 low current level (standby current) is set by RCN1: 2-15. This value of current can be calculated as follows:

$$\text{Standby Current Level (amps)} = 8 \left[\frac{1 \text{ x } 10^4}{\text{RCN1: 2-15}} \right]$$

where RCN1: 2-15 is in ohms

The high current level (running current) involves the selection of RCN1: 3-14 and RCN1: 2-15 (determined above). The value can be calculated as follows:

$$\text{Running Current Level (amps)} = 8 \left[\frac{1 \text{ x } 10^4}{\text{RCN1: 2-15}} + \frac{1 \text{ x } 10^4}{\text{RCN:1 3-14}} \right]$$

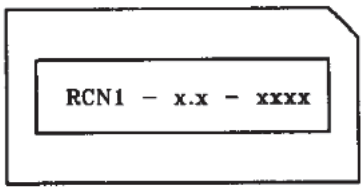
where RCN1: 2-15 and RCN1: 3-14 are in ohms

NOTE: RCN1: 1-16, RCN1: 4-13 and RCN1: 5-12 are factory selected for the DMV Series modules. These components should **never** be changed by the user.

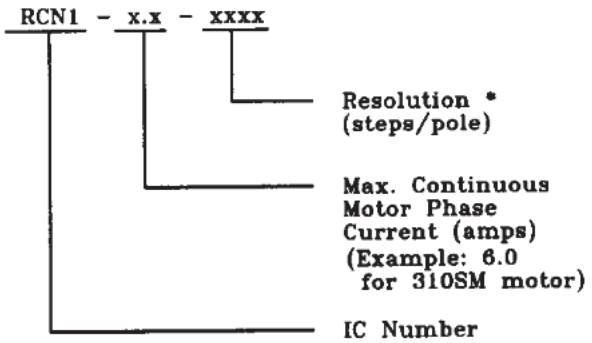
The DMV Series modules are shipped with a standard Personality module, which is defined by the resolution and rated phase current of the Stepping motor being used. If the DMV Series is being used with a standard Aerotech Stepping motor, the user need only define the desired resolution in which the motor is to operate. If the DMV Series is not being used with a standard Aerotech motor, the user must define the type of Stepping motor being used, with its rated phase current, as well as the DMV Series resolution in which it is to operate.

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A list of Personality modules used with standard Aerotech Stepping motors is listed below. The label on the Personality module defines the resolution (of the internal oscillators) and motor phase current parameters for that module. If the user is not using Aerotech motors, a custom Personality module can be ordered using the part numbering format shown in the following illustration. Given the rated current and resolution information for a particular motor, Aerotech will set the Home oscillator and the Run/Standby phase current levels. Although it is not generally recommended, the user also has the option of changing the parameters of the Personality module by using the equation listed in Items 6-1-2-8 and 6-1-2-9 of this section.



PERSONALITY MODULE RCN1



* This number defines the resolution (in steps per pole), for which the Home oscillator, as well as the current levels of the Personality module, are "tailored" to operate.

Recommended standard RCN1 modules for the DMV Series modules:

Aerotech Translator	Aerotech Motor	Phase Current (amps)	Torque (oz-in)	Recommended Personality Module (RCN1)
DMV8008	310SM	6	370	RCN1 6.0 - xxxx
DMV16008	1010SM	8.6	1050	RCN1 8.0 - xxxx

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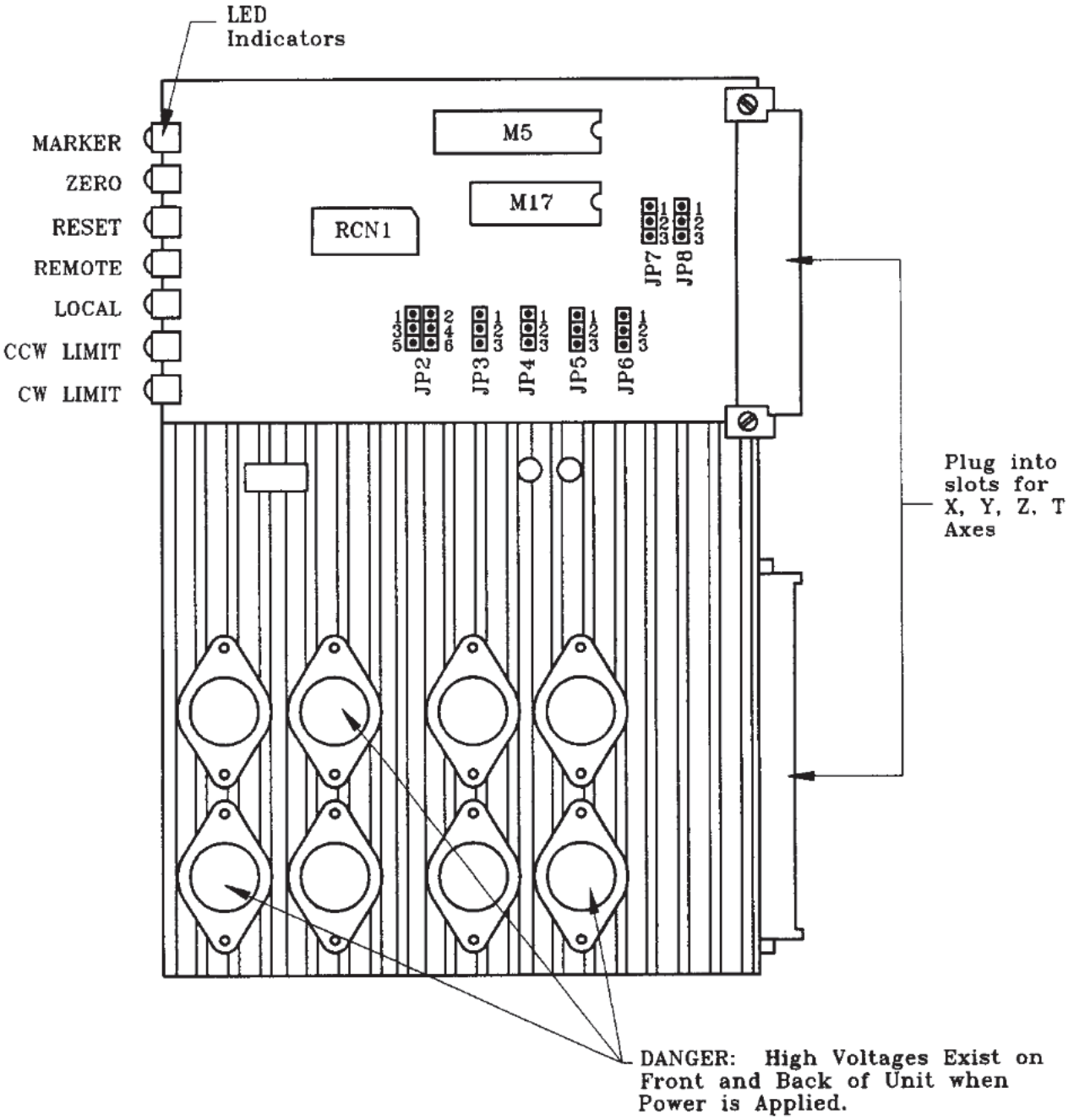


Figure 6-3: Outline of the DMV8008 and DMV16008 Stepping Drive Modules

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STEPPING DRIVE P/N	DMV8008	DMV16008
STEPPING MOTOR P/N	310SM	1010SM
STATIC TORQUE OZ.-IN. N-m	370 2,61	1050 7,41
MOTOR SPEED MAX. RPM	2000	2000
MAXIMUM MOTOR OUTPUT POWER WATTS	250	400
MOTOR ROTOR INERTIA OZ.-IN.-SEC.^{2} Kg-M^2	.027 0,187 x 10^{-3}	.114 0,805x10^{-3}
MOTOR FRAME NEMA 2	34	42
MOTOR TYPE (AMPS/PHASE)	6	8
STEPPING DRIVE VOLTS DC AMPS TYPE	80 6 BIPOLAR	160 8 BIPOLAR
WEIGHTS MOTOR (LBS.) (KG)	8.1 3,68	20 9,09
CHASSIS WEIGHTS U14S (LBS.) (KG)	36 16,5	36 16,5
U14R (LBS.) (KG)	30 13,5	30 13,5
U14H (LBS.) (KG)	35 16	35 16
INPUT POWER VOLTS AMPS Allowable voltage tolerance (+/- 10% Max.)	80 VDC 8	160 VDC 8

Table 6-2: DMV8008 and DMV16008 Specifications

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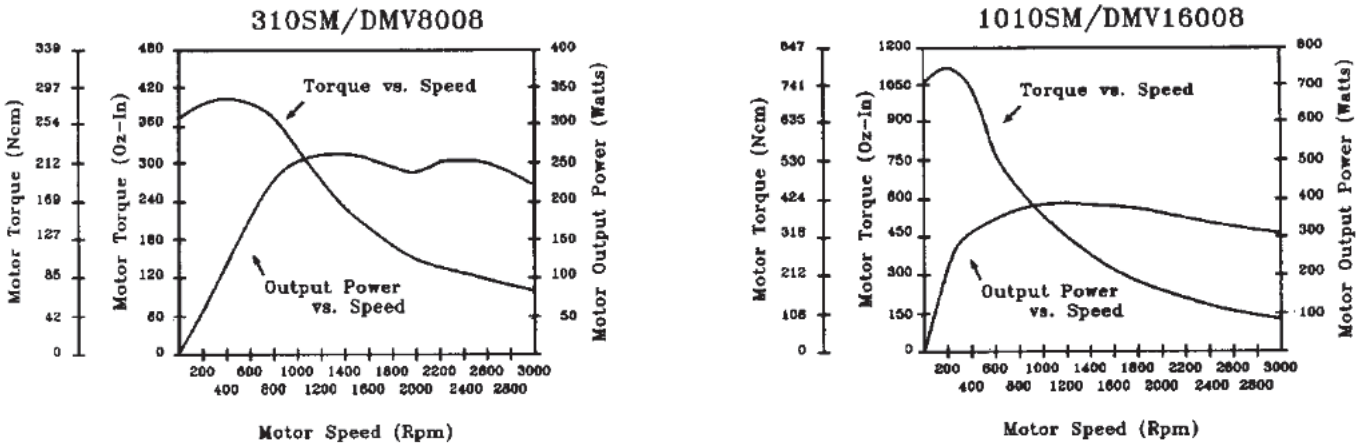


Figure 6-4: DMV8008 and DMV16008 Torque/Speed Curves

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SECTION 6-2 DSL3015, 4020, 8020, AND 16020 DC SERVO DRIVE MODULES

6-2-1: CIRCUIT DESCRIPTION

The DSL3015, 4020, 8020 and 16020 DC Servo Drive Modules have been designed to accurately control a standard DC brush Servo motor with torque ranges of between 10 and 400 oz-in. This module runs the Servo motor under closed loop control through an incremental square wave or amplified sine wave Encoder. Position and velocity loops are both "closed" with circuitry contained on this module. Analog "position locking" can be obtained with the use of an amplified sine wave Encoder for applications requiring high "in-position" stability at varying load torques. Protection is included on this module for detecting "faulty" (or missing) Encoder feedback signals or excessive position command to position feedback error. Emergency shutdown is automatic under these conditions.

Unlike the D and DM Series Stepping motor Drive modules described in the previous sections, the DSL DC Servo Drive modules require a DC bus power supply and +5, ±12 VDC control supply for operation. The external DC bus power supply, made up mainly of Transformer T1 and/or T2 and capacitors C1 through C4 is shown in Figures 5-2 and 5-3. A separate power supply board module (explained later in this chapter) is required for +5, ±12 VDC control power to the DSL modules.

6-2-2: DSL DC SERVO DRIVE MODULES OPERATION

The DSL position control loop circuit works on the principle of command and feedback pulse summation. That is, CW and CCW command pulses are received from the control board module (described in the next section) and "summed" with the CW and CCW feedback pulses derived from the incremental Encoder. The summation technique involves decoding logic, a counter to sum the feedback and command pulses and a D/A converter (Digital to Analog) whose output represents the position error between the summation of the command and feedback pulses. The position error signal is used as a velocity command signal to the pre-amplifier (described later). In addition to the position control circuit, (described above), an additional circuit is provided to "measure" the rate of CW and CCW feedback pulses per unit time in order to derive a representation for motor speed. The output of this circuit can be said to be an "electronically derived" velocity feedback signal from the motor. This circuit can also be configured to accept an optional tachometer.

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For "locking" the motor at rest (zero count position error), a third circuit is provided to "hold" the DC motor firmly within a ±1/2 step rest. This function is termed Analog Lock, and applies to sine wave type Encoders only. The Analog Lock feature eliminates "one bit" jitter when the motor is in the rest position and an external torque is being applied to its shaft.

A fourth circuit is provided on this board to "sum" the output signals of the three circuits just described. This circuit, labeled the "pre-amplifier" circuit, provides a signal as its output that is representative of the motor torque required to satisfy the position loop. This signal is actually the current command signal to the power amplifier portion of the DSL Drive Module (current drive directly proportional to torque). A block diagram of the four circuits described above is shown on Figure 6-5.

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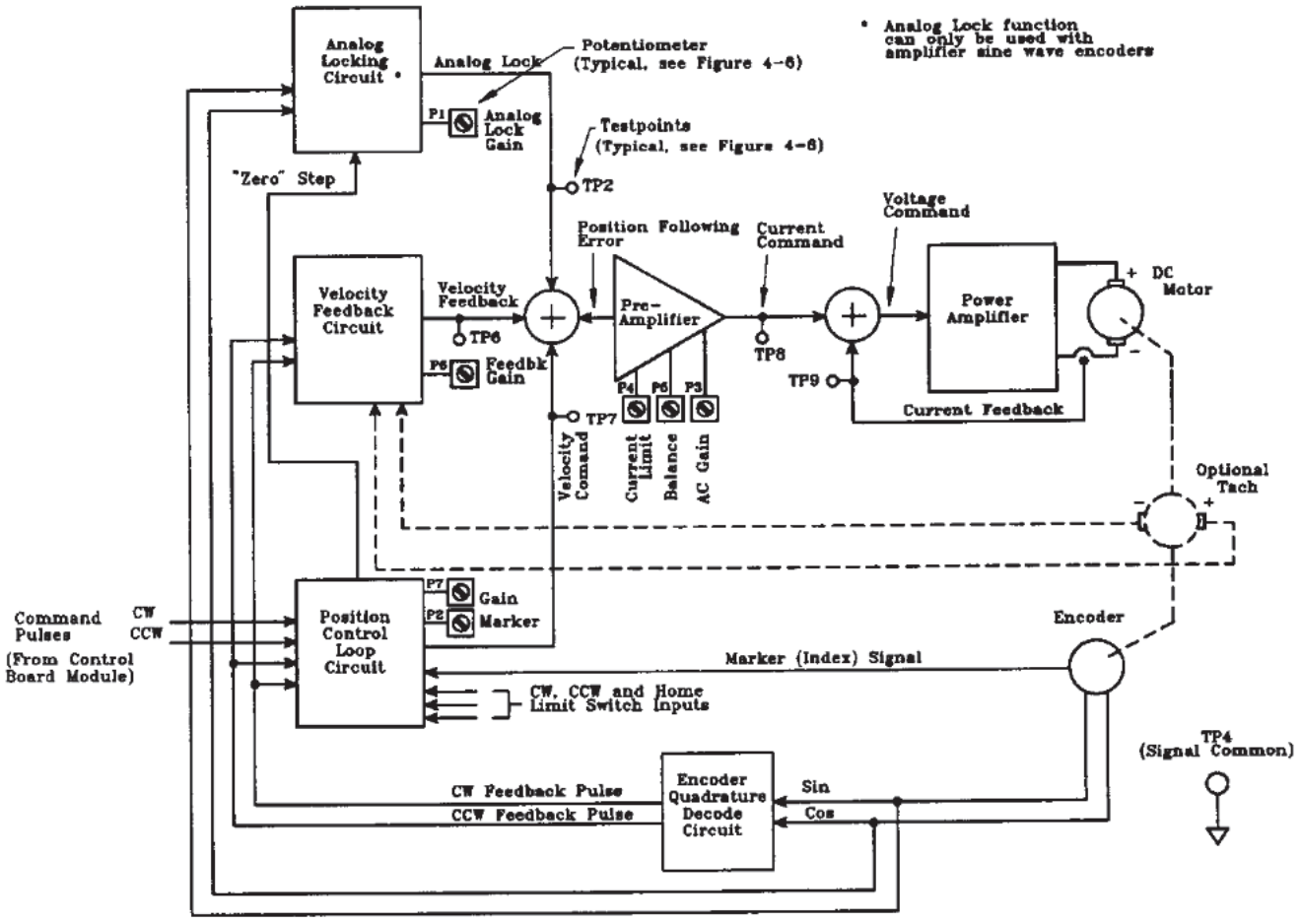


Figure 6-5: Block Diagram of DSL Drive Modules Control Circuit

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6-2-3: OPTIONAL TACHOMETER

For the DSL4020, 8020 or 16020 to be used with an optional tachometer, it is necessary to reconfigure jumper JP11 and to remove .47μf lead capacitor at RCN5: 3-14.

JP11	RCN5 3-14	
1-2	.47μf	Electronic Tach (standard)
2-3	Out	Analog Tach (optional)

6-2-4: MOTOR/ENCODER/TACHOMETER PHASING

If the Motor, Encoder, and/or optional Tachometer is user supplied, it must be phased properly.

IMPORTANT: Improper phasing can cause loop instability or even a runaway condition to occur.

Aerotech defines proper Motor, Tach, and Encoder phasing with respect to CW motor rotation when viewed from the motor mounting flange. When a positive voltage is applied to the positive motor lead and a negative voltage to the negative lead, the motor will rotate CW. When the motor turns CW, this should cause the cosine to lead the sine Encoder signal and the Tach to generate a positive feedback voltage.

6-2-5: MOTOR LOAD FUSE RATINGS FOR FUSE F1/CUR LIM

The motor load fuse is located on the bottom of the DSL Servo module (see Figures 6-8 and 6-9). For Aerotech motors, the following fuse rating should be used.

Aerotech Motor	Motor Fuse F1	Current Limit
1017LT	4 amps	±16 amps
1035LT	4 amps	±16 amps
1050LT	5 amps	±20 amps
1075LT	5 amps	±20 amps
1135LT	5 amps	±20 amps
1410LT	8 amps	±20 amps
1960LT	12 amps	±20 amps

NOTE: All fuses are 3AG type/slow-blow.

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The motor fuse is sized according to the continuous current or torque rating of the motor and protects the motor from over-heating. The current limit setting of the DSL Servo modules are meant to limit peak current and is generally set to ±20 amps or four times the value of the motor fuse, whichever is less.

CAUTION: On smaller motors, due to the thermal time constant, the current limit setting is set at a much lower ratio. Check motor data sheets for actual value.

6-2-6: "HOME" REFERENCE DEFINITION & OPTIONS

All Unidex 14 Controllers are capable of generating a cold start reference position, which is the "Home" position. The basic "Home" cycle involves the following series of events. When the "Go Home" command is issued, the motor will turn CCW (standard) or CW (optional) until a "Home Limit Switch" activation occurs.

NOTE: The CCW and CW rotational references are viewed "looking" into the motor mounting flange.

Upon "Home Limit Switch" activation, the motor reverses and rotates in the opposite direction until the switch deactivates. If a "Marker" pulse option does exist (see Section 6-2-7). The motor reverses and continues to rotate until the "Marker" pulse is located and then stops.

The Home speed is determined by the value of the RCN5: 6-11 resistor and will vary, depending on the system resolution.

Rotary Encoder (Steps/Rev)	Linear Encoder (Steps/mm)	Frequency	RCN5 6-11
200	50	2.5kHz	20K
400	100	5.0kHz	10K
1000 & up	250 & up	10.0kHz	5.1K

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For most rotary motion stages, the "Home Limit Switch" referenced above is an independent switch incorporated specifically for the "Home" cycle. For linear motion stages, the "Home Limit Switch" could also be an independent switch. However, in most cases, the "CCW" or "CW" limit switches perform double duty and act as the "Home Limit Switch". The "Home Limit Switch" wiring to either the CW or CCW limit switch is done at the motor/stage, external to the Unidex 14.

It is not possible to use the "Home Limit" input at J13, 14, 19 or 20, when Opto 22 coupled limits are being used. When used in this fashion, "CCW" or "CW" limit input may be paralleled to the "Home Limit" input by reconfiguring jumper JP3 on the DSL PC board. The jumper definition is as follows:

JP3 HOME LIMIT SOURCE:

(Standard) From Home Limit Input: Jumper JP3-3 to 4 , Remove JP3- 1 to 2, JP3-5 to 6.
(Optional) From CCW Limit Input: Jumper JP3-1 to 2, Remove JP3-3 to 4, JP3-5 to 6.
(Optional) From CW Limit Input: Jumper JP3-5 to 6, Remove JP3-1 to 2, JP3-3 to 4.

See Figures 6-8 and 6-9 for jumper locations.

When the Home command is issued, the standard direction of motor rotation is CCW. If CW rotation is required, jumper JP1 on the DSL board must be reconfigured.

JP1 HOME DIRECTION JUMPER:

(Standard) CCW Home - Jumper JP1-2 to 3, Remove JP1-1 to 2.
(Optional) CW Home - Jumper JP1-1-2, Remove JP1-2 to 3.

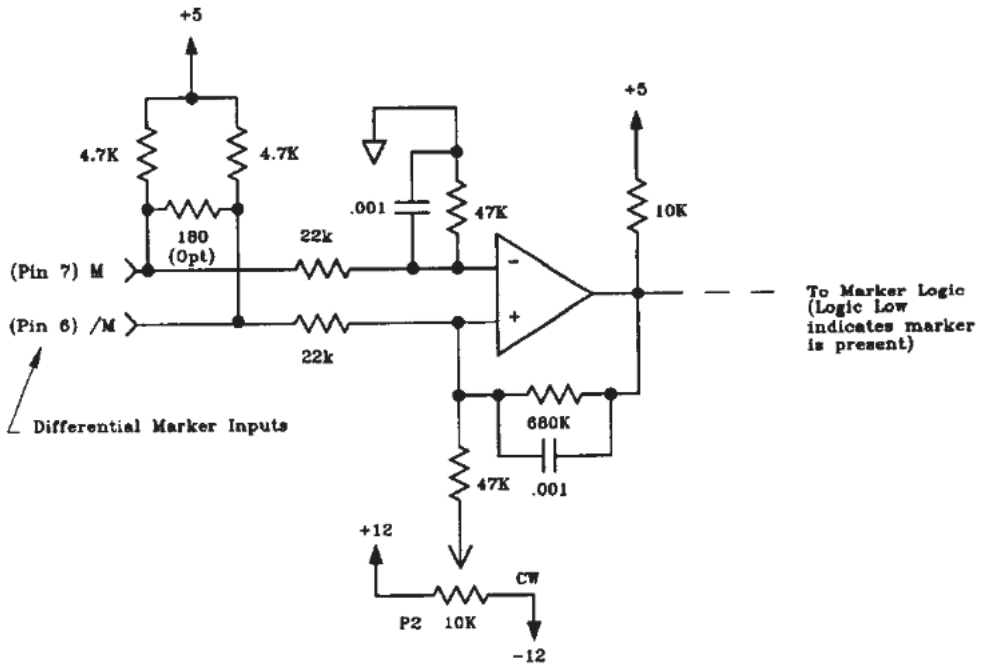
See Figures 6-8 and 6-9 for jumper locations.

NOTE: Positive move commands to the Unidex 14 causes the motor to rotate in the CCW direction.

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6-2-7: MARKER INPUT CIRCUIT

Shown below is a circuit diagram of the differential Input Marker circuit:



Potentiometer P2 in the circuit diagram above allows the threshold of the Input Marker signal to be adjusted. The threshold level is increased by turning P2 CCW. To activate the Marker logic, the voltage signal at "M" must rise slightly higher than the voltage signal at "/M", plus the threshold setting at P2. In other words:

M /M + P2 (threshold)

For a TTL Marker connection, the signal common of the TTL circuit should be tied to signal common with the Marker tied to "M". P2 should be adjusted to approximately +1VDC at the P2 wiper.

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6-2-8: LIMIT SWITCH POLARITY SELECTION

As a standard, Unidex 14 controllers are configured to interface to normally open (active low) limit switches (CCW, CW and Home). If use of normally closed (active high) limit switches is required, jumpers JP2, JP4, and JP5 on the DSL board must be reconfigured. The jumper definitions follow:

LIMIT/LIMIT-N JUMPERS (JP2, JP4, JP5)

(Standard) CCW Limit, Normally Open - Jumper JP5-2 to 3, Remove JP5-1 to 2.
(Optional) CCW Limit, Normally Closed - Jumper JP5-1 to 2, Remove JP5-2 to 3.
(Standard) CW Limit, Normally Open - Jumper JP2-2 to 3, Remove JP2-1 to 2.
(Optional) CW Limit, Normally Closed - Jumper JP2-1 to 2, Remove JP2-2 to 3.
(Standard) Home Limit, Normally Open - Jumper JP4-2 to 3, Remove JP4-1 to 2.
(Optional) Home Limit, Normally Closed - Jumper JP4-1 to 2, Remove JP4-2 to 3.

See Figures 6-8 and 6-9 for jumper locations.

6-2-9: ENCODER MULTIPLICATION PARAMETERS

Incremental Encoders produce two output signals generally referred to as sine and cosine. These signals are displaced 90 degrees with respect to each other (i.e., in quadrature with respect to each other). These qaudrature signals can be in the form of either amplified sine waves or square waves. (The amplified sine wave type being applicable to analog lock control.)

Through electronic decoding logic on the DSL Servo Module, these quadrature signals can be interpreted as providing 1, 2 or 4 individual steps (machine steps) per one full cycle of sine and cosine.

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Multiplying the Encoder signal by 1, 2, or 4 (X1,X2,X4), involves the manipulation of jumpers and, in case of amplified sine wave Encoders, the changing of resistor values on the Encoder interface module (see Figures 6-8 and 6-9). For square wave Encoder operation, only jumpers on the main board must be selected.

ENCODER MULTIPLICATION	MULTIPLIER	R5	R6	R7	R8	JUMPER	JUMPER JP7	JUMPER JP8	JUMPER JP19	JUMPER JP18
SINE WAVE 690C1333 CIRCUIT BOARD MODULE	X1	22K	OUT	OUT	43K	2-3	2-3	2-3	2-3	2-3
	X2	22K	OUT	OUT	43K	2-3	2-3	1-2	2-3	2-3
	X4	OUT	43K	22K	OUT	1-2	1-2	2-3	2-3	NONE
SQUARE WAVE 690C1334 CIRCUIT BOARD MODULE	X1	(No change)	(No change)	(No change)	(No change)	(No change)	2-3	2-3	2-3	2-3
	X2						2-3	1-2	2-3	2-3
	X4						1-2	2-3	2-3	NONE
Encoder Interface Module							Main Board			

NOTE: Changing resolution will also change system gains. For optimum performance, it may be necessary to change the Accel./Decel. parameter and/or the gain setting of the DSL Servo Module.

6-2-10: ADJUSTMENTS

Seven potentiometers and six test points are provided on the DSL Servo module. A description of these pots and test points are as follows (refer to Figures 6-5, 6-8 and 6-9).

P1 **ANALOG LOCK GAIN ADJUST**

This pot adjusts the sine lock gain for analog lock in the "zero" step (rest) position. This pot is applicable to sine wave Encoders only. This pot *must* be turned to the full CW position when using square wave type Encoders. Analog lock is adjusted by monitoring testpoint TP2 (with respect to signal common, TP4) and the zero LED indicator. Turning P1 CCW increases the analog lock gain.

Analog lock is adjusted by monitoring testpoint TP2 (with respect to signal common, TP4) and the zero LED indicator. Turning P1 CCW increases the analog lock gain.

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When the motor is at rest (no command pulses), the "ZERO" LED indicator must first be set to energize by adjusting the BALANCE pot P5 (discussed below). When the ZERO LED is energized, the analog lock testpoint (TP2) should be monitored (with an oscilloscope) and both the BALANCE pot P5 and the ANALOG LOCK pot P1 should be adjusted until TP2 reads close to zero volts.

P2 **MARKER ADJUST**

This pot adjusts the threshold of the Marker (index) input pulse from the incremental Encoder (see Marker input circuit, Section 6-5-7).

P3 **AC GAIN ADJUST**

This pot adjusts the AC gain of the pre-amplifier. Pot P7 and P6 affect the DC as well as the AC gain of the pre-amplifier as discussed below. Turning the AC GAIN pot (P3) CCW increases the AC gain of the pre-amplifier.

P4 **CURRENT LIMIT ADJUST**

This pot adjusts the clamping level of current applied to the Servo module through the power stage of the DSL Driver. The full CCW position allows maximum current. The full CW position clamps the current command to zero (no motor current). The current command signal can be monitored at test point TP8.

The motor current feedback signal, which is summed with the current command signal to produce a voltage command signal to the power amplifier (see Figure 6-5), may be monitored at testpoint TP9.

Both the Current Command and Current Feedback testpoints (TP8 and TP9 respectively) provide signal gain ratio of ±3 amps per volt.

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The summation circuitry for Current Feedback and Current Command (specifically an integral-lead circuit) provides a motor current bandwidth of approximately 1000 Hz (assuming a 2 - 5 milliHenry load inductance).

P5 **BALANCE POT**

This pot adjusts analog offsets inherent in the pre-amplifier circuit (see Figure 6-5) which can cause position error. This pot is adjusted when the DC motor is at rest. Set the pot to a position such that the "zero" LED remains lit. Test the netting by making a move and comfirming that the "zero" LED lights up when the motor comes to rest.

P6 **VELOCITY FEEDBACK GAIN**

This pot adjusts the amount of DC Velocity Feedback Gain to the pre-amplifier. Velocity Feedback is electronically derived from the Encoder or from an optional tachometer (see Figure 6-5). Velocity Feedback has two purposes. First, to provide "damping" to the position control loop to eliminate position loop oscillation. Secondly, the Velocity Feedback provides a means of generating position "following error" in the position loop. Following error provides the desirable effect of eliminating position "overshoot" when operating the motor at high Accel./Decel. rates. Testpoint TP6 provides a monitor for the Velocity Feedback signal. Turning this pot CW increases Velocity Feedback Gain and typically reduces motor positioning response.

P7 **COMMAND GAIN**

This pot adjusts the amount of DC Velocity Command Gain to the pre-amplifier. Command Velocity is derived from the accumulated difference (or error) between the command pulses from the control board module and the feedback pulses generated by the Encoder. Testpoint TP7 provides a monitor for the Velocity Command signal. The ratio of the voltage of this signal with respect to actual command motor

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velocity varies with the encoder resolution and the setting of the Velocity Feedback Gain described above, and therefore cannot be directly defined.

NOTE: Adjustment of the COMMAND VELOCITY GAIN pot (P7) and FEEDBACK VELOCITY GAIN pot (P6) may require that the BALANCE pot (P5) be readjusted to obtain the "ZERO" step condition discussed earlier.

6-2-11: ADJUSTING POSITION & VELOCITY LOOP

The DSL Drive Module is factory adjusted for given Aerotech DC Servo motor(s) (i.e., 1050LT, 1135LT, etc.) shipped with the Unidex 14. *If a user-supplied motor and Encoder is to be used with Unidex 14, Aerotech should be notified of the motor and Encoder parameters at the time of purchase to insure compatibility and proper factory set up.*

If the Motor, Encoder and Translation stage are user supplied, the following adjustment procedure is recommended:

⚠ **DANGER:** PRIOR TO MAKING ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS. MAKE CERTAIN ALL ELECTRICAL POWER SWITCHES ARE IN THE "OFF" POSITION.

NOTE: An oscilloscope is required for the following procedure.

1. If the Motor, Encoder and optional Tachometer are one assembly, disconnect them from the load if possible.

2. With power turned off, rotate the motor CW (as viewed from the motor mounting flange), and check motor polarity. A positive voltage can be measured from the positive terminal with respect to the negative terminal of the motor.

3. **REMOVE MOTOR FUSE** (see Figures 6-8 and 6-9), connect the oscilloscopes common lead to TP4 (Signal Common), Channel 1 probe to TP3 (Cosine Square) and Channel 2 probe to TP5 (Sine Square). For the placement of testpoints and motor fuse, see Figures 6-8 and 6-9. Apply power, manually turn motor CW and check phasing of Encoder signals at TP3 and TP5. Note that signals at TP3 and TP5 will always be square wave signals, even if sine wave Encoders are used. Also check for a positive Velocity Feedback voltage at TP6 while turning the motor CW.

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4. Turn off power, replace motor fuse (see Section 6-2-5 for fuse ratings), and turn P1 full CW, P3 full CW, P4 full CW (minimum current limit), P5 mid-range, P6 full CW, and P7 full CCW. This should set the GAIN and CURRENT LIMIT to their lowest adjustable value. Apply power and slowly adjust the CURRENT LIMIT adjustment, P4 CCW and observe the system. If the system is stable, turn P4 full CCW, ±20 amps, or adjust to desirable level by monitoring TP9, Current Feedback testpoint (3 A/V) while running a program.

5. Write a small program that will run Unidex 14 back and forth with a 1-second dwell between moves. Set the Feedrate for 1/2 of the maximum system speed. Set the Accel./Decel. rate to 10 times the system speed is (steps/sec), linear profiling. Make certain that the move is long enough to affirm that the motor can accelerate and run at programmed speed.

6. Replace the motor fuse, apply power, and run the program detailed in Step 5. Adjust P7 (COMMAND GAIN) CW for less than or equal to ±4V of following error at TP7 with respect to TP4 (Signal Common). If the motion stops, this means that the range of the D/A has been exceeded. If this is the case, turn P7 more CW, and turn drive chassis power off, then on again, to clear fault condition and try again. If you do not have enough range with P7, then turn P6 (VELOCITY FEEDBACK) CCW to decrease the following error. If the error condition persists, the problem may be due to one of the following:

   a. The requested program speed exceeds the capabilities of the motor and amplifier.

   b. There may not be enough acceleration torque available to accelerate the motor and/or load up to speed. If this is the case, it may be necessary to decrease the Accel./Decel. rate.

7. If the load was disconnected in Step 1, reconnect it.

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8. Turn AC GAIN ADJUSTMET, P3, CCW, until the system starts to oscillate. Then turn P3 CW 1/8 turn past the point where it stops oscillating.

9. The system should now be stable and the gain adjustments very conservatively set (over damped). At this point the system should be running the program from Step 5 very smoothly. To optimize positioning time, run the program from Step 5 at maximum system speed and turn P7 (COMMAND GAIN) further CW, to achieve the results at TP7 (VELOCITY COMMAND) as shown in Figure 6-6. If you do not have enough range with the P7 adjustment, it may be necessary to turn P6 (VELOCITY FEEDBACK GAIN) more CCW. However, you must remember that if you adjust P6 you will also have to readjust P3 (AC GAIN) by following the description in Step 8, (or by viewing the results at TP6 while running the program).

10. Increase the Accel./Decel. rate until you start to notice overshoot at TP7 (VELOCITY COMMAND) is noticed.

11. To adjust the Balance for a square wave Encoder system, send the axis to the "Home Position" and adjust P5 (BALANCE) until both the "Marker" and the "Zero" indicator LEDs on the Unidex 14 front panel are energized.
    To adjust the Balance for a sine wave Encoder system, adjust the P1 (ANALOG LOCK GAIN) and P5 (BALANCE). When the system is at rest, adjust P5 until the "ZERO" indicator LED for the respective axis is lit on the front panel of the Unidex 14. Connect the probe of the oscilloscope to TP2 (Lock Signal) and the Common lead of the oscilloscope to TP4 (Signal Common). Turn P1 (ANALOG LOCK GAIN) mid-range and adjust P5 (BALANCE) for zero volts (±.5V) at TP2. Execute a one step move and adjust P1 for approximately 25% overshoot at TP2 upon completion of the move with little or no ringing (as shown in Figure 6-7). After adjusting P1 it may also be necessary to readjust P5 once again.

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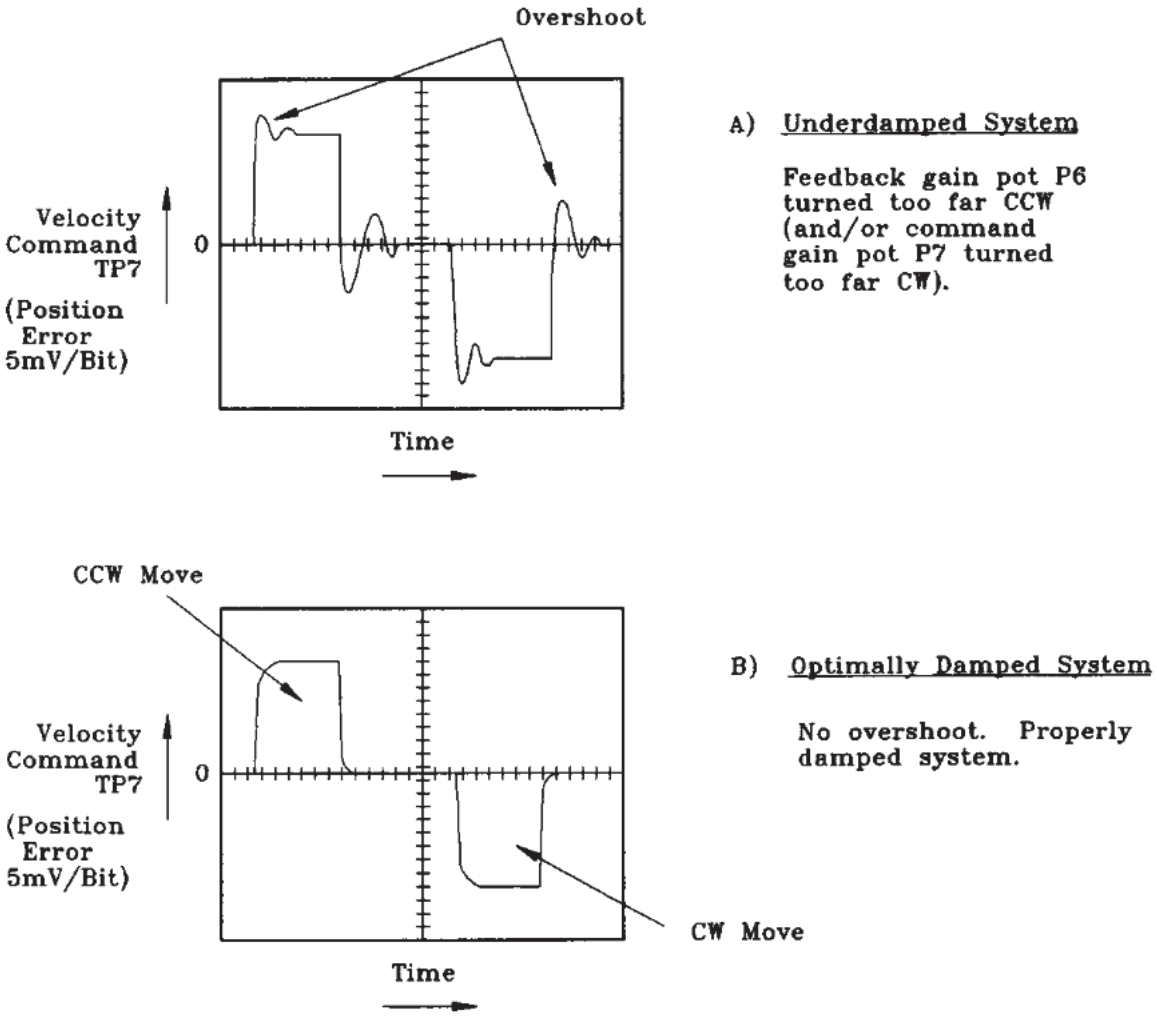


Figure 6-6: Velocity Command refers to TP7 for Underdamped (A), and Optimally Damped (B), Position Loop Response

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NOTE: The velocity command shown in Figure 6-6 also represents the position error which is scaled to a 5mV/machine step.

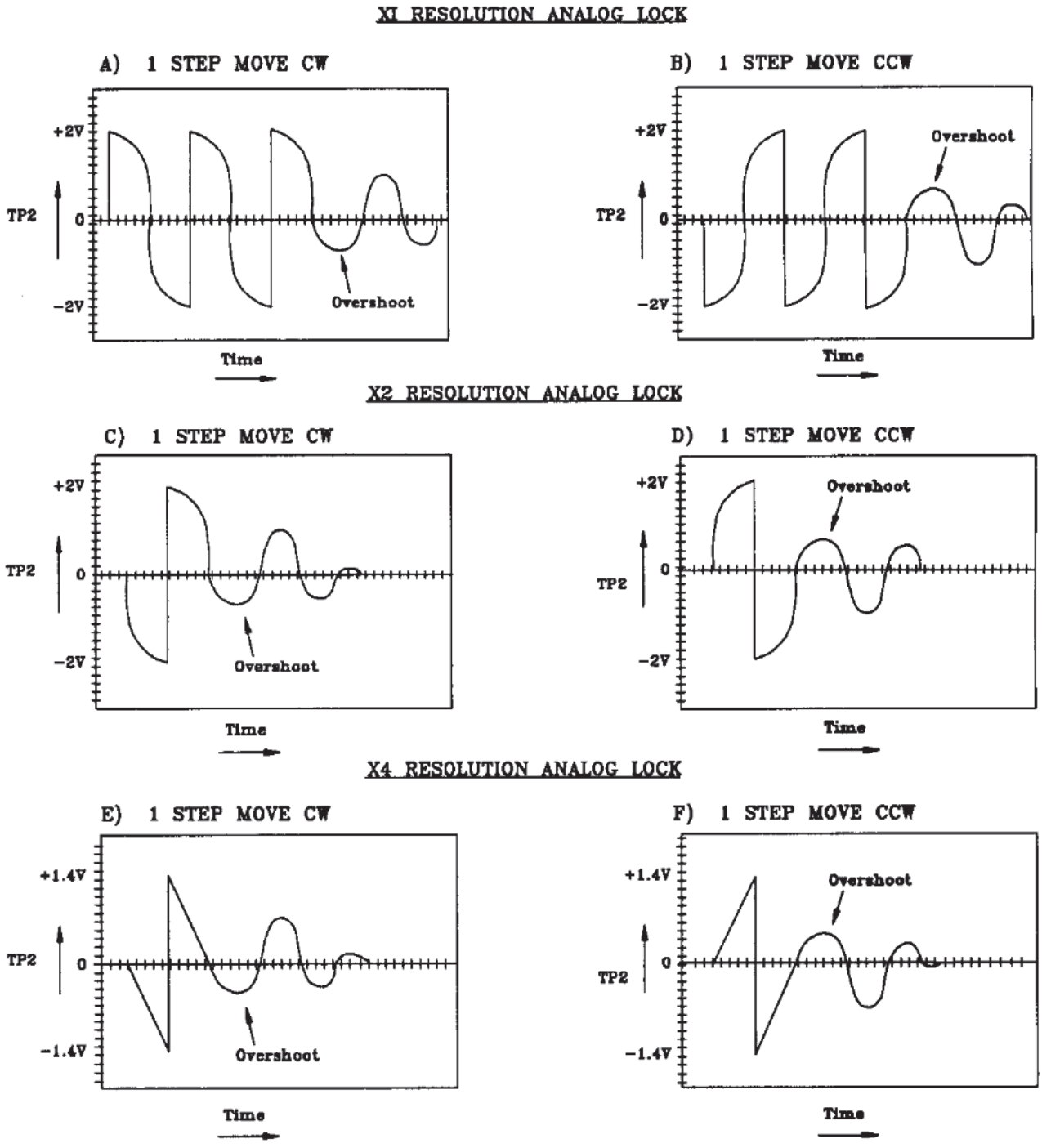


Figure 6-7: Analog Lock Signal at TP2 for X1, X2 and X4 Resolution (shown for Sine Wave Encoders only)

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The DSL Drive Module is Now Ready for Operation

Before programming normal motion, index the motor (at a very low velocity) into the CW Travel Limit switch and CCW Travel Limit switch. Be certain that the CW and CCW limit LEDs energize in their proper sequence and that Unidex 14 responds by stopping motion *before* the motor reaches its mechanical end stop (normally a minimum distance of one motor revolution should exist between the respective limit switch activating point and the mechanical end stop).

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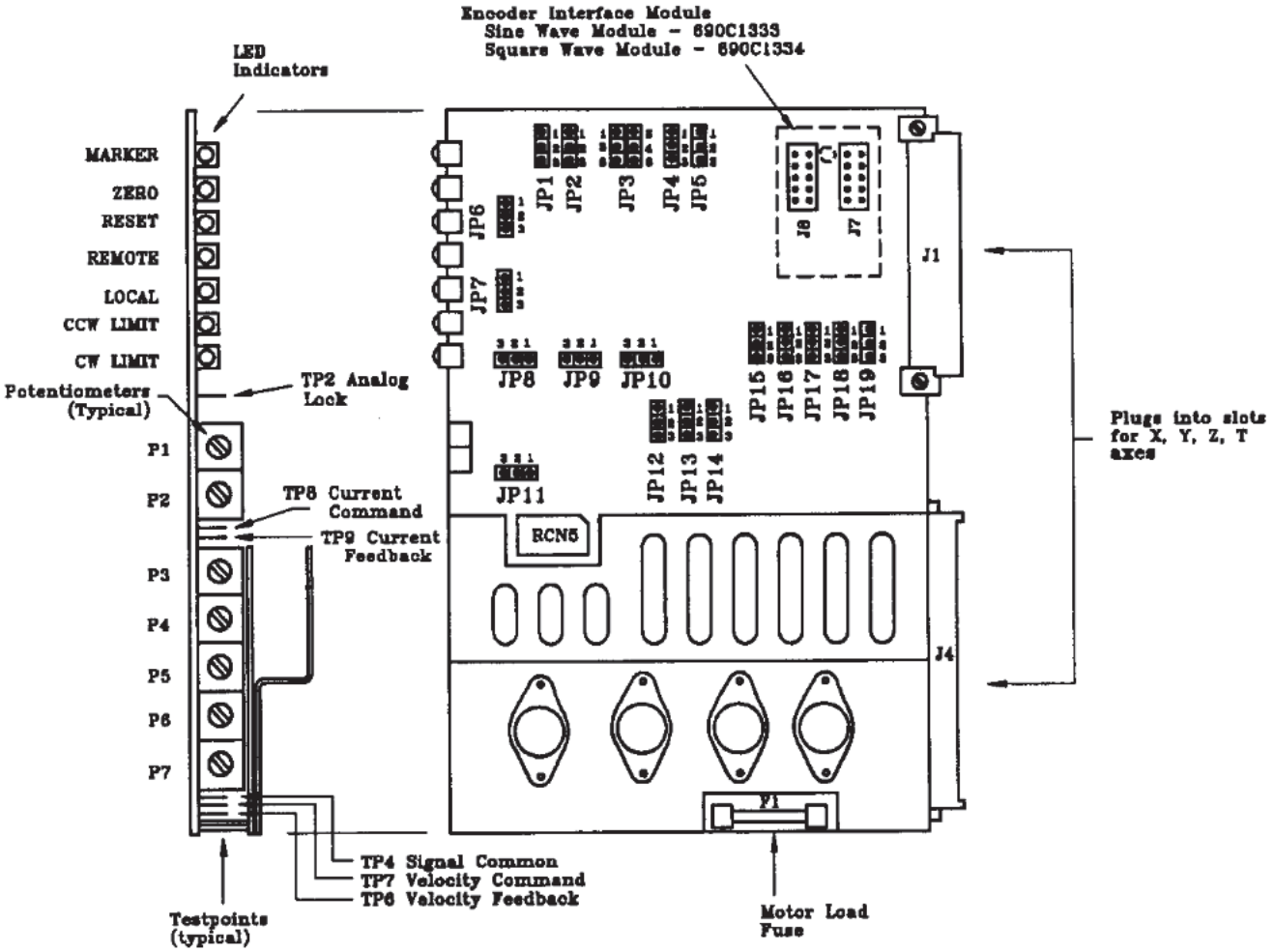


Figure 6-8: Outline of the DSL4020, 8020 AND 16020DC Servo Drive Module

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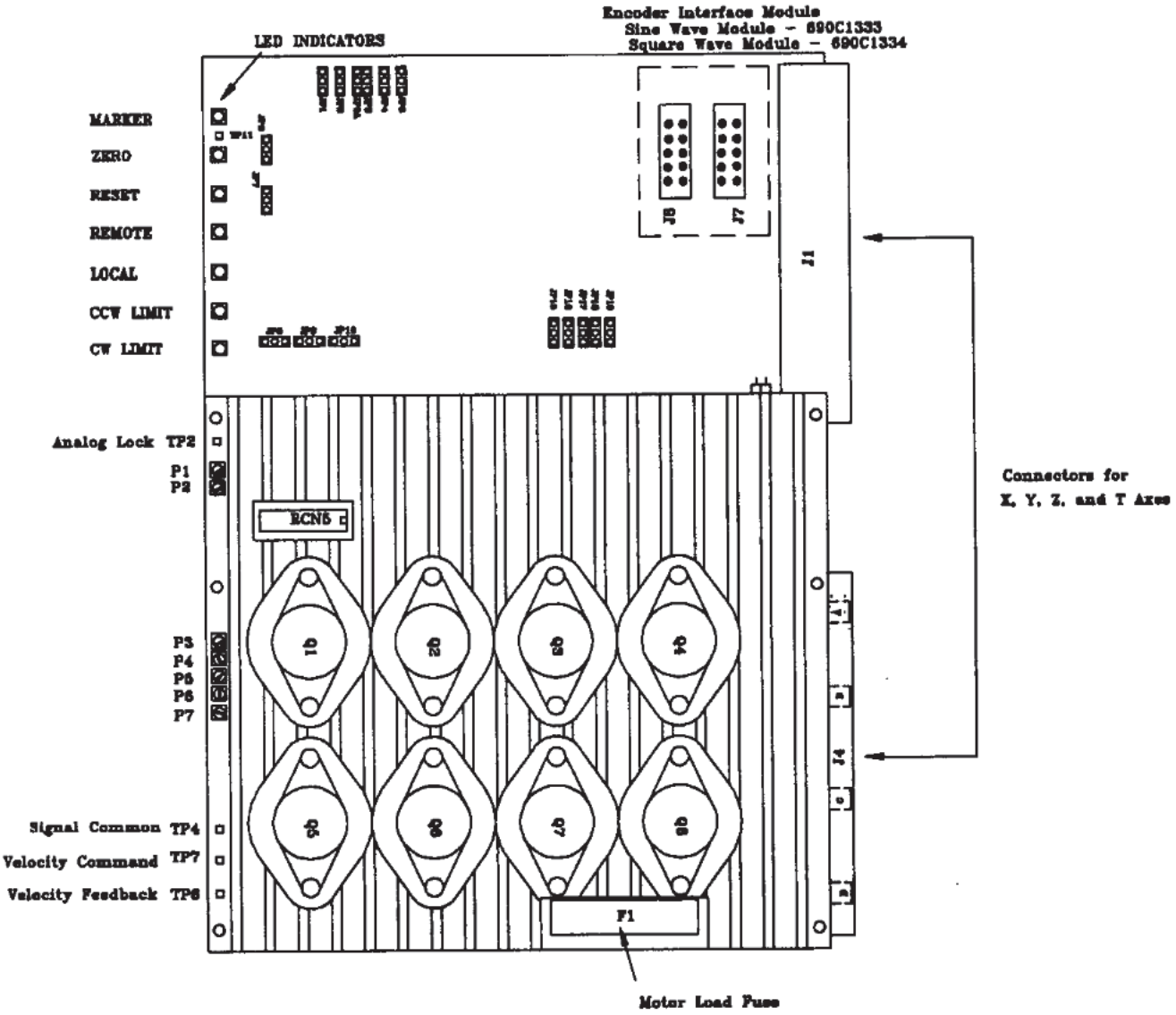


Figure 6-9: Outline of the DSL3015 DC Servo Drive Module

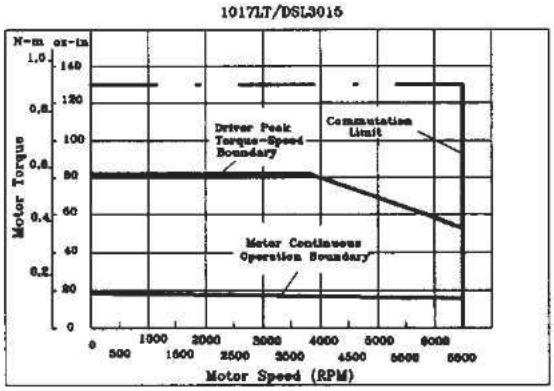
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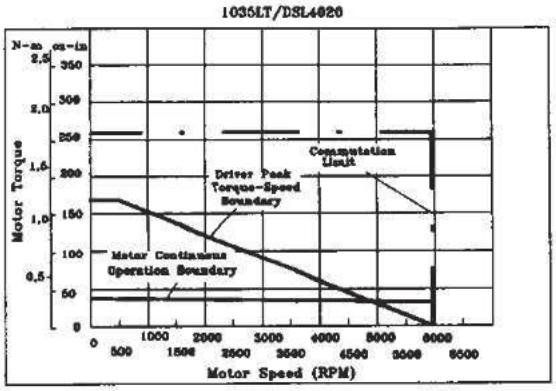
DC DRIVE MODEL NO.	—DSL3015—		—— DSL4020 ——		—— DSL8020 ——			—— DSL16020 ——		
DC MOTOR MODEL NO.	1017LT		1035LT	1050LT	1075LT	1135LT	1210LT	1410-02 -1600-99	1560LT	1960LT
Continuous Torque (Max.) Oz-in / N-m	17 / 0.12		35 / 0.25	50 / 0.35	75 / 0.53	135 / 0.95	210 / 1.5	410 / 2.9	560 / 4.1	800 / 5.6
Peak Torque (Max.) Oz-in / N-m	62 / 0.44		170 / 1.20	186 / 1.31	280 / 2.0	490 / 3.46	700 / 4.94	880 / 6.3	1300 / 9.2	2000 / 14.1
Maximum Speed (RPM)	5000		5000	4200	5000	3600	2500	1800	1800	2400
Motor Rotor Inertia Oz-in-Sec² / Kg-M²	0.004		0.0054 / 0.038 x 10^{-4}	.008 / 0.057 x 10^{-4}	.023 / 0.16 x 10^{-4}	.052 / 0.36 x 10^{-4}	.18 / 1.3 x 10^{-4}	.37 / 2.6 x 10^{-4}	.26 / 1.8 x 10^{-4}	.37 / 2.6 x 10^{-4}
DC Drive Amplifier Settings	standard	optional*								
DC Bus Voltage	20	30	40	40	80	80	80	80	160	160
Max. Peak Current	15	15	20	20	20	20	20	20	20	20
Output Fusing, Amps	4	5	4	5	5	6	6.25	6.25	5	10
Maximum Input DC Drive Power (Watts)	80		108	145	170	240	260	395	713	1340
Maximum Output Motor Shaft Power (Watts)	37		86	155	185	239	220	325	600	1190
Weights										
Motor (lbs.)	2.5		3.3	3.8	5.8	10.3	10.8	14.3	25.3	36
(Kg)	1.1		1.5	1.7	2.6	4.7	4.9	6.5	11.5	17.3
Chassis										
U12S Lbs.						50				
Kg						23				
U12R Lbs.						42				
Kg						19				
U12H Lbs.						57 (60 with 2P12 dual supply)				
Kg						26 (36 with 2P12 dual supply)				

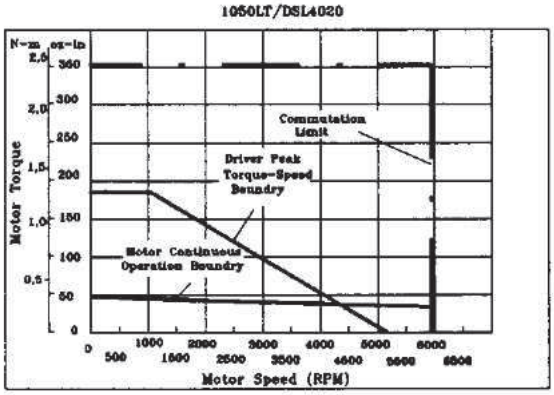
* Must be equipped with additional cooling fan.

Table 6-3: DSL3015, DSL4020, DSL8020 and DSL16020 Specifications

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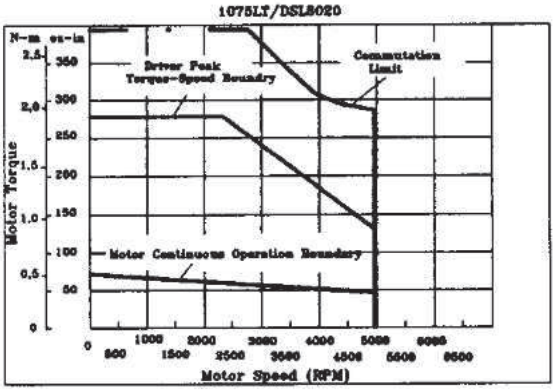
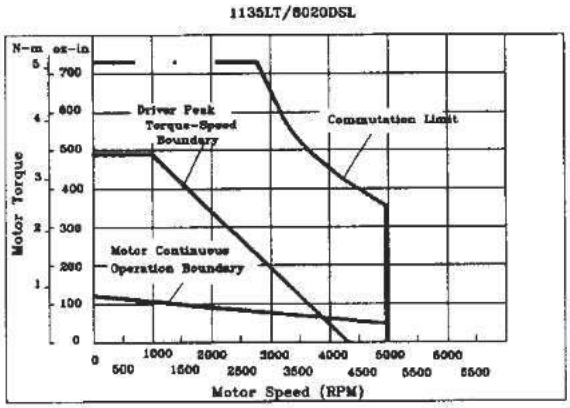
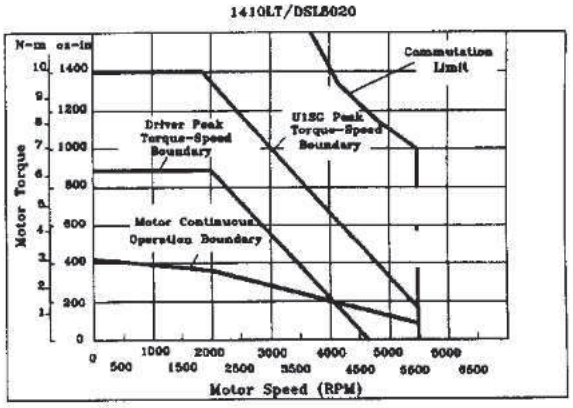


Figure 6-10: DSL Torque/Speed Curves

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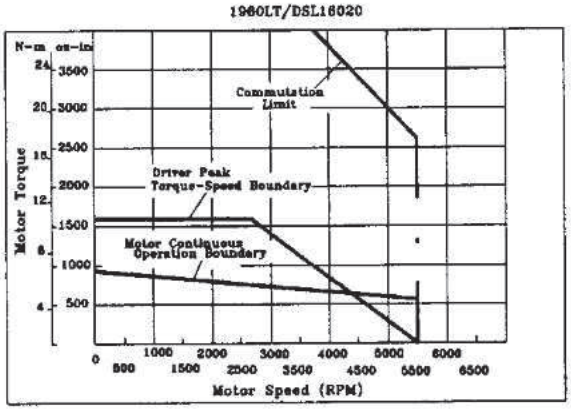


Figure 6-10 (con't): DSL Torque/Speed Curves

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SECTION 6-3: DAV4008 & 16008 (AERODRIVE) STEPPING DRIVE MODULES

6-3-1: CIRCUIT DESCRIPTION

The DAV4008 and DAV16008 Drive Modules have been designed to accurately control a standard 1.8 degree Stepping motor with torque ranges of between 50 and 1200 oz-in under closed loop control. This module runs under closed loop control through an amplified sine wave feedback Encoder. Position and velocity loops are both "closed" with circuitry contained on this module. Analog "position locking" is obtained with the use of an amplified sine wave Encoder. Protection is included on this module for detecting faulty (or missing) Encoder feedback signals or excessive position command to position feedback error. Emergency shutdown is automatic under these conditions.

Analog position locking provides a very high level of Encoder feedback gain when the motor is within ±1 encoder step of final position. With proper adjustment of the analog locking circuit, full motor torque may be generated with as little as .05 degree deflection of the motor shaft from the zero (or rest) position.

An outline of the DAV Drive Module is shown in Figure 6-14. Table 6-4 provides DAV Specifications and Figure 6-15 provides Torque/Speed curves.

The DAV Drive Module can be used in Unidex 14 chassis U14S, U14R and U14H.

6-3-2: DAV DRIVE MODULE OPERATION

The Aerodrive position control loop circuit works on the principle of command and feedback pulse summation. That is, CW and CCW command pulses are received from the control board module (described in the next section) and "summed" with the CW and CCW feedback pulses derived from the Encoder. The summation technique involves decoding logic, a counter to sum the feedback and command pulses and a D/A converter (Digital to Analog) whose output represents the position error between the summation of the command and feedback pulses. The position error signal is used as a velocity command signal to the pre-amplifier (described later). In addition to the position control circuit, (described above), an additional circuit is provided to "measure" the rate of CW and CCW feedback pulses per unit time in order to derive a representation for motor speed. The output of this circuit can be said to be a "electronically derived" velocity feedback signal from the motor.

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For "locking" the motor at rest (zero count position error), a third circuit is provided to "hold" the DC motor firmly within a ±1/2 step of "rest". This function is termed Analog Lock, and applies to sine wave type Encoders only. The Analog Lock feature eliminates "one bit" jitter when the motor is in the rest position effectively canceling any external torque applied to the shaft, while maintaining "zero error" position.

A fourth circuit is provided on this board to "sum" the output signals of the three circuits just described. This circuit, labeled the "pre-amplifier" circuit, provides a signal as its output that is representative of the motor torque required to satisfy the position loop. This signal is actually the current command signal to the power amplifier portion of the Aerodrive (current drive directly proportional to torque). A block diagram of the four circuits described above is shown on Figure 6-11.

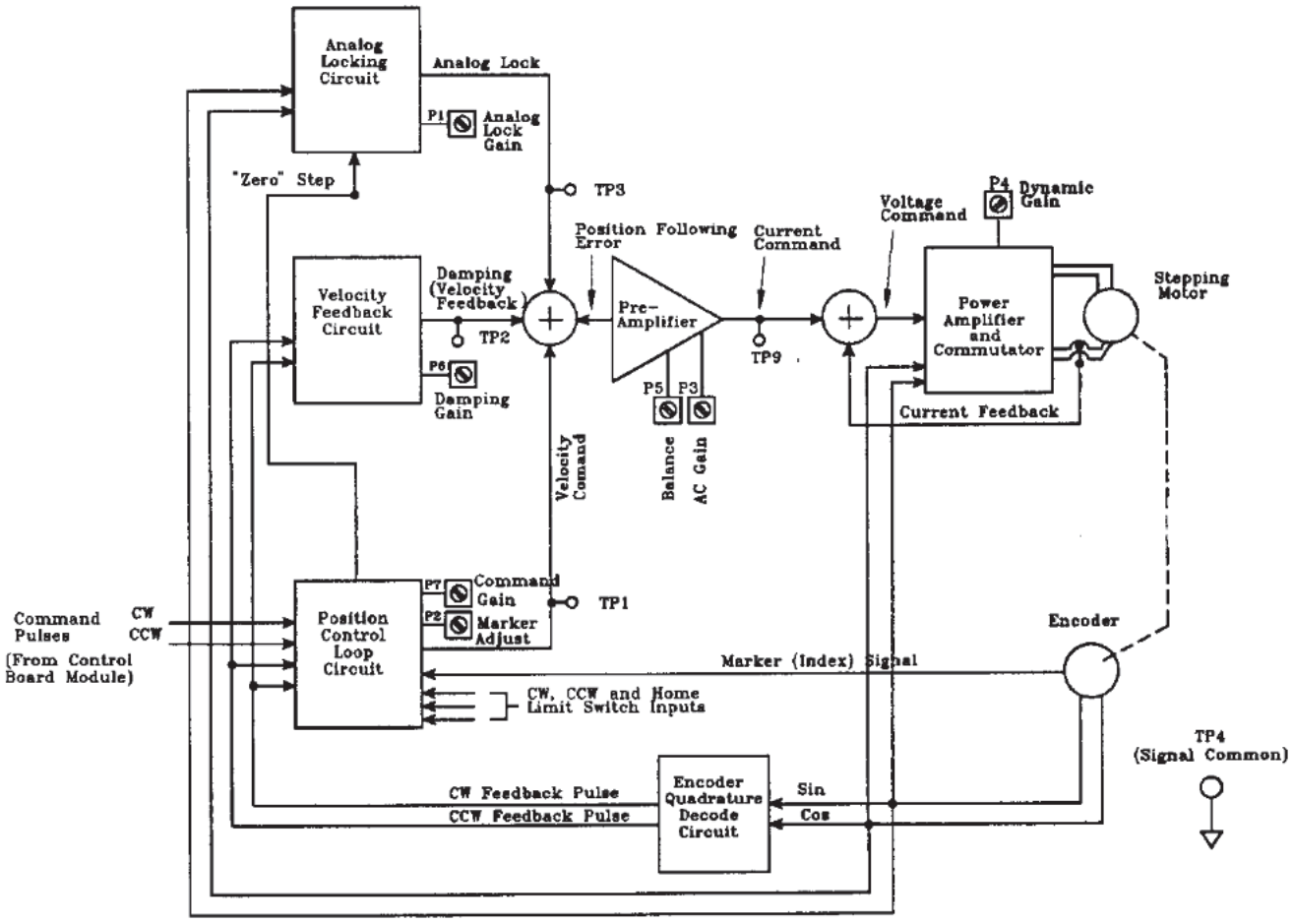


Figure 6-11: Block Diagram of DAV4008 and 16008

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6-3-2-1: "HOME" REFERENCE DEFINITION & OPTIONS

All Unidex 14 Controllers are capable of generating a cold start reference position, which is the "Home" position. The basic "Home" cycle involves the following series of events. When the "Go Home" command is issued, the motor will turn CCW (standard) or CW (optional) until a "Home Limit Switch" activation occurs.

NOTE: The CCW and CW rotational references are viewed "looking" into the motor mounting flange.

Upon "Home Limit Switch" activation, the motor reverses and rotates in the opposite direction until the switch deactivates. If a "Marker" pulse option exists (see Section 6-3-2-2), the motor reverses and continues to rotate until the "Marker" pulse is located, and then stops.

The Home speed is determined by the value of the RCN5 6-11 resistor and will vary, depending on the system resolution.

Rotary Encoder (Steps/Rev)	**Linear Encoder (Steps/mm)**	**Frequency**	**RCN5 6-11**
200	50	2.5kHz	20K
400	100	5.0kHz	10K
1000 & up	250 & up	10.0kHz	5.1K

For most rotary motion stages, the "Home Limit Switch" referenced above is an independent switch incorporated specifically for the "Home" cycle. For linear motion stages, the "Home Limit Switch" is also often an independent switch. In most cases, the "CCW" or "CW" limit switches perform double duty and act as the "Home Limit Switch". The "Home Limit Switch" wiring to either the CW or CCW limit switch is done at the motor/stage, external to the Unidex 14.

It is not possible to use the "Home Limit" input at J13, 14, 19 or 20 when Opto 22 coupled limits are being used. When used in this fashion, "CCW" or "CW" limit input may be paralleled to the "Home Limit" input by reconfiguring jumper JP5 on the Aerodrive PC board. The jumper definition is as follows:

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JP3 HOME LIMIT SOURCE:

(Standard) From Home Limit Input: Jumper JP5-3 to 4 , Remove JP5- 1 to 2, JP5-5 to 6.
(Optional) From CCW Limit Input: Jumper JP5-1 to 2, Remove JP5-3 to 4, JP5-5 to 6.
(Optional) From CW Limit Input: Jumper JP5-5 to 6, Remove JP5-1 to 2, JP5-3 to 4.

See Figure 6-14 for jumper locations.

When the Home command is issued the standard direction of motor rotation is CCW. If CW rotation is required, jumper JP3 on the Aerodrive board must be reconfigured.

JP1 HOME DIRECTION JUMPER:

(Standard) CCW Home - Jumper JP3-1 to 2, Remove JP3-2 to 3.
(Optional) CW Home - Jumper JP3-2-3, Remove JP3-1 to 2.

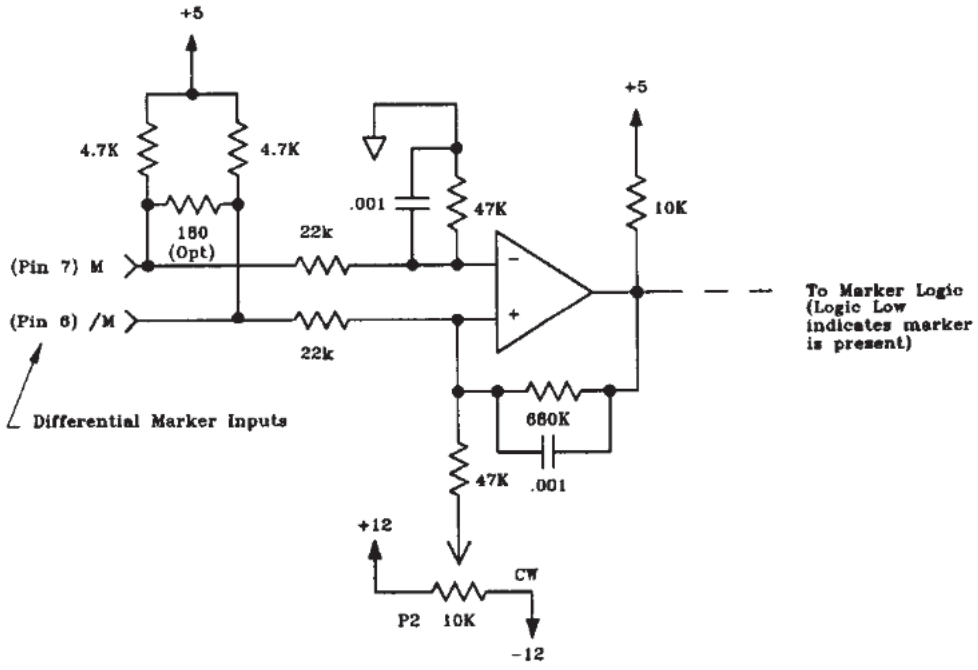
See Figure 6-14 for jumper locations.

NOTE: Positive move commands to the Unidex 14 causes the motor to rotate in the CCW direction.

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6-3-2-2: MARKER INPUT CIRCUIT

Shown below is a circuit diagram of the differential Input Marker circuit:



Potentiometer P2 in the circuit diagram above allows the threshold of the Input Marker signal to be adjusted. The threshold level is increased by turning P2 CCW. To activate the Marker logic, the voltage signal at "M" must rise slightly higher than the voltage signal at "/M", plus the threshold setting at P2. In other words:

M /M + P2 (threshold)

To adjust the marker, it is recommended that the Aerodrive is given a Home command. This will maintain a motor "search" for the CW, CCW or Home Limit Switch. When the limit is reached, the motor will reverse directions and the Aerodrive will seek the first marker pulse. Pot 2 should then be adjusted such that the pulse is successfully detected by the Aerodrive homing logic.

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6-3-2-3: LIMIT SWITCH POLARITY SELECTION

As a standard, Unidex 14 controllers are configured to interface to normally open (active low) limit switches (CCW, CW and Home). If use of normally closed (active high) limit switches is required, jumpers JP2, JP4, and JP5 on the Aerodrive board must be reconfigured. The jumper definitions follow:

LIMIT/LIMIT-N JUMPERS (JP2, JP4, JP5)

(Standard) CCW Limit, Normally Open - Jumper JP7-2 to 3, Remove JP7-1 to 2.
(Optional) CCW Limit, Normally Closed - Jumper JP7-1 to 2, Remove JP7-2 to 3.
(Standard) CW Limit, Normally Open - Jumper JP4-2 to 3, Remove JP4-1 to 2.
(Optional) CW Limit, Normally Closed - Jumper JP4-1 to 2, Remove JP4-2 to 3.
(Standard) Home Limit, Normally Open - Jumper JP6-2 to 3, Remove JP6-1 to 2.
(Optional) Home Limit, Normally Closed - Jumper JP6-1 to 2, Remove JP6-2 to 3.

See Figure 6-14 for jumper locations.

6-3-2-4: ENCODER MULTIPLICATION PARAMETERS

Incremental Encoders produce two output signals generally referred to as sine and cosine. These signals are displaced 90 degrees with respect to each other (i.e., in quadrature with respect to each other). These qaudrature signals are in the form of amplified sine waves.

Through electronic decoding logic on the Aerodrive, these quadrature signals can be interpreted as providing 1, 2 or 4 individual steps (machine steps) per one full cycle of sine and cosine.

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Multiplying the Encoder signal by 1, 2, or 4 (X1,X2,X4), involves the manipulation of jumpers and, in case of amplified sine wave Encoders, the changing of resistor values on the Encoder interface module (see Figure 6-14).

ENCODER MULTIPLICATION	MULTIPLIER	R5	R6	R7	R8	JUMPER	JUMPER JP9	JUMPER JP8	JUMPER JP15	JUMPER JP14
SINE WAVE 690C1333	X1	22K	OUT	OUT	43K	2-3	2-3	2-3	2-3	2-3
	X2	22K	OUT	OUT	43K	2-3	2-3	1-2	2-3	2-3
	X4	OUT	43K	22K	OUT	1-2	1-2	2-3	2-3	NONE
Encoder Interface Module							Main Board			

NOTE: Changing resolution will also change system gain. For optimum performance, it may be necessary to change the Accel./Decel. parameter and/or the gain setting of the DAV Drive Module.

6-3-2-5: ADJUSTMENTS

Seven potentiometers and six test points are provided on the Aerodrive module. A description of these pots and test points are as follows (refer to Figure 6-14).

NOTE: If the Aerodrive module is supplied with an Aerotech motor, all adjustments have been factory set for that motor, further adjustments should not be necessary.

P1 ANALOG LOCK GAIN ADJUST

This pot adjusts the sine lock gain for analog lock in the "zero" step (rest) position. Analog lock is adjusted by monitoring testpoint TP3 (with respect to signal common, TP4) and the zero LED indicator. Turning P1 CCW increases the analog lock gain.

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When the motor is at rest (no command pulses), the "ZERO" LED indicator must be energized by adjusting the BALANCE pot P5 (discussed below). When the ZERO LED is energized, the analog lock testpoint (TP3) should be monitored (with an oscilloscope) and both the BALANCE pot P5 and the ANALOG LOCK pot P1 should be adjusted until TP3 reads close to zero volts.

P2 MARKER ADJUST

This pot adjusts the threshold of the Marker (index) input pulse from the incremental Encoder.

P3 AC GAIN ADJUST

This pot adjusts the AC gain of the pre-amplifier. Pots P7 and P6 affect the DC as well as the AC gain of the pre-amplifier as discussed below. Turning the AC GAIN pot (P3) CCW increases the AC gain of the pre-amplifier.

P4 DYNAMIC (DYN) GAIN

This pot adjusts the motor commutation angle relative to motor speed for the purpose of increasing motor torque at higher speeds. Turn the pot CW to increase the commutation angle relative to motor speed.

The motor current feedback signal, which is summed with the current command signal to produce a voltage command signal to the power amplifier (see Figure 6-14), can be monitored at testpoint TP9.

Both the Current Command and Current Feedback testpoints (TP8 and TP9 respectively) provide signal gain ratio of ±4.3 amps per volt.

The summation circuitry for Current Feedback and Current Command (specifically an integral-lead circuit) provides a motor current bandwidth of approximately 1000 Hz (assuming a 2 - 5 milliHenry load inductance).

P5 BALANCE POT

This pot adjusts analog offsets inherent in the pre-amplifier circuit (see Figure 6-13) which can cause position error. This pot is adjusted when the motor is at rest. Set the pot to a position such that the "zero" LED remains lit. Test the setting by making a move and confirming that the "zero" LED lights when the motor comes to a stop.

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P6 VELOCITY FEEDBACK GAIN

This pot adjusts the amount of DC Velocity Feedback Gain to the pre-amplifier. Velocity Feedback is electronically derived from the Encoder (see Figure 6-14). Velocity Feedback has two purposes. First, to provide "damping" to the position control loop to eliminate position loop oscillation. Secondly, the Velocity Feedback provides a means of generating position "following error" in the position loop. Following error provides the desirable effect of eliminating position "overshoot" when operating the motor at high Accel./Decel. rates. Testpoint TP6 provides a monitor for the Velocity Feedback signal. Turning this pot CW increases Velocity Feedback Gain and typically reduces motor positioning response.

P7 COMMAND GAIN

This pot adjusts the amount of DC Velocity Command Gain to the pre-amplifier. Command Velocity is derived from the accumulated difference (or error) between the command pulses from the control board module and the feedback pulses generated by the Encoder. Testpoint TP1 provides a monitor for the Velocity Command signal. The ratio of the voltage of this signal with respect to actual command motor velocity varies with the encoder resolution and the setting of the Velocity Feedback Gain described above, and therefore cannot be directly defined.

NOTE: Adjustment of the COMMAND VELOCITY GAIN pot (P7) and FEEDBACK VELOCITY GAIN pot (P6) may require that the BALANCE pot (P5) be readjusted to obtain the "ZERO" step condition discussed earlier.

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6-3-2-6: ADJUSTING POSITION & VELOCITY LOOP

The DAV4008 and DAV16008 Drive Modules are factory adjusted for given Aerotech Aerodrive motor(s) (i.e., 50SM, 310SM, etc.) shipped with the Unidex 14. *If a user-supplied motor and Encoder is to be used with Unidex 14, Aerotech should be notified of the motor and Encoder parameters at the time of purchase to insure compatibility and proper factory set up.*

If the Motor, Encoder and Translation stage are user supplied, the following adjustment procedure is recommended:

DANGER: PRIOR TO MAKING ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS. MAKE CERTAIN ALL ELECTRICAL POWER SWITCHES ARE IN THE "OFF" POSITION.

NOTE: An oscilloscope is required for the following procedure.

1. If the Motor, Encoder and optional Tachometer are one assembly, disconnect them from the load, if possible.

2. Turn P1 full CW, P3 full CW, P4 mid-range, P5 midrange, P6 full CW, and P7 full CCW. This will set the gain to the lowest adjustable value. Apply power.

3. Write a short program that will run Unidex 14 back and forth with a 1-second dwell between moves. Set the feedrate for 1/3 of the maximum system speed (typically for Aerotech supplied Motors command a velocity of 40,000 steps/second). Set the Accel/Decel rate 400,000 steps/sec^2, linear profiling. Make certain that the move is long enough to affirm that the Motor can accelerate and run at programmed speed.

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4. Adjust P7 (COMMAND GAIN ADJUSTMENT) CW for less that or equal to ±4V of velocity command at testpoint TP1 with respect to testpoint TP4 (SIGNAL COMMON). If the motion stops, the range of the D/A has been exceeded. If this is the case, turn P7 full CW, turn the power OFF and then ON, clearing the fault condition and repeat the preceding procedure. If the range of P7 does not prove sufficient, turn P6 (DAMPING) CCW to decrease following error.

   If the fault condition persists, the problem may be due to one of the following:

   a) The requested program speed exceeds the capabilities of the Motor and Amplifier.

   b) There may not be enough acceleration torque available to accelerate the Motor and/or load up to speed. If this is the case, it may be necessary to decrease the Accel/Decel rate from by a factor of two.

   c) The velocity command is too high with respect to the Dynamic gain pot setting. Turn the Dynamic gain pot further CW.

5. If the load was disconnected in Step 1, reconnect it at this time.

6. Turn the AC gain adjustment, P3, slowly CCW, such that the system begins to oscillate. Turn P3 slowly CW such that system oscillation stops then continue to turn P3 CW 1/8 turn more.

7. The system should now be stable and the gain adjustments very conservatively set (OVER DAMPED). At this point the system should be running the program of Step 5 very smoothly. To optimize positioning time, run the program of Step 5 at maximum system speed (typically 90,000 steps/second) and turn P7 (COMMAND GAIN) further CW, to achieve the results at testpoint TP1 (VELOCITY COMMAND) as shown in Figure 6-12. If the range of P7 is not sufficient, it may be necessary to turn P6 (DAMPING) further CCW. If adjustment is made to P6 you must also readjust P3 (AC GAIN). (Follow the procedure outlined in Step 6.)

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8. Increase the Accel/Decel rate until you start to notice overshoot at testpoint TP1 (VELOCITY COMMAND).

9. To adjust the Balance it is necessary to adjust the P1 (ANALOG LOCK GAIN) and P5 (BALANCE ADJUSTMENT). With the system at rest, adjust P5 until the "Zero" indicator LED is lit on the front of the Unidex 14. Connect the probe of the oscilloscope to testpoint TP3 (LOCK SIGNAL) and the common of the oscilloscope to testpoint TP4 (SIGNAL COMMON). Turn P1 (ANALOG LOCK GAIN) mid-range and adjust P5 (BALANCE) for zero volts (±.5V) at testpoint TP3. Execute a one step move and adjust P1 for approximately 25% overshoot at testpoint TP3 upon completion of the move with little or no ringing (as shown in Figure 6-13). After adjusting P1 it may also be necessary to readjust P5.

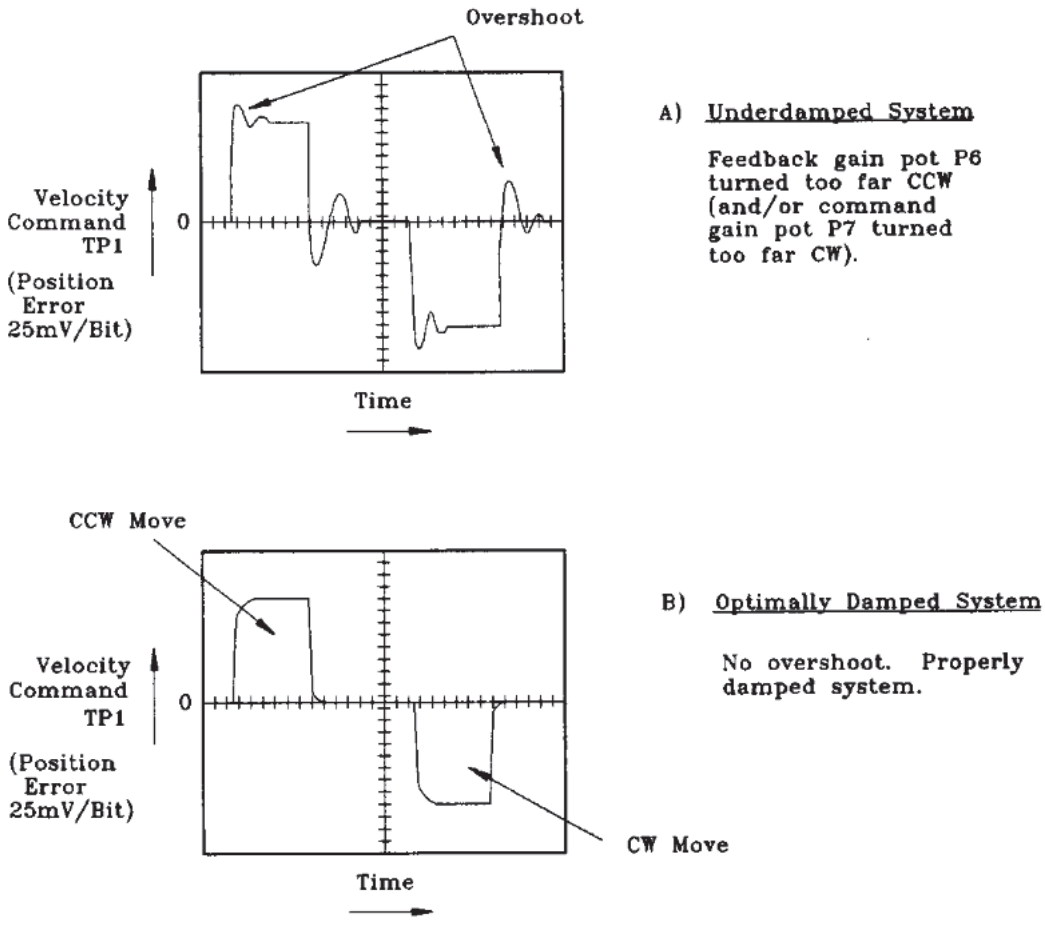


Figure 6-12: Velocity Command refers to TP1 for Underdamped (A), and Optimally Damped (B), Position Loop Response

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NOTE: The velocity command shown in Figure 6-12 also represents the position error which is scaled to a 25mV/machine step.

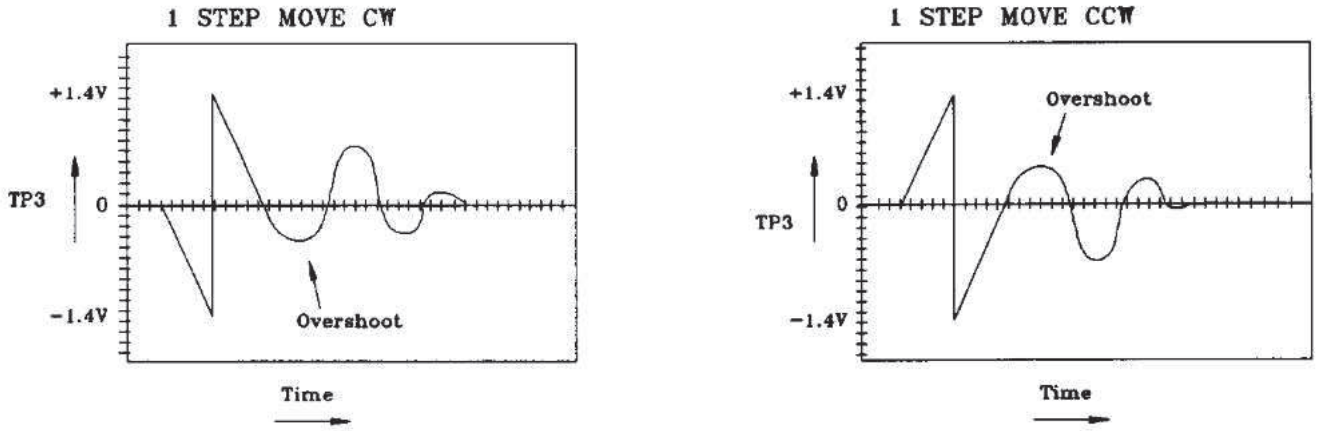


Figure 6-13: Analog Lock Signal at TP3

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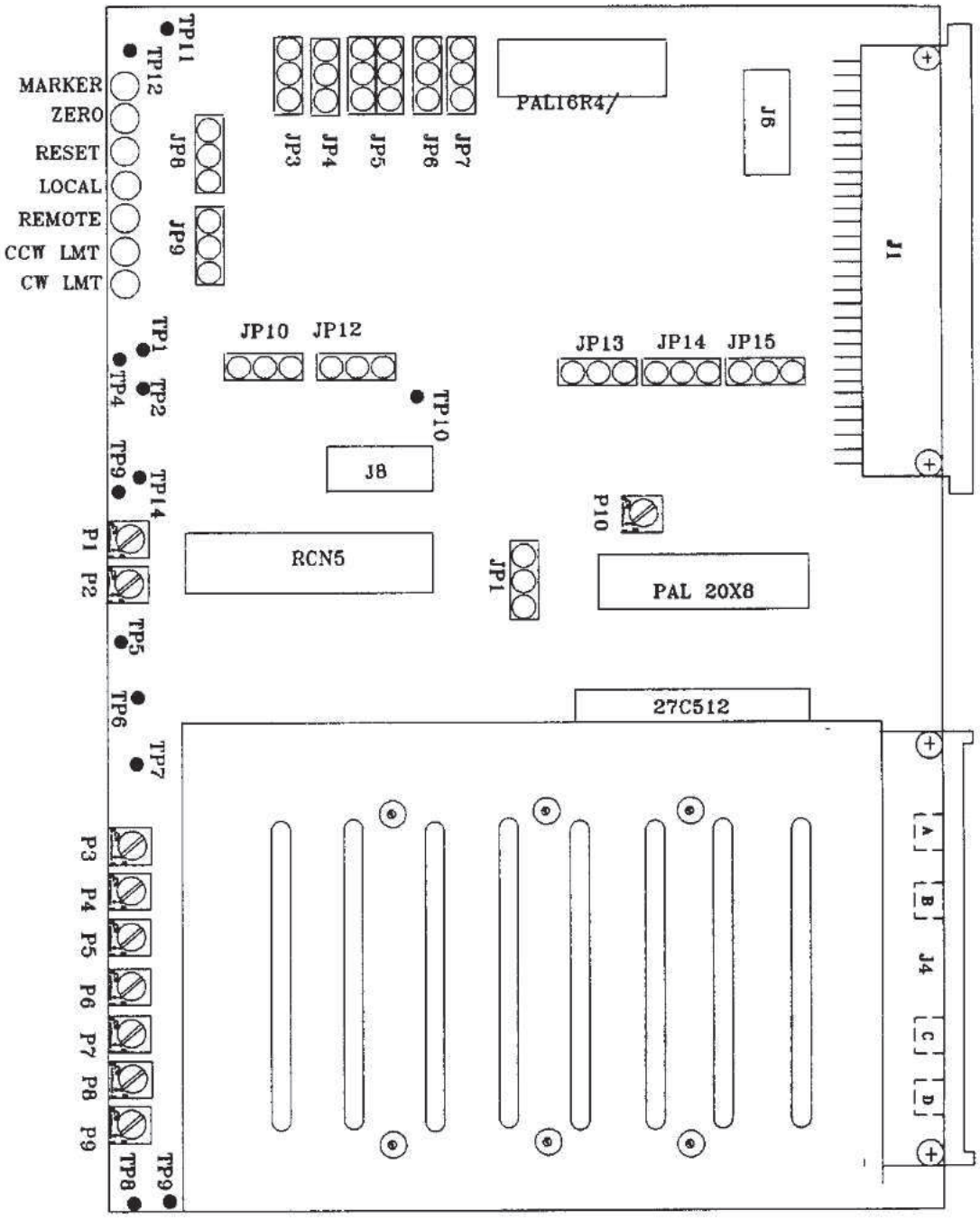


Figure 6-14: Outline of the DAV4008 and DAV16008 Drive Module

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AERODRIVE P/N	DAV4008	DAV4008	DAV16008	DAV16008
MOTOR P/N	50SM	101SM	310SM	1010SM
STATIC TORQUE (PEAK) OZ.IN. (CONTINUOUS)	55 38	200 90	570 370	1150 1050
PEAK TORQUE AT 2000 RPM (OZ.IN.)	10	55	150	200
MOTOR OUTPUT POWER (WATTS)	14	62	290	400
MOTOR ROTOR INERTIA OZ-IN-SEC ^{2} KG-M ^{2}	 1.66E $^{-3}$ 11.8E $^{-6}$	 5E $^{-3}$ 35E $^{-6}$	 26.5E $^{-3}$ 187E $^{-6}$	 114E $^{-3}$ 805E $^{-6}$
MOTOR FRAME NEMA 2	23	23	34	42
POSITION RESOLUTION	2000 STEP/REVOLUTION (STANDARD)			
DRIVE VOLTS (DC) AMPS TYPE	 40 1 BIPOLAR	 40 5 BIPOLAR	 60 6 BIPOLAR	 160 8.6 BIPOLAR
WEIGHTS MOTOR (LBS.) (KG) MOTOR/DRIVE (LBS.) (KG) (INCLUDES ALL INTER-CONNECTING CABLES)	 2.3 1,04 17.3 7,85	 3.6 1,63 18.6 8,44	 8.1 3,67 23.5 10,66	 20 9,07 30 13,61
INPUT POWER VOLTS (50/60 HZ) AMPS (ALLOWABLE VOLTAGE TOLERANCE- +/-10% MAX)	 115/220-240 .5	 115/220-240 1	 115 ONLY 3	 115 ONLY 4

Table 6-4: DAV4008 and DAV16008 Specifications

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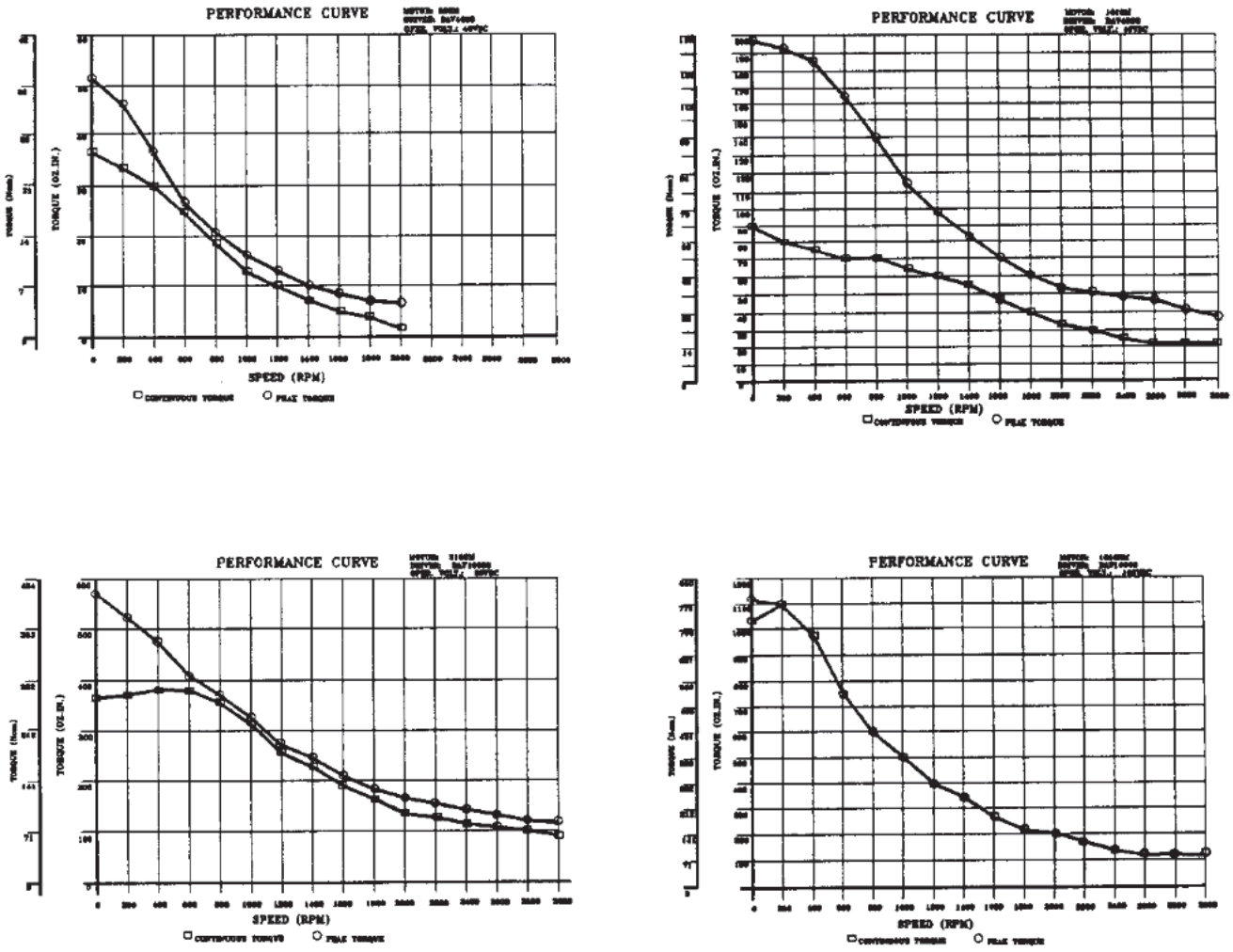


Figure 6-15: DAV4008 and DAV16008 Torque/Speed Curves

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SECTION 6-4: POWER SUPPLY BOARD

6-4-1: CIRCUIT DESCRIPTION

The Power Supply board (module) is provided for use with the DMV8008, DMV16008, the DSL3015, DSL4020, DSL8020 and DSL16020, as well as the DAV4008 and DAV16008. This module provides +5VDC and ±12VDC control voltages to the DMV, DSL and DAV Drive modules (note that D3001, D1401, DM1501, DM4001, DM4005 and DM6006 Stepping Drive modules do not require this board for control power generation since all control and motor supply voltages are generated on the board).

An outline of the Power Supply board is shown in Figure 6-16.

A DC Shunt Regulator circuit is also provided on the Power Supply board to clamp excessive regenerative energies present when motors with high inertial loads are decelerating. The Shunt Regulator (slot P5) can only accommodate one DC bus power supply & must shunt the power supply associated with Drive module slot P4. If P3, P2 and P1 share the same supply as slot P4, these slots also share shunt regulation.

The Shunt Regulator circuit is factory set to operate with DC Bus voltages of ≤80V or 160V (DMV16008, DSL16020 and DAV16008 only).

Referring to Figure 6-16, it can be noted that eight testpoints are provided as monitor points for the user. These testpoints are described as follows:

TP5 +5VDC (for Encoders, Optical Markers, or Optical Limit Switches)
TP6 +5VDC (for DMV and DSL Series Drive Modules)
TP8 +12VDC (for DMV and DSL Series Drive modules)
TP7 -12VDC (for DMV and DSL Series Drive modules)
TP4 Signal common
TP1 +DC bus voltage (Shunt Regulator bus voltage)
TP3 +DC bus voltage return (reference point for Shunt Regulation)
TP2 Shunt Regulation switching reference

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The voltage at which the Shunt Regulator circuit begins to function (the Shunt Voltage Threshold) is adjustable via potentiometer P2 (see Figure 6-16). This pot is set at the factory for a threshold of 95 VDC for all bus voltages of 80V or less, and for a threshold of 185VDC for a bus voltage of 160VDC.

If it is necessary to change these settings, the Shunt Regulator Threshold can be readjusted by monitoring TP2 with respect to TP3. The voltage on TP2 will switch between the given bus voltage and zero when the Shunt Voltage Threshold is reached. Turning P2 CCW decreases the Voltage Threshold point, and turning P2 CW increases the Voltage Threshold point. The range of P2 adjustment is from 80VDC to 200VDC. The Shunt Voltage Threshold is typically adjusted by first accelerating and decelerating all motors simultaneously at full speed while monitoring TP2. The regenerative bus voltage level should not be allowed to exceed 20% of the rated drive voltage while the motors are decelerating. Note that excessive shunt regulation will cause F5 to open.

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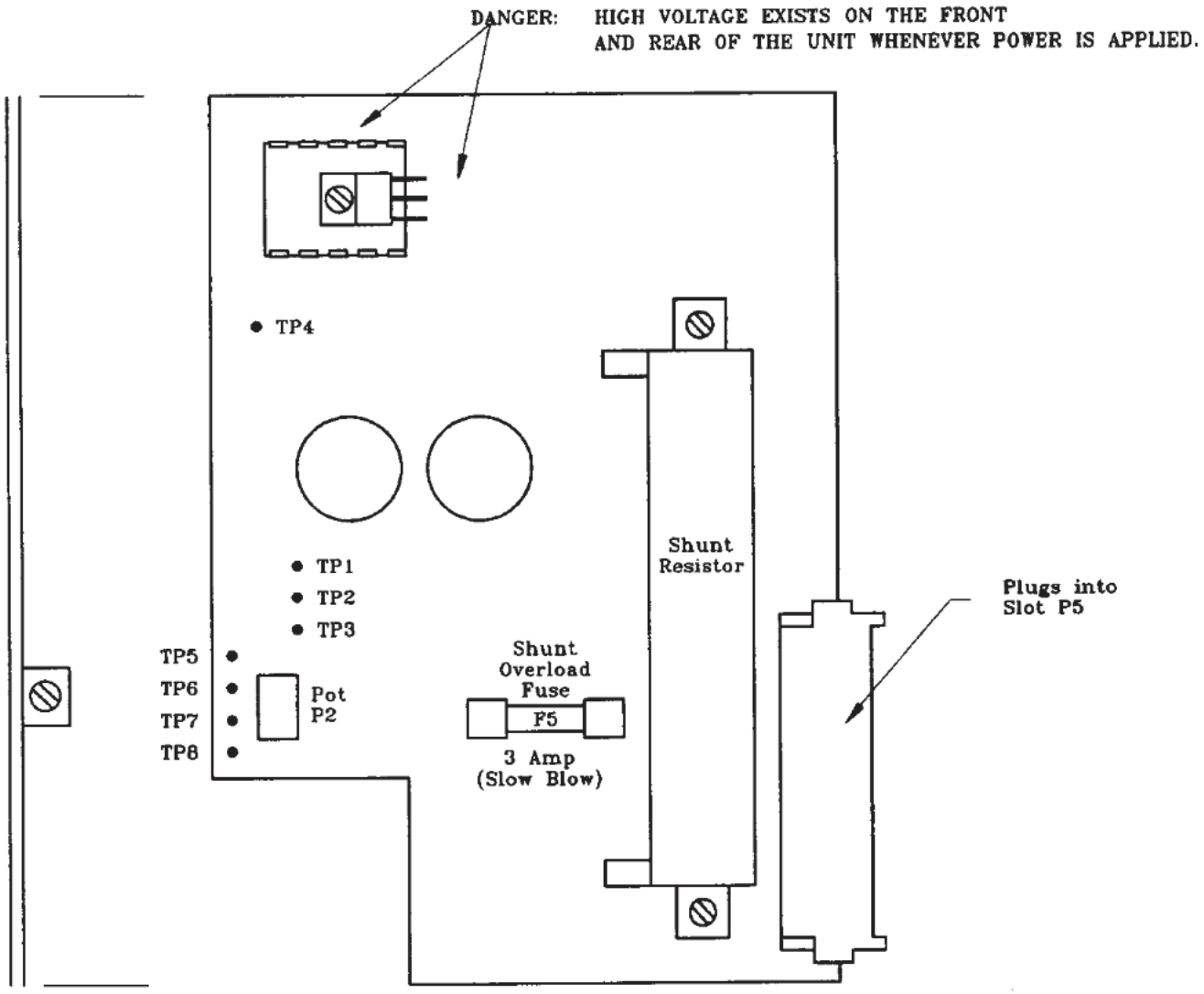


Figure 6-16: Outline of the Power Supply Board Module

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CHAPTER 7: STEPPING DC SERVO & AERODRIVE MOTORS

SECTION 7-1: HARDWARE SPECIFICATIONS

Dimensional data for Stepping, DC Servo and Aerodrive motors used with the Unidex 14 family of Drives is illustrated in this section.

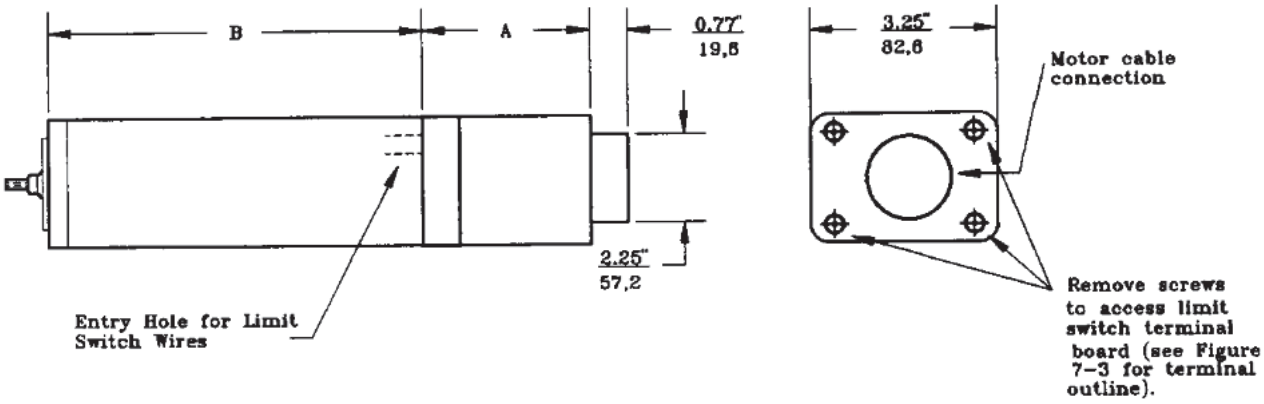
Figure 7-1 shows dimensional data for the DC Servo motors. Figure 7-2 shows dimensional data for the Stepping motors. Detailed mechanical data such as shaft lengths and shaft keying are not shown in these figures. This data is supplied in separate documents.

Figure 7-3 shows pin-out assignments for the Limit Switch interface board associated with most of the motors illustrated in Figure 7-1 and 7-2.

Figure 7-4 provides dimensional data for the Unidex 14 Control enclosures.

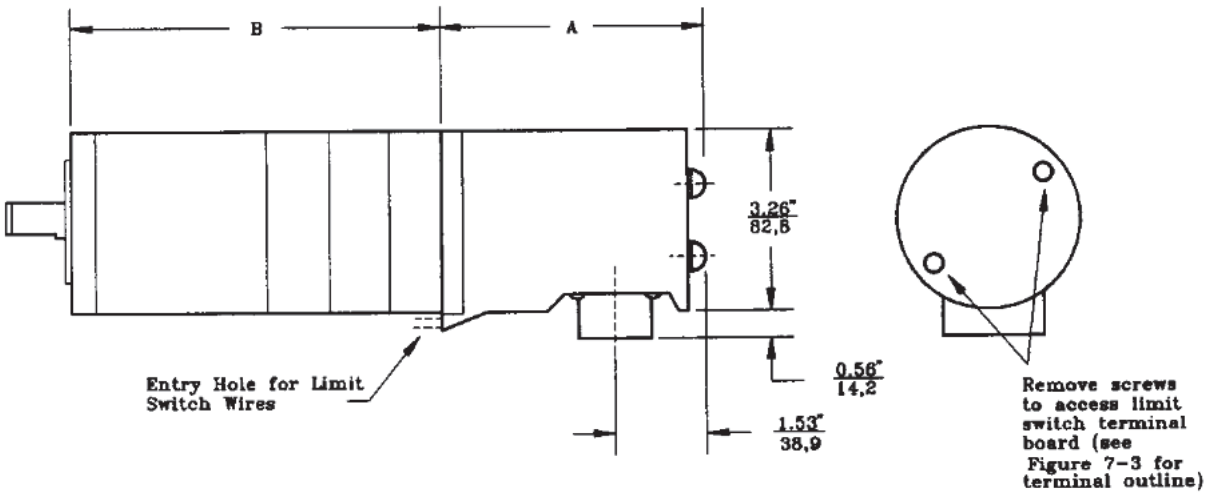
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MS01 – 1017LT, 1035LT, 1050LT Motors



	A	B
1017LT	2.91" 73,9	3.30" 83,8
1035LT	2.91" 73,9	4.11" 104,4
1050LT	2.91" 73,9	4.91" 124,7

MS01 – 1075LT, 1135LT Motors

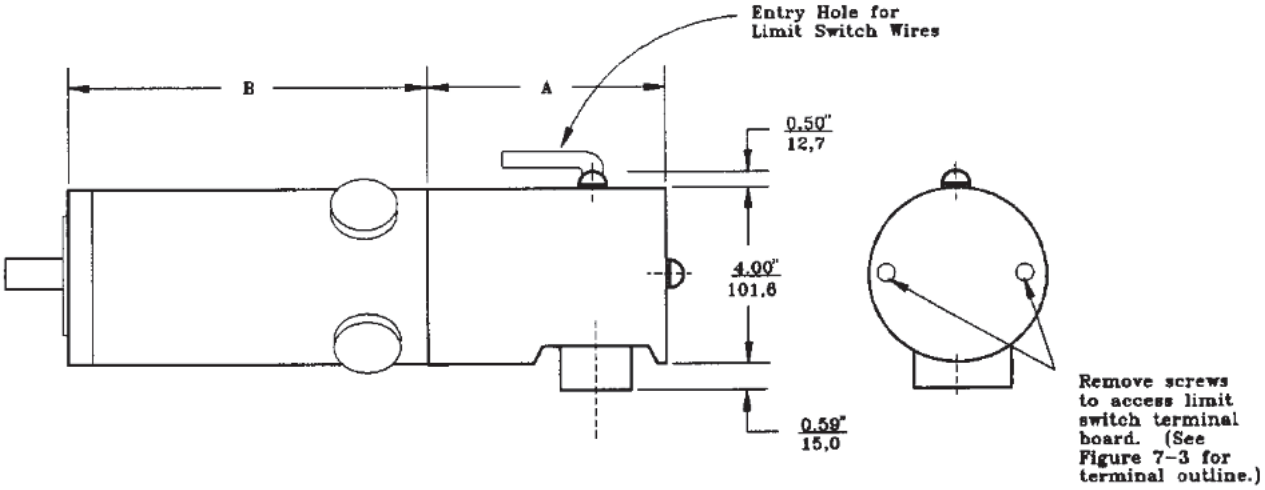


	A	B
1075LT	4.85" 123,2	4.88" 124,0
1135LT	4.85" 123,2	6.38" 162,1

Figure 7-1: Mechanical Dimensions for Unidex 14 DC Motors

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MS01 – 1210LT, 1410LT Motors

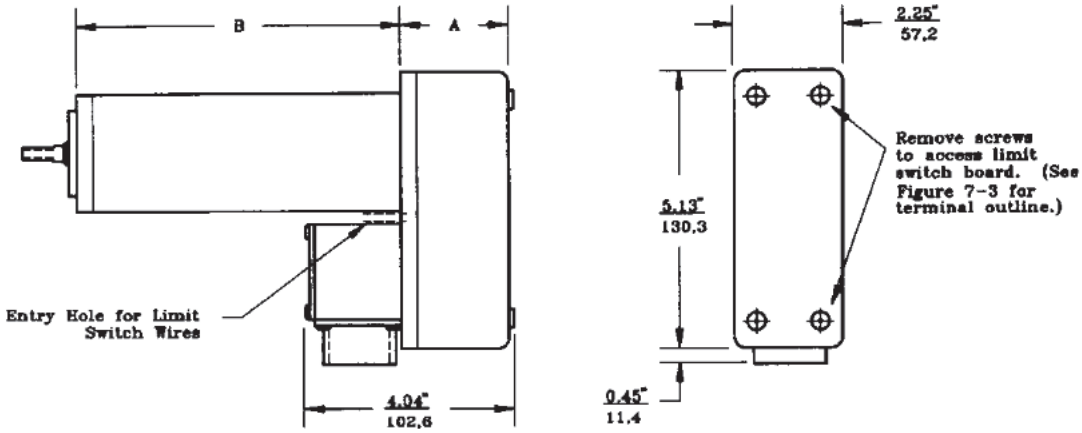


	A	B
1210LT	4.34" 110,2	5.34" 135,6
1410LT	4.34" 110,2	6.84" 173,7

Figure 7-1: Continued

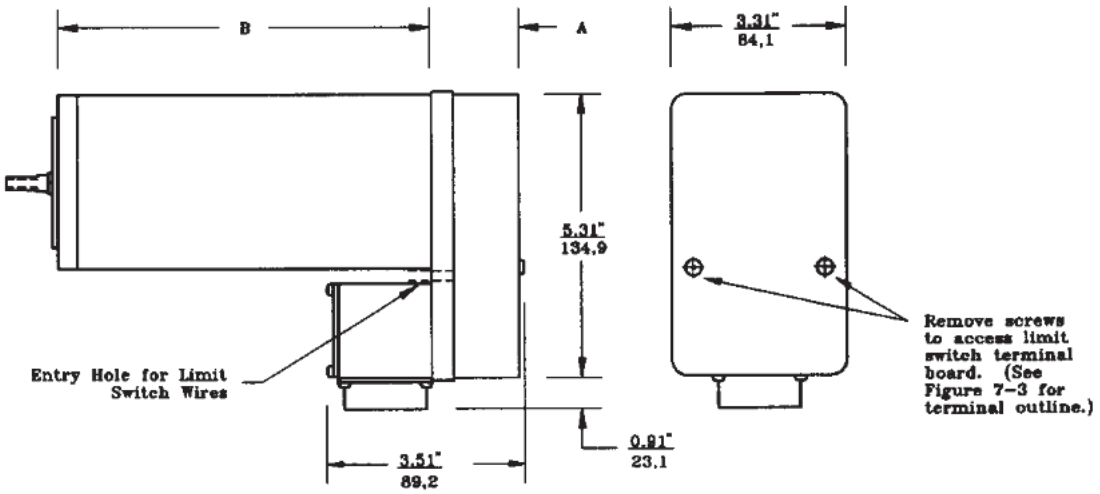
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MSOF – 1017LT, 1035LT, 1050LT Motors



	A	B
1017LT	2.12" 53.8	3.30" 83.8
1035LT	2.12" 53.8	4.11" 104.4
1050LT	2.12" 53.8	4.91" 124.7

MSOF – 1075LT, 1135LT Motors

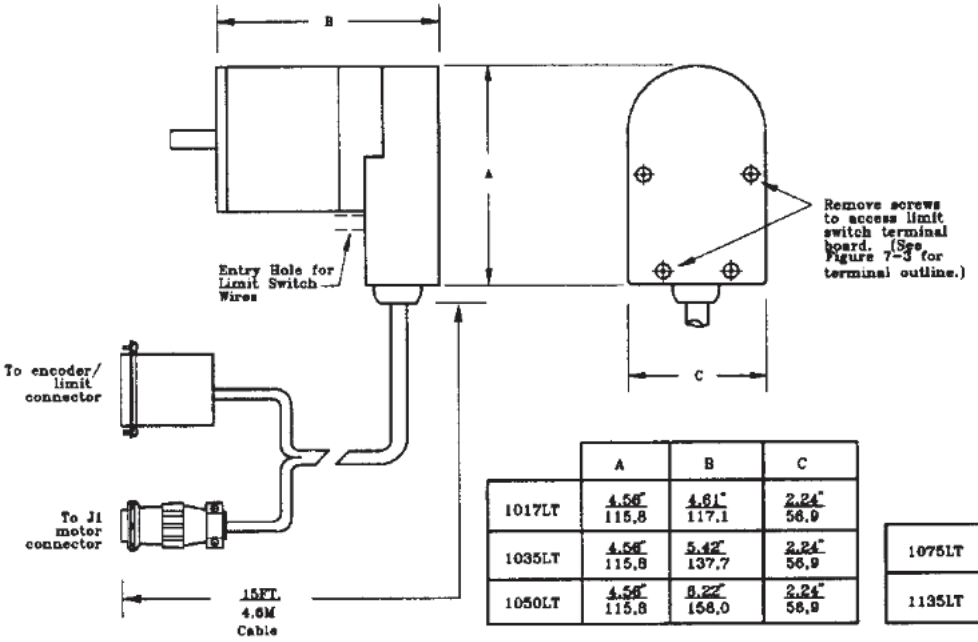


	A	B
1075LT	1.60" 40.6	4.88" 124.0
1135LT	1.60" 40.6	6.38" 162.1

Figure 7-1: Continued

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DC2 – 1017LT, 1035LT, 1050LT Motors
DC3 – 1075LT, 1135LT Motors



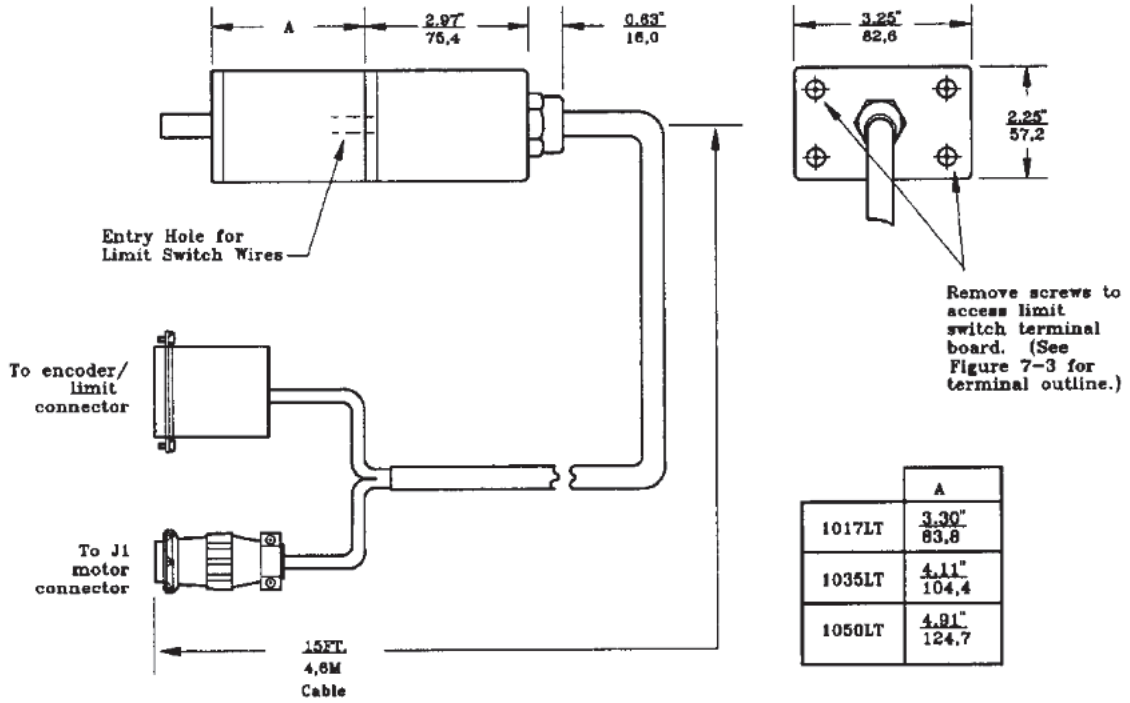
	A	B	C
1017LT	4.56" 115,8	4.61" 117,1	2.24" 56,9
1035LT	4.56" 115,8	5.42" 137,7	2.24" 56,9
1050LT	4.56" 115,8	6.22" 158,0	2.24" 56,9

DC2

	A	B	C
1075LT	5.25" 133,3	6.25" 158,8	3.24" 82,3
1135LT	5.25" 133,3	7.73" 196,4	3.24" 82,3

DC3

DC2E – 1017LT, 1035LT, 1050LT

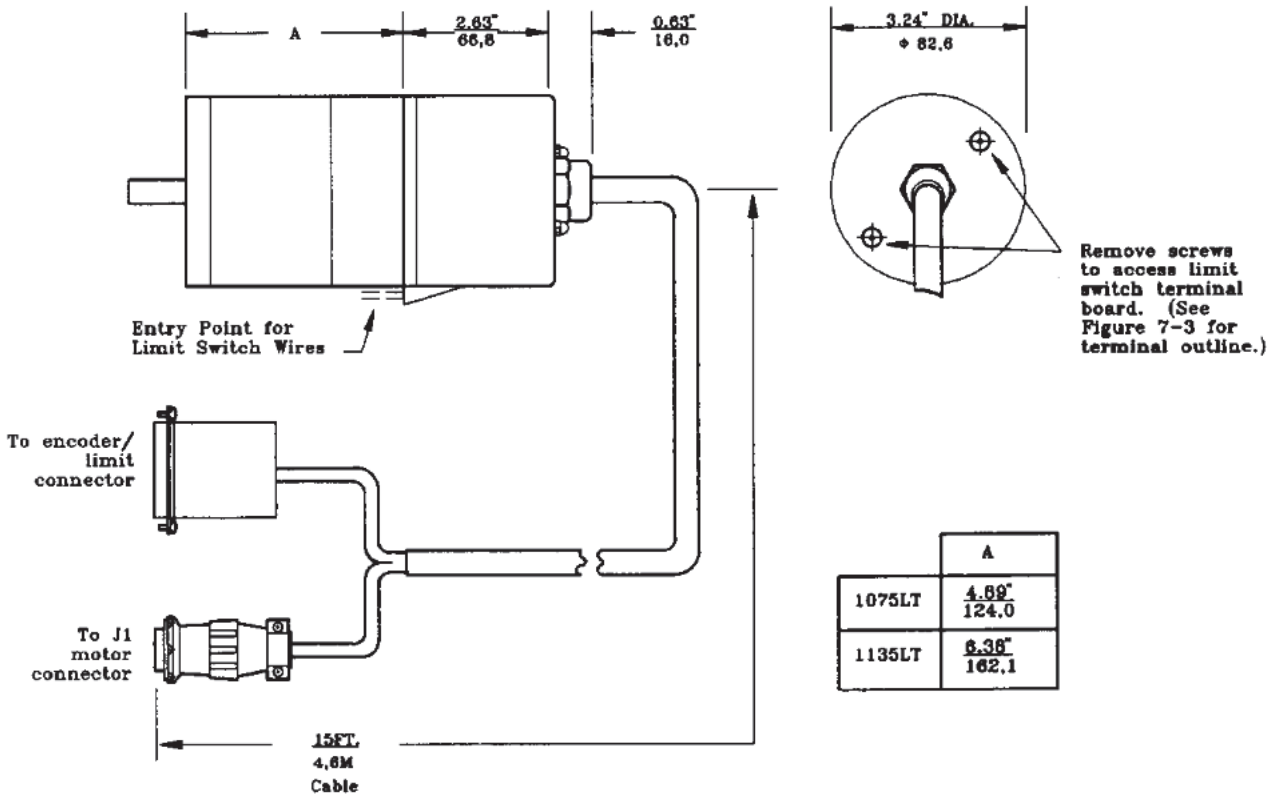


	A
1017LT	3.30" 83,8
1035LT	4.11" 104,4
1050LT	4.91" 124,7

Figure 7-1: Continued

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DC3E – 1075LT, 1135LT

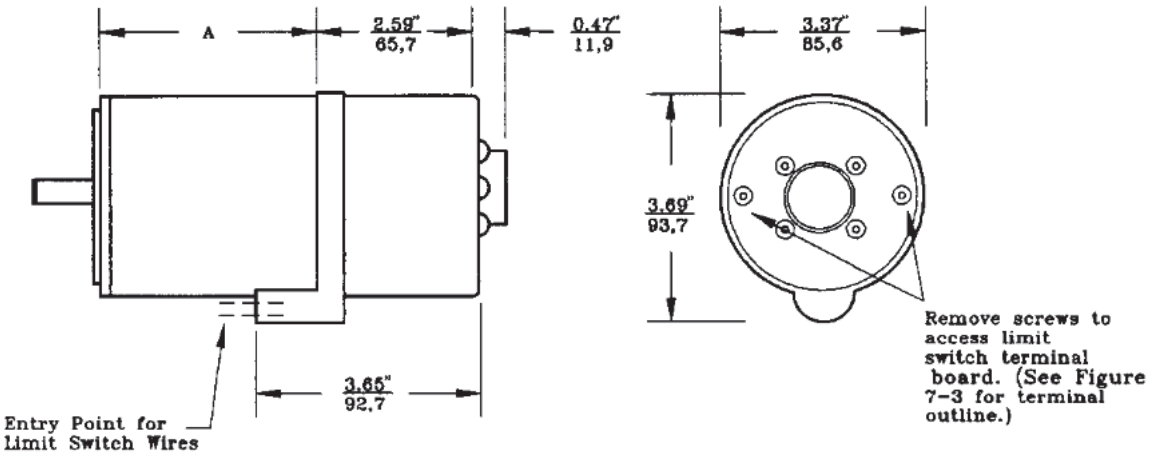


	A
1075LT	4.89" 124.0
1135LT	6.36" 162.1

Figure 7-1: Continued

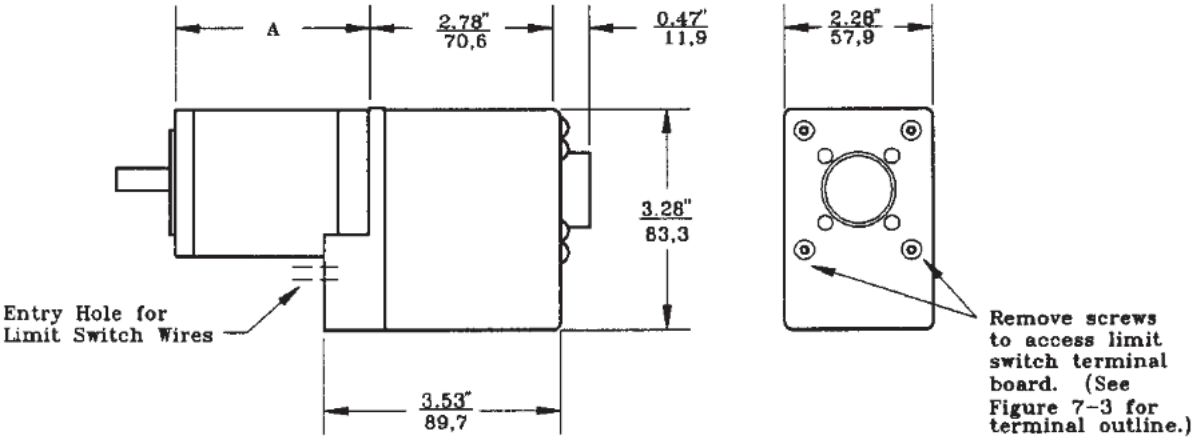
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B3E-HM – 300SM, 310SM Motors
B3E-EXXXAS 310



	A
300SM	5.06" 128,5
310SM	5.06" 128,5

B2E-HM – 50SM, 101SM Motors
B2E-EXXXAS 50 or 101

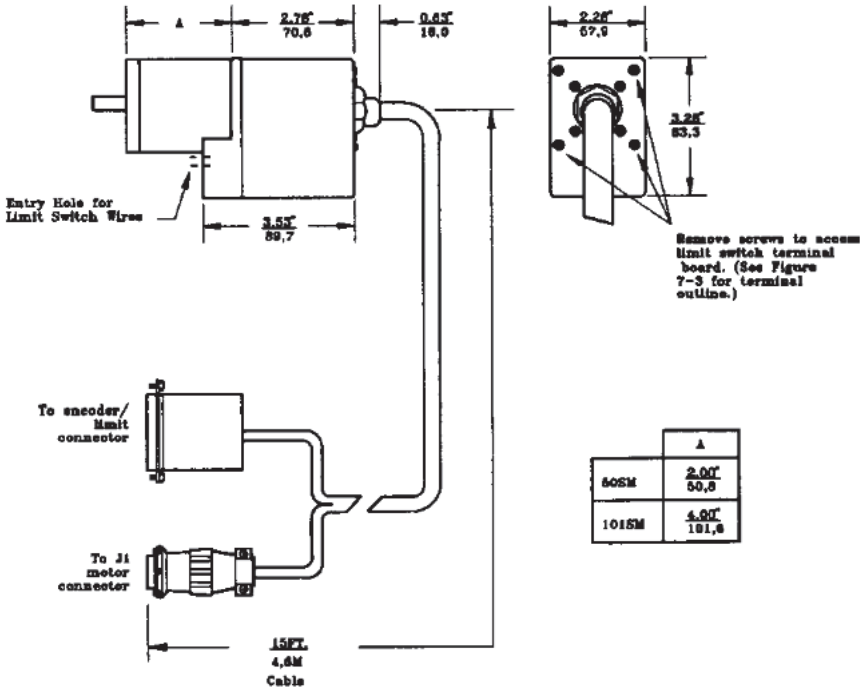


	A
50SM	2.00" 50,8
101SM	4.00" 101,6

Figure 7-2: Mechanical Dimensions for Unidex 14 Stepping/Aerodrive Motors

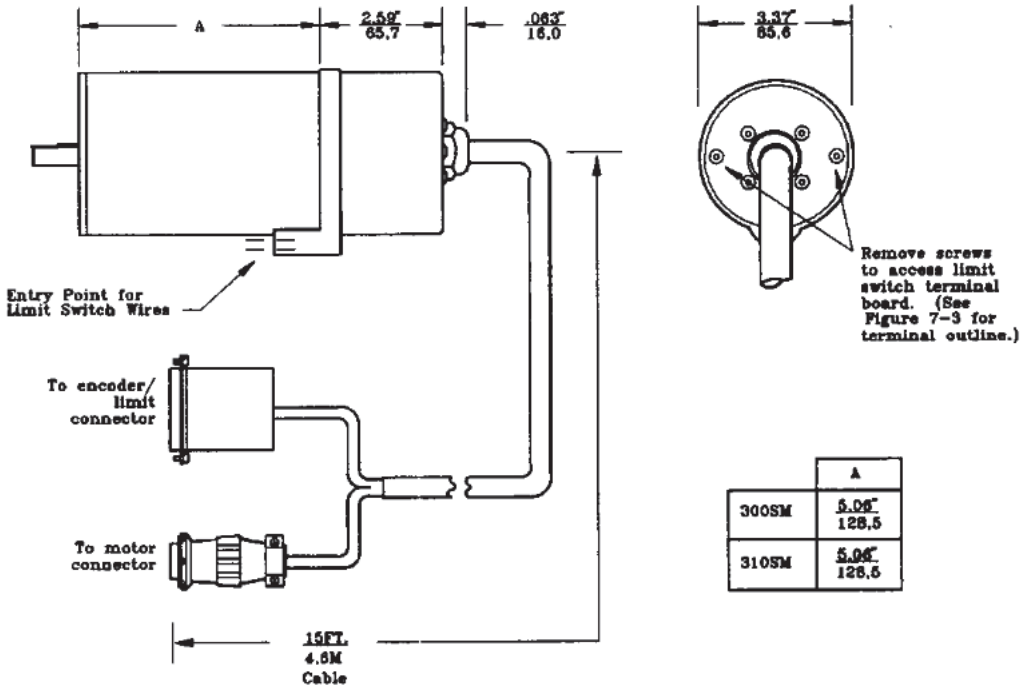
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C2E-HM - 50SM, 101SM Motors
C2E-BXXXAS 50 or 101



	A
50SM	2.00" 50.8
101SM	4.00" 101.6

C3E-HM - 300SM, 310SM Motors
C3E-BXXXAS 310

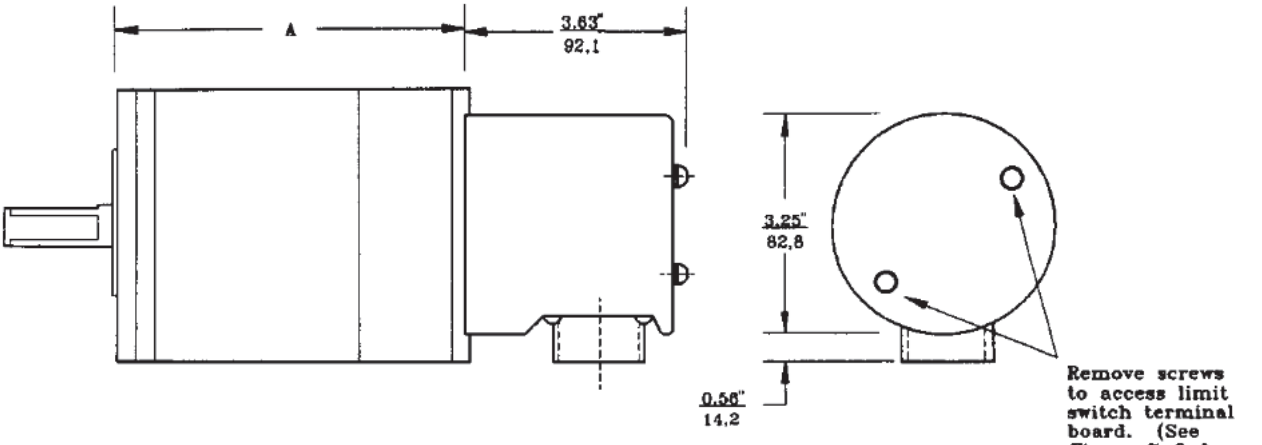


	A
300SM	5.06" 128.5
310SM	5.06" 128.5

Figure 7-2: Continued

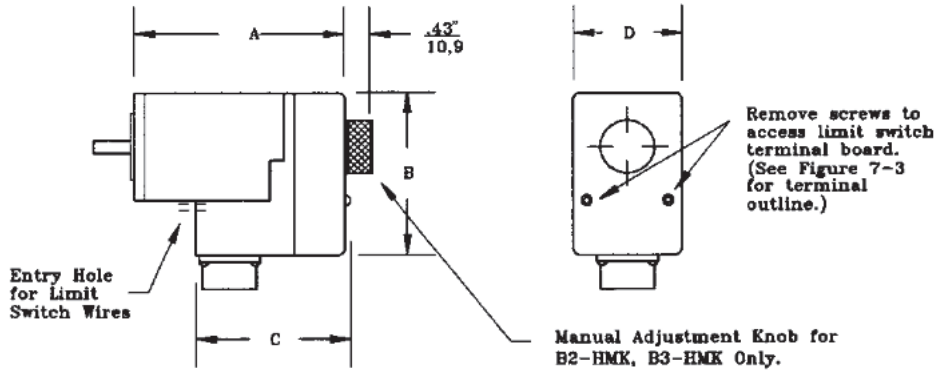
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B4-HM - 510SM, 1010SM Motors
B4-EXXXAS 510 or 1010



	A
510SM	5.44" 138,2
1010SM	7.56" 192,1

B2-HM, B2-HMK - 50SM, 101SM Motors
B2-EXXXAS 50 or 101
B3-HM, B3-HMK - 300SM, 310SM Motors
B3 EXXXAS 310 only



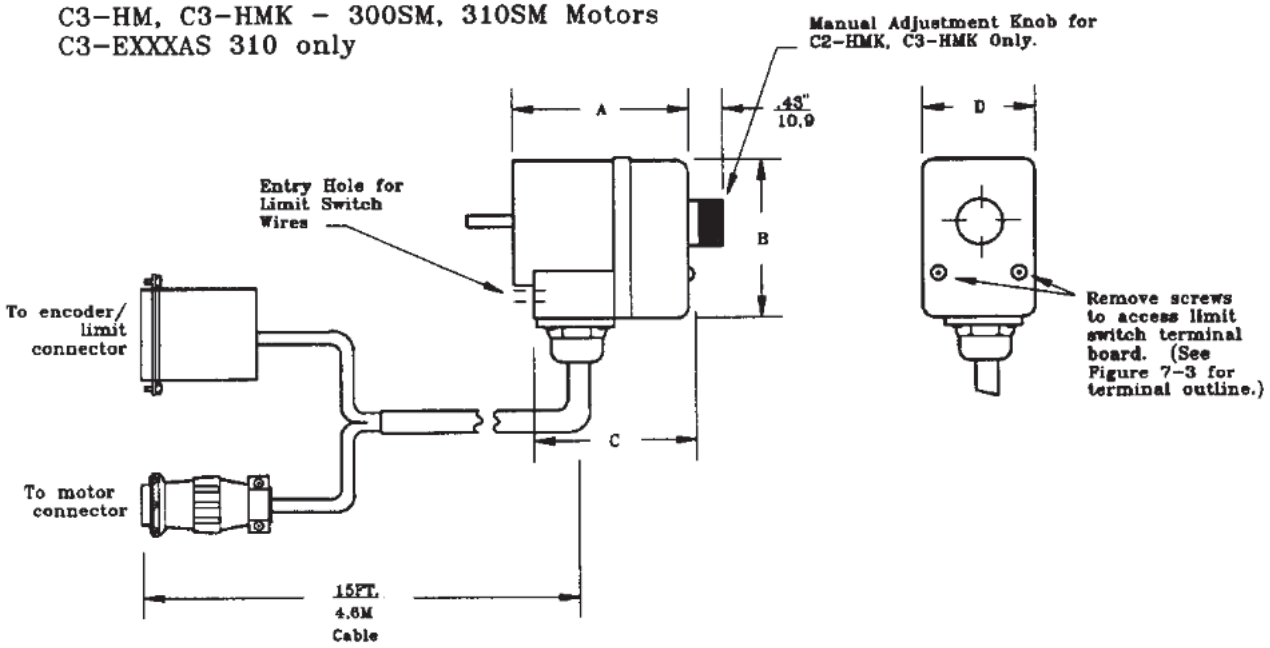
	A	B	C	D
50SM	3.32" 84,3	3.28" 83,3	3.04" 77,2	2.28" 57,9
101SM	5.32" 135,1	3.28" 83,3	3.04" 77,2	2.28" 57,9

	A	B	C	D
300SM	6.51" 165,3	4.12" 104,7	3.45" 87,6	3.40" 86,4
310SM	6.51" 165,3	4.12" 104,7	3.45" 87,6	3.40" 86,4

Figure 7-2: Continued

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C2-HM, C2-HMK - 50SM, 101SM Motors
C2-EXXXAS 50 or 101
C3-HM, C3-HMK - 300SM, 310SM Motors
C3-EXXXAS 310 only

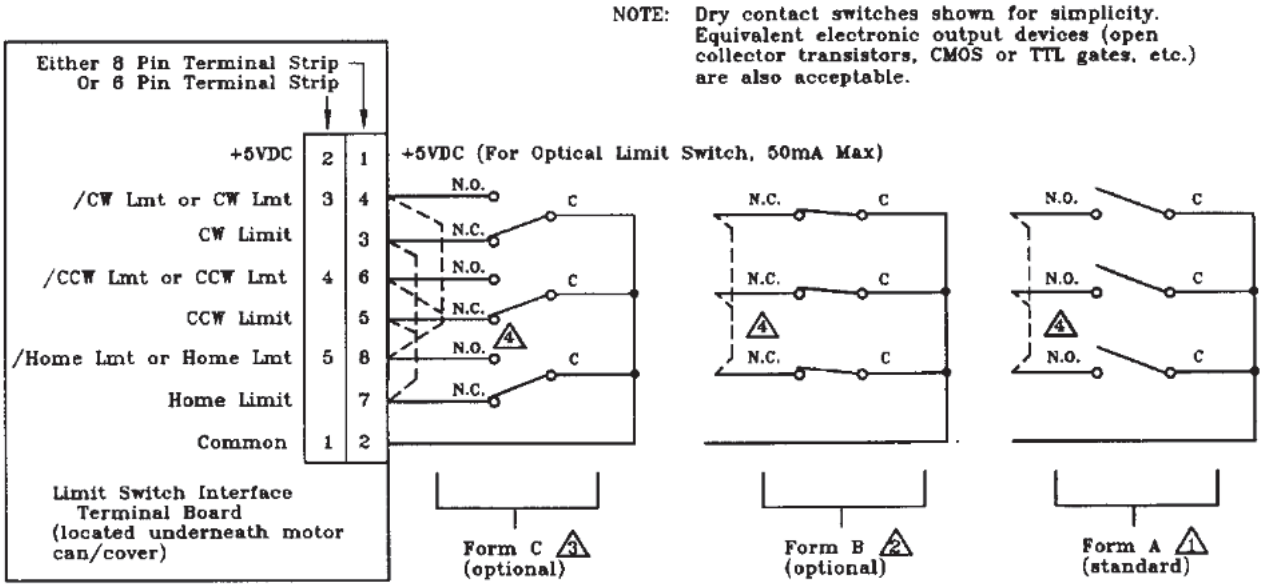


	A	B	C	D
50SM	3.32" 84,3	3.26" 83,3	3.04" 77,2	2.28" 57,9
101SM	5.32" 135,1	3.26" 83,3	3.04" 77,2	2.28" 57,9

	A	B	C	D
300SM	6.51" 165,3	4.12" 104,7	3.45" 87,6	3.40" 86,4
310SM	6.51" 165,3	4.12" 104,7	3.45" 87,6	3.40" 86,4

Figure 7-2: Continued

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1 Form A, normally open (switch closes when in limit). Standard configuration unless otherwise specified.

2 Form B, normally closed (switch opens when in limit). Optional configuration.

3 Form C (used with limit debounce latch). Optional configuration. If use is required, contact factory.

4 All Unidex 14 Controllers are configured to accept (require) Home limit inputs. This input may come from an independent switch (cam option on rotary stages) or may be paralleled from the CCW (standard) or CW (optional) limit switches (on linear stages).

Figure 7-3: Limit Switch Terminal Board Definitions

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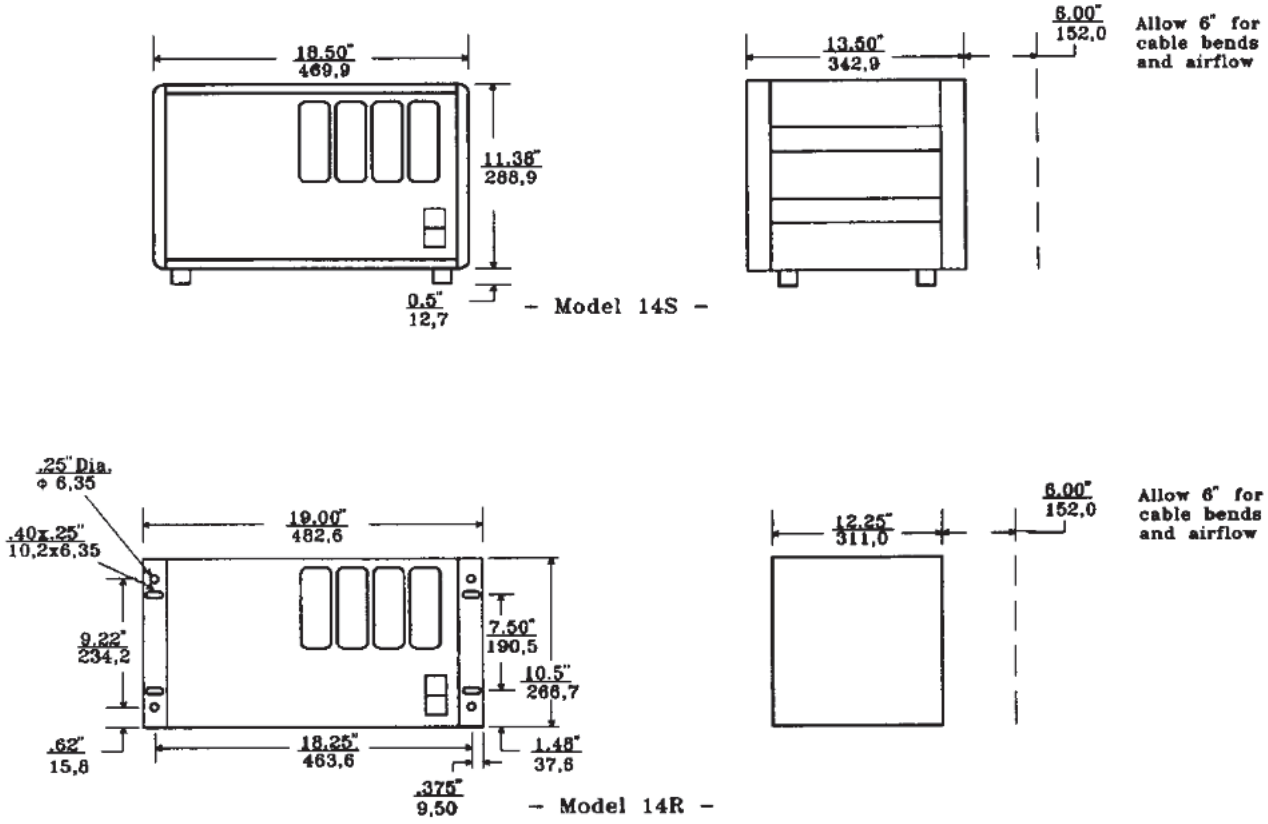


Figure 7-4: Dimensional Data for the Unidex 14 Family of Controllers

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CHAPTER 8: COMMAND STRUCTURE

SECTION 8-1: INTRODUCTION

An extensive command structure is built into the Unidex 14. It includes a 200 command and parameter buffer for each axis and a command loop counter which allows multiple executions of any command string.

All of the commands are two ASCII characters and some of them expect a numerical operand to follow. These commands are identified with a '#' after the command. The operand must be terminated by a space, carriage return or semi-colon to indicate the end of the number. No terminator is required on the other commands, but may be included to improve readability. This operand must immediately follow the command with no space or separation character.

If User units are not enabled,the '#' indicates that a signed numerical input parameter is required. If User units are enabled fixed point number of the format ##.# is required. With User units enabled, distances, velocity andacceleration parameters will be input in the specified units.

Synchronized moves may be made by entering the AA command. This command performs a context switch which allows entering the commands in the format MRx#,y#,z#,t#;. Numbers are entered for each axis that is commanded to move. An axis may be skipped by entering the comma with no parameter. The command may be prematurely terminated with a ";", i.e. a move requiring only the X and Y axes would use the command MRx#,y#; followed by the GO command. Each axis programmed to move will start together upon executing the GO command. The Unidex 14 can be switched back to the unsynchronized mode by entering the desired axis command such as AX.

The AM command is provided for complex applications where the host manages multiple motion processes by a multitasking operating system. This mode shares the same instructions as the AA mode but allows starting a task while some other task involving one or many axes is active. For example the X and Y axes could be doing linear interpolation while the Z axis is making an unrelated move simultaneously.

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The constant velocity contouring provides a fourth mode wherein the move parameters are predefined by entering AA then CD#,#;. The Unidex 14 will then calculate the move profile in advance and move at constant velocity in the prescribed pattern as required for machine tool and other applications. It can do linear interpolation on all 4 axes between the predefined points or it can do circular interpolation mixed with linear on two axes.

The input characters are placed in a circular queue on input then removed and interpreted. The commands are then placed in separate circular queues for each axis. As they are executed the space is reclaimed allowing the host to pass commands ahead of the moves actually being processed. The tables following each command in this section define the queue requirements for each command in each command mode for reference. The RQ command may be used to determine the actual space available at any time. The queues operate independently allowing each axis to perform separate processes simultaneously.

The synchronized modes (AA) insert special wait opcodes which allow the axes to be synchronized in this mode. When the commands are nested within loops, the queue space is not reclaimed until after the loop has been executed the programmed number of times. For loops larger than the queue space, the loop may never be completed since it cannot reclaim the queue space and cannot accept the loop terminator. The RQ command may be used to examine the remaining queue space. A control-D may clear this condition if the input character queue is not also filled since it bypasses the command interrupter.

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SECTION 8-2: AXIS SPECIFICATION COMMANDS

The following commands set the context, directing the commands to the appropriate axis. They remain in effect until superseded by another command of the same type specifying a different axis. Most of the commands are placed in the appropriate command queue to be executed while others are executed immediately, allowing the return of status information in a timely way rather than when encountered in the command stream.

Queue status is provided in table format for each command. Commands that are not queued are indicated by an "immediate" status. The single axis cases are indicated by the mode reference designating the appropriate axis. The synchronized mode is indicated by the mode identifier AA. The contouring case is indicated by AA/CD for multiple axes in contour definition mode.

The syntax example also illustrates the applicable mode (AA,AX,AY,AZ,AT,AA/CD).

NOTE: **All of the commands in this section are modal (remain in effect until superseded by another command of the same type) so the axis mode specifier is not required to immediately precede the command example.**

AA AXIS ALL

The AA command will perform a context switch to coordinated moves.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AA MA30, -73, ,11; GO

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AM AXES MULTITASKING

The AM mode allows several tasks to be managed simultaneously. A task may be performing coordinated motion on 2 axes while a second task is performing unrelated but simultaneous motion on a third axes.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

AX AXIS X

The AX command sets the context to direct all the following commands to the X axis. This mode is the default at power up or reset.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX MT-46793; GO

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AY AXIS Y

The AY command sets the context to direct all the following commands to the Y axis.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AY MR-46793; GO

AZ AXIS Z

The AZ command sets the context to direct all the following commands to the Z axis.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AZ LP-91263;

AT AXIS T

The AT command sets the context to direct all the following commands to the T axis.

QUEUE REQUIREMENTS

MODE	
AX-AV	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AT VL15000;

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SECTION 8-3: SYSTEM CONTROL COMMANDS

These commands allow control of various system parameters and operating modes to allow the user to optimize the response of the system for his/her application needs.

EN ECHO ON

The EN command enables echoing. All commands and parameters will be echoed to the host. This mode is useful for debugging command strings from a terminal. This mode also outputs English readable error messages to the host which may be echoed to the terminal or computer to aid in debugging.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Not valid
AA/CD	Not valid

Example: Enable echoing by the Unidex 14 so that commands are echoed and error messages are returned to the host in readable ASCII strings. This command would probably be the first command executed after turning on the system when this mode is desired.

Enter: EN

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EF ECHO OFF

The EF command disables echoing from the Unidex 14 motion system. This is the default mode at power up or reset.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Not valid
AA/CD	Not valid

Example: Stop echoing to the terminal.

Enter: EF

HH HOME HIGH

Sets the sense of the home switches to active high. This allows the use of a normally closed switch.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

(See HL command for example)

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HL HOME LOW

Sets the sense of the home switches to active low. This is the default setting on reset or power up.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Example: A faster home sequence may be used in applications which have a long distance to travel to reach home. The stage is moved through home at high speed with the home switch set for active high then reversed at low speed to meet the 1024 steps per second requirement of the home command.

Enter: AX VL20000 HH HM0
VL1000 HL HR0

Note: See BL# command for hardware home command.

LF LIMITS OFF

The LF command disables the sensing of the limit switches for the addressed axis, by the Unidex 14 indexer card. The drive modules themselves prevent overtravel by means of hardware sense circuit.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Syntax: AX LF;

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LN LIMITS ON

The LN command restores the operation of the limit switches for the addressed axis. This is the default state on power up or reset.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Syntax: AY LN;

CN COSINE ON

Enable cosine velocity ramps, i.e. half sinusoid acceleration profiles for all axes. The cosine is not truncated in moves that do not reach full speed. See Chapter 2 for explanation of velocity profiles.

NOTE: This command should not be given while an axis is in motion or the results may be unpredictable.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AA CN;

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PN# PARABOLIC ON

Sets all axes to truncated parabolic ramps. This acceleration profile starts at 100% of the programmed acceleration and decreases in steps of 10% of the initial acceleration down to a low of 10%. The parameter supplied selects the number of steps. It must be in the range of 3 to 10 corresponding to 70% and 10% acceleration at the peak respectively. A parameter out of this range or no parameter supplied defaults to 70% or 3 steps. Note that the parameter is the number of steps, not the acceleration values. The larger number is a lower acceleration at the peak. See Chapter 2 for explanation of velocity profiles.

NOTE: **This command should not be given while an axis is in motion or the results may not be predictable.**

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX PN;

PF PARABOLIC OFF

Restores all axes to linear acceleration and deceleration ramps (default at reset or power on).

NOTE: **This command should not be given while an axis is in motion or the results may not be predictable. This is the default mode at power up or reset.**

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX PF;

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RS RESET

The RS command is a software reset which causes Unidex 14 to reinitialize. All previously entered data and commands are lost. All internal parameters are initialized to defaults and all interrupts are disabled. This command is intended for catastrophic failure recovery only. Use the KL command to reset queues or return the system to a known state.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX RS

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SECTION 8-4: COMMANDS FOR USER I/O

The following commands are for reading and writing the User Definable I/O.

AN AUXILIARY ON

The AN command turns on the selected auxiliary output ports. It may be used to change power level on driver modules so equipped, trigger another board's sync input or other user definable output. A parameter must be supplied for the desired axes when used in the AA mode so that the other axes are not affected. No parameter is required in the single axis mode. This is the default mode at power up or reset.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	2

Example: To turn on the Y axes auxiliary output in the single axis mode.

Enter AY AN

Example: To turn on the X and Z axes auxiliary outputs when in the AA command mode. A parameter of 0 defines the active state as off while a 1 defines the active as on. The Y axis is unchanged in this example.

Enter: AA ANO,,1;

Note: Stepper axis use the auxiliary output to control idle/run current. See PA# command.

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AF AUXILIARY OFF

The AF command deactvates the selected auxiliary outputs. It may also be used to change power level on driver modules. The same parameter rules apply as the AN command.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	2

(See AN command for example)

PA# POWER AUTOMATIC

The PA command will activate or deactivate the auxiliary outputs at the beginning of each GO command execution and complement the outputs after the GO command is executed. The auxiliary will be actvated before the GO if the parameter is zero or not specified in the single axis mode. If the parameter is non-zero, the sense is reversed i.e. the auxiliary output is deactivated at the beginning of the GO command and activated at the end.

This mode need only be set once and can be deactivated by using the AN or AF command. Axes can be selectively affected in the AA mode by following the syntax as described for the AN command. The following queue requirements apply to each GO command in the command stream in the AA and single axis modes.

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

Example: To activate the Y axis auxiliary output during a move and turn the T axes output off during a move while in the AA command mode.

Enter: AA PA,0,,1;

Note: This command should be used with stepper axis to control idle/run current. The output should be activated during motion to achieve running current. EX: AX PA.

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BL# BIT LOW

The BL command sets the selected output to active low (ON). The 6 outputs are numbered 8 thru 13. Bits 12 and 13 are normally reserved for system functions. For normal operation bit 12 is set HI to enable the Unidex 14 indexer card to control the Unidex 14 Drive Chassis. Toggling bit 13 low for 9 mSec enables a CCW hardware home cycle on all four axis. See also INITSYS and home subprograms in Chapter 9. Refer to Section 4-4 for additional information on Output Signals.

OUTPUT QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

Example: To turn on output bit 10 after a move.

Enter: AX MA1000 GO BL10

BH# BIT HIGH

The BH command sets the selected output to high (OFF). The 6 outputs are numbered 8 thru 13. Bits 12 and 13 are normally reserved for system functions. (See above)

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

(See BL command for example)

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BX BIT REQUEST IN HEX

The BX command returns the state of the 8 input bits in hex format.

INPUT QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	Not valid

Example: AA BX; returns LF CR $\phi\phi\phi\phi$ 1F LF CR indicating all 5 user inputs are high.

Note: **Input bits 0,1,2,3,4,5,6, and 7 are user inputs. Following is a description of the alternative uses for bits 5-7:**

Bit 5 HI indicates the completion of a hardware home command (See BL# instruction and "HOME" subprogram in Chapter 9). Bit 6 HI indicates a fault condition is present on a DC Servo or Aerodrive axis (See "FAULT" subprogram in Chapter 9). Bit 7 HI indicates DC Servo and Aerodrives axis have completed motion (See "INPOS" subprogram in Chapter 9).

Refer to Sectiom 4-4 for more information on Input and Output control.

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SECTION 8-5: MOVE SPECIFICATION COMMANDS

These commands allow specification of move parameters. They allow move parameters to be tailored to the users system requirements.

AC# ACCELERATION

The AC command sets the acceleration/deceleration register to the operand which follows the command. The parameter must be greater than zero and less than 8,000,000. All the following move commands for the axis being programmed will accelerate or decelerate at this rate until another AC command is entered. All acceleration registers default to 2,000,000 steps per second per second at power on or reset. The acceleration register may be modified by an ML or MT instruction in the AA or AM mode. The user must then redefine them with an AC command when returning to the single axis mode or when using move commands in the AA or AM mode which do not do interpolation such as the MA or MR commands.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	4	15	15
AA,AM	4	15	15
AA/CD		Not valid	

Example: In the single axis mode, set the Y axis acceleration to 200,000 counts per second per second.

Enter: AY AC200000

Example: In the AA mode, set the acceleration of the X axis to 200,000 and the Z axis to 50,000 and leave the other axis with their previous values.

Enter: AA AC200000,,50000;

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VL# VELOCITY

The VL command sets the maximum velocity register of the axis being programmed to the operand which follows the command. The operand must be greater than zero and less than or equal to 524,000 steps per second. The velocity defaults to 200,000 at power up or reset. This register controls the maximum velocity used in relative and absolute position moves except as modified by the linear interpolation instructions. If the velocity register is modified by an ML or MT instruction in the AA or AM modes, the user must redefine the velocity with a VL command when returning to the single axis mode or using a move command which does not use interpolation in the AA or AM modes.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	2	13	13
AA,AM	2	13	13
AA/CD		Not valid	

Example: In the single axis mode, set the X axis velocity to 10,000 counts per second per second.

Enter: AX VL10000

Example: In the AA mode, set the peak velocity of the X axis to 5,000 and the T axis to 50,000 and leave the other axis with their previous values.

Enter: AA VL5000,,,50000;

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VB# VELOCITY BASE

The VB command allows the velocity ramp to start at the specified velocity. This allows faster acceleration and the ability to pass through resonance quickly for some applications. The velocity jumps instantly to the specified velocity, then ramps as usual. The deceleration is the same in reverse. This mode is active only for linear ramps. It is ignored for cosine and parabolic ramps but not flagged as a command error. The parameter must be greater than zero and less than the programmed velocity. The base velocity defaults to zero at power up or reset.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	2	2	2
AA,AM	2	2	2
AA/CD		Not valid	

Syntax: AA VB200,2000,200,2000;

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LP# LOAD POSITION

The LP command will immediately load the position supplied as a parameter in the absolute position register of the axis. The parameter will be loaded into the encoder position register and the (parameter times the encoder ratio) will be loaded into the position counter. If no parameter is supplied, the value of zero is used. This command turns off the position hold and interrupt on slip modes.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	2	4
AA,AM	Not valid	
AA/CD	Not valid	

Example: The following loads the X axis position register with 1000.

Enter: AX LP1000

Example: The following loads the Y axis position register with 20000 and the encoder position register with 30000 counts.

Enter: AY ER3,2 LP30000

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MA# MOVE ABSOLUTE

The MA command will set up the axis to move to the absolute position supplied as a parameter. In the AA mode, an axis may remain stationary by entering the comma but omitting the parameter. The move is actually initiated by a GO command. The default value of zero is used if no parameter is supplied.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	2	2	2
AA,AM	2	2	2
AA/CD		Not valid	

Example: Move the X axis to absolute position 100,000 counts with the previously entered acceleration and velocity parameters.

Enter: AX MA100000 GO

Example: Move the Y axis to absolute position 10,000 counts and the T axis to absolute position 1,000 counts. The other axis will remain in their current positions.

Enter: MA,10000,,1000; GO

MR# MOVE RELATIVE

The MR command will set up the axis to move relative from the current position at the time the move is executed. In the AA mode, an axis may remain stationary by entering the comma but omitting the parameter. The move is actually initiated by a GO command. The command syntax is the same as the MA command listed previously.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	2	2	2
AA,AM	2	2	2
AA/CD		Not valid	

Syntax: AX MR-42768; GO

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ML#,#, MOVE LINEAR

The ML command uses linear interpolation to perform a straight line relative move to the new location. Input parameters are relative distance for each axis in the move. Velocity and acceleration parameters of each axis may be automatically adjusted by the Unidex 14 controller to perform the linear move. If linear and single axis moves are mixed, it will be necessary to reset the velocity and acceleration parameters for the single axis move following a linear move. The parameters may have been modified by the Unidex 14 depending on the relative distances of the linear move. The ML command should be followed by a GO to start the axes together. The velocity and acceleration parameters are scaled to allow the axes to move and finish together.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	6	30	30
AA,AM	6	30	30
AA/CD		Not valid	

Example: In the AA mode move the Y, Z and T axis 10,000, 100 and 1,000 counts respectively with each starting and finishing together. The other axes remain in their previous positions.

Enter: AA ML, 10000, 100, 1000; GO

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MT#,#; MOVE TO

The MT command uses linear interpolation to move to the specified absolute position. The syntax is similar to the ML command. This command is invalid while in the CN mode if loops are being used. The command will become valid again after executing a ST or KL command. **When used in the contour definition mode, only the axes being used in the contour must be provided in the MT syntax.**

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	6	30	30
AA,AMF	6	30	30
AA/CD		4 + number of axes	

Example: In the AA mode move the X, Y and T axis to absolute positions 1,000 10,000 and 100 counts respectively with each starting and finishing together. The unused axes remain in their previous positions.

Enter: AA MT1000, 10000,,100; GO

MO MOVE ONE PULSE

The MO command will output one step pulse in the current direction (do not use the GO command). The direction may be reversed by use of the MM or MP command. This command generates the output pulse in one sample interval and thus eliminates the latency of generating a ramp with an MR1 GO command sequence.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Syntax: AX MO;

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RM# REMAINDER

The RM command will divide the position counter by the parameter supplied and replace the position counter with the resulting remainder. The parameter must be greater than zero and less than 65000. This command is used in applications where the controller is managing the motion of a continuously rotating object. It allows the position counter to keep track of the absolute position without regard to the number of revolutions it may have rotated.

Example: A RM2000 command with a position counter of -4050 will return a position of 1950 since it is within 50 counts of rolling over at -4000, i.e. the axis is 1950 counts from the starting point.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Syntax: AX RM2000;

SECTION 8-6: MOVE EXECUTION COMMANDS

These commands allow execution of the moves which have been previously specified.

GO GO

The GO command will initiate the move which has been previously programmed. No operand is required with the GO command.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	4	7
AA,AM	5	8
AA/CD	Not valid	

Syntax: AA MA10000,,1000; GO

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GD GO and RESET DONE

The GD command may be substituted for a GO command. It will reset the done flags, then proceed with the move identical to the GO command. In the single axis mode only the done flag for the selected axis will be reset. In the AA mode all the done flags will be reset. In the AM mode the axes involved in the move will be reset. This allows the host to reset the interrupts on the axis involved in the next move without affecting other axes which may be still active. Note that this command is probably not useful in applications where commands are queued in advance since the interrupt may be reset before the host has the opportunity to service it if the GD command is waiting in the queue.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	4	7
AA,AM	5	8
AA/CD	Not valid	

Syntax: AA MA10000,,1000; GD

JG# JOG

The JG command is a constant velocity mode and will jog the axis at the velocity supplied as a parameter. The JG command will accelerate to the programmed velocity and run until stopped by an ST, KL or another JG command. The axis will then stop and wait further commands. The jog velocity may be changed by following the command with another JG command of a different velocity. The axis must be stopped before reversing directions.

QUEUE REQUIREMENTS

MODE	LINEAR	PARABOLIC	COSINE
AX-AT	2		Linear ramp
AA,AM		Not valid	
AA/CD		Not valid	

Example: Jog the motor at 100,000 steps per second then change to 35,000 steps per second when the second JG is entered then stop by decelerating to a stop.

Enter: AX JG100000 JG35000 ST

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VS#,#,# VELOCITY STREAMING

The VS command will generate a pulse train without acceleration or deceleration at the rates specified. The parameters are timed in 1/1024 second sample intervals, X velocity, and Y velocity. This is a slave mode and cannot be mixed or queued with other com mands. The X axis must be active since the VS commands and all parameters are inserted in the X command queue. The VS command does not require a "GO" command.

QUEUE REQUIREMENTS

MODE	
AX	5
AY-AT	Not valid
AA,AM	Not valid
AA/CD	Not valid

SECTION 8-7: MOVE TERMINATION COMMANDS

The following commands allow termination of move sequences in process.

ST STOP

The ST command flushes the queue for the current axis only in the single axis mode and causes the axis to decelerate to a stop at the rate previously specified in an AC command. This command is used to stop the motor in a controlled manner from the jog mode or an unfinished GO command. This command is executed immediately. No status or position information is lost. The ST command is equivalent to the SA command in the AA mode.

QUEUE REQUIREMENTS

MODE	
AX-AT	Flush +2
AA,AM	Flush +2
AA/CD	Not valid

Syntax: AX JG1000 ST

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SA STOP ALL

The SA command flushes all queues and causes all axes to decelerate to a stop at the rate previously specified in an AC command. All status and position information is retained.

QUEUE REQUIREMENTS

MODE	
AX-AT	Flush +2
AA,AM	Flush +2
AA/CD	Not valid

Syntax: AX JG1000 AY JG5000 AA SA

KL KILL

The KL command will flush the command queue and terminate pulse generation of all axes immediately. It is intended for emergency termination of any program and to reset the input queues to a known state. The motor may not stop immediately even though no more pulses are delivered due to inertia of the motor rotor and load. Therefore, the position counter may not accurately reflect the true position of the motor following this command. The home sequence should be used to reestablish the position counters. A control-D is a short cut for the KL command. It bypasses the command interpreter and may work when the queue is full and the KL command can not get through the interpreter.

QUEUE REQUIREMENTS

MODE	
AX-AT	Flush +2
AA,AM	Flush +2
AA/CD	Not valid

Syntax: AX MR999999 GO KL

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SECTION 8-8: LOOP CONTROL COMMANDS

These commands allow move sequences to be repeated within loops. Loops can be nested up to four levels deep on each axis.

LS# LOOP START

The LS command sets the loop counter for the axis being programmed in the single axis mode and all axes in the AA mode. The command expects a loop counter operand following the command. The commands up to the LE loop terminator will be executed the number of times specified by the operand. Loops may be nested up to four levels deep on each axis. The parameter must be less than 32,000.

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

Example: Execute a 100,000 count relative move on the Z axis 5 times.

Enter: AZ LS5 MR100000 GO LE

Note: The first move will occur immediately after entering the GO command. The remaining 4 moves will be executed after the loop terminator LE has been entered.

Example: Execute a 100,000 count move relative on the X axis together with a 100 count move on the T axis followed by a move absolute to 100 counts on the X axis and 200 counts on the T axis four times.

Enter: LS4 ML100000,,,100; GO MT100,,,200; GO LE

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LE LOOP END

The LE command terminates the most recent LS command. The axis will loop back and repeat the commands within the loop the number of times specified in the LS command.

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

(See the LS command for an example)

WS# WHILE SYNC

The WS command will execute the commands between the WS and WD commands as a loop while the user definable I/O line is true i.e. low. When the I/O line goes high it will exit the loop and execute the commands which follow. The test is at the bottom of the loop i.e. it will always be executed at least once.

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	Not valid
AA/CD	Not valid

(See the WD command for a syntax example)

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WD WHILE END

The WD command serves as the loop terminator for the WS command

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	Not valid
AA/CD	Not valid

Syntax: WS2 AY MR1000; GO WT 1; WD

WH WHILE

The WH command will execute all commands between it and the terminating WG command as a loop until terminated by a CW command. This allows repeated execution of a command sequence which can be terminated by the host after it senses an external event has occurred. These commands may not be nested but may be executed sequentially.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

Syntax: WH AX MR1000; GO WG CW condition dependent upon time delay.

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WG WHILE FLAG

The WG command serves as the terminator for the WH command

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

(See WH command for a a syntax example)

CW CLEAR WHILE

The CW command breaks the WH command upon execution of the remaining commands in the loop, i.e. the current execution of the loop is finished. The WH loop is always executed at least one time since the test for the flag is at the bottom.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	Not valid
AA/CD	Not valid

(See WH command for a syntax example)

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SECTION 8-9: HOME AND INITIALIZATION CONTROL COMMANDS

These commands allow the initialization of the controller to an absolute position.

HM# HOME

The HM command will cause the current axis to find home. The position counter will be initialized to the position supplied as a parameter. The velocity should be less than 1024 counts per second to maintain accuracy of the home position loaded. The axis will not stop at home, but will initialize the position counter when the home switch becomes true and decelerate to a stop. The axis may be commanded to go home by following this command with a move absolute to the same position as specified in the HM command. The parameter defaults to zero if none is supplied.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	4	5
AA,AM	Not valid	
AA/CD	Not valid	

Example: Find the physical home position of the X axis of the stage. (NOTE: The velocity should be less than 1024 pulses per second to minimize position error for this command.) The motor runs until the home switch input is activated and then initializes the position counter to the parameter supplied. Since the motor decelerates to a stop after reaching home, it is necessary to do a MA# to the same position as specified in the home command if it is desired to physically position the device at home. The following commands will find home, initialize it to 1000 counts, then return to home. In many cases it will not be necessary to return home, only find the position and synchronize the controller to it.

Enter: AX VL1000 HM1000 MA1000 GO

Note: **See BL# command for hardware home command.**

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HR# HOME REVERSE

The HR command will find home and initialize the position counter to the position supplied as a parameter. It behaves exactly like the HM command above except it travels in the negative direction. The parameter defaults to zero if none is supplied.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	4	5
AA,AM	Not valid	
AA/CD	Not valid	

Example: In a long stage it may be awkward to travel the full distance to home at less than 1024 pulses per second. The following will get close to home at higher speed, then refine the position at lower speed in the reverse direction.

Enter: AX VL100000 HH HM VL1000 HL HR

KM HOME AND KILL

The KM command will find home and stop generating pulses immediately, i.e. no deceleration ramp will be generated. The position counter is not affected.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	1	1
AA,AM	Not valid	
AA/CD	Not valid	

Syntax: AX VL1000 KM

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KR HOME REVERSE AND KILL

The KR command will find home in reverse and stop generating pulses immediately, i.e. no deceleration ramp will be generated. The position counter is not affected.

QUEUE REQUIREMENTS

MODE	NO ENCODER	ENCODER
AX-AT	1	1
AA,AM	Not valid	
AA/CD	Not valid	

Syntax: AX VL1000 KR

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SECTION 8-10: MOVE SYNCHRONIZATION COMMANDS

These commands allow the synchronization of moves with external events or multiple axis sequences.

ID INTERRUPT DONE

The ID command will set the done flag and interrupt the host if the interrupt has been enabled by writing the correct value to the done flag register and the status register. This allows the Unidex 14 to signal the host when a string of commands has been completed. In the AA mode, the done flag register bits will be set as each axis encounters the ID in its command stream but the done flag in the status register will not be set until all axes have executed the ID command. In the AM mode only the axes active in the most recent move will set their done flags.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	Not valid

Example: Interrupt the host CPU after the execution of Move Absolute is finished. When the move is finished the ID command will be encountered in the command queue and will set the done flags.

Enter: AX MA100000 GO ID

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II INTERRUPT INDEPENDENT

The II command allows the control to interrupt the host when each axis finishes a move. Only those axes which have been supplied a parameter in the most recent move command will cause interrupts.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	Not valid

Example: The following command sequence would cause interrupts when the Y and T axes finish. If they do not complete at the same time, two interrupts would be generated.

Enter: MR,1000,,10000; GO II

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IN# INTERRUPT NEARLY DONE

The IN command allows the control to interrupt the host when the axis or combination of axes is nearly complete. When used in an application involving probing a part after a move, the probes could start accelerating down while the stage is finishing its move, improving the overall system throughout. This command is valid in all modes. The IN command must be entered before the GO command since it is executed before the move is complete. The test is only performed during deceleration. If the IN parameter is greater than the ramp down distance, the interrupt will be generated when the control starts ramping down.

QUEUE REQUIREMENTS

MODE	
AX-AT	2
AA,AM	2
AA/CD	Not valid

Example: The following sequence would interrupt the host when the X axis is complete and the Z axis is within 10000 counts of being complete. The Y axis completion would be ignored in this example.

Enter:
```
IN0,,10000;
MR100000, 100000; GO
MR,,50000; GO
```


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IC INTERRUPT CLEAR

The IC or the ASCII character Control-Y (hex 19) command will clear the done and error flags in the Unidex 14 status register and the done flag register. This command will be executed immediately and will usually be placed in the done and error handler interrupt service routine or after polling to reset the interrupt and the associated flags. The Control-Y version of this command is preferred to minimize the latency in its execution.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Example: The IC command must be used after an ID to reset the done flags, otherwise the axis would always appear to be "done". This would normally be done in the interrupt service routine that services the DONE interrupt or the poll routine that handles the task. The control Y version of this command is preferred since it minimizes latency. The flags may be polled by an RA or RI command which will also reset the flags.

Enter: IC (or control Y, Dec. value 25, HEX 19)

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SW# SYNC WAIT

The SW command allows synchronization of multiaxes moves on one or more Unidex 14's boards through the sync line, by enabling a wait until specified input bit goes high. This command causes the axes to wait for completion of other events, i.e. until the user definable I/O bit has been released before pro ceeding with the next command. The auxiliary line from several other axes can be wired together to cause the axis to wait until the others are all finished.

QUEUE REQUIREMENTS

MODE	
AX-AT	1
AA,AM	1
AA/CD	Not valid

Example: The following command sequence will cause the X axis to wait until the Y axis has finished its move and turned off its auxiliary output. Here the Y aux output is wired to input 0.

Enter:
```
AY AN MR2000 GO AF
AX SW0 MR10000 GO
```

WT# WAIT

The WT command will wait for the specified number of milliseconds before proceeding with the next command in the queue. In the AA mode all axes will wait. Immediate commands will not "wait". The parameter must be between 1 and 32,000.

QUEUE REQUIREMENTS

MODE	
AX-AT	3
AA,AM	3
AA/CD	Not valid

Syntax: WT5

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SECTION 8-11: SYSTEM STATUS REQUEST COMMANDS

These commands allow the host to request the status of various move parameters including the status of limit and home switches.

WY WHO ARE YOU

The WY command returns the model and software revision of the Unidex 14 being addressed. A string similar to "LFCR PC38 version 1.39-4E LF CR" will be returned surrounded by carriage returns.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX WY
will return: LFCR PC38 Ver 1.39-4E LFCR

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RP REQUEST POSITION

The RP command returns the current position of the currently addressed axis in the single axis mode or all positions separated by commas in the AA mode. The position will be returned to the host via the data port in ASCII format. This command is not queued, i.e. the current position will be returned immediately even if the axis is in motion. The response is surrounded by LFCR sequences (shown below).

NOTE: The current position will be returned in steps and is not scaled by User units.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Not valid

Syntax: AX RP
will return (Single axis mode) LFCR 400 LFCR
Syntax: AA RP
will return (AA axis mode) LFCR 400, 20, 6100, 801 LFCR

RQ REQUEST QUEUE STATUS

The RQ command returns the number of entries available in the queue of the currently addressed axis in the single axis mode or all axes separated by commas in the AA mode. The ASCII string is surrounded by LF CR sequences. The maximum available in each command queue is 200. The numbers are fixed in length at 3 characters. When issuing an RQ command while defining a contour the available space in the contouring queue will be returned. The maximum available is 1000. The number is fixed in length at 4 characters.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Immediate
AA/CD	Immediate

Syntax: AX RQ
will return (Single axis mode) LFCR 200 LFCR
Syntax: AARQ
will return (AA axis mode) LFCR 200, 200, 200, 200 LFCR

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RA REQUEST AXIS STATUS

The RA command returns the state of the limit switches, home switches and done/error flag for the axis which is addressed. The limit flag in the hardware status register will be reset by the RA command providing that another axis is not in limit. The status is returned in the following format:

CHARACTER MEANING

CHAR	SENT		DESCRIPTION
1	LF		Line feed
2	CR		Carriage return
3	CR		Carriage return
4	P	Either Character	Moving in positive direction
	M		Moving in negative direction
5	D	Either Character	Done (ID has been executed. This bit is reset by this command or an IC command)
	N		No ID executed yet
6	L	Either Character	Axis in overtravel. Char 4 tells which direction. This bit is reset when the limit switch opens.
	N		Not in overtravel in this direction
7	H	Either Character	Home switch closed. This bit is reset when the home switch opens.
	N		Home switch not closed
8	LF		Line feed
9	CR		Carriage return
10	CR		Carriage return

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Not valid
AA/CD	Not valid

Syntax: AX RA

The following may be returned.

LFCRCR PNNN LFCRCR

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RI REQUEST INTERRUPT STATUS

The RI command is an AA mode command that returns the same status information on all axes as the RA command in the single axis mode. The 4 character fields for each axis are separated by commas and the total string is surrounded by carriage returns and line feeds.

QUEUE REQUIREMENTS

MODE	
AX-AT	Not valid
AA,AM	Immediate
AA/CD	Not valid

Syntax: AA RI
will return LF CR CR PNNN, PNNN, PNNN, PNNN LFCRCR

QA QUERY AXIS

The QA command returns the status of the single addressed axis similar to the RA command except flags are not cleared.

QUEUE REQUIREMENTS

MODE	
AX-AT	Immediate
AA,AM	Not valid
AA/CD	Not valid

Syntax: AX QA
will return LFCRCR PNNN LF CRCR

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