UNIDEX™ 1
AERODRIVE
CLOSED LOOP
MOTION CONTROLLER
USER'S MANUAL

PN: EDU109

DISCLAIMER:

The information contained in this manual is subject to change due to improvements in design.

Though this document has been checked for inaccuracies, Aerotech does not assume responsibility for any errors contained herein.

NOTICE:

The information presented in this manual provides a detailed explanation of the Unidex 1 Aerodrive Closed Loop Motion Controller. Detailed information pertaining to Unidex 1 programming as well as motor, input power, and external control interconnections, is provided in this manual.

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CHAPTER 1: INTRODUCTION

SECTION 1-1 GENERAL DESCRIPTION

The single axis Unidex 1 Aerodrive is a microprocessor-based motion controller featuring the ability to provide "Closed Loop" Servo Control capability to the standard 1.8 degree Hybrid Stepping Motors. Tables 1-1 and 1-2 list the Unidex 1 Aerodrive Motion Controller motor/drive part numbers and specifications for the associated drive configurations.

The Unidex 1 Aerodrive (Hereafter referred to as Unidex 1)may recieve control from four sources; 1) User supplied Host Computer (any PC or terminal capable of transmitting ASCII characters) 2) Optional TFX Hand Held Programming Terminal, 3) Optional Thumbwheel Programmer,(TP) and the 4) Optional Thumbwheel Indexer, (TI).

SECTION 1-2 UNIDEX 1 FEATURES

Program Capacity

- Capacity to store approximately 545 1-axis moves
- Stores up to 99 randomly accessible programs

Programmable Acceleration/Deceleration Parameters

- Accel/decel ramp time = 50 - 9999 milliseconds
- Feedrate = 1 - 125000 steps/second
- Accel/decel profile = Linear or Parabolic

RS-232 Command Mode Features

- Setup mode for modal parameters
- Immediate command execution

- Downloading User programs
- Program run in Auto-run or Block-run mode
- Print - Directory, Axis Position, Single Program, Entire Memory, System Status
- Interactive control capability (Service Request Mode)

Hand-held Terminal (Model TFX) Features (optional)

- Special menu-assist screens
- Setup mode for modal parameters
- Immediate command execution
- Enter and edit up to 99 programs
- Program run in Auto-run or Block-run mode
- Print: Directory, Program, Axis Position, System Status
- Special operations: Home, Index, Stop Axis
- Tracking Display: Continuously displays Mode of Operation, Position, Direction of Travel, and Marker Status while the Motor is running.

Thumbwheel Operation (Optional)

- Selection of 99 pre-programmed motion sequences.
- No Operator alteration.

Thumbwheel Indexer (Optional)

- Enter and execute single moves as well as complete programs.
- Distance, speed, and acceleration for the move may be set up by the seven digit thumbwheel.
- Selection of up to 99 pre-programmed motion sequences.
- Slew capability
- Reset the Unidex 1 to Power-Up conditions

Daisy Chain Operation

- Up to 30 Unidex 1s can be connected and accessed at one time
- Address selectable

Auto-Boot Program

- Select any of 99 programs for automatic execution upon power up

Key Program Mode Features

- Conditional program label and subroutine branching via logic input status
- Interrupt program label and subroutine branching via logic input status
- Programmable position boundaries (limits) in program run mode

SPECIFICATIONS

MEASURES

Resolution

Standard	0.18 degrees (2000 steps/rev.)
Optional:	0.09 degrees (4000 steps/rev.)
Accuracy	+/- 3 arc min. +/- 1/2 count typical unloaded, biodirectional
Repeatability	+/- 3 arc min. +/- 1/2 count typical unloaded, unidirectional

MOTIONS

Position Range	+/- 1,999,999,999 counts (Range with standard resolution. No limit in free run mode.
Speed Range	0.00025 to 50 rev./sec (0.015 to 3000 rpm)
Acceleration Ramp	50 to 9999 msec
Acceleration Profile	Linear, parabolic (selectable)
Positioning Modes	Absolute, incremental (programmable)

PROGRAMMING

Programs Storable	99, randomly-accessible
	Memory (user) 6KB standard, 14KB extended; battery-backed

Modes:

SET-UP:	Set basic device parameters
AUTO:	Program runs automatically (usual operating mode)
IMMEDIATE:	Block of commands executed immediately on entry
BLOCK RUN:	Permits execution of a motion program one block at a time
EDIT:	Allows new program entry or existing program alteration
REMOTE:	Facilitates clock and direction type control through Unidex 1 from external device
HOLD:	Stop motion; released by trigger or cancel commands
FREE RUN:	Constant speed with infinite position range

Branching	Conditional, interrupt and program initiated GOTO and GOSUB
Subroutine Nesting	Up to 8 levels
Other Features	Auto Boot: Selected program execution upon power-up
	Software Travel Limits

INTERFACES

Command (Port A)

Communication	Serial RS-232-C (defaults:9600 baud, 7 data bits, 1 stop bit, even parity)
	Up to 30 Unidex 1's daisy-chainable on one RS-232 line +5 VDC
	@ 30 mA to power remote programming terminal 9 pin, female,
	type-D Connector

Table 1-1 Specifications

Inputs/Output (Port B)

Discrete Input	4 programmable, optically-isolated
	1 set-up, function select
	2 external clock and direction
	1 feed hold function select, optically isolated
	2 CW, CCW limits, optically-isolated
Discrete Outputs	4 programmable, optically-isolated
	1 fault, optically-isolated
Connector	25 pin, female, type-D
Control (Port C)	Buffered inputs for: CW, CCW limits, Marker , Encoder
Connect	25 pin, female, type-D
Indicators	7 LEDS, front panel,indicate status and help in diagnosis

ENVIORMENTAL

Ambient Temperature

Operating	0 to 50 degrees C (32 to 122 degrees F)
Storage	- 30 to 85 degrees C (122 to 185 degrees F)
Humidity	0 to 95%, non-condensing

POWER INPUT

AC Power	115 VAC (nom.), 50/60 Hz, 1000 VA (max.), single-phase
	Optional 230 VAC (nom.) 50hz., or 100 VAC (nom.), 50Hz.

MODEL NUMBER	U1RA	U1RB	U1RC	U1RD	U1RE	U1RF	U1RG	U1RH	U1RJ	U1RK
AERODRIVE P/N	DAV4008	DAV4008	DAV16008	DAV16008	DAV16008	DAV16008	DAV4008	DAV4008	DAV16008	DAV16008
MOTOR P/N	50SM	101SM	300SM	310SM	510SM	1010SM	80SR	140SR	490SR	1300SR
STATIC TORQUE (PEAK) OZ.IN. (CONTINUOUS)	55 / 38	200 / 90	650 / 350	570 / 370	620 / 520	1150 / 1050	125 / 80	250 / 140	600 / 500	1500 / 1300
PEAK TORQUE AT 2000 RPM (OZ.IN.)	10	55	80	150	150	200	45	70	190	390
MOTOR OUTPUT POWER (WATTS)	14	62	115	290	253	400	74	93	290	580
MOTOR ROTOR INERTIA OZ-IN-SEC² / KG-M²	$1.66E^{-3}$ / $11.8E^{-6}$	$5E^{-3}$ / $35E^{-6}$	$26.5E^{-3}$ / $187E^{-6}$	$26.5E^{-3}$ / $187E^{-6}$	$55E^{-3}$ / $388E^{-6}$	$114E^{-3}$ / $805E^{-6}$	$1.66E^{-3}$ / $11.8E^{-6}$	$3.75E^{-3}$ / $26.5E^{-6}$	$20.5E^{-3}$ / $140E^{-6}$	$55E^{-3}$ / $388E^{-6}$
MOTOR FRAME NEMA 2	23	23	34	34	42	42	23	23	34	42
POSITION RESOLUTION		2000 STEP/REVOLUTION (STANDARD)								
DRIVE VOLTS (DC)	40	40	80	80	80	160	40	40	80	160
AMPS	1	5	6	6	8.6	8.6	5	5	6	8.6
TYPE	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR
WEIGHTS MOTOR (LBS.)	2.3	3.6	8.1	8.1	14	20	1.7	2.7	6.1	20
MOTOR/DRIVE (LBS.) (INCLUDES ALL INTER-CONNECTING CABLES)	17.3	18.6	23.5	23.5	31	30	16.7	17.7	21.2	31
INPUT POWER VOLTS (50/60 HZ)	115/220-240	115/220-240	115 ONLY	115 ONLY	115 ONLY	115 ONLY	115/220-240	115/220-240	115 ONLY	115 ONLY
AMPS (ALLOWABLE VOLTAGE TOLERANCE - +/-10% MAX)	.5	1	1.5	3	3	4	1	1	3	4

U1RA PERFORMANCE CURVE

MOTOR: 50SM
DRIVER: DAV4008
OPER. VOLT.: 40VDC

TABLE 1-3

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

SPEED (RPM)

TORQUE (OZ.IN.)

TORQUE (N·cm)
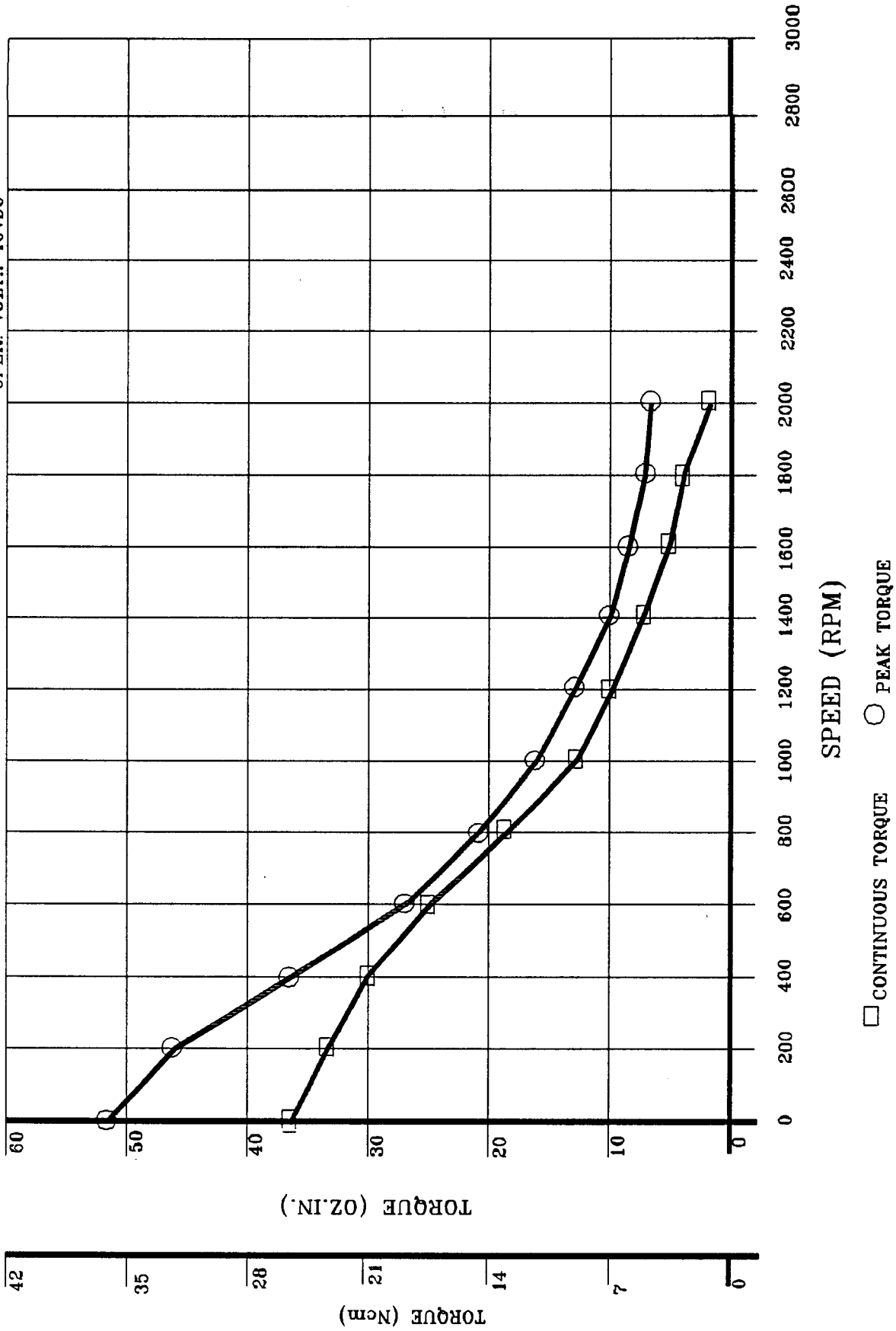
U1RB PERFORMANCE CURVE

MOTOR: 101SM
DRIVER: DAV4008
OPER. VOLT.: 40VDC

TABLE 1-4

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

SPEED (RPM)

TORQUE (OZ.IN.)

TORQUE (N·cm)

U1RC PERFORMANCE CURVE

MOTOR: 300SM
DRIVER: DAV16008
OPER. VOLT.: 60VDC

SPEED (RPM)

○ PEAK TORQUE

□ CONTINUOUS TORQUE

TORQUE (OZ.IN.)

TORQUE (N·cm)
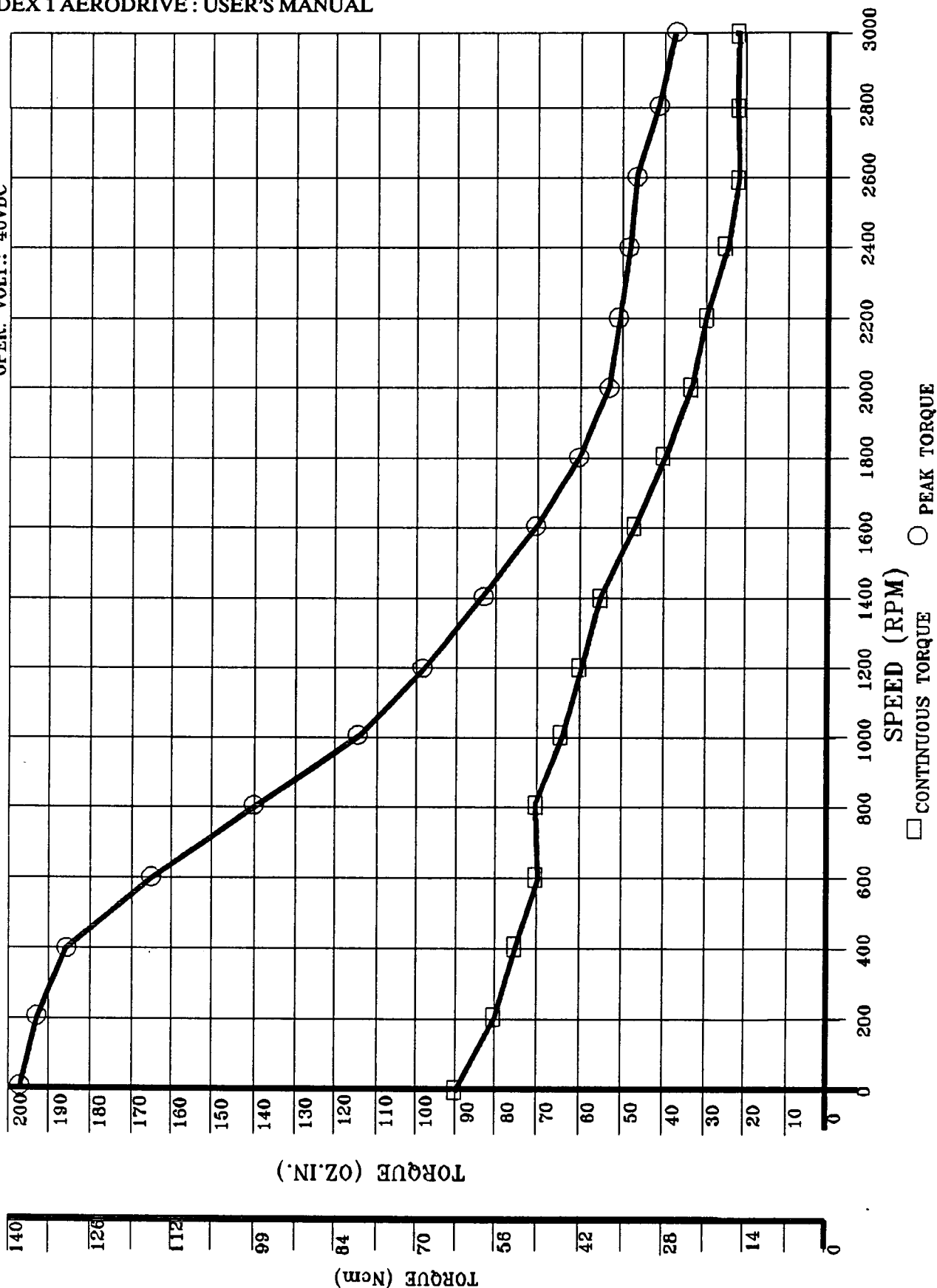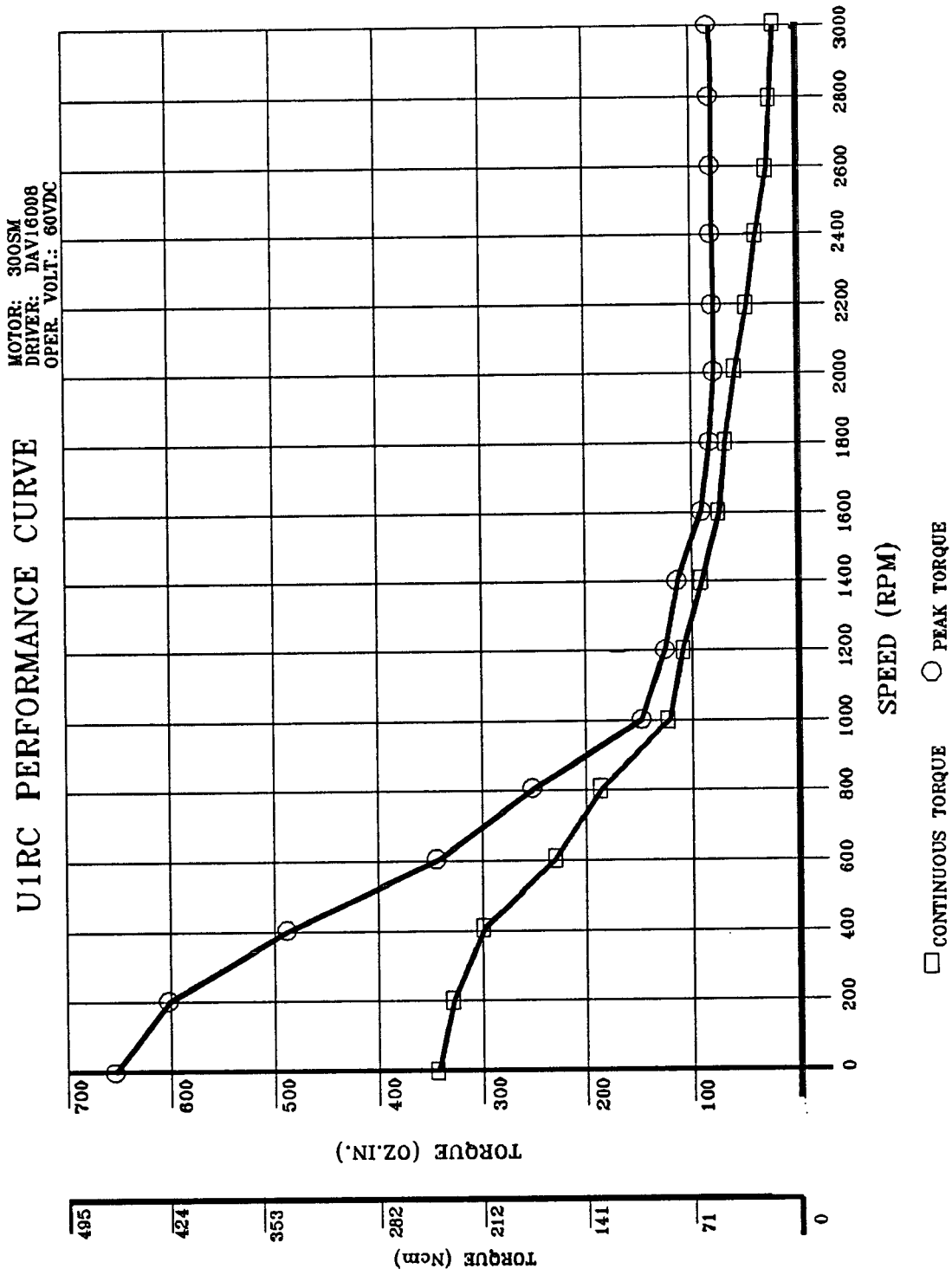
U1RD PERFORMANCE CURVE

MOTOR: 310SM
DRIVER: DAV16008
OPER. VOLT.: 80VDC

□ CONTINUOUS TORQUE ○ PEAK TORQUE

TABLE 1-6

TORQUE (OZ.IN.)

TORQUE (Ncm)

SPEED (RPM)
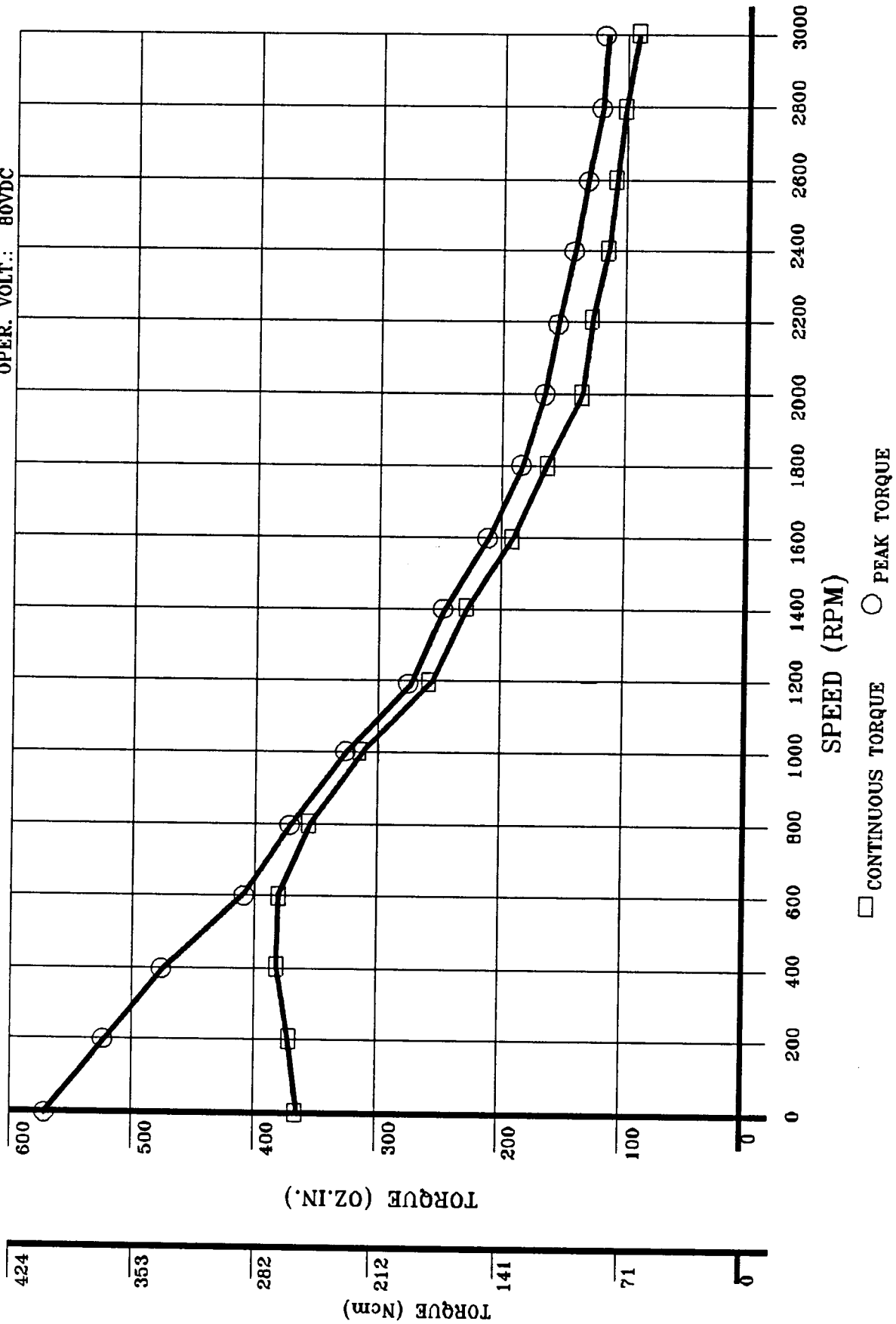
U1RE PERFORMANCE CURVE

MOTOR: 510SM
DRIVER: DAV16008
OPER. VOLT.: 80VDC

TORQUE (OZ.IN.)

| | | | | | | | | | | | | | | | |
|700|600|500|400|300|200|100| | | | | | | | | |

SPEED (RPM)

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

TORQUE (N·cm)

495 424 353 282 212 141 71 0
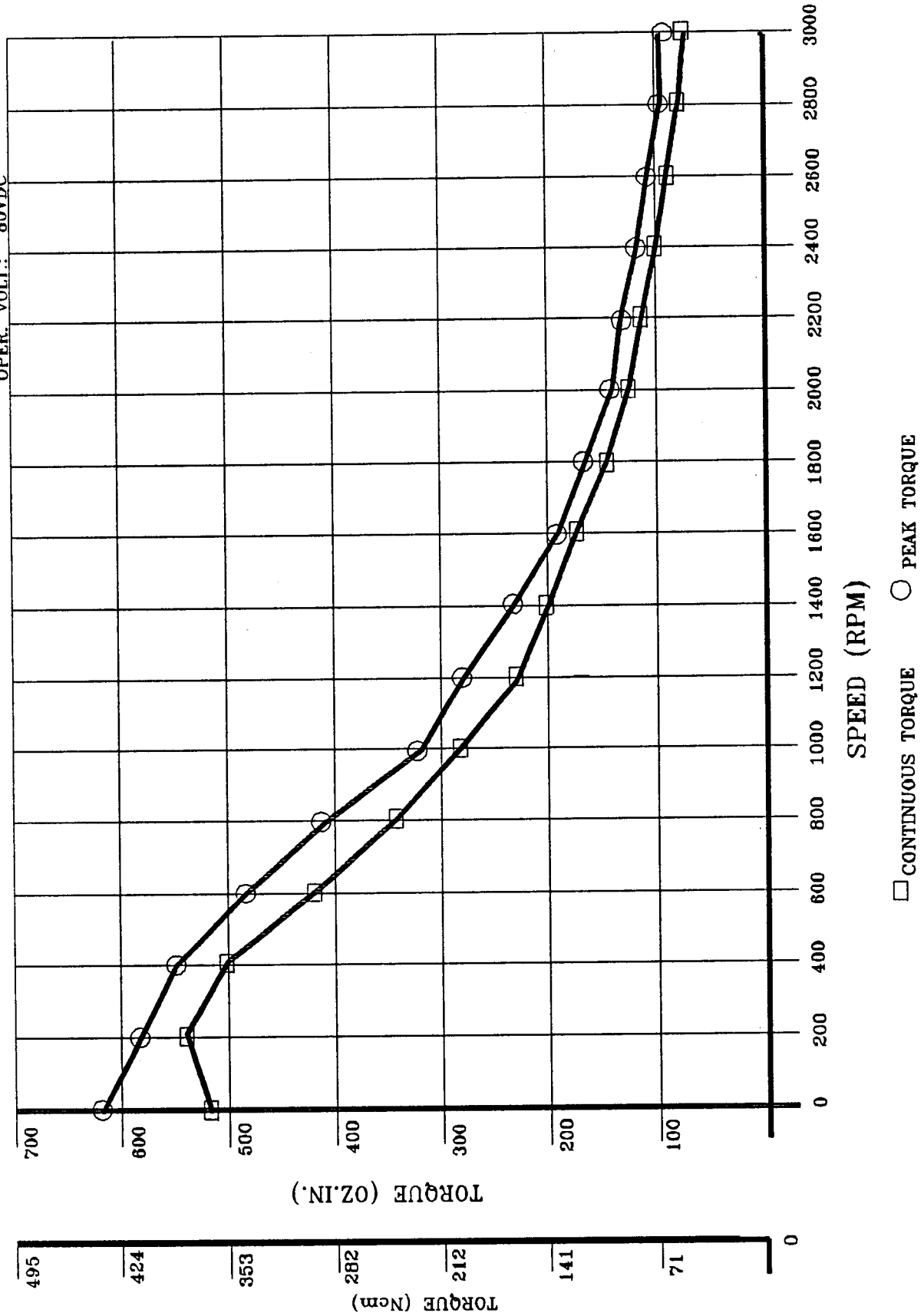
U1RF PERFORMANCE CURVE

MOTOR: 1010SM
DRIVER: DAV16008
OPER. VOLT.: 160VDC

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

SPEED (RPM)

TORQUE (OZ.IN.)

TORQUE (Ncm)

TABLE 1-8

U1RG PERFORMANCE CURVE

MOTOR: 80SR
DRIVER: DAV4008
OPER. VOLT.: 40VDC

SPEED (RPM)

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

TORQUE (OZ.IN.)

130 120 110 100 90 80 70 60 50 40 30 20 10

TORQUE (Ncm)

84 70 56 42 28 14 0

TABLE 1-9

U1RH PERFORMANCE CURVE

MOTOR: 140SR
DRIVER: DAV4008
OPER. VOLT.: 40VDC

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

TABLE 1-10

U1RJ PERFORMANCE CURVE

MOTOR: 490SR
DRIVER: DAV16008
OPER. VOLT.: 80VDC

TORQUE (OZ.IN.)

SPEED (RPM)

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

TORQUE (Ncm)

TABLE 1-11

U1RK PERFORMANCE CURVE

MOTOR: 1300SR
DRIVER: DAV16008
OPER. VOLT.: 160VDC

□ CONTINUOUS TORQUE   ○ PEAK TORQUE

SPEED (RPM)

TORQUE (OZ.IN.)

TORQUE (Ncm)

TABLE 1-12

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CHAPTER 2: SYSTEM LAYOUT/EXT. CONNECTIONS

Unidex 1 Aerodrive is available in three output voltage ranges: 40 VDC, 80 VDC, and 160 VDC, depending on the motor used. The packaging configuration is the same for all three models.

SECTION 2-1 INPUT/OUTPUT POWER CONNECTION

(Models U1RA, U1RB, U1RC, U1RD, U1RE, U1RF, U1RG, U1RH, and U1RJ, U1RK)

The Unidex 1 U1RA, U1RB, U1RG, and U1RH, packages may be factory wired for either a 115 VAC 60 Hz or 220-240 VAC 50/60 Hz input. Unidex 1 Aerodrive models U1RC, U1RD, U1RE, U1RF, U1RJ, and U1RK are supplied with 115 VAC 50/60 Hz input power connections. Figure 2-1 shows an outline of the INPUT POWER receptacle and ON/OFF switch for the Unidex 1 Aerodrive Family of Controllers.

WARNING: INPUT POWER SPECIFICATIONS ARE CONTAINED ON A LABEL LOCATED ON THE BOTTOM OF THE UNIDEX 1 CHASSIS. ANY DEVIATION FROM THE INPUTS SPECIFIED COULD RESULT IN PERMANENT DAMAGE TO THE EQUIPMENT. CONSULT YOUR AEROTECH REPRESENTATIVE FOR FURTHER INFORMATION.

Refer to Table 1-2 for current ratings.

ON/OFF Switch
(0 IS OFF)
(1 IS ON)

INPUT POWER

Neutral

Line

Earth Ground
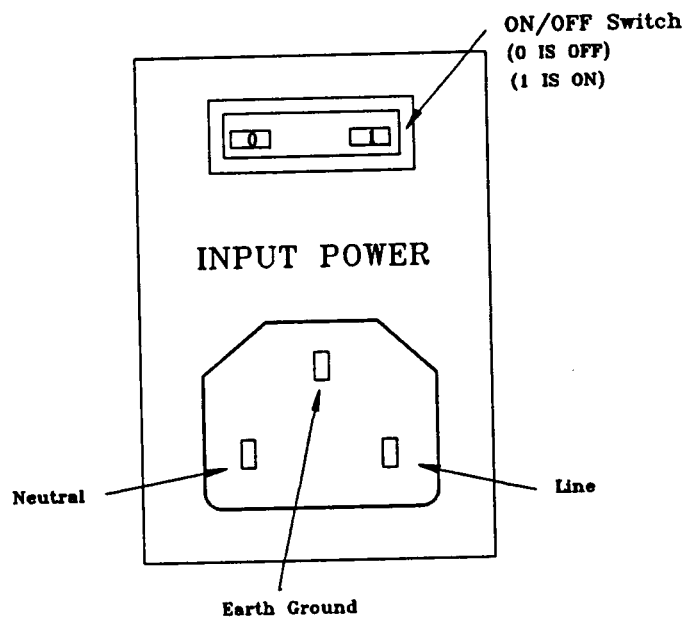
NOTE: Mating cable is supplied with unit.

Figure 2-1: AC INPUT POWER Connector and POWER SWITCH.

FRONT VIEW

SIDE VIEW

ITEM DESCRIPTION

A. Removable rubber bumpers (for desktop mounting)	F. Input Power/ON–Off Switch (115 or 230 VAC depending on label specification on bottom of Unit)
B. LED Indicators	
C. Flanges (top and bottom) for panel mounting	G. Unit specification label (located on bottom of Unit)
D. Control and Limit Interface Ports	H. Fan
E. Stepping Motor Connection	I. Motor Overload Fuse
	J. Potentiometer adjustment access

LED DESCRIPTION (ITEM B)

MARKER	LED is ON when a marker signal is present.
ZERO	LED is ON when motor is in high current mode, and OFF when motor is in high current mode.
RESET	LED is ON during reset.
REMOTE	LED is ON when external clock and direction inputs are enabled or during Home cycle.
LOCAL	LED is ON when REMOTE LED is OFF ·
CCW LMT	LED is ON when in CCW Limit
CW LMT	LED is ON when in CW Limit

Figure 2-2: Unidex 1 Aerodrive Package Outline (Models U1RA through U1RK)

SECTION 2-2 MOTOR CONNECTIONS

The Unidex 1 Aerodrive utilizes two types of Motor connections (see Item E, of Figure 2-2). The motor power receptacles outlined in Figure 2-3 show the two connectors configurations and delineates the model numbers associated with each. Figure 2-4 also illustrates the connectors shown below.

NOTE: If the Unidex 1 Aerodrive is supplied with an Aerotech motor it will be prewired with the appropriate connector configuration. The following illustrations are then for information only.
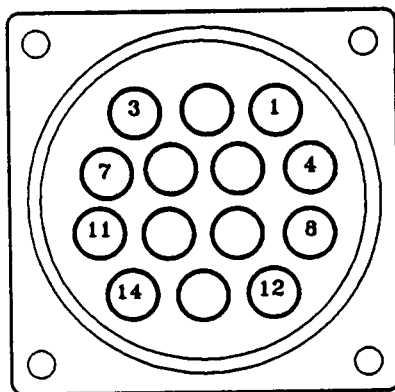
14 Pin Plastic Style
(U1RA, U1RB, U1RC, U1RD, U1RG, and U1RH Models)
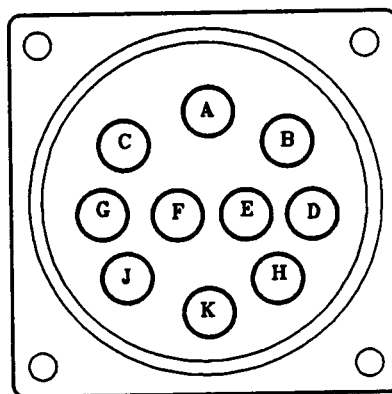
10 Pin Metal Style
(U1RE, U1RF, U1RJ and U1RK Models)

Figure 2-3: Outline of Motor Connections for Unidex 1 Aerodrive.
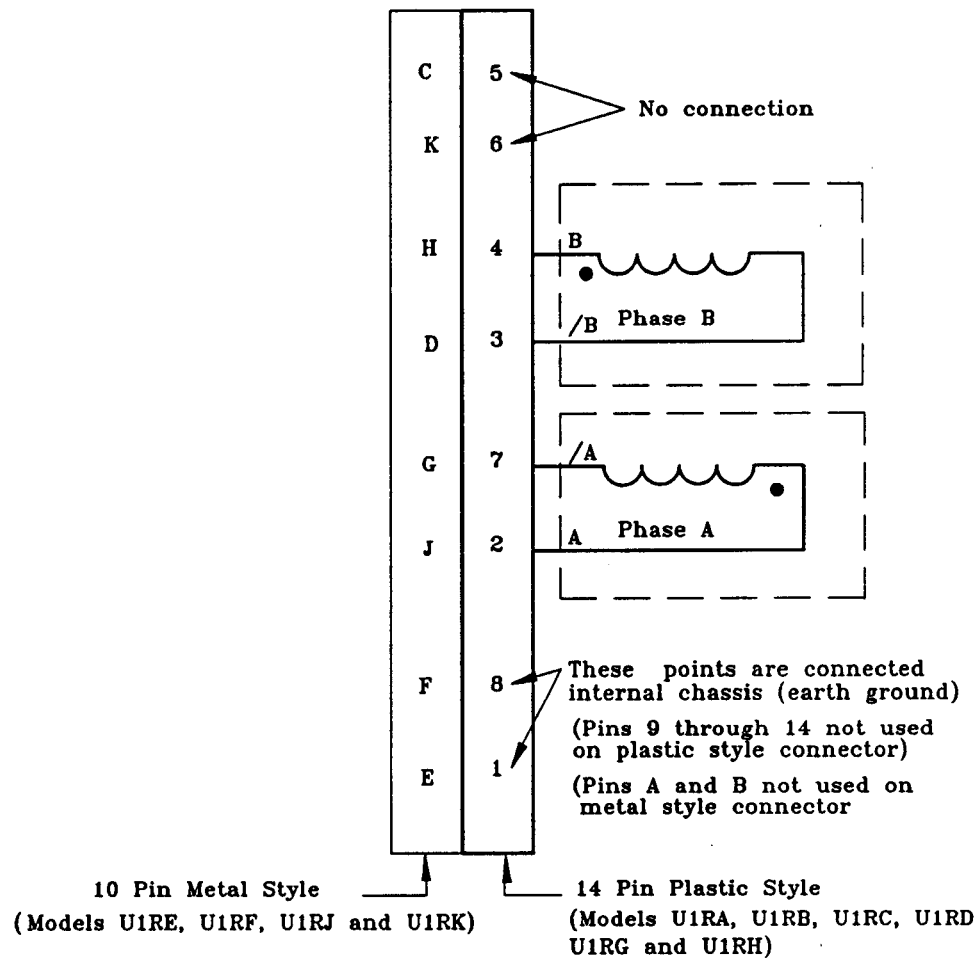
Figure 2-4: Unidex 1 Aerodrive Motor Connections

SECTION 2-3 CONTROL CONNECTIONS, PORT A, B, C

(For All Units)

There are three control connectors on Unidex 1 (labeled Port A, Port B and Port C). The location of each of these connectors is shown in Figure 2-2. See Figure 2-5 for a description of each connector and its mate.

Port A

Port B and Port C

(Female, 9 pin "D" type)

(Female, 25 pin "D" type)
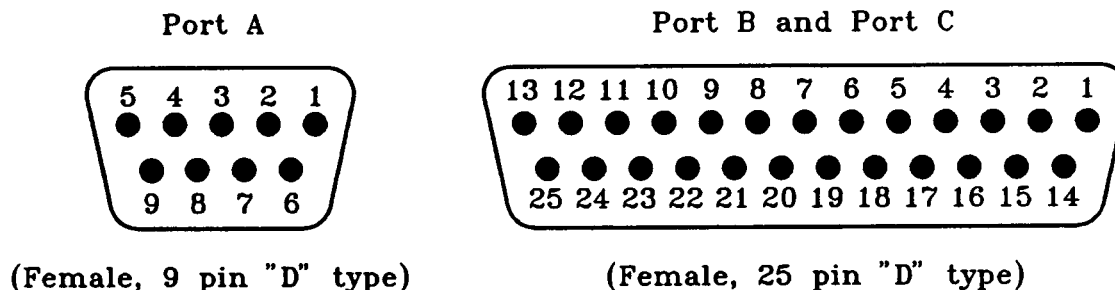
NOTE: Outline drawings refer to Unidex 1 RECEPTACLES ONLY (mate of each is mirror image, as described below).

Mating connector for 9 pin "female" "D-type" connector. (Computer Interface (Port A)

Molded cable type "male" Belden, No. 49902. Solder pot type "male" TRW-CINCH, No. DEM-9P. Ribbon connector type "male" TRW-CINCH, No. FC-9P.

Mating connector for 25 pin "female" "D-type" connectors. (Input/Output (Port B) Limits (Port C))

Molded cable type "male" Belden, No. 49670 Solder pot type "male" TRW-CINCH, No. DBM-25P Ribbon connector type "male" TRW-CINCH, No. FC-25P.

Figure 2-5: Outline and Mating Connector Description for Unidex 1 Control Connectors (Ports A, B and C)

SECTION 2- 3-1   INTERFACE CONNECTOR (PORT A)

Port A receptacle provides for the termination of the Computer Interface cable. Following is the pinout listing for the RS - 232 receptacle. (See Chapter 8 for details.)

COMPUTER INTERFACE (PORT A)

PIN	DESCRIPTION
1	Shield
2	Received data (RXD)
3	Transmitted data (TXD)
4	Data terminal ready (DTR)
5	Signal common
6	Data set ready (DSR)
7	Request to send (RTS)
8	Clear to send (CTS)
9	+5V (External +5V limited to 30mA max)

SECTION 2-3-2   INPUT/OUTPUT CONNECTOR (PORT B)

Port B receptacle provides the means of terminating inputs (I1, I2, I3, I4) and outputs (O1, O2, O3, O4) as well as auxiliary control inputs.

The pinouts for the Port B receptacle are as follows (see Figure 2-5 for outline drawing).

INPUT/OUTPUT CONNECTOR (PORT B)

Pin	Description
1	FAULT (Opto Isolated)
2	OUTPUT 03 (Opto Isolated)
3	OUTPUT 01 (Opto Isolated)
4	INPUT I3 (Opto Isolated)
5	INPUT I1 (Opto Isolated)
6	/SETUP
7	EXT CLK
8	COMMON
9	INPUT COMMON
10	CW LIMIT (Opto Isolated)
11	CURRENT COMMAND (see note below)
12	VELOCITY FEEDBACK (see note below)
13	SHIELD
14	OUTPUT 04 (Opto Isolated)
15	OUTPUT O2 (Opto Isolated)
16	INPUT I4 (Opto Isolated)
17	INPUT I2 (Opto Isolated)
18	/FEEDHOLD (Opto Isolated)
19	EXT DIR
20	+ 5 VDC
21	OUTPUT COMMON
22	CCW LIMIT (Opto Isolated)
23	VELOCITY COMMAND (see note below)
24	ANALOG LOCK (see note below)
25	ZERO COUNT (see note below)

NOTE: Pins 11, 12, 23, 24 and 25 are testpoints for use with the adjustment procedures described in Chapter 9.

Shield termination is made through the two strain relief screws on the connector.

A. INPUT (I1, I2, I3, I4) CONFIGURATION

The four condition inputs (see Section 8-8 for conditional input description) are Opto Isolated as shown in the following configuration.
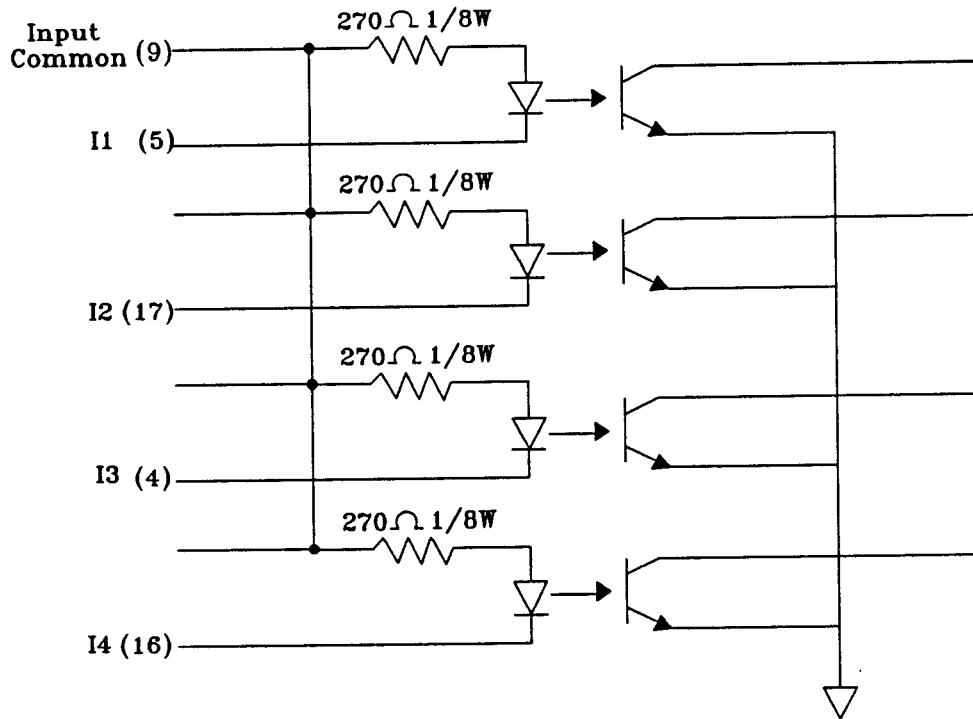
NOTE: Input common (pin 9) is also used as a common return for the Opto Isolated CW and CCW Limits and Feedhold (described later).

Figure 2-6: Input I1, I2 ,I3, and I4 Opto Isolation

B. TYPICAL ISOLATION INPUT APPLICATION EXAMPLE
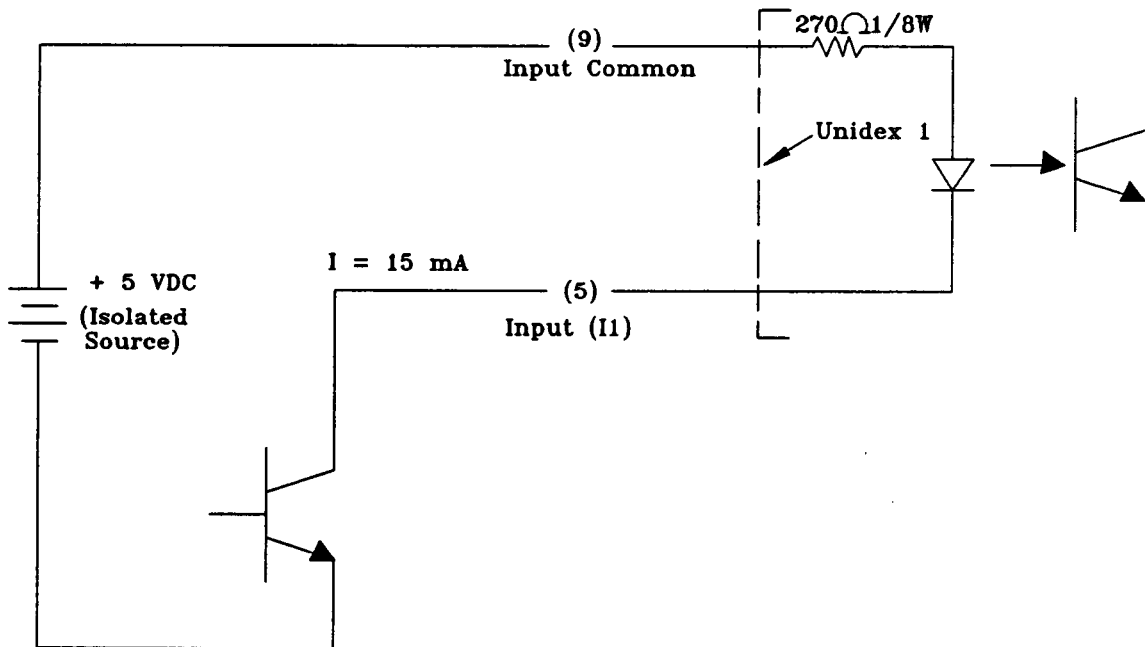
OPTO ISOLATED INPUT SPECIFICATIONS

Maximum input current (I1, I2, I3, I4,):	20mA
Maximum voltage (Input common to any input):	6V
Activation voltage range (Input common to any input):	4V–6V
Maximum reverse voltage (Input common more negative than any input):	6V

Figure 2-7: Opto Isolated Input Specifications

The opto isolated inputs may be made to operate at up to 30 volts by adding resistance in series with the input (I1 - I4) lines. To determine the resistance required, use the following formulas:

$$R_{(ohms)} = \frac{[(Voltage) - 5V]}{.015}$$

$$W_{(watts)} = .015 \times (Voltage - 5V)$$

Example: Selecting a resistor value for an operating voltage of 12 volts:

1) $R = \dfrac{[(Voltage) - 5V]}{.015}$

$R = \dfrac{(12 - 5)}{.015}$

R = 467 Ohms (Select nearest value)

(Use 470 Ohm resistor.)

2) $W = .015 \times (Voltage - 5V)$

$W = .015 \times 7$

W = .105 Watt

(Use 1/4 Watt or 1/2 Watt resistor.)

C. OUTPUT (O1, O2, O3, O4) CONFIGURATION

The four programmable outputs (see Section 5-8 for Programmable Output description) are opto isolated with the following configuration:
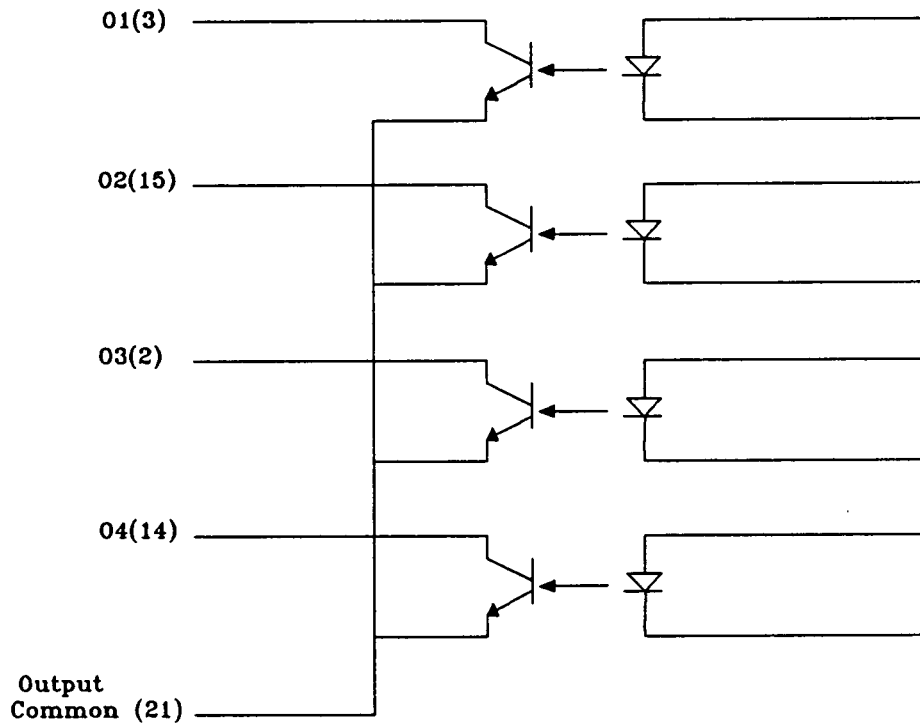
Figure 2-10: Opto Isolated Output Configuration

Outputs are capable of driving one TTL load. A typical application is shown below:
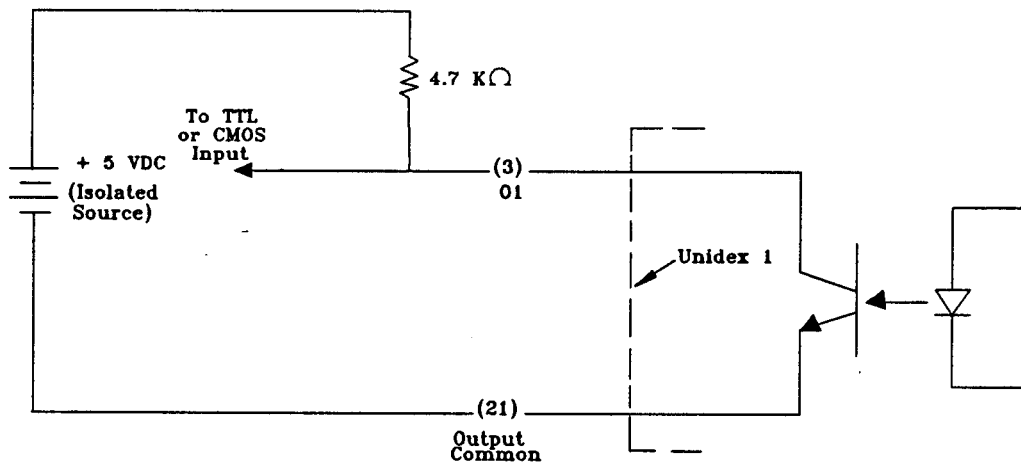
OUTPUT SPECIFICATIONS

Maximum voltage "Off State" (Collector to Emitter):	30V
Maximum reverse voltage	−7V
Maximum collector saturation voltage (I_c = 2mA):	.5V
Maximum power dissipation:	150mW

Figure 2-11: Typical Output Application

D. FEEDHOLD CONFIGURATION

The feedhold input is an opto isolated input with the following configuration:
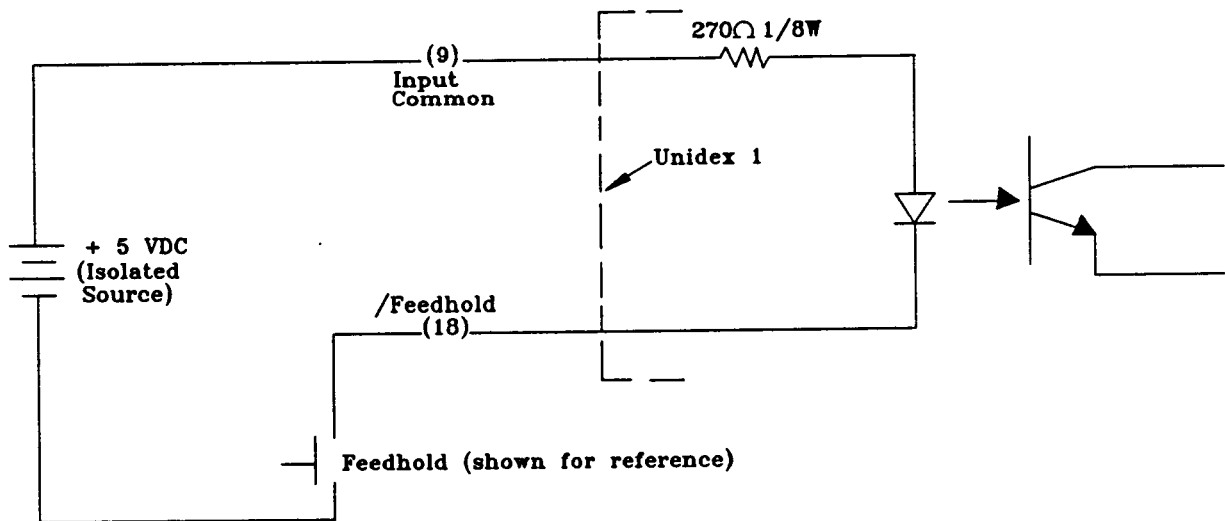
NOTE: Input common (Pin 9) is used for all opto isolated inputs.

The feedhold input specifications is the same as the opto isolated inputs. (See Subsection B of this section for specifications.)

The feedhold input is designed to bring to a controlled stop, any of the 99 programs executed by the Unidex 1 Indexer. The motion is allowed to continue when the switch is reopened.

E. CW/CCW LIMIT CONFIGURATION

The CW/CCW limit connections described in Section 2-4 can be provided with opto-isolation. When these isolated limits are used, the Limit Inputs on the Limit connector (Port C) must not be connected.

The opto isolated limit specifications for the CW and CCW Limit Inputs are the same as those for the general purpose opto isolated inputs (I1 through I4) described previously. (See Subsection B of this section for specifications.)

Following is a typical opto isolated Limit application:
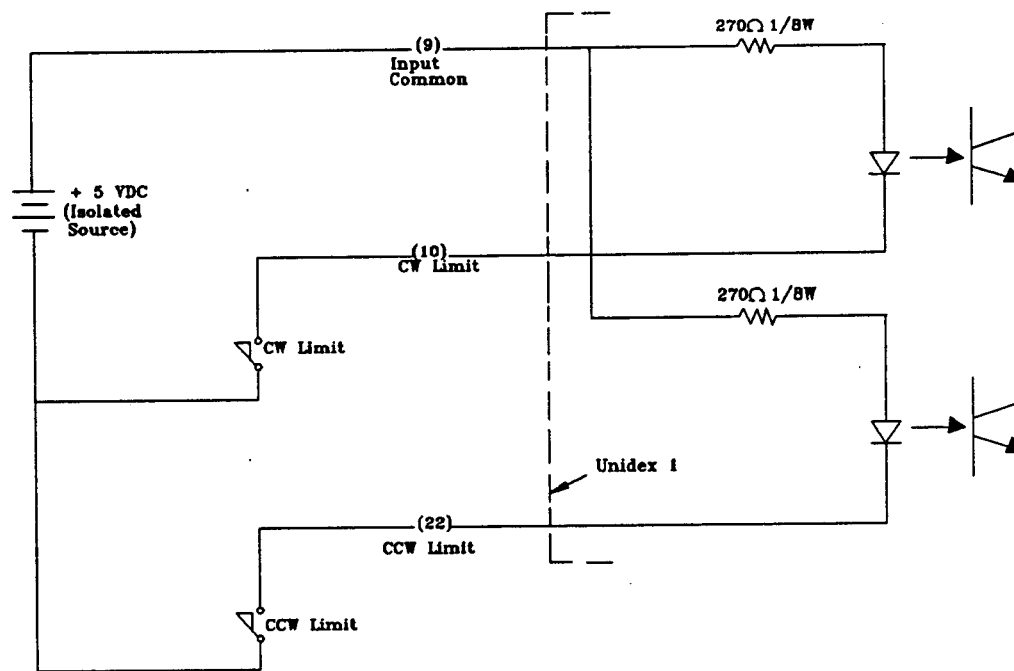
NOTE: Input common is used for all opto isolated inputs.

Figure 2-12: Typical Opto Isolated Limit Application

F. EXTERNAL CLOCK AND DIRECTION

The External Clock and Direction inputs allow External Clock and direction commands to be applied to the Translator, when the Unidex 1 is placed in the REMOTE mode (see Section 7-7). The Unidex 1 Controller will keep track of these pulses, updating the position register. The External Clock and Direction inputs require +5V (logic 1) and 0V (logic 0) voltage levels. The External Clock and Direction input signal provides the same CMOS buffering as described for the Limit input connections in Section 8-3A.

PORT B

Pin 7	External Clock
Pin 19	External Direction
Pin 8	Signal Common

G. SETUP INTERFACE CONNECTIONS

The Setup line is used to put Unidex 1 in the Setup Mode (see Chapter 5). For Setup operation, connect the Setup input to Common. *At any other time the Setup line should be left disconnected.*

PORT B

Pin 6	/Setup
Pin 8	Signal Common

H. FAULT INTERFACE CONNECTIONS

The Fault Interface is an optically isolated output used to indicate that Unidex 1 is not ready. The "not ready" state is indicated when the Fault Output Transistor is "off". When Unidex 1 is in the ready state the Fault Output Transistor will be on. Specifica-

tions for the Fault interface are the same as the Output specification. The Fault Output configuration is shown below:
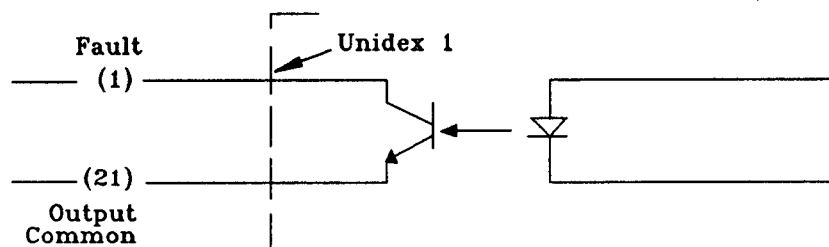
SECTION 2-3-3   LIMIT CONNECTOR (PORT C)

The Port C Limit Connector provides for the termination of the basic control interface signals between the Stepping Motor and Unidex 1. Connections to this port are *not* optically isolated. Motor travel limits and homing signals are terminated at the Limit Connector. The pinout for the Limits Connector is as follows (see Figure 2-7 for receptacle outline).

ENCODER/LIMITS CONNECTOR (PORT C)

Pin	Description
1	Shield
3,16	+5 VDC
6	/M
7	M
8,9,20,21	Common
12	/CWLimit
14	Cos
15	/Cos
17	Sin
18	/Sin
22	/Home Limit
24	/CCW Limit

Form "B" Limit contacts can be accommodated for all three Limit Inputs (consult your Aerotech Representative). Both configurations are outlined below (CW Limit used as example).

The polarity of these limits are normally factory set for Form "A" (normally open). The CW and CCW limits provide Travel Limit protection for the drive system. The Home limit switch is used to reference the "Home" position (see Section 7-8 for Home command). When a Home command is issued, the motor turns CCW until the Home switch closes. When the Home switch closes, the direction of the motor is automatically reversed, and the motor rotates CW. When the Home switch opens, (it was previously closed), the Marker inputs (designated "M" and "/M" on Port C) are automatically monitored until the first Marker pulse is observed. The Home cycle is then terminated.

Before continuing, it should be noted that the terms CW and CCW rotation are rela-

To pin 12   To pin 12

Form "A"   Form "B"
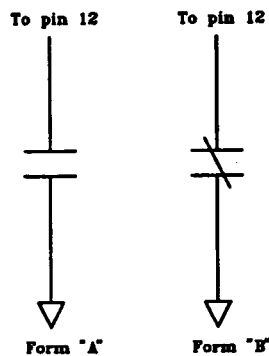
Contact positions are shown when not in limit

tive to Aerotech Motors shipped with the Unidex 1. Direction of rotation is directly related to the Motor wiring. Wiring on a user-supplied Stepping Motor may require manipulation to provide the correct rotation (CW or CCW) as referred to within this manual.

As previously mentioned, the Home Limit switch is used to reference the Home position (see Section 7-8 for details of the Home command). When a Home command is issued, the Motor will turn CCW (Standard) or CW (optional) until a Home Limit Switch activation occurs. Upon Home Limit Switch activation, the Motor will then reverse and rotate in the opposite direction until the switch deactivates.

When the Home Limit Switch reopens, rotation will continue until an active "Marker" indication is present at pins 6 and 7. At this time, motion will cease.

If interfacing to a standard optical encoder that has a once- per-revolution "Marker" pulse, the "Marker" input at pin 7 is active high:

and the "/marker" input at pin 6 is active low:

NOTE: All encoders supplied by Aerotech have once per revolution "Marker" and "/Marker" signals.

If using an encoder that does not have a "Marker" signal, pin 7 should be tied high ($+5V$) and pin 6 should be tied low (common).It is important to note that the "Marker" is ignored until the closure of the Home Switch during the Home cycle. This allows the use of a "once per rev" Marker pulse to be referenced to the Home Limit Switch.

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. Note that the process of putting the Home Limit Switch in parallel with the CCW or CW Limit Switch is standardly done at the motor/stage, external to the Unidex 1 (reference Chapter 3).

A. LIMIT INPUTS

The CW Limit, CCW Limit and Home Limit Input buffering scheme is shown below:
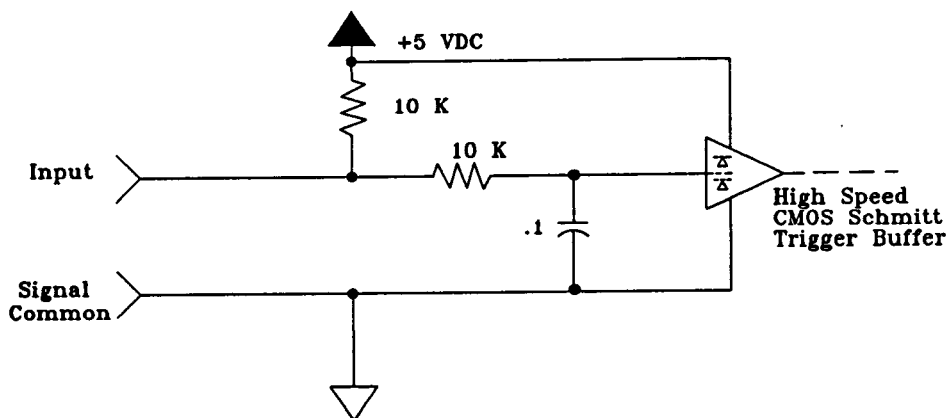
All Limit Inputs are protected against accidental over voltage of +/- 30 volts. All logic inputs such as dry contact, open collector, TTL, or 5 to 15 volt CMOS can be used.

The maximum current draw on the +5 VDC external connection (pin 3 and 16) is limited to 30 mA.

The presence of a visual indication for acknowledging CW Limit, CCW Limit and Marker can be made by viewing the LED indicators on the front panel of the Unidex 1 (see Figure 2-1). The optional TFX Hand Held Terminal also provides an indication of the presence of a Limit or Marker (see Chapter 6).

B. ENCODER INPUTS

The Encoder Inputs are the Sin, Cos, and Marker.The Encoder must be a Differential Sine wave type. The standard Encoder resolution for the Unidex 1 Aerodrive is 500 lines per revolution operated in the "times 4" (X4) mode providing an effective resolution of 2000 steps per revolution. Other Encoder resolutions may be used, however,

certain limitations do exist. Consult your authorized Aerotech representative for further information.

"Times Four" Encoder multiplication is performed internally in the Unidex 1.That is, the Encoder frequency (resolution) is multiplied by four as the effective feedback resolution. Encoder resolutions less than 500 lines per revolution are not recommended.

Encoder phasing must be 90 degrees +/-20 degrees at 50kHz (minimum). (See Figure 2-13 for Encoder signal definition.)

ENCODER SIGNAL DEFINITION

CW

≧ 2V (Typical)

/COS

0

≦.8v (Typical)

Waveforms:
CW rotational
reference is
looking into
motor flange

COS

0

SIN

0

/SIN

0

/M

0

(Marker pulses are
once per revolution)

M

0

Signal shown with reference to system common
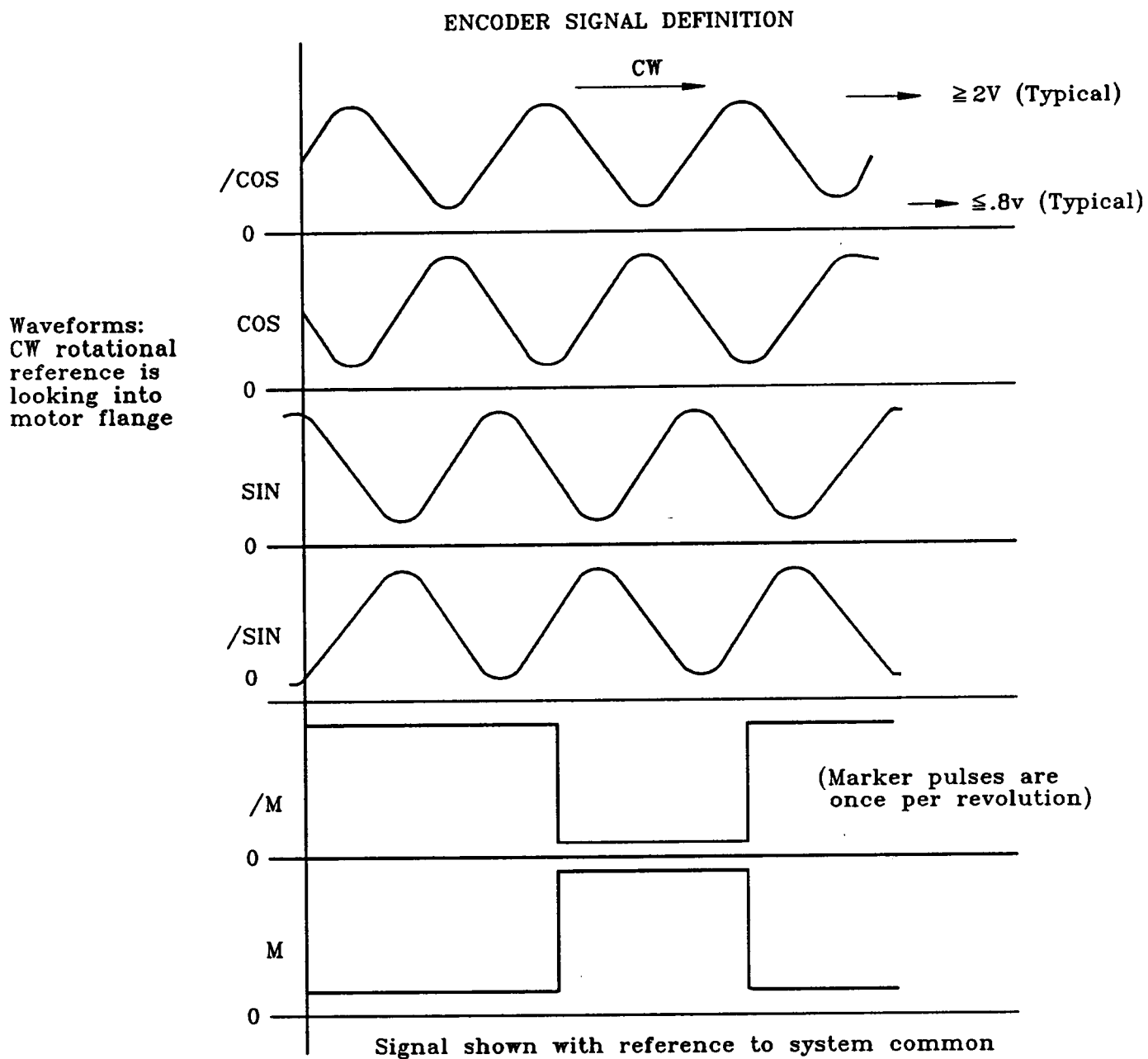
Figure 2-13: Encoder Signal Definition

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CHAPTER 3: MOTOR CONNECTIONS

The mechanical specifications for the standard Motor supplied with the Unidex 1 Aerodrive are outlined in the following section. External Limit Switch connections to the Motor are also defined. Note that the Port C connection serves to return the Limit Switch connections to the Unidex 1 Aerodrive.

SECTION 3-1 MOTOR TYPE U1RA,U1RB,U1RG and U1RH SPECIFICATIONS

The following specifications are with reference to the Limit Switch interface and Home Marker.

TYPE	MOTOR LENGTH "L"
U1RA	2.00 (50.8)
U1RB	4.08 (101.6)
U1RG	2.08 (54.8)
U1RH	3.00 (76.2)

ROTATIONAL CHARACTERISTICS

"+" COMMAND   CW ROTATION

"-" COMMAND   CCW ROTATION

HOME DIRECTION IS INITIATED IN CCW DIRECTION

NOTES:

1. DIMENSIONS SHOWN IN INCHES OVER MILLIMETERS

2. END PLAY: 0.005"(0.12) MAX WITH 16 OZ.
   (0.45 kg) LOAD
   RADIAL PLAY: 0.001" (0.02) MAX.

3. SHAFT RUNOUT: 0.002" (0.05) MAX
   SHAFT TOLERANCE: -0.005"(-0.013)

LIMIT SWITCH WIRING SPECIFICATION

Signal	Pin
+5VDC	1
CW LIMIT	4
CW LIMIT	3
CCW LIMIT	6
CCW LIMIT	5
HOME LIMIT	8
HOME LIMIT	7
SIG COM	2

1. INPUT NOT APPLICABLE TO UNIDEX 1

2. CONSULT FACTORY FOR NORMALLY CLOSED LIMITS

3. CCW (OR CW) LIMIT SIGNAL CAN BE USED IN PLACE OF SEPARATE HOME LIMIT SIGNAL BY INSERTING JUMPER

FORM "A" DRY CONTACT

OPEN COLLECTOR

SECTION 3-2 MOTOR TYPE U1RC,U1RD and U1RJ SPECIFICATIONS

The following specifications are with reference to the Limit Switch interface and Home Marker.
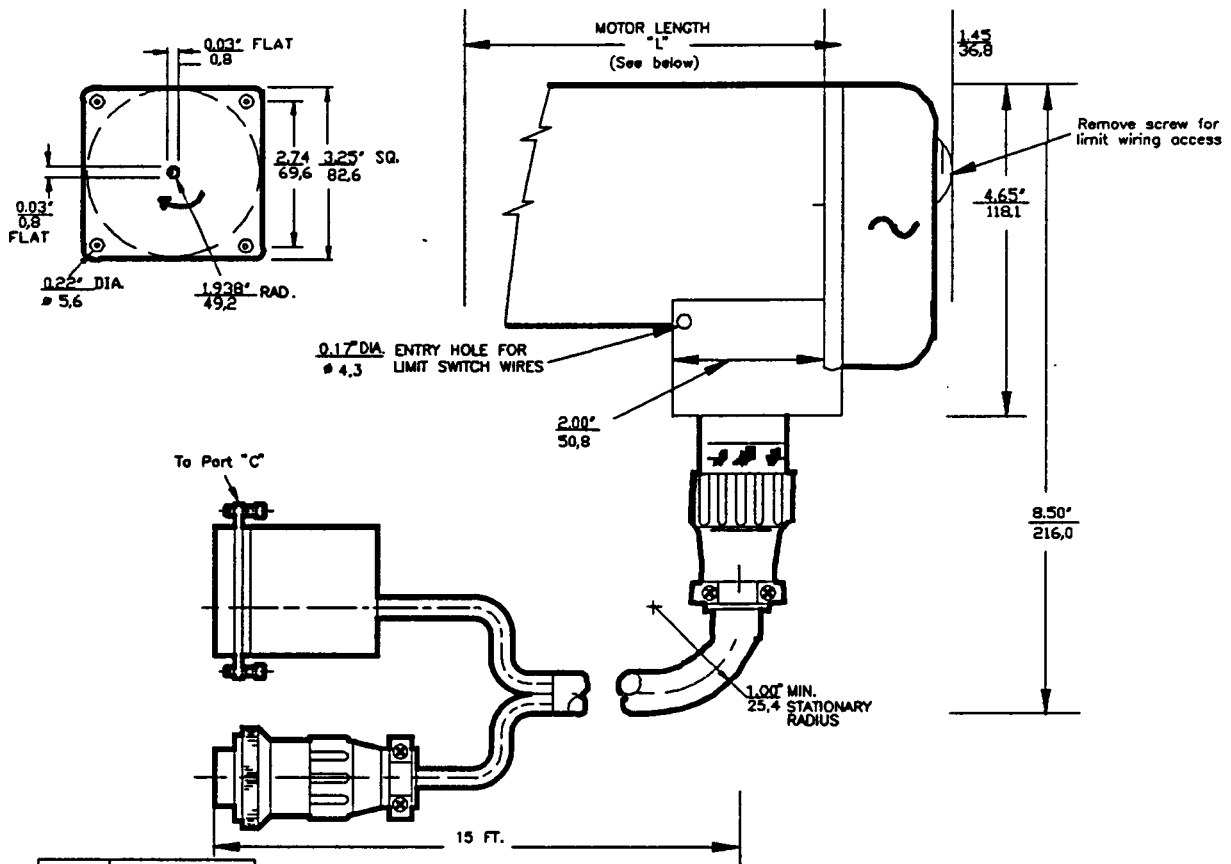
TYPE	MOTOR LENGTH "L"
U1RC	5.00 (127,0)
U1RD	5.00 (127,0)
U1RJ	3.75 (95,25)

ROTATIONAL CHARACTERISTICS

"+" COMMAND   CW ROTATION

"-" COMMAND   CCW ROTATION

HOME DIRECTION IS INITIATED IN CCW DIRECTION

NOTES:

1. DIMENSIONS SHOWN IN INCHES OVER MILLIMETERS
2. END PLAY: 0.005"(0,12) MAX. WITH 16 OZ. (0.45 kg) LOAD
   RADIAL PLAY: 0.001" (0,02) MAX.
3. SHAFT RUNOUT: 0.002" (0,05) MAX.
   SHAFT TOLERANCE: -0.005"(-0,013)

LIMIT SWITCH WIRING SPECIFICATION

+5VDC	1
CW LIMIT	4
CW LIMIT	3
CCW LIMIT	6
CCW LIMIT	5
HOME LIMIT	8
HOME LIMIT	7
SIG COM	2

1. INPUT NOT APPLICABLE TO UNIDEX 1
2. CONSULT FACTORY FOR NORMALLY CLOSED LIMITS
3. CCW (OR CW) LIMIT SIGNAL CAN BE USED IN PLACE OF SEPARATE HOME LIMIT SIGNAL BY INSERTING JUMPER

FORM "A" DRY CONTACT

OPEN COLLECTOR
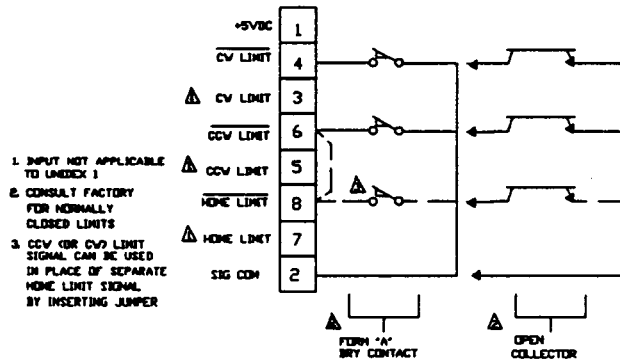
SECTION 3-3 MOTOR TYPE U1RE, U1RF, and U1RK SPECIFICATIONS

The following specifications are with reference to the Limit Switch interface and Home Marker.
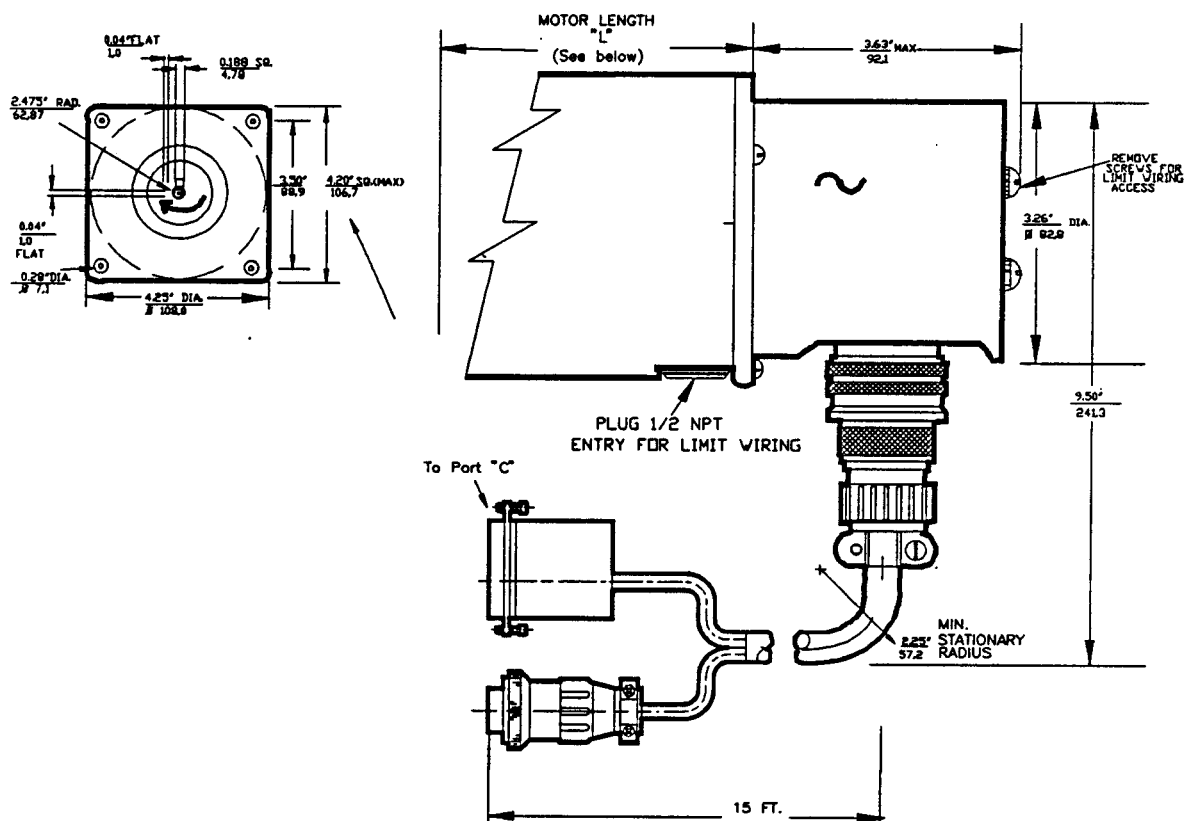
TYPE	MOTOR LENGTH "L"
U1RE	5.50 (139.7)
U1RF	7.50 (190.5)
U1RK	8.00 (203.2)

ROTATIONAL CHARACTERISTICS

"+" COMMAND   CW ROTATION

"−" COMMAND   CCW ROTATION

HOME DIRECTION IS INITIATED IN CCW DIRECTION

NOTES:

1. DIMENSIONS SHOWN IN INCHES OVER MILLIMETERS
2. END PLAY: 0.005"(0.12) MAX. WITH 16 OZ. (0.45 kg) LOAD
   RADIAL PLAY: 0.001" (0.02) MAX.
3. SHAFT RUNOUT: 0.002" (0.05) MAX.
   SHAFT TOLERANCE: −0.005"(−0.013)

LIMIT SWITCH WIRING SPECIFICATION

1. INPUT NOT APPLICABLE TO UNIDEX 1
2. CONSULT FACTORY FOR NORMALLY CLOSED LIMITS
3. CCW (OR CW) LIMIT SIGNAL CAN BE USED IN PLACE OF SEPARATE HOME LIMIT SIGNAL BY INSERTING JUMPER

Signal	Pin
+5VDC	1
CW LIMIT	4
CW LIMIT	3
CCW LIMIT	6
CCW LIMIT	5
HOME LIMIT	8
HOME LIMIT	7
SIG COM	2

FORM "A" DRY CONTACT   OPEN COLLECTOR

1 — Com
2 — +5VDC
3 — CW
4 — CCW
5 — Home
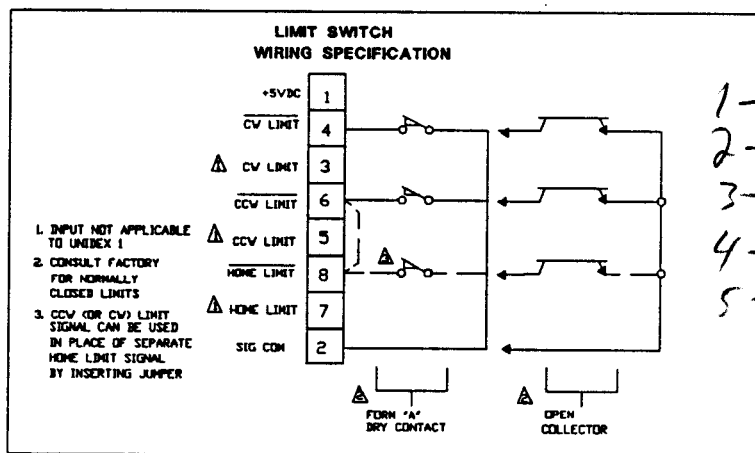
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CHAPTER 4: ADJUSTMENTS

SECTION 4-1: CIRCUIT DESCRIPTION

The Unidex 1 Aerodrive Module has 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 for applications involving 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.

As previously mentioned, 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 Final) position.

SECTION 4-2: AERODRIVE POSITION LOOP 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 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 a "electronically derived" velocity feedback signal from the Motor.

For "locking" the motor in-position (zero error) with the Feedback Encoder, a third circuit is provided to "hold" the motor firmly within a ± 1/2 step of "zero error". This function is termed Analog Lock. This Analog Lock feature eliminates "one bit" jitter when the motor is in the rest position effectively canceling any external torque being 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 in Figure 4-1.
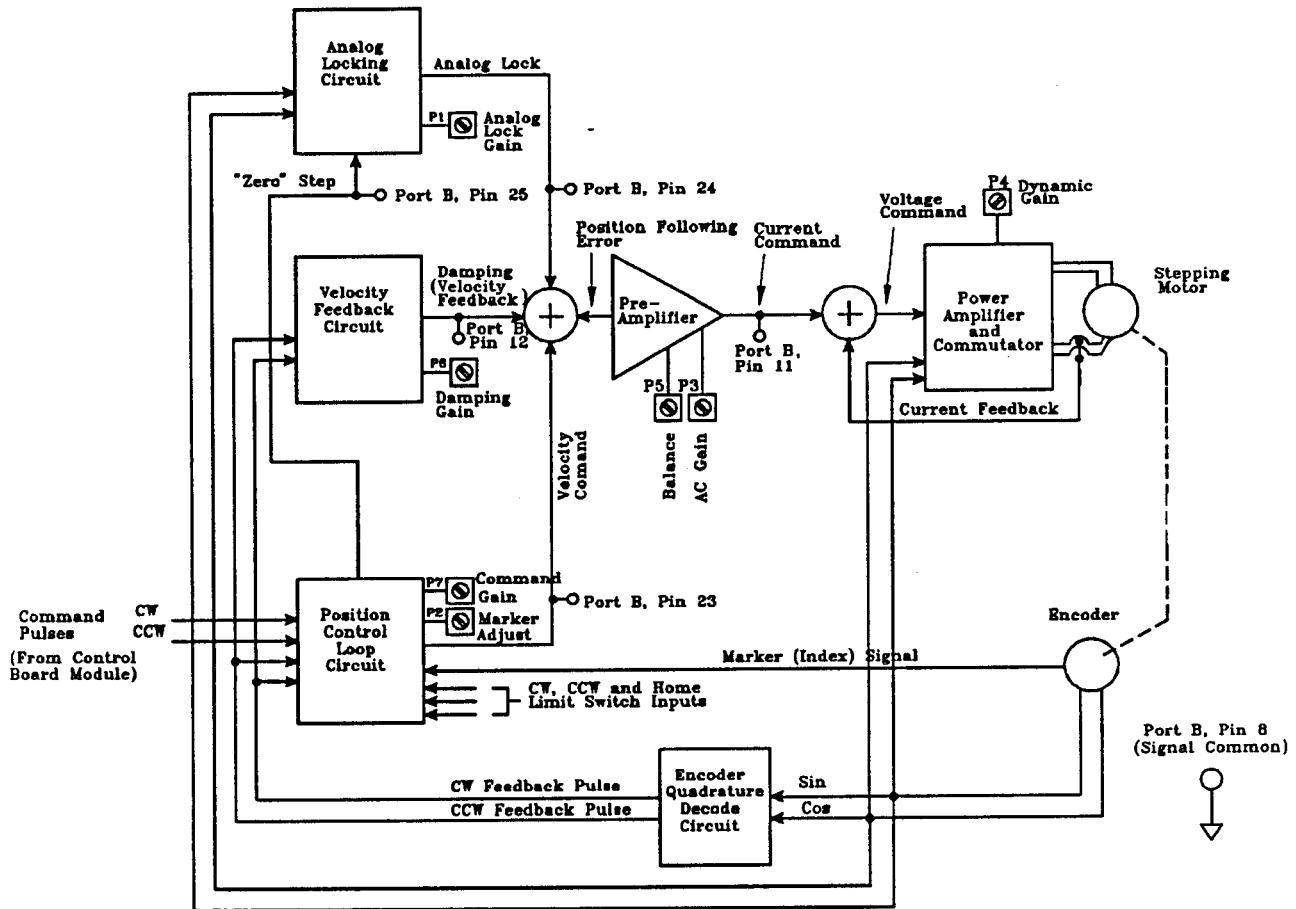
NOTE: The location of adjustment pots P1 thru P7 can be found on Figure 2-1. The location of Test Points (Pins 11, 12, 23, 24, and 25 of Port B can be found on Figures 2-1 and 2-2. Test Point reference may be found in Section 2-9

Figure 4-1 Block Diagram of Unidex 1 Aerodrive Control Circuit

SECTION 4-3: MOTOR LOAD FUSE RATINGS

The Motor load fuse is located on the bottom of the Aerodrive Servo Module (see Figure 2-1). For Aerotech motors, the following fuse rating should be used.

Aerotech Drive/Motor	Motor Fuse F1 *	Current Limit (Internally set)
U1RA1 50SM	2 amps	± 1.5 amps
U1RB1 101SM	8 amps	± 7.5 amps
U1RC1 300SM	10 amps	± 9 amps
U1RD1 310SM	10 amps	± 9 amps
U1RE1 510SM	12 amps	± 12 amps
UR1F1 1010SM	12 amps	± 12 amps
U1RG1 80SR	8 amps	± 7.5 amps
U1RH1 140SR	8 amps	± 7.5 amps
U1RJ1 490SR	12 amps	± 12 amps
U1RK1 1300SR	12 amps	± 12 amps

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

*NOTE: Some fuse ratings are higher than the current ratings due to the location in which the fuse is placed in the circuit.

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 Aerodrive is meant to limit peak current to the Motor during acceleration and deceleration. Because of the placement of the load fuse in the Aerodrive circuit, the load fuse is typically sized to 1.4 times the continuous current rating of the Motor. This method of sizing does not inhibit the ability of the fuse to protect against Motor over-loading.

SECTION 4-4: ADJUSTMENTS

Seven potentiometers and five test points (Accessed from Port B, See Figure 2-2) are provided on the Unidex 1 Aerodrive module. A description of these pots and test points follows.

> **Note: If the Unidex 1 Aerodrive is supplied with a Aerotech Motor, all adjustments have been factory set for that motor and no further adjustments should be necessary. It is suggested however, that the reader review the following sections to become familiar with the adjustment procedures should the need arise.**

In the following descriptions, reference may be made to Figures 2-1 and 4-1.

P1   ANALOG LOCK GAIN ADJUST

This pot adjusts the sine lock gain for analog lock in the "zero" error (rest) position. Analog Lock is adjusted by monitoring testpoint Port B, Pin 24 (with respect to signal common, Port B, Pin 8) and the Zero LED indicator. Turning P1 CCW increases the Analog Lock gain.

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. An outline of the Marker Input Circuit with an adjustment description is illustrated in Figure 4-2.

Potentiometer P2 in the circuit diagram below allows the threshold of the marker input 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. (see Section 3-3 for additional information)

To adjust the Marker, it is recommended that the Aerodrive is given a Home command (see Section 8-8, Item D). This will maintain Motor "search" for the CW, CCW, or Home Limit Switch (Factory selected). When the limit has been reached, the Motor will switch directions and the Aerodrive will look for the first Marker pulse. Pot P2 then should be adjusted such that the pulse is successfully read by the Aerodrive homing logic.
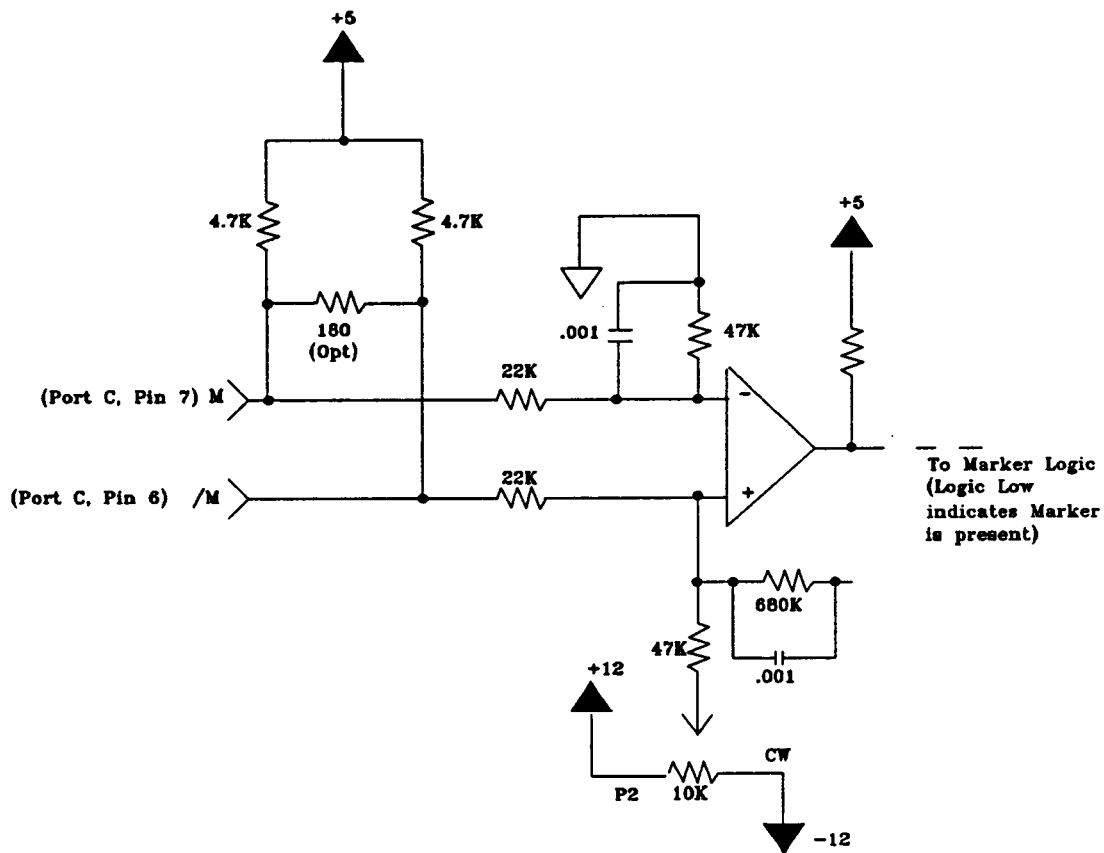
Figure 4-3 Marker Circuit Description

P3   **AC GAIN ADJUST**

This pot adjusts the AC gain of the Pre-Amplifier. Potentiometer P7 and P6 affects 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. Turning the pot CW increases the commutation angle relative to Motor speed.

The Motor current command signal, which is summed with the current feedback signal to produce a voltage command signal to the Power Amplifier (see Figure 3-1), can be monitored at testpoint Port B, Pin 11.

For Aerodrive modules U1RA, U1RB, U1RG and U1RH the current command testpoint provides gain of ±2.1 amps per volt. For modules U1RC, U1RD, U1RE, U1RF, U1RJ and U1RK the current command testpoint provides a gain ±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 which can cause position error. This pot is adjusted when the Motor is at rest. The Zero LED indicator should be viewed while adjusting this pot when the Motor is at rest. The "zero" error condition is present, meaning that the same number of feedback pulses have been registered as command pulses applied.

P6   **DAMPING GAIN**

This pot adjusts the amount of DC velocity feedback gain to the Pre-Amplifier. Velocity feedback is electronically derived from the Encoder. 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 Port B, Pin 12 provides a monitor for the velocity feedback signal. Turning this pot CW increases velocity feedback gain and typically reduces motor positioning response.

P7   **COMMAND (CMD) 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 and the feedback pulses generated by the Encoder. Testpoint Port B, Pin 24 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 gain pot (P7) and DAMPING gain pot (P6) may require that the Balance pot (P5) be readjusted to obtain the "Zero" serror condition discussed earlier.

4-5   ADJUSTING POSITION & VELOCITY LOOP GAINS

The following section contains a step-by-step procedure for adjusting the Position and Velocity loops of the Unidex 1 Aerodrive. Refer to Figure 2-1 and 3-1 when reviewing this procedure.

WARNING: TO MINIMIZE THE POSSIBILITY OF ELECTRICAL SHOCK AND BODILY INJURY, PRIOR TO MAKING ANY ELECTRICAL CONNECTIONS/DISCONNECTIONS MAKE CERTAIN THAT ALL ELECTRICAL POWER SWITCHES ARE IN THE "OFF" POSITION.

NOTE: An oscilloscope is required for the following procedures.

1)   If possible, disconnect the Motor from the load.

2)   Turn P1 full CW, P3 full CW, P4 mid-range, P5 mid-range, 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 1 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 to 100mS, linear profiling. Set the motion format to "corner-rounding" mode. In the corner-rounding mode, the Unidex 1 will not wait for the "in-position" signal before continuing as commanded by the next command in the program. Make certain that the move is long enough to affirm that the Motor can accelerate and run at programmed speed.

4)   Adjust P7 (Command Gain Adjustment) CW for less than or equal to ±4V of velocity command at testpoint Port B, Pin 23 with respect to testpoint Port B, Pin 8 (Signal Common). If the motion stops and "AXIS IN LIMIT" error message appears on the TFX Hand Held Terminal (see Note which follows) display, 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.

NOTE: It is assumed that the TFX Hand Held Terminal is being used as the Unidex 1 interface (see Section 7-1).

If "AXIS IN LIMIT" error message 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 increase the Accel/Decel parameter from 100 mS to 200 mS.

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 ocillation 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 Port B, Pin 23 (velocity command) as shown in Figure 4-4. 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.)

8) Decrease the Accel/Decel value from 100mS until you start to notice overshoot at testpoint Port B, Pin 23 (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 1. Connect the probe of the oscilloscope to testpoint Port B, Pin 24 (Lock Signal) and the common of the oscilloscope to testpoint Port B, Pin 8 (Signal Common). Turn P1 (Analog Lock gain) mid-range and adjust P5 (Balance) for zero volts (±.5V) at testpoint Port B, Pin 24. Execute a one step move and adjust P1 for approximately 25% overshoot at testpoint Port B, Pin 24 upon completion of the move with little or no ringing (as shown in Figure 4-5). After adjusting P1 it may also be necessary to readjust P5.

Overshoot

Velocity
Command
Port B, Pin 23

(Position
Error 2.5 mV/Step)

Time
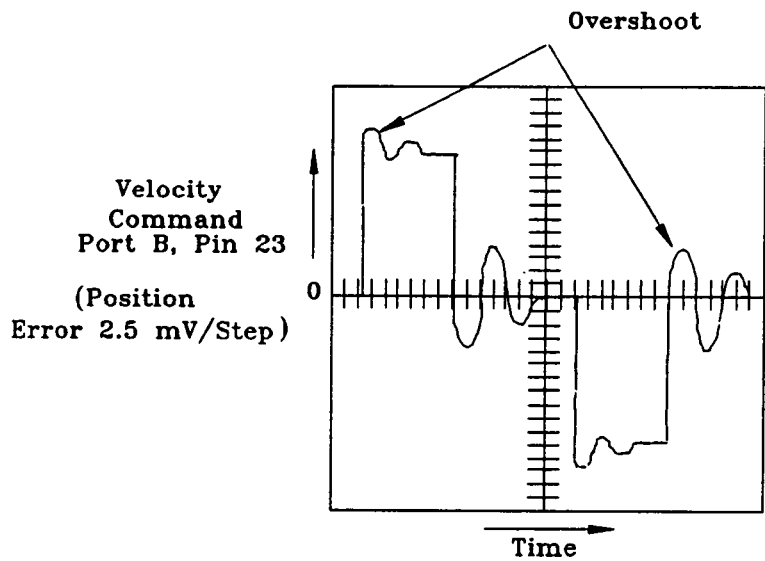
A) Underdamped System

Feedback gain pot P6
turned too far CCW
(and/or command
gain pot P7 turned
too far CW).

CCW Move

Velocity
Command
Port B, Pin 23

(Position
Error 2.5 mV/Step)

Time
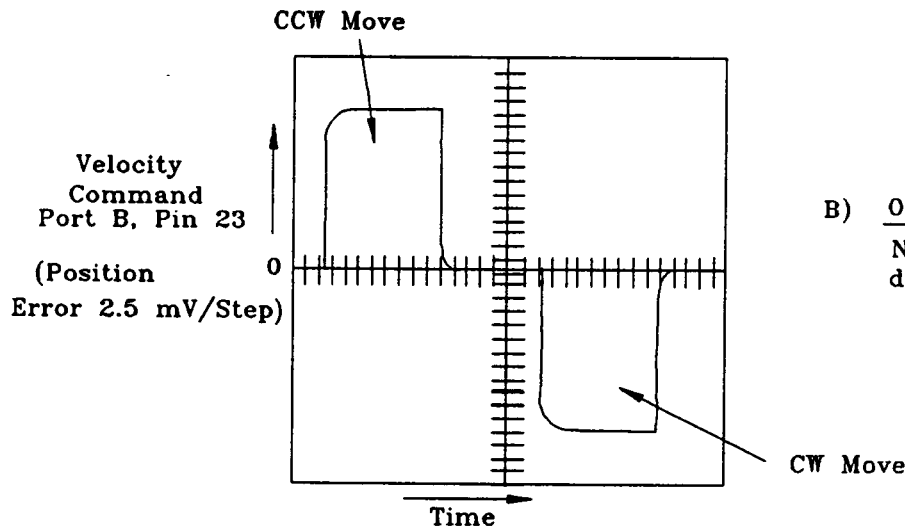
B) Optimally Damped System

No overshoot. Properly
damped system.

CW Move

NOTE: The velocity command shown in this
Figure also represents the position error
which is scaled to a 2.5 mV/ machine step.

Figure 4-4: Velocity Command refers to Testpoint Port B, Pin 23 for Underdamped (A), and Optimally
Damped (B), Position Loop Response

1 STEP MOVE CW

+1.4V

TP2   0

Overshoot

−1.4V

Time

1 STEP MOVE CCW

+1.4V

Overshoot

TP2   0

−1.4V

Time
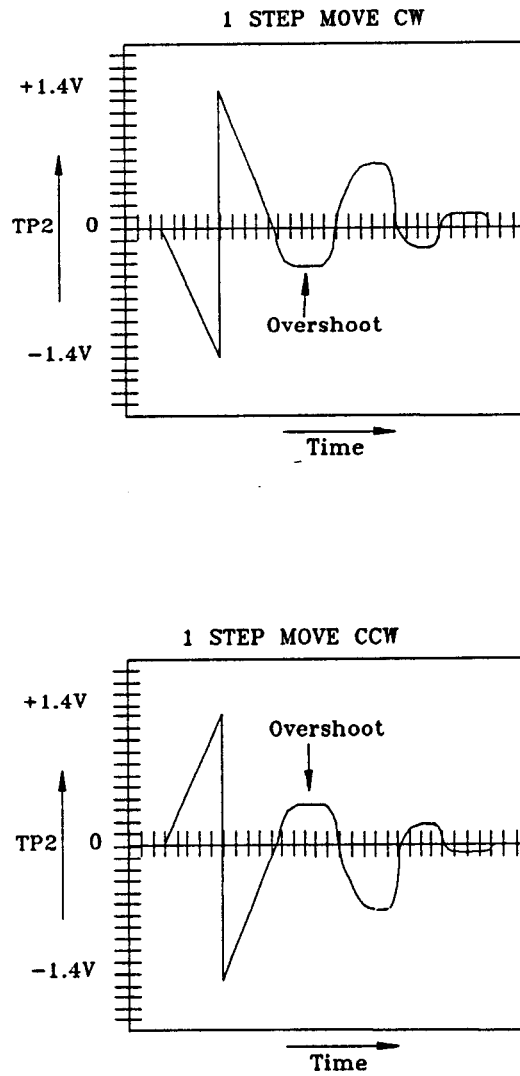
Figure 4-5: Analog Lock Signal at Testpoint Port B, Pin 24

The Unidex 1 Aerodrive is Now Ready for Operation

Before programming normal motion, slew 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 the Unidex 1 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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CHAPTER 5: POWER UP

SECTION 5-1 POWER UP

Prior to applying input power to the Unidex 1 Aerodrive Motion Controller the system must be configured in accordance to the specifications of Chapters 1, 2, 3, and 4.

> **WARNING: TO MINIMIZE POSSIBLE DAMAGE TO THE CONTROLLER, MAKE CERTAIN THAT THE AC INPUT VOLTAGE IS IN ACCORDANCE WITH THE UNIT SPECIFICATION LABEL LOCATED ON THE BOTTOM OF THE CONTROLLERS CHASSIS.**

When the appropriate input voltage has been connected to the Unidex 1 Aerodrive, move the POWER ON/OFF Switch into the ON position. One or more LEDs will light. The RESET LED must go out within several seconds. If an Auto-Boot program is present, it will be executed at this time (see Section 5-5).

SECTION 5-2 INITIALIZATION

The Unidex 1 operates in one of two modes; the Computer Interface mode (Chapter 7) or the optional Hand Held Input mode. Both are activated in a similar fashion as described below. This description applies to a single unit. Activating more than one Unidex 1 (daisy-chain mode) is described in a following section. All Unidex 1's must be in the inactive state before an activation command is given. If there are any active units, a deactivation command must be sent first (see Section 5-3).

Mode	Activation Command
Computer Interface	> >nn <CR>
Hand Held Terminal	## nn <ENTER>
Thumbwheel Program Control	< < <CR> *
Thumbwheel Index Control	@@ <CR> *

* NOTE (1): The TP and TI Controllers generate these codes automatically. The activation characters are transparent to the User. (See Chapter 6 for details).

NOTE (2): "nn" denotes the device address number.

NOTE (3): When all Unidex 1's are inactive, all characters sent from a host computer or the optional TFX Hand Held Terminal will be echoed back. These characters will appear as double characters on the screen. For example, "####0011" will appear to activate device #1. Consider the echo character as a check on the communication loop (all Unidex 1's are receiving the command) and not a part of the command.

EXAMPLE:

To activate the Computer Interface, send two "greater than" signs (>), followed by the device number of Unidex 1 (shown above as nn). If the device number is unknown, it can be checked and set (see in Chapter 3, Set Up). (The default address is 01.)

> **NOTE:** Digit codes 00 and 01 should not be selected as device numbers for daisy chained Unidex 1s because of the possible interference with the set up of daisy chain operations (00 is used for Setup operations and 01 is the default address).

After the two digit device number has been entered, a <CR> must be sent. Following the <CR>, a short wait is necessary before sending another character. This wait time is needed to allow the Unidex 1 to configure itself as a talker. The wait time is dependent upon the baudrate and can be calculated using the following formula.

$$\text{Time (seconds)} = 12/\text{Baudrate}$$

For example, the wait time required for 9600 baudrate would be calculated as follows:

$$T = 12/9600 = .00125 \text{ seconds (or 1.25 milliseconds)}$$

(Wait time must be equal to or greater than .00125 seconds for a 9600 baudrate.)

The Unidex 1 will now be active and ready to receive a command. The Computer Interface will give no immediate response unless requested. A print command (see Section 7-7) can be used to verify activation.

When one Unidex 1 has been activated by the optional Hand Held Terminal, the Hand Held Terminal will respond immediately with a Menu Screen, (Refer to Chapter 6 for details on the TFX, TI and TP Hand Held Terminals, and Chapter 7 for details on Computer Interface.)

SECTION 5-3   DEACTIVATING UNIDEX 1

To deactivate a Unidex 1 Unit, send the <CTRL> B character (hex code 02). This will deactivate all active Unidex 1s and put them in the echo mode. Following the <CTRL> B, a short wait is required before sending another character (see Section 5-2).

SECTION 5-4   MULTI-AXIS ACTIVATION (DAISY CHAIN)

It is recommended that the Computer Interface mode be utilized if commands will be issued simultaneously to more than one Unidex 1.

To activate more than one axis at a time, enter a comma or space between each two-digit device code, and enter a <CR> after the last device number. To activate (in the Computer Interface mode) units 02, 05, 11, 21 and 30, enter the following code:

> > 02,05,21,30,11 <CR>

It is not required that device numbers be entered in numerical sequence.

NOTE: A deactivation command <CTRL> B should be sent preceding the activation command, if there is any active Unidex 1 presently on line.

It is not recommended that the Hand Held Terminal mode be used if more than one Unidex 1 is active (except for Trigger operation), since the Hand Held Terminal mode does not support interactive control. If more than one Unidex 1 is active at any time, information will not be sent to the Hand Held Terminal from any of the units.

See Section 8-1 for "Daisy Chain" Specifications of Unidex 1.

SECTION 5-5   AUTO BOOT PROGRAM OPERATION

After the Unidex 1 has been powered up, the Auto Boot program will be immediately executed. The Auto Boot program can be any of the 99 possible programs in memory, and may be selected through the Setup mode (Chapter 6). If a program does not exist for the Auto Boot program number, the Unidex 1 will be ready to be activated and receive a command upon being powered up.

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CHAPTER 6: SETUP

SECTION 6-1   DESCRIPTION

The Setup mode allows the configuration of certain Unidex 1 system features. These include:

- Device Address
- Baud Rate
- Stop Bits
- Parity
- Word Length
- Accel/Decel Ramp Time
- Start/Stop Frequency
- Ramp Profile
- Output Active Level
- Boot Program #
- Load Default Values
- Hand Held Terminal Initialization
- Enable/Disable Motor Operating Current
- Thumbwheel Indexer Index Speed

SECTION 6-2 SETUP MODE SELECTION

To enter the Setup mode, the Unidex 1 must be powered down and a connection must be made between the Setup input (pin 6 of the Input/Output connector, Port B; see Section 2-3-2) and Signal Common (pin 8 of the Input/Output connector).

WARNING: TO MINIMIZE THE POSSIBILITY OF ELECTRICAL SHOCK AND BODILY INJURY, PRIOR TO MAKING ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS MAKE CERTAIN ALL ELECTRICAL POWER SWITCHES ARE IN THE OFF POSITION.

The Setup mode requires the TFX Hand Held Terminal or the Computer Interface be set to the following settings (even if previously set up to a different value):

- Baud Rate: 9600
- Stop Bits: 1
- Word Length: 7
- Parity: Even

The Setup mode must always operate in the above configuration.

See Section 6-2 if the TFX Hand Held terminal must be initialized to the above settings.

With the jumper between pin 6 and 8 of Port B, power up and activate Unidex 1 by entering one of the following commands. (**This cannot be done with Port A wired in daisy chain.**)

Hand Held Terminal: ## 00 <ENTER>
Computer Interface: > > 00 <CR>

The TFX Hand Held terminal will display the following screen when activated:

```
1 DISPLAY SETUP
2 ALTER  SETUP
```

The Computer Interface mode will give no indication of being in the Setup mode unless the host device sends a print setup command (PV<CR>).

SECTION 6-3 TFX HAND HELD TERMINAL INITIALIZATION

The TFX Hand Held Terminal Setup mode allows parameters to be read or changed. It also provides a method of initializing the Hand Held terminal.

A special Hand Held terminal Initialization mode is provided to automatically initialize the Hand Held terminal to the Setup Communications protocol of the Unidex 1 (9600 Baud, see Section 5-2). Once initialized, under normal conditions it should never require re-initialization, however, certain abnormal transient conditions may accidentally alter the internal Hand Held terminal memory.

WARNING: TO MINIMIZE THE POSSIBILITY OF ELECTRICAL SHOCK AND BODILY INJURY, PRIOR TO MAKING ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS MAKE CERTAIN ALL ELECTRICAL POWER SWITCHES ARE IN THE OFF POSITION.

To initialize the Hand Held terminal, power down Unidex 1. Connect Set Up pin (pin 6 of I/O, Port B connector) to Signal Common pin (pin 8 of I/O, Port B connector) with a removable jumper plug. The Hand Held terminal must be connected to the Port A connector (it cannot be in a daisy chain configuration).

Power up Unidex 1, after power has been applied for at least 10 seconds disconnect the Setup to Signal Common jumper. The Hand Held terminal will start displaying characters while initializing. When the Hand Held terminal has been initialized, it will display the following screen. (Initialization time is less than 30 seconds.)

```
┌─────────────────────────┐
│      TERMINAL SET        │
│     9600 BAUD, EVEN      │
│                         │
└─────────────────────────┘
```

**NOTE: Do not turn off power until the "Terminal Set" screen is present.
The unit must be powered down to exit this mode.**

SECTION 6-4 HAND HELD TERMINAL: DISPLAY/SETUP

After the Hand Held terminal has been placed in the Setup Mode and activated (as described previously in Section 6-2) the Hand Held terminal will display:

```
┌─────────────────────────┐
│    1 DISPLAY SETUP       │
│    2 ALTER   SETUP       │
│                         │
└─────────────────────────┘
```

To display the Setup, press the F1 key.
Every time the F1 key is pressed, a Setup parameter will be displayed. When the sequence has displayed the last setup code, the display will move back to the first Setup code. If the F5 key is pressed, the display will go back to the Display/Alter select screen. A description of each of the codes can be found in Section 6-7.

To change a setup parameter press F2 .
The following screen will appear:

```
┌─────────────────────────┐
│   ENTER SETUP CODE       │
│                         │
└─────────────────────────┘
```

To change a Setup code, enter the code directly into the keyboard as described in the Setup code description (see Section 6-7). After the code has been entered, *a* *
(End Of Block) character must be entered. After the * character has been entered, the Setup code will be updated.

During the process of entering the Setup code, the <BACKSPACE> key will delete one character each time it is pressed, beginning with the last one entered. The changed Setup code can be verified by using the Display command.

To exit the Setup Mode, power down the Unidex 1 and then remove the setup jumper (6-8 of I/O connector, Port B).

SECTION 6-5 COMPUTER INTERFACE: PRINT SETUP

To print the Setup codes, Unidex 1 must be active and in the Setup mode.

The Computer Interface Print command is PV <CR>. Upon receiving the PV command, Unidex 1 will send Setup codes and their values to the host device. A description of all of the Setup codes is given in Section 6-7.

SECTION 6-6 COMPUTER INTERFACE: ALTER SETUP

To alter the Setup codes in the Computer Interface mode, Unidex 1 must be active and in the Setup mode. To change a Setup code, enter the complete setup code followed by an "*" character. A description of all Setup codes can be found in Section 6-7.
For example:
BR 14 *

This is a baud rate Setup code. The "*" character will cause the Setup code to be updated. However, the given code will not be activated until both Power and the Set-up jumper are removed.

SECTION 6-7 SET UP CODE DESCRIPTION

This section describes each of the Setup codes. These codes are valid in the Hand Held Terminal and Computer Interface modes.

A. BAUD RATE

The baud rate setup command is used to set the communication baud rate for normal operating mode. (This does not affect the current Setup mode communication protocol. See Section 6-2.)
For example:

BR 14 *

This command will set the baud rate to 9600 baud (code 14 as shown in the following table). The following codes can be used to set their associated baud rates (Hand Held terminal operation uses 9600 baud rate.)

Baud Rate Codes

CODE	BAUD	CODE	BAUD
01	50	09	1800
02	75	10	2400
03	109.92	11	3600
04	134.58	12	4800
05	150	13	7200
06	300	14	9600
07	600	15	19200
08	1200		

NOTE: Any code other than those listed above is invalid.

B. WORD LENGTH

The communication word length can be either 7 or 8 bits. TFX Hand Held terminal operation requires a word length of 7:

WL 7 *

The above command sets the word length to 7 bits.

C. STOP BITS

The communication Stop bit can be selected for either 1 or 2 bits. The Hand Held terminal operation requires 1 stop bit:

SB 1 *

The above command sets the Stop bit to 1.

D. PARITY

The parity command allows a parity of even (E), odd (O) or no parity (N) to be selected. Even parity is typically used for TFX Hand Held terminal operation.

PY E *

The above command will set the parity to Even.

E. DEVICE ADDRESS

The device address command sets the address which will activate Unidex 1. The device address must be a number from 0 to 31. (It is recommended, however, that 0 and 1 not be used as addresses, since 0 is used in the Setup mode, and 1 is the default address.)

For example:

DA 24 *

The above example command will set the Unidex 1 to address 24.

F. BOOT PROGRAM

The boot program command sets the program number (from 1 to 99) to be executed upon power up. (**Enter a boot program number of 00 to disable the boot program feature.**)

BP 49 *

The above example will set program 49 to execute when Unidex 1 is powered up.

G. OUTPUT ACTIVE STATE

The output active state command allows the Unidex 1 to be setup for an active high (H) or an active low (L) state.

OT H *

This command sets the output active state to active high.

H. ACCEL./DECEL.

The ramp time command sets the Accel/Decel time in milliseconds. Ramp time must be between 0 and 9999.

AD 250 *

The above command will set the ramp time to 250 milliseconds.

I. START/STOP

The start/stop code sets the start/stop frequency for ramped moves. The start/stop frequency is entered in steps/sec and must be between 1 and 125000. Once entered into Unidex 1, the start/stop frequency will be converted to the nearest usable frequency.

SS 10000 *

The above example would set the start/stop frequency for 10,000 steps/sec.

Due to the Unidex 1's 1 μS feedrate accuracy, the SS frequency will be automatically rounded to the nearest achievable feedrate. Displaying the Setup commands by typing PV < CR > (computer interface mode only, with Setup mode active) will show the actual value.

J. RAMP PROFILE

The ramp profile code allows either a linear "L" or Parabolic "P" Accel/Decel ramp curve.

RP P *

This command sets the Accel/Decel ramp profile to parabolic profile.

K. ENABLE/DISABLE HIGH MOTOR CURRENT

Motor current control can be automatically configured for High Current When Running/Low Current When Stationary (EH Y Command) or Low Current When Running/Low Current When Stationary (EH N Command). The actual high and low motor current levels are factory set. The high level is analogous to the Continuous Motor Current/Driver Rating (Table 1-2). The low level is analogous to one half (1/2) the continuous motor/driver rating. The command format is as follows:

EH Y* or EH N*

In the High/Low level mode, Unidex 1 will switch automatically to the High current level during any type of indexed move (manual or programmed). When the move is finished, Unidex 1 will automatically switch to the Low current level. In the Low/Low level mode, Unidex 1 will stay at the low current level for both an indexed move and a rest (stationary) condition.

L. LOAD DEFAULT

The load default command will set the Setup mode to the following. (The commands listed below will not be displayed.)

LD *

Command	Setting
BR 14	Baud rate = 9600
WL 7	Word length = 7
SB 1	Stop bits = 1
PY E	Parity = Even
DA 01	Device Address = 1
BP 00	Boot program = Disabled
OT L	Active low
AD 250	Accel./Decel. = 250
SS 8065	Start/Stop = 8065
RP L	Ramp profile = L
EH Y	Enable high current (while running)
TS 10000	Thumbwheel Indexer Index speed = 10000

The LD command offers a fast and easy means of resetting Unidex 1 to the factory default setup parameters.

M. THUMBWHEEL INDEXER INDEX SPEED

The default Thumbwheel Indexer index speed is selectable to between 2 and 250,000 steps/second.

TS 10000*

The above command will set the Thumbwheel Indexer index speed to 10000 steps/second.

N. PRINT SETUP VALUES

The print setup command will display all setup parameters currently set. For this command a Carriage Return must follow the command. This command is not applicable to the TFX Hand Held terminal interface.

PV <CR>

DISPLAY FORMAT

BR nn
WL n
SB n
PY n
DA nn
BP nn
OT n
AD nnnn
SS nnnnnnn
RP n
EH n
TS nnnnnnn

This concludes the explanation of the setup.

Make certain that the jumper between pin 6 and 8 of Port B is removed following Setup.

The Setup procedures outlined in this section will not operate if the communication to Port A is configured for the daisy chain mode. The RS-232 terminal, computer or optional TFX Hand Held terminal must be directly linked to Port A.

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CHAPTER 7: UNIDEX 1 OPTIONS

Aerotech provides three control interface options for the Unidex 1 Controller. These are the TFX Hand Held terminal, the Thumbwheel Programmer (TP) and the Thumbwheel Indexer (TI). These options are outlined in Figures 7-1, 7-2 and 7-3 respectively.

The TFX Hand Held terminal option provides the user with the ability to enter both manual and program command instructions to the Unidex 1 directly, eliminating the need for a bulky data terminal or computer interface.

The Thumbwheel Programmer (TP) option is supplied for applications requiring a very simple means of commanding program execution for the Unidex 1. This option is geared to factory automation, where program motion has already been pre-defined.

The Thumbwheel Indexer (TI) option is supplied for applications involving variable distance/feedrate motion commands under manual control. This option is similar to that of the TFX Hand Held terminal option in the manual indexing mode, except that this option provides for a more simplified user-machine interface.

SECTION 7-1   TFX HAND HELD TERMINAL

SECTION 7-1-1 INTERFACE CONNECTIONS

The TFX Hand Held terminal (Figure 7-1) is supplied with a cable that is designed to plug into the Communication Interface Connector, Port A, of the Unidex 1 (see Section 2-3-1). No additional interconnect wiring is required. The TFX Hand Held terminal receives its power directly from Unidex 1.

DANGER: TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK AND/OR BODILY INJURY NEVER MAKE ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS WHILE POWER IS APPLIED.

It should be noted that the TFX Hand Held terminal cable can be altered for "daisy chaining" 2 to 30 Unidex 1 controllers to one TFX Hand Held terminal (see Figure 7-3). Pin out definitions for the TFX Hand Held terminal are shown in Figure 7-3.

SECTION 7-1-2 OPERATION

Two configurations of the TFX Hand Held terminal are currently being supplied. Functionally the two terminals are identical however slight differences exist on the keypad (see Figures 7-1 and 7-2).

The TFX Hand Held terminal performs a self check upon power up. This process takes approximately 5 seconds, after which the screen will be blank, except for the blinking cursor. If a blinking cursor does not appear, the TFX Hand Held terminal may need to be initialized (see Section 5-2).

NOTE 1: If you need to reset all Unidex 1s ("daisy chain" mode) on the bus through the TFX Hand Held terminal, enter <CTRL> D.

NOTE 2: A Soft Reset is also available and will reset only the active Unidex 1(s). It is initiated by entering "<CTRL> A" through the TFX Hand Held terminal. This reset will stop program execution and/or motion (DECEL to stop) in all active Unidex 1s. All units that have responded to this reset will still be active. The following screen will be displayed:

```
1 EDIT 2 DISPLAY
3 RUN  4 ETC
```

(The above screen is not displayed if more than one axis is active.)

NOTE 3: The escape character, <ESC>, should never be used, since certain Escape sequence codes will lock up the TFX Hand Held terminal and will require that it be re-initialized (Section 5-4).

To activate Unidex 1 through the TFX Hand Held terminal following a power up or a Reset (Note 1 and 2 above), you must enter:

nn <ENTER>

The "nn" designates the appropriate Unidex 1 device number.

NOTE 1: If TFX Hand Held terminal is used in the "daisy chain" mode, the characters entered will be "echoed" until the given device is activated. (For example: **#### nnnn**).

NOTE 2: The <SHIFT> key may have to be depressed to make the above entry (dependant on the Serial Number of the TFX terminal being used). Notice the cursor becomes larger when the upper case is active. Function keys are considered upper case. **If pressing a Function Key (F1 to F5) gives no result, check the cursor to make certain it is in the upper case mode**

After activating the Unidex 1, you will see the following display:

```
1 EDIT 2 DISPLAY
3 RUN 4 ETC
```

Press function key F1 for **EDIT,** F2 for **DISPLAY,** F3 for **RUN** and F4 for **ETC.**
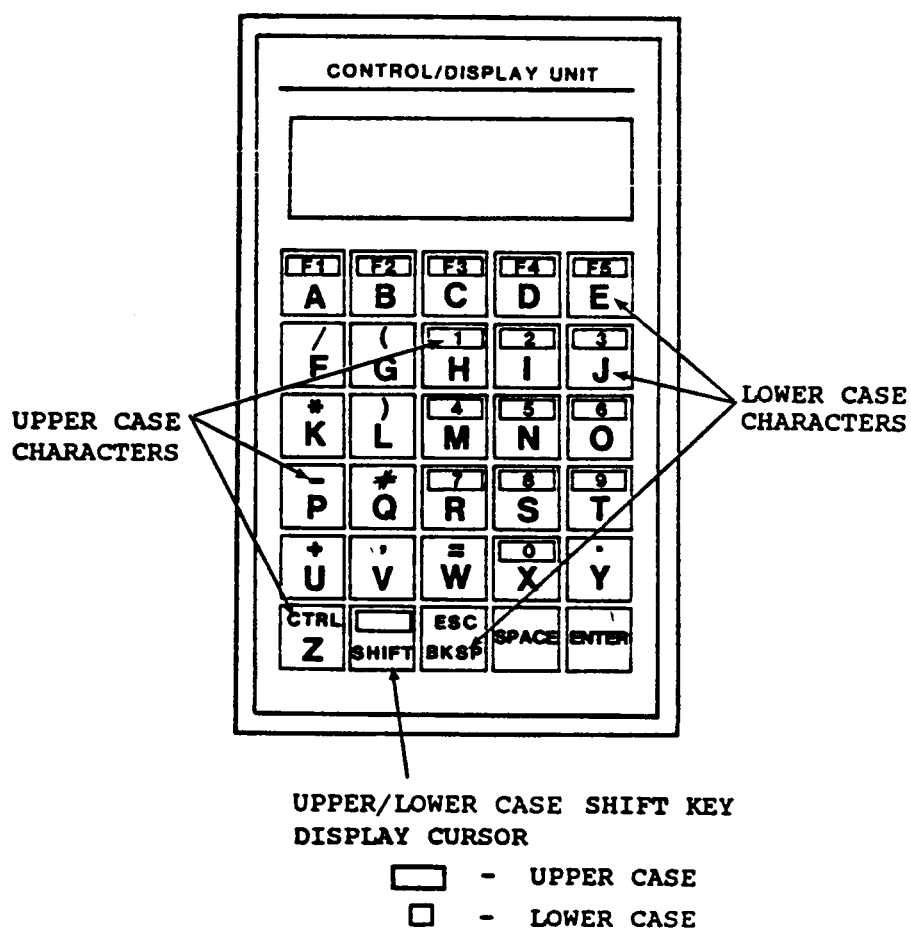
Figure 7-1: Outline of the TFX Hand Held Terminal Option (S/N EFK901) for Unidex 1
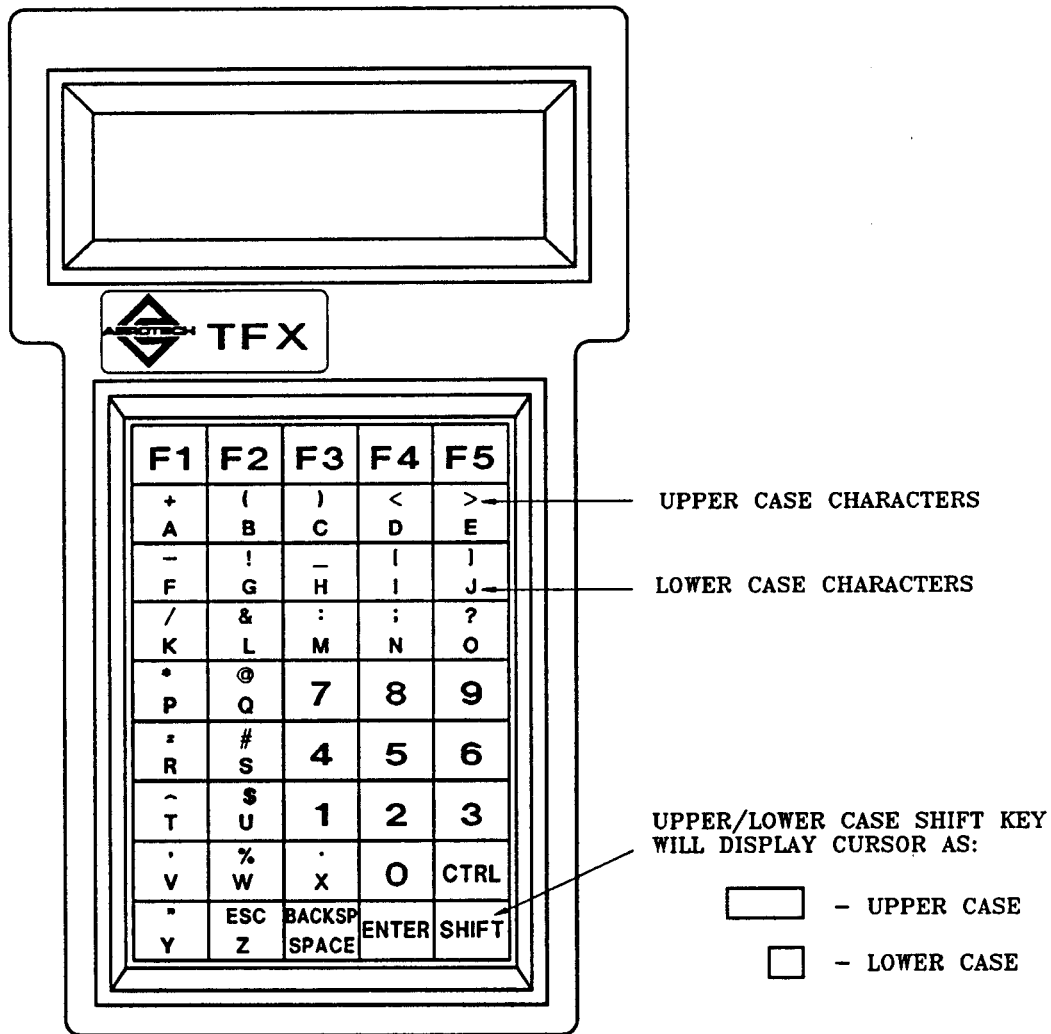
Figure 7-2: Outline of the TFX Hand Held Terminal Option (S/N EFK904) for Unidex 1

The following sections will explain each of these modes.

A. EDIT

Press F1, **EDIT**, from the main menu screen, to enter the editing mode. You will see:

```
         1 PGM  2 ALTER
         3 DELETE 5 RTN
```

Press F1 **PRG**, to input a new program, F2 **ALTER**, to edit an existing program, F3 **DELETE**, to delete a program, and F5 **RETURN**, to return to the previous menu.

> **NOTE:** F5 is not always displayed on the menu screen but may still be used to return you to the previous menu.

The following subsections will describe each Edit menu.

1. INPUT PROGRAM

Press F1, **PRG**, to see:

```
         INPUT PROGRAM
         00  ENTER
```

Enter the new program number. You will then see:

```
         INPUT BLOCK ?
         1  CONTINUE  5 END
```

Press F1, CONTINUE, to see:

```
INPUT BLK CMD
```

You may now begin to enter commands. (See Chapter 7 for a summary of Unidex 1 program commands.)

Enter the * (End of Block) when the program commands have been entered to return to the EDIT menu.

2. ALTER PROGRAM

Once several blocks of commands are entered, you may find it necessary to step through the program in order to edit it. Press F5, **END**, of the Input Program mode to get back to the main EDIT menu. Then press F2, **ALTER**, to see:

```
INPUT PROGRAM
00 ENTER
```

Enter the program number to be edited to see:

```
1 DSP 2 GET BLK
3 INS 4 DEL 5 BK
```

Press F1 **DSP** to display the program commands. Continue to press F1 to view subsequent command blocks, (F2 to go back over previous blocks). When you get to a point where more commands must be inserted, press F5 to return to the ALTER menu. Then press F3, **INSERT**, to insert a block of commands. It will be inserted **before** the block where F5 was pressed. Pressing F3 will show:

```
INPUT BLK CMD
```

You may now insert a command block.

NOTE: F5 is not valid at this time. To exit without entering a command, enter an End-Of-Block character (*). You will be taken back to your program. If you enter an invalid command, you will see:

```
FORMAT WARNING
1 CONTINUE
```

Press F1 to re-enter the program then press F5 to exit if desired.

Commands may also be inserted by pressing F2, **GET BLK**, from the ALTER Program menu. You will see:

```
ENTER BLOCK #
0000  ENTER
```

Enter a block number, such as 2. That program block will be displayed. You cannot directly change the block by overwriting it. Instead you must press F5 to see the ALTER Program menu again:

```
1 DSP  2 GET BLK
3 INS  4 DEL 5 BK
```

You may now press F3 INS to Insert a new block of program commands before the program block just viewed, F4 DEL, to delete that program block, F2 GET BLK, to go to a certain block, F1 DSP, to re-enter the program, or F5 BK, to go back to the main EDIT menu.

Remember, once in the program via any ALTER menu function (except, of course, F5) you may step through your program via **F1 and F2**, even though these functions are not displayed on the screen at the time. Use these functions to check your program while editing.

```
1 PGM  2 ALTER
```

3. DELETE PROGRAM

Press F5, **BK**, to go back to the main edit menu. You will see the main EDIT menu:

```
1 PGM  2 ALTER
3 DELETE 5 RTN
```

Press F3, **DELETE.** The display will show:

```
1 CLR MEMORY
2 DEL PGM  5 RTN
```

Press F1, **CLR MEMORY,** to clear all programs from memory. **Depressing F1 when in the DELETE Menu deletes ALL programs.**

Press F2, **DEL PRG,** to see:

```
INPUT PROGRAM
00  ENTER
```

Enter a program number. That program will be deleted from Unidex 1 memory and the TFX Hand Held terminal will again display the main EDIT menu.

4. RETURN

Pressing F5, **RTN,** of the main EDIT menu will return you to the main menu.

B. DISPLAY

Press F2, **DISPLAY,** of the main menu screen to see:

```
1 PSN  2 PRG
3 DR 4 ETC 5 RTN
```

The above menu will display: Axis Position, a Program, the Directory, Input Status, Output Status and Setup Parameters. Each will be described in a following subsection.

1. POSITION DISPLAY

Once in the display mode, the position will constantly update. The display will show:

```
X 0000002000
5 RTN
```

(To maintain consistency with the Aerotech Unidex 11 Series Controllers, the axis label (X) is allocated to this position. Since Unidex 1 is a one-axis system, X will always be displayed.)

Press F5, **RTN**, to return to the main DISPLAY menu.

2. PROGRAM DISPLAY

Press F2, **PRG**, to see:

```
INPUT PROGRAM
00   ENTER
```

Once you enter any program number which exists in memory, you will see:

```
PRESS F1 TO CONT
PRESS F2 TO EXIT
```

Press F1 to step through the program. Each time F1 is pressed, a subsequent block will appear. (Note that the program editing can only be accomplished in the EDIT mode — see Section 6-2.)

Once you come to End-of-Program, press F5 to return to the main display.

3. DIRECTORY DISPLAY

Press F3, **DR**, to see:

```
┌─────────────────────────────────┐
│        PRESS F1 TO CONT          │
│        PRESS F5 TO EXIT          │
└─────────────────────────────────┘
```

If any program is residing in memory, pressing F1, **CONT**, will give the program number and how many bytes of memory it uses. For example:

```
┌─────────────────────────────────┐
│        PROGRAM # 01              │
│        00035  BYTES              │
└─────────────────────────────────┘
```

Press F1 again to see each subsequent program. When the last program has been displayed, the remaining bytes in memory that are free will be given. For example:

```
┌─────────────────────────────────┐
│        05961 FREE BYTES          │
│        5 RTN                     │
└─────────────────────────────────┘
```

Press F5 to return to the main DISPLAY menu.

4. ETC

Press F4, **ETC**, to see:

```
┌─────────────────────────────────┐
│        1 SETUP  2 STATUS         │
│        3 INPUT  5 RTN            │
└─────────────────────────────────┘
```

a) Setup Display

Press F1, **SETUP**, to see the setup parameters chosen. (For detailed information on the Setup parameters, see Chapter 6, Setup.) The first setup displayed is the Baud Rate:

```
┌─────────────────────────────────┐
│        BR 14                     │
│        1 CONT   5 RTN            │
└─────────────────────────────────┘
```

Press F1 to continue. You will see Word Length:

```
          WL 7
          1 CONT   5 RTN
```

Press F1 to see Stop Bits:

```
          SB 1
          1 CONT   5 RTN
```

Press F1 again for Odd, Even or No Parity:

```
          PY E
          1 CONT   5 RTN
```

The subsequent screens describe the following:
   Device Address (1 through 30):

```
          DA 01
          1 CONT   5 RTN
```

Boot Program (1 through 99):

```
          BP 01
          1 CONT   5 RTN
```

Output Active State (high or low):

```
          OT L
          1 CONT   5 RTN
```

Accel./Decel. time (0-9999 mS) (see Chapter 9):

```
          AD 0250
          1 CONT   5 RTN
```

Start/Stop frequency (default speed if move is too short for Accel/Decel rate; see Section 9-2 and 9-5).

```
┌─────────────────────────────────────┐
│            SS 0000500                │
│            1 CONT   5 RTN            │
└─────────────────────────────────────┘
```

Accel/decel Ramp Profile (linear or parabolic) (see Chapter 9):

```
┌─────────────────────────────────────┐
│            RP L                      │
│            1 CONT   5 RTN            │
└─────────────────────────────────────┘
```

Enable (Yes) or Disable (No) high motor operating current :

```
┌─────────────────────────────────────┐
│            EH Y                      │
│            1 CONT   5 RTN            │
└─────────────────────────────────────┘
```

If F1 is pressed again, the display will wrap around to the Baud Rate .

Press F5 at any time to return to the ETC display.

b) Status Display

Press F2, **STATUS**, to see the present Unidex 1 status. Status codes, described in Chapter 10 (Troubleshooting) will be displayed if valid. Press F1 to continue and F5 to return.

The output status (high or low) is the next to the last status screen and is always displayed:

```
┌─────────────────────────────────────┐
│            01-04 : ( 1111 )          │
│            1 CONT   5 RTN            │
└─────────────────────────────────────┘
```

Press F5 to return or F1 for the next screen.

The software version is the last status screen and is always displayed:
(where xx represents the software level).

```
SOFTWARE USI  xx
5 RTN
```

c) **Input Display**

Press F3, **INPUT,** to display the status of the inputs (high or low):

```
I1-I4: (1111)
5 RTN
```

Press F5 once to return to the ETC menu, and again to return to the main DIS-PLAY menu.

C. RUN MODE

Press F3, **RUN,** from the main menu, to see:

```
1 IMD  2 AUTO
2 BLOCK  5 RTN
```

The Run mode allows you to execute a program in the AUTO or BLOCK mode, or execute a string of commands in the IMMEDIATE mode.

Each of these modes will be covered the following subsections.

1. IMMEDIATE MODE

Press F1, **IMD,** to see:

```
INPUT BLK CMD
```

Enter a block of commands, such as:

HX*

the screen will display:

```
┌─────────────────────────────────┐
│          AXIS IN HOME           │
│          CYCLE                  │
└─────────────────────────────────┘
```

When Unidex 1 is finished executing the command, you will see the main RUN menu displayed again.

2. AUTO MODE

Press F2, **AUTO**, of the Run menu. You will see:

```
┌─────────────────────────────────┐
│         INPUT PROGRAM           │
│         00   ENTER              │
└─────────────────────────────────┘
```

Once the program number has been entered, you will see:

```
┌─────────────────────────────────┐
│         WAIT FOR TRIGGER        │
│         1 YES      2 NO         │
└─────────────────────────────────┘
```

If you want Unidex 1 to suspend execution of the program until it receives a Trigger, press F1, **YES**. You will see:

```
┌─────────────────────────────────┐
│         WAIT FOR TRIGGER        │
│         PRESS T                 │
└─────────────────────────────────┘
```

Press T to begin program execution. The tracking display will be displayed as they execute. When finished, the main RUN menu will be displayed again. The Trigger function may be used with multiple Unidex 1s (daisy chain). The Unidex 1s may be enabled to listen with all beginning to execute the same program simutaneously when the T is pressed.

If no Trigger is required, press F2, **NO**, when in the AUTO mode. As soon as F2 is pressed, the program will execute, displaying the tracking display as it runs. When execution is finished, the main RUN mode will be displayed again. However, at this point, multiple Unidex 1s may be enabled to listen (see Section 5-4), with all beginning to execute the same program simultaneously when T is pressed.

3. BLOCK MODE

Press F3, **Block**, of the RUN menu. You will see:

```
INPUT PROGRAM
00  ENTER
```

Enter your program number, the first command block will execute. You will then see:

```
PRESS F1 TO CONT
PRESS F5 TO EXIT
```

Press F1, **CONT**, to execute the next block, or F5, **EXIT**, to exit the program and re-enter the main RUN menu.

You will continue to receive the above message as long as there are blocks to execute. When the end of the program is reached, the main RUN menu will again be displayed.

Press F5, **RTN**, to return to the Main menu.

D ADDITIONAL MODES

Press F4, **ETC**, of the Main menu to see:

```
1 STOP   2 INDEX
3 HM 4 RMT 5 RTN
```

The following subsections will describe each of the ETC menus.

1. STOP

Press F1, **Stop**, to stop the axis motion. When this mode can be accessed, pressing F1 will halt the axis move. (This command is useful in resetting a "free-run" command.)

2. INDEX

Press F2, **Index**, to see:

```
1 EXECUTE  2 INC
3 FD 4 DST 5 RTN
```

Once in the INDEX mode, you may set a Feedrate (F3) and Distance (F4) at which to Execute (F1) your move. The move may be made in the Incremental or Absolute mode (F2). The details of these modes will be described in the following subsections.

NOTE: Press F2, INC, to switch to the ABS mode. These two modes toggle, but the default mode is Incremental. Notice the difference in the Index menu display when the Absolute mode is active. You will now see:
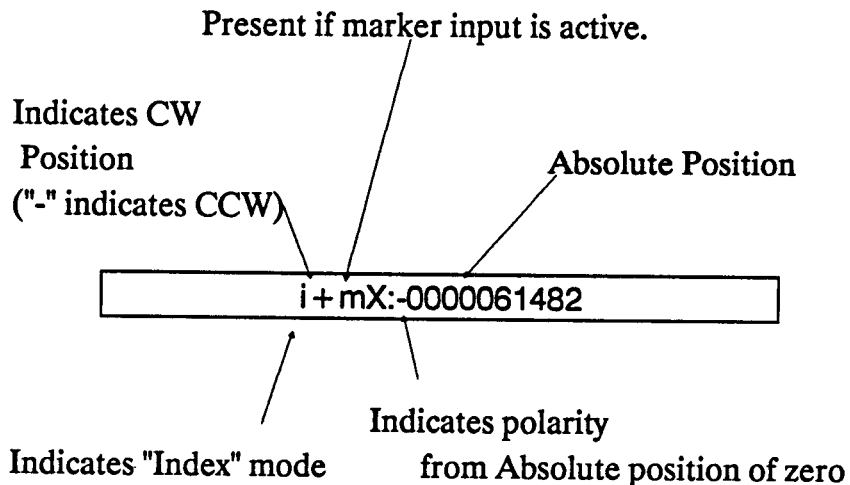
```
1 EXECUTE  2 ABS
3 FD 4 POS 5 RTN
```

The F4 mode changes as a reminder that in the Absolute mode, data entered is not distance, but a *specific position* that the axis is to reach.

a) Execute

Press F1, **EXECUTE**, to make the Axis Index (move a specific distance at a specific feedrate). This distance and feedrate is set via F3, **Feedrate**, and F4, **Distance**. If you do not enter new values, the last ones entered will remain in effect. (They will stay the same even after a reset, or power down.)

If you press F1, **EXECUTE**, you will see a display similar to the example shown above.

Present if marker input is active.

Indicates CW
Position
("-" indicates CCW)

Absolute Position

```
i + mX:-0000061482
```

Indicates "Index" mode

Indicates polarity
from Absolute position of zero

Once execution of the move is complete, you will see a display such as:

```
 i  X: 0000065000
    1 EXECUTE  5 RTN
```

Press F1, **EXECUTE**, to re-execute the same index. Press F5, **RTN**, to go back to the main ETC menu.

> **NOTE:** You will see the previous screen whether you are in the absolute or incremental mode. However, in the absolute mode, once a position is attained (such as 65000 in the above sample screen) pressing F1, **EXECUTE**, will do nothing (the position has already been reached). To continue indexing, either change the position data in F4, **POSITION**, or change to the incremental mode by pressing F2.

b) Absolute/Incremental mode

With F2, INC/ABS, you may toggle between these two modes. As mentioned above, in the incremental mode, distance (F4) is how many steps the axis is to move from its present position.

Absolute is a specific position. Once it is reached, executing the same distance (position) will do nothing.

c) Feedrate

Press F3, **FD**, to see a screen similar to:

```
    FD = 0010000
    ENTER
```

When an index is executed, the axis will move at a feedrate of 10000 steps/second.

d) Distance or Position

Press F4, **DST**, (when in the Incremental mode), to see a screen similar to:

```
    DST = 0000020000
    ENTER
```

When an index is executed in the incremental mode, the axis will move the distance specified (20000 steps in the above example) from the current position.

```
POS = -0000020000
ENTER
```

Press F4, **POS**, (when in the Absolute mode), to see a screen similar to:

When an index is executed in the absolute mode, the axis will move to the absolute position (-20000 steps in the previous example).

3. HOME

```
AXIS IN HOME
CYCLE
```

Pressing F3, **HM**, of the ETC menu, will send the axis home. Press F3 to see:

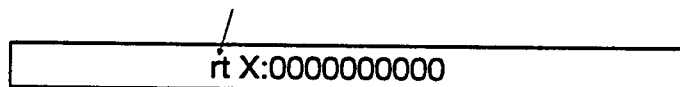Once "Home" is reached, you will see:

```
AXIS AT HOME
1 HM    5 RTN
```

Press F1 to start another Home cycle. Press F5 to return to the main menu.

4. REMOTE

Press F4, **RMT**, to see a screen such as:

Indicates REMOTE mode

```
                    /
    ┌─────────────────────────────────────┐
    │            rt X:0000000000          │
    └─────────────────────────────────────┘
```

The REMOTE display monitors any pulses coming in from the Translator (External Clock and Direction Inputs, Input/Output connector; see Section 2-3-2, Subsection F).

SECTION 7-2   THUMBWHEEL PROGRAMMER(TP)

SECTION 7-2-1   INTERFACE CONNECTIONS

The Thumbwheel Programmer (TP) (Figure 7-3) is supplied with a molded interconnect cable that is designed to plug directly into the Communications Interface Connector, Port A of the Unidex 1 (see Section 2-10). No additional interconnect wiring is required by the user. The TP derives its power directly from the Unidex 1.

> **DANGER: TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK AND/OR BODILY INJURY NEVER MAKE ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS WHILE POWER IS APPLIED.**

Unlike the Hand Held Terminal option (Section 7-1), the Thumbwheel Programmer option *cannot* be "Daisy-chained" to other Unidex 1 Controllers.

SECTION 7-2-2 OPERATION

The Unidex 1 Thumbwheel Programmer Option will call and execute any of 99 possible programs from in Unidex 1 memory. The programs must have previously been entered into Unidex 1 using the TFX Hand Held terminal or the users computer interface (as described in this Chapter and in Chapter 7). Upon completion of the program, the Unidex 1 will respond with a READY LED signal. If the program called has not been executed completely or an ERROR has occurred, Unidex 1 will respond with an ERROR LED signal.
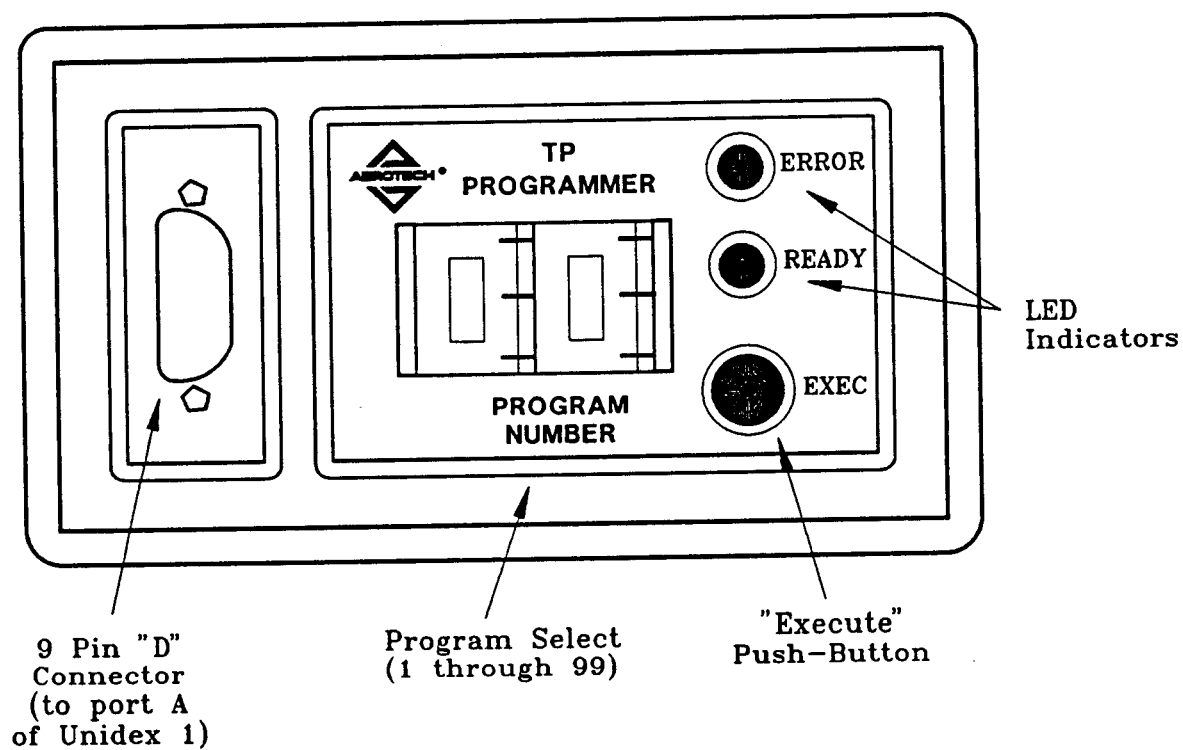
Figure 7-3: *Thumbwheel Programmer (TP) Option*

The use of the Unidex 1 Thumbwheel Programmer requires that the Unidex 1 be set to the following specifications (see Section 6-2 for a description of these codes):

Baud Rate	: 9600
Stop Bits	: 1
Word Length	: 7
Parity	: even

B. THUMBWHEEL PROGRAMMER POWER UP

The Unidex 1 Thumbwheel Programmer must be connected before power up to insure that the Thumbwheel Programmer will be recognized. When the Unidex 1 is powered up, the READY LED should be on and the ERROR LED should be off. To check the Thumbwheel Programmer, set the Thumbwheels to 00 (Program 00 *cannot* exist) and press the EXECUTE pushbutton. Upon pressing the pushbutton, both the READY and ERROR LEDs must come on. If both LEDs do not come on, the problem may be any of the following:

1.   Unidex 1 and Unidex 1 Thumbwheel Programmer are not powered up properly.

2.   Interface cable between Unidex 1 and Unidex 1 Thumbwheel Programmer damaged or not connected properly.

3.   Communication parameters (see Section 6-2) not as required.

To execute a program using the Unidex 1 Thumbwheel Programmer, move the Thumbwheels to select the desired program and then press the EXECUTE pushbutton. Program execution will begin immediately and will be indicated by both the READY and ERROR LEDs being off. When the program has been completed with no errors, a ready signal will be sent and the READY LED signal will re-light. If the program does not exist or an error occurs during execution of the program, the program execution will be terminated and a error signal will be sent. The error signal will cause the READY and ERROR LEDs to come on simultaneously.

The EXECUTE pushbutton should not be pressed while both LEDs are off, since it may clear the Unidex 1 response signal and result in the the ERROR and READY LED status not being set. Pressing the EXECUTE pushbutton while the program is being executed (READY and ERROR LEDs off) may also cause brief interruptions in the program execution. If EXECUTE is pressed at the same time that a Unidex 1 response signal is being sent back, the displayed LED status may be cleared or incorrect. *A questionable or missing LED status cannot be recovered.* Commands from the Unidex 1 Thumbwheel Programmer are not accepted during program execution and cannot be used to terminate any programs in progress.

SECTION 7-3   THUMBWHEEL INDEXER (TI)

SECTION 7-3-1 INTERFACE CONNECTIONS

The Thumbwheel Indexer (TI) (Figure 7-3) is supplied with a molded interconnect cable that is designed to plug directly into the Communications Interface Connector, Port A, of the Unidex 1 (see Section 2-3-1). No additional interconnect wiring is required by the user. The TP derives its power directly from the Unidex 1.

DANGER:TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK AND/OR BODILY INJURY NEVER MAKE ANY ELECTRICAL CONNECTIONS OR DISCONNECTIONS WHILE POWER IS APPLIED.

Like the Thumbwheel Programmer (Section 7-2), the Thumbwheel Indexer *cannot* be "Daisy-chained" to other Unidex 1 Controllers.

SECTION 7-3-2 OPERATION

The Unidex 1 Thumbwheel Indexer option is similar to the Thumbwheel Programmer option discussed in Section 7-2, except that it provides a much greater level of manual motion control. The TI option allows not only the selection of program execution, as with the TP option, but also the selection of 9 additional levels of motion commands and command modes. These are as follows:

Mode 0/ Home

Send axis to "Home" position. (Similar to RS-232 command "Home"; see Section 8-8 D.)

Mode 1/ Index

Move axis the prescribed distance as set by "data" thumbwheel settings (limited to 7 digits). The feedrate can be set by Mode 2. The power-up feedrate defaults to the feedrate set in the Thumbwheel Indexer index speed command (see Section 8-9). (Similar to RS-232 command "Index"; see Section 8-8 B.)

Mode 2/ Feedrate

Set axis feedrate to be used with all subsequent indexes. (Similar to RS-232 command "Index"; see Section 8-8 B.)

Mode 3/ Accel/Decel

Set axis Accel/Decel rate to be used with all subsequent indexes. (Similar to RS-232 command "Accel/Decel"; see Section 8-8 Y.)

Mode 4/ Absolute / Incremental

Set index mode so that index length set in "data" thumbwheel is relative to preset point (absolute) or with respect to last move (incremental). (Similar to RS-232 command "INC/ABS"; see Section 8-8 P.)

Mode 5/ Load Position

Set axis position tracking register (limited to 7 digits). (Similar to RS-232 command "Load Position Register"; see Section 8-8 O.)

Mode 6/ Run Program

Execute specific Unidex 1 program (1 through 99). (Similar to RS-232 command "Auto Run"; see Section 8-7 B.)

Mode 7/ Output

Set the four output control signals to 1 (true) or 0 (false) as designated by the first four digit positions of the "data" thumbwheel. Values 2 through 9 for the given digit specify the "don't care" state. (Similar to RS-232 command "Output State"; see Section 8-8E.)

Mode 8/ Slew   Slew (jog) axis at specified feedrate (±0 to 250,000 steps/sec) as designated by the data thumbwheels. The sign indicates direction (+ for CW, - for CCW). The "Execute" push-button controls the slew (or jog) process.

Mode 9/ Reset   Reset the Unidex 1 (equivalent to a Ctrl-A "soft reset"). The "EXECUTE" push-button performs the reset. (Similar to RS-232 command "Reset"; see Section 8-7 AA.)

For the above mode definitions, modes 1, 2, 3, 5, 6, and 8 require the respective numerical parameter of the given command be set up in the "data" entry thumbwheel. Standard numerical limits for the given command apply, i.e., Accel/Decel has a value limitation of between 0 through 6500 mSec, etc.

For modes 0 and 9, data entry on the "data" thumbwheel are not applicable. Depress the "EXECUTE" push-button to execute these commands.

For mode 7 (output), the first four (least significant) data thumbwheel switches are used (digit 1 for output 1, digit 2 for output 2, etc.). With these four digits, only value 0 (false) and 1 (true) are applicable as set or reset indicators. Digit values 2 through 9 signify "don't care" for the given output.

For mode 4, the "-" data digit selects the absolute mode and the " + " data digit selects the incremental mode. All other data digits are ignored by this mode.

The Unidex 1 Thumbwheel Indexer option requires that Unidex 1 be set to the following specifications (see Section 6-2 for a description of these codes):

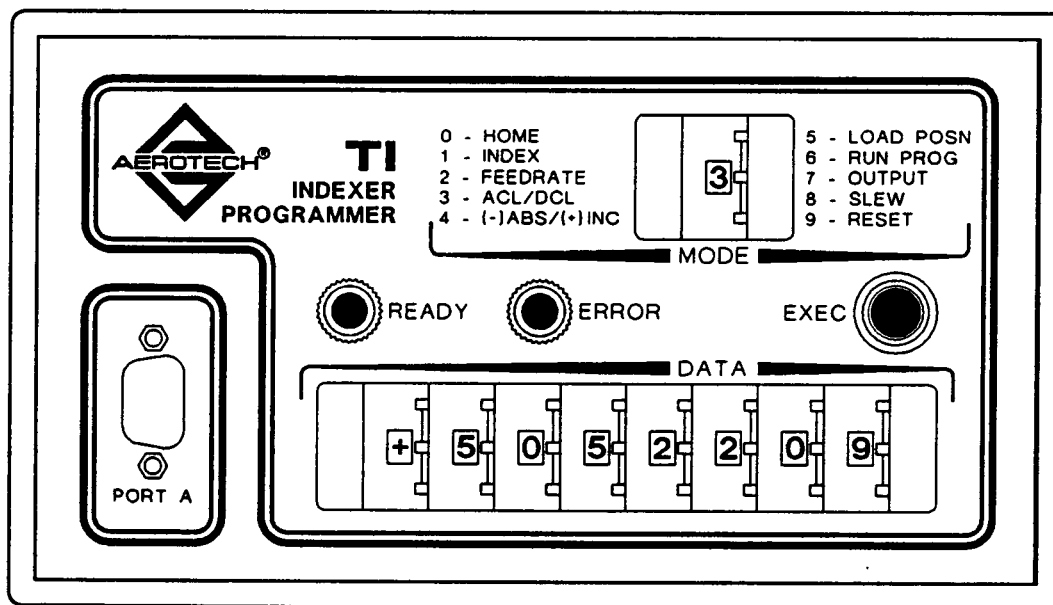|	
Baud Rate	:9600
Stop Bits	:1
Word Length	:7
Parity	:even

Figure 7-4: *Thumbwheel Indexer (TI) Option*

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CHAPTER 8: COMPUTER INTERFACE (PORT A)

The Computer Interface (i.e., RS-232C/daisy chain) option for the Unidex 1 makes it possible to control the Unidex 1 from a host device (CRT terminal, Personal Computer, etc.) via serial port A. A simple command sequence to the Computer Interface gains control of the device. The host may, from this point on, perform different tasks using Unidex 1. These tasks include executing command block(s) in the immediate mode, downloading a program into the user memory, running a program from the memory in auto-run or block-run mode, and reading the axis position, system statuses, directory, program or the entire memory.

Unidex 1 may also be configured for interactive control. In this mode, Unidex 1 sends a service request after executing a program or a command block, or if there is an error condition. Subsequently, the host device is required to poll Unidex 1 before proceeding further.

SECTION 8-1   REQUIRED HARDWARE

The Port A Computer Interface port (see also Section 8-10) is a 9 pin "D" type female connector implementing the following signal lines:

PIN 1	Not used
PIN 2	Receive Data (RX)
PIN 3	Send Data (TX)
PIN 4	Data Terminal Ready (DTR)
PIN 5	Signal Common (SG)
PIN 6	Data Set Ready (DSR)
PIN 7	Request To Send (RTS)
PIN 8	Clear To Send (CTS)
PIN 9	+5V

Figures 8-1, 8-2 and 8-3 show three examples of Communication Interfaces. The first two show interface connections required for RS-232 devices. Figure 8-3 shows a multi-axis Hand Held Terminal (the Hand Held Terminal is described in Chapter 5) interface example.

The daisy chain configuration can be extended to up to 30 Unidex 1s. When adding more units, repeat Unidex 1 connections as shown in Figures 8-2 and 8-3.
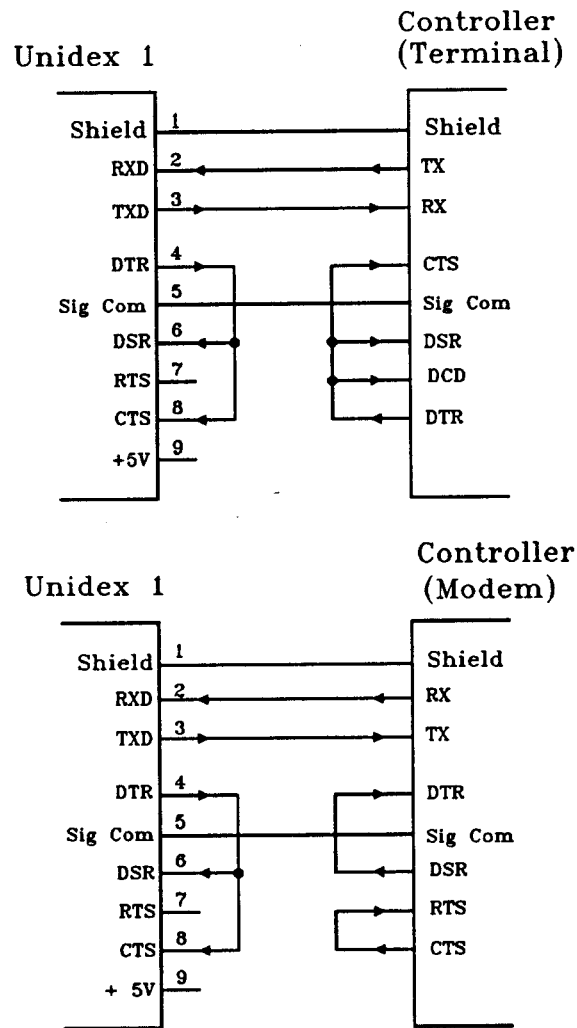
NOTE: RS-232C Interface cable must be shielded

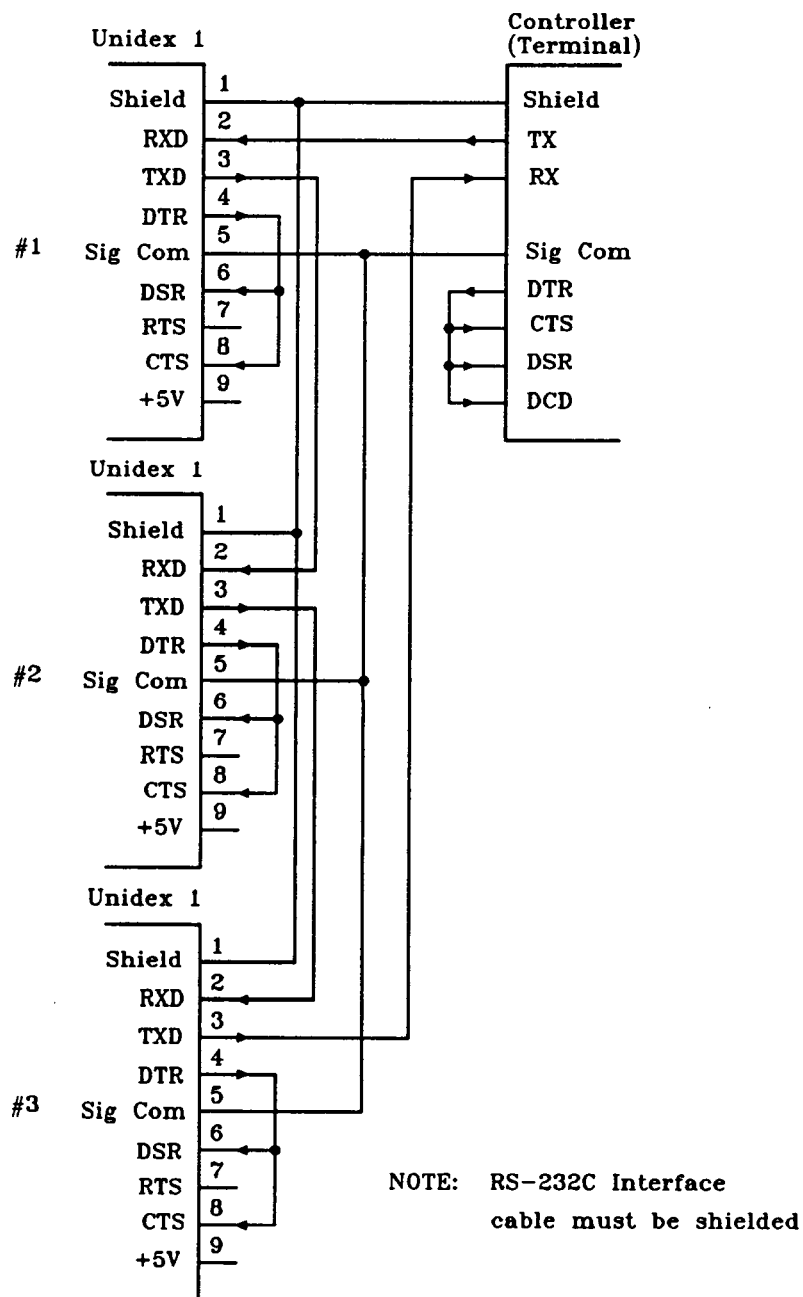*Figure 8-1: Single-Axis RS-232C Interface*

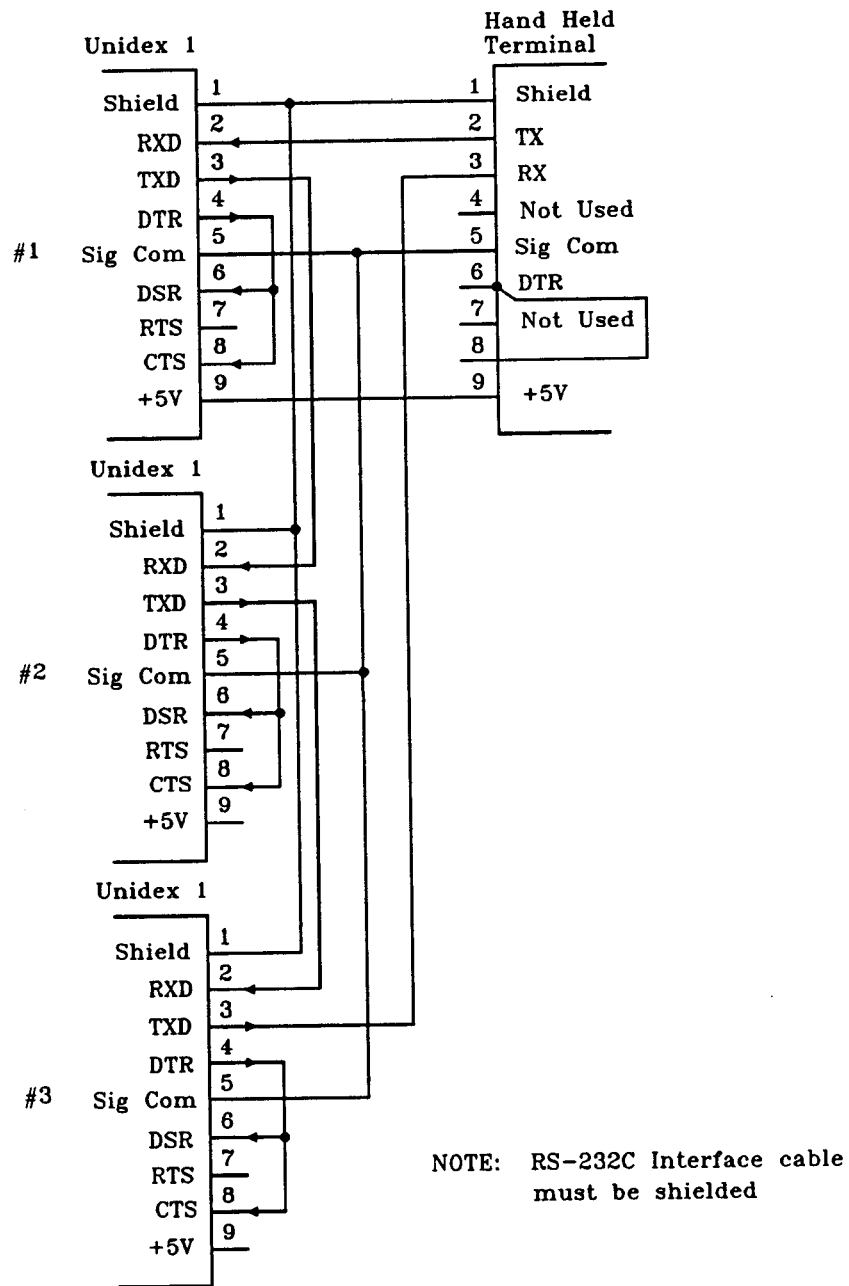*Figure 8-2: Multi-Axis (Daisy Chain) RS-232C Interface*

Figure 8-3: Multi-Axis (Daisy Chain) Hand Held Terminal Interface

SECTION 8-2   COMPUTER INTERFACE FORMAT SETUP

It is required that certain communication parameters of the sending device match those of the receiving device to enable data to be transferred. These parameters determine the format for communication. There are four parameters that must be set up in Unidex 1. They are:

Baud Rate

This relates to the rate of transfer of data. The value represents the "number of bits per second" of transfer. Unidex 1 may be set up for a baud rate of from 50 to 19200. (Settings include 50, 75, 109.92, 134.58, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 and 19200.)

Character Length

Each byte of data is encoded in either 7 or 8 bit length.

Number of Stop Bits

The end of each byte is indicated by the stop bit sequence. This is also the minimum time required by the receiver to start looking for the next byte after the 7 or 8 bits of the current byte are received. Number of stop bits may be 1 or 2.

Parity

The parity bit is an extra bit added to the character (in addition to the 7 or 8 bits described above) so as to make the number of "1" bits either even or odd, thus adding an extra check for accuracy of data. Parity may also be disabled so that no parity bit is added. Unidex 1 may be set up for ODD or EVEN or DISABLED parity.

Unidex 1 defaults to the following values upon power-up if there is no battery back-ed user memory or if the "Load Default" operation is performed.

Baud Rate	:	9600
Character Length	:	7 Bits
No. of Stop Bits	:	1
Parity	:	Even

To change the above values, Unidex 1 must be put in the Set-up Mode as described in Chapter 6.

SECTION 8-3   COMMUNICATING THROUGH PORT A

Unidex 1 is ready for communication at power up if the Computer Interface format has been correctly set up or if the default values are the required format.

The host device must now send the "attention" command to Unidex 1. This consists of the character string > > followed by the 2 digit device number and <CR> (see Section 5-2 for more information). The two > > signs must be consecutive. Unidex 1, upon receiving the "attention" command, will accept and execute any valid command.

The attention command for the Hand Held Terminal mode is "## nn", as explained in Chapter 6. (The ## characters should not be used for the operation described in this Chapter.) Unidex 1 will echo back characters which must be cleared from the computer's input buffer.

SECTION 8-4 TYPES OF COMMANDS

Commands sent to Unidex 1 via the Computer Interface may be classified into two types, System commands and Program commands. Tables 8-1 and 8-2, which follow, respectively summarize these two command sets.

Table 8-1: Unidex 1 System Command Summary

NOTE: System commands must be entered as UPPER CASE letters.

>>nn<CR>	: Activate RS-232C interface (where "nn" = device address)
A nn <CR> <LF> *	: Run program #nn in Auto mode (nn = 0 to 99)
B nn <CR>	: Run program #nn in Block mode (subsequent < CR > will execute successive program blocks)
C <CR>	: Reset Unidex 1 (to power up conditions)
D <CR>	: Cancel Remote mode
E nn *	: Begin downloading program #nn. Existing program #nn will be deleted automatically
E $ nn *	: Delete program # nn
E $ 00 *	: Clear program memory (all programs)
F <CR>	: Insert block (line) numbers when printing programs (for editing purposes)
G <CR>	: Cancel block (line) number printing (default)
H <CR>	: Put Unidex 1 in Hold mode (Trigger required to execute programs). Hold mode cancelled by O <CR> <LF>
I (string)* <CR>	: Execute program block (string) in the Immediate mode ("stepping" is any valid motion program command)
J <CR>	: Set up Unidex 1 to send Service Request after execution
K <CR>	: Cancel set up to send SRQ (default)
M <CR>	: Set up to transmit status in binary format (default)

N <CR>	: Set up to transmit status in Hex-ASCII format
O <CR>	: Cancel Hold mode (default)
PX <CR>	: Print X axis position register value
PD <CR>	: Print directory listing
Pnn <CR>	: Print program #nn
P00 <CR>	: Print all programs in memory
PS <CR>	: Print status bytes
PF <CR>	: Print software level
Q <CR>	: Query (Serial Poll); Unidex 1 returns a byte
R <CR>	: Enable Remote mode from host controller
T <CR>	: Trigger to start program execution
<DEL> (hex 7F) or <CTRL>D(hex 04)	: Hardware reset Unidex 1
<CTRL>A(hex 01)	: Reset (cancel the in-progress motion of Unidex 1)
<CTRL>B(hex 02)	: Deactivate all Unidex 1s
<CTRL>D(hex 04)	: Hardware reset all Unidex 1s
<CTRL>Q (hex 11)	: Start transmission after <CTRL>S is received
<CTRL>S (hex 13)	: Stop transmission until <CTRL>Q is received

* The line feed <LF> is optional and is not required to execute any command.

Table 8-2: Unidex 1 Program Command Summary

* or /	: End of block (terminates the block commands listed below)
X F ffffff Dvddddddddddd * (see note 1)	: X axis move at feedrate ffffff steps/sec a distance of dddddddddd steps, CW (v="+") or CCW (v="-")
X F ffffff Rv *	: X axis free run at feedrate ffffff steps/sec, CW (v="+") or CCW (v="-")
DW nnn.n *	: Dwell nnn.n seconds
H X *	: X axis home

OT 10XX *

: Output O1, O2, O3, O4 (Opto-coupler outputs) 1: True 0: False X: Don't care

IT X001 *

: Wait until input state I1,I2,I3,I4 (Opto-coupler inputs) matches X001

OS 0011 *

: OUT/STOP state (drive outputs to 0011 on activation of feedhold input)

OR XXXX *

: OUT/RUN state (drive output to XXXX on deactivation of feedhold input)

RS nnnn * (see note 2)

: Repeat loop start nnnn times

RE * (see note 2)

: Repeat loop end

RC 10X0 * (see note 2)

: End Repeat loop on input condition 10X0

RX *

: Start free run axis X after Stop (S X)

SX *

: Stop free run axis X

RP * (see note 2)

: Repeat program

LXvddddddddddd *

: Load position register X with ddddddddddd, v = + or -

IN *

: Set Incremental mode position tracking

AB *

: Set Absolute mode position tracking

LB nn * (see note 2)

: Label # nn (assign block to label #nn)

GT nn * (see note 2)

: GoTo label #nn

GS nn * (see note 2)

: GoSub label #nn

SR * (see note 2)

: Subroutine Return

PS * (see note 2)

: Program Stop (end of program execution)

CT nn I10X0 * (see note 2)

: GoTo label #nn if condition input state is 10X0, else continue

CS nn I1XXX * (see note 2)

: GoSub label #nn if input state is 1XXX, else continue

RI 0X10 *

: Go to remote mode if input conditions match (stay in remote if inputs remain the same)

MT nn * (see note 2)

: GoTo label #nn on marker

MS nn * (see note 2)

: GoSub label #nn on marker

BI nn I XXX1 * (see note 2)

: Branch to label #nn on interrupt input condition XXX1

SI nn I X1X0 * (see note 2)

: GoSub label #nn on interrupt input condition X1X0

EI * (see note 2)	: Enable interrupt
DI * (see note 2)	: Disable interrupt
EH *	: Enable high/low motor operating current
DH *	: Disable high/low motor operating current
AD nnnn *	: Accel/Decel ramp time in milliseconds (parabolic or linear ramp profile is selected in Setup Mode)
LP dddddddddd * (see note 2)	: Load positive limit with dddddddddd
LM dddddddddd * (see note 2)	: Load minus limit with dddddddddd
EP * (see note 2)	: Enable positive limit
EM * (see note 2)	: Enable minus limit
EL * (see note 2)	: Enable both limits
DP * (see note 2)	: Disable positive limit
DM * (see note 2)	: Disable minus limit
DL * (see note 2)	: Disable both limits
;	: Program comment may begin after ; (comments terminated by <CR>)
%	: End edit (downloading)

NOTE 1: "X" axis designated to maintain consistency with the Unidex 11 series Controllers.

NOTE 2: Command not valid in the Immediate mode.

A brief description of both command types is given below.

SYSTEM COMMANDS

These commands interact with Unidex 1 as a device and perform operations such as resetting Unidex 1, printing a program, printing position values, running a program, downloading a program, transferring status byte information from Unidex 1, etc. Each system command establishes a mode of operation once it is received by Unidex 1. A detailed description of these commands is given in Section 8-7.

PROGRAM COMMANDS

These are the user program blocks in a motion program that Unidex 1 executes when running a program in the auto or block mode. Program commands are valid only if entered in the Immediate or Edit mode. A detailed description of these commands is given in Section 8-8.

SECTION 8-5   SERVICE REQUEST AND SERIAL POLL

Service Request is an important concept in device control when there is a controller (host computer) as the master and the controlled device (such as a printer or Unidex 1) as the slave. The purpose of Service Request is for the slave device to catch the attention of the master controller. Typically, a controller has more than one device being controlled by it and it would be very inefficient for the master controller to continually read the statuses of all the devices to check for error states. The controlled (slave) device therefore has the capacity to send a signal (Service Request) to the master controller whenever it requires the attention of the master. The reason for requesting service may be to signal an error condition or to signal the completion of a task.

Unidex 1 implements a service request by sending a predetermined byte of data followed by a <CR>. The controller (master) may be set up to be interrupted by this data byte whereupon it must take a necessary action. *Service requests are only sent if the Unidex 1 is the only active unit.* Otherwise, it will wait until it is the only active unit.

The minimum necessary action that the controller must take once Unidex 1 has sent the service request signal is to poll Unidex 1 by sending the query (Serial Poll) command Q <CR>. Unidex 1 waits until the query command is received, and will not respond to any other system command until this is done. The purpose of the query command Q <CR> is to transfer a status byte from Unidex 1 to the controller. The 8 bits of this status byte represent different internal states of Unidex 1. Serial polling may be done any time the Computer Interface is active, not necessarily only after a Service Request.

The status byte may be analyzed by the controller to determine the cause of the Service Request. A description of each of the bits in the status byte follows:

	ZERO	ONE
BIT 0	Incremental mode	Absolute mode
BIT 1	Not running a program	Running a program
BIT 2	Block run mode	Auto run mode
BIT 3	(Not used)	(Not used)
BIT 4	Communication disabled	Communication enabled
BIT 5	Inactive - Not executing a command in immediate mode	Active - Executing a command in immediate mode
BIT 6	No service request signal sent	Service request signal sent, waiting for Q
BIT 7	No errors detected	Error detected

Unidex 1 may be put into the Service Request Mode by the system command J <CR>. The default Service Request data byte sent by Unidex 1 defaults to %. Unidex 1 sends % <CR> as a Service Request signal.

This byte may also be programmed by the user by entering a character immediately after J. This entry becomes the new Service Request character. For example, if J! <CR> were entered, the Service Request character would become ! and Unidex 1 would send ! <CR> as the Service Request signal.

NOTE: The characters >, < and # should not be used, since they are activation characters.

The Service Request Mode may be cancelled by sending the system command K <CR>. In this mode, Unidex 1 will not send a Service Request signal for any reason. This is the default mode. In this mode, to determine if an immediate command or a program has been completed, a Serial Poll (Query) may be done as explained on the previous page and the status byte analyzed (bit 1 and bit 5). When these bits are clear (zero), Unidex 1 is ready to accept the next command.

When in the Service Request Mode , Unidex 1 sends a Service Request (SRQ) character under the following conditions:

1.   When an Immediate command execution is complete.

2.   When a program is completely executed in the Auto Run mode.

3.   When a block is executed in the Block Run mode.

4.   When a run time error condition is generated and the program is aborted.

5.   When an axis limit is activated.

6.   At the end of a program download operation, if an error was generated while downloading. (The SRQ character is sent by Unidex 1 after the "%" that ends the downloading of the program.)

7.   When it is requested that a nonexistent program be printed. (If Pnn <CR>, Ann <CR> or Bnn <CR> is sent to Unidex 1 and program number "nn" does not exist, Unidex 1 will send the SRQ character.)

NOTE: For more information on error bytes, see Section 8-6.

SECTION 8-6   ERROR CODES

An error condition may be detected by the host computer checking the most significant bit (bit 7) of the Serial Poll Status Byte (Section 8-5). If this bit is set to "1", an error has occurred.

To further determine the type of error, the system status may be read by the host by sending the command **PS <CR>**. Unidex 1 will send back 9 bytes followed by <CR> <LF>. These 9 bytes represent a complete status report of Unidex 1. They are described as follows:

BYTE 1   Same as Serial poll status byte described in Section 8-5.

BYTE 2 EDITOR ERROR STATUS		
	ZERO	**ONE**
BIT 0	No illegal character during download	Illegal character during download (illegal command code)
BIT 1	Memory not full during download	Memory full during download
BIT 2	No user memory check-sum error	Checksum error during download of program
BIT 3	No command format error	Command format error
BIT 4	No memory repair	Memory repair
BIT 5 - 7	Not used	Not used

NOTE: If one of these errors is generated during download operation, Unidex 1 will send an SRQ (Service Request) character if in the Service Request Mode. It is recommended that the user then edit and correct that program.

BYTE 3   RUN TIME   ERROR STATUS 1

	ZERO	**ONE**
BIT 0	Axis not in hardware limit	Axis in hardware limit
BIT 1	No axis software limit	Axis software limit
BIT 2	Not used	Not used
BIT 3	No illegal program exit	Illegal program exit
BIT 4	No illegal byte in memory	Illegal byte in memory
BIT 5	Program number valid	Invalid program called out for run (does not exist)
BIT 6	Memory not clear	No programs in memory (memory clear)
BIT 7	No user memory check-sum error	User memory checksum error

BYTE 4   RUN TIME   ERROR STATUS 2

	ZERO	**ONE**
BIT 0	Not used	Not used
BIT 1	No "Repeat Loop End In-valid" error	"Repeat Loop End" error (no Repeat Loop Start command)
BIT 2	No "Repeat Loop Incom-plete" error	Repeat loop incomplete (no repeat loop end com-mand)
BIT 3	Eight nested repeat loops not exceeded	Eight nested repeat loops exceeded
BIT 4	No "Return from Sub-routine Invalid" error	"Return from Subroutine" invalid (no GoSub com-mand)
BIT 5	No "Incomplete sub-routine" error	Incomplete subroutine (no Sub Return command)
BIT 6	Eight nested subroutines not exceeded	Eight nested subroutines exceeded
BIT 7	No "Missing Label" error	Missing label

BYTE 5   COMMUNICATION STATUS 1

	ZERO	ONE
BIT 0	Not used	Not used
BIT 1	Not used	Not used
BIT 2	Not used	Not used
BIT 3	Not used	Not used
BIT 4	Not used	Not used
BIT 5	No Serial Poll initiated	Serial poll initiated by sending Q. Wait
BIT 6	Not in SRQ mode	In SRQ mode
BIT 7	Not in Hold mode	In Hold mode

BYTE 6   COMMUNICATION STATUS 2

	ZERO	ONE
BIT 0	Not used	Not used
BIT 1	Not used	Not used
BIT 2	In Hold mode, but no Trigger command received	In Hold mode, and Trigger command received
BIT 3	Unidex 1 "receive buffer" not full	Unidex 1 "receive buffer" full
BIT 4	X on received during transmit	X off received during transmit
BIT 5	Not in program download mode	In program download mode
BIT 6	Status bytes printed in binary format	Status bytes printed in Hex-ASCII format
BIT 7	Not used	

BYTE 7   AXIS MOTION STATUS

	ZERO	**ONE**
BIT 0	X axis not moving	X axis moving
BIT 1 to BIT 7	Not used	Not used

BYTE 8   FREE RUN MODE STATUS

	ZERO	**ONE**
BIT 0	X axis not in free run mode	X axis in free run mode
BIT 1 to BIT 7	Not used	Not used

BYTE 9   I/O STATUS

	ZERO	**ONE**
BIT 0	Input 1 is a 0 (I1)	Input 1 is a 1 (I1)
BIT 1	Input 2 is a 0 (I2)	Input 2 is a 1 (I2)
BIT 2	Input 3 is a 0 (I3)	Input 3 is a 1 (I3)
BIT 3	Input 4 is a 0 (I4)	Input 4 is a 1 (I4)
BIT 4	Output 1 is a 0 (O1)	Output 1 is a 1 (O1)
BIT 5	Output 2 is a 0 (O2)	Output 2 is a 1 (O2)
BIT 6	Output 3 is a 0 (O3)	Output 3 is a 1 (O3)
BIT 7	Output 4 is a 0 (O4)	Output 4 is a 1 (O4)

SECTION 8-7   SYSTEM COMMANDS

System commands interact with Unidex 1 as a device and perform operations such as resetting Unidex 1, printing a program, printing position values, running a program, downloading a program, transferring status byte information from Unidex 1, etc. Commands requiring Unidex 1 to send back information will be ignored if more than one Unidex 1 is active. Each system command establishes a mode of operation once it is received by Unidex 1. Each system command must be entered as an **upper case letter.**

A. GETTING UNIDEX 1'S ATTENTION

The system command required from the host device to get Unidex 1's attention is two consecutive >, the two-digit device number and <CR>. For example:

> >01 <CR>

B. AUTO RUN MODE

Executing a program in the Auto Run mode enables the program to run automatically, executing the motion commands of the program with no need of further user intervention.

To run a program in the Auto Run Mode, send A, the program number "nn", and <CR>. For example:

A 10 <CR>

If in Service Request mode (see Section 8-5), once the program has been executed, Unidex 1 will send the Service Request character and wait for a Serial Poll. After the Serial Poll, you may execute the same program again by sending another <CR>. To run a different program, send **A nn <CR>** again.

C. BLOCK RUN MODE

A motion program can be run one block at a time, instead of automatically, as discussed in the above subsection. To run a program in the Block Run mode, send **B** for Block, the program number ("nn") and a <CR>. For example:

B 10 <CR>

If in the Service Request mode, Unidex 1 will send the SRQ character after each block has been executed. If this is the case, the host must Serial Poll Unidex 1 after the execution of each block.

After the execution of the first command block and the Serial Poll, send a <CR> to execute the next block. Bit 1 of the status byte (Section 7-5) may be checked to detect completion of the program.

The print status (PS) and print position (PX) commands can be used in the Block Run Mode after the block had been executed. To quit Block Run Mode without going through the entire program, use <CTRL>A (hex 01).

> **NOTE:** During interrupt operations, the interrupts will cause some blocks to terminate or be exited while motion is still in progress. An example of such a block is HX*.

D. REMOTE RESET (C)

Sending the command C followed by <CR> resets Unidex 1. This will take it back to power up conditions. For example:

C <CR>

This will stop motion (decel to stop) and program execution in all active Unidex 1s. All units that have responded to this reset will need to be reactivated before they will accept a command again.

E. DISABLING REMOTE MODE

The system command D<CR> will disable the Remote Mode and return control to the host. (The position registers are updated with the absolute position values before returning control.)

When the Remote Mode is active, Unidex 1 will only recognize the D command and the Serial Poll command. All other system commands will be ignored.

F. DOWNLOADING A PROGRAM FROM HOST

The E command, followed by a program number ("nn") and an end-of-block character (* or /), will put Unidex 1 into the Edit mode and set it up to enter the program commands into program "nn" in the user memory. If an existing program with the same number already resides in Unidex 1, it will be deleted automatically when the new

program "nn" is downloaded. At the end of the program, a % must be sent to terminate the editor, and return to the system command level.

G. DELETING A PROGRAM

In order to delete a program from the Unidex 1 user memory, send the command E, followed by the character $, the program number "nn" and an end-of-block character, either * or /. The following example would erase program 10:

E $ 10 / (or *)

H. DELETING ALL PROGRAMS FROM USER MEMORY

In order to delete **all** programs from the Unidex 1 user memory, send the command E, followed by the character "$", two zeros ("00") and an end-of-block character, either * or /. Sending **E $ 00 /** would erase all programs.

I. BLOCK NUMBERING

If you want programs to be printed with block numbers, send **F < CR >**. Block numbering may make editing the program easier.

After this command is sent to Unidex 1, any program printed will contain block numbers.

J. BLOCK NUMBERING CANCEL

In order to cancel block numbering when a program is printed, as established in the above subsection, send the command G along with < CR >. After sending G < CR > to Unidex 1, programs will be printed without block numbering.

System commands F and G do not change the system set up feature stored in the battery backed memory (see Section 8-2).

K. HOLD

The command to "hold" the execution of a command string or an entire program is established by the H command and a < CR >. Sending H < CR > will cause Unidex 1 to suspend execution of any Immediate, Auto or Block commands which may follow it. This is useful when synchronizing axis motion to some other action. Unidex 1 will only execute the commands when it receives a "T" (for trigger) command. For example:

H < CR >
A 20 < CR >   Program #20 held (not executed)
T < CR >   Program #20 triggered (executed)

L. IMMEDIATE MODE

The I command, followed by motion program commands, an end-of-block character (* or /) and a < CR >, allows a motion command to be executed immediately instead of being entered as a motion program. (For an explanation of the motion program commands, see Section 8-8. For a summarization, see Table 8-2.) Each block of immediate commands must begin with an I. For example:

I X F10000 D20000 * < CR >

The above immediate command will send the X axis 20000 steps at a feedrate of 10000 steps per second (or whatever units might be set in the system). If in SRQ mode, Unidex 1 will send a Service Request and wait for a Serial Poll after the command is executed. After being polled, Unidex 1 is ready to execute another block of commands.

M. SERVICE REQUEST SET UP

In order to establish the Service Request mode, send the J command, followed by < CR >. After the SRQ mode has been established via the J command, Unidex 1 will send the SRQ signal % < CR > under conditions described in Section 8-5. It will then wait until it receives a Serial Poll from the host device before executing any further commands. For more detailed information on SRQ, see Section 8-5.

The SRQ character may be programmed for something other than % by sending the character after the J command. For example:

J ! <CR>

This command sets the SRQ character to "!". Keep in mind a service request will only be sent by Unidex 1 if it is the only active unit. Otherwise, it will wait until this is the case.

N. SERVICE REQUEST CANCEL

In order to cancel the Service Request (SRQ) mode set up by the J command (see above), send a **K <CR>**. (This is the default status.)

O. STATUS BYTE IN BINARY FORMAT

Sending the command **M <CR>** establishes the format of the status bytes as binary upon transmission. Transmission of the status bytes in binary format is the default status.

P. STATUS BYTES IN HEX-ASCII FORMAT

To establish the status bytes in the Hex-ASCII format upon transmission, send **N <CR>**. In this mode, each status byte will be sent as two bytes. Each byte will be the equivalent ASCII character of each hexadecimal byte.

Q. HOLD MODE CANCEL

· To cancel Hold mode, send the command "O" along with <CR>. After sending **O <CR>**, programs will no longer require a trigger (T command).

R. PRINT AXIS POSITION

1. Print X Axis Position (PX)

   In order to print the X axis position register, send **PX** < CR >.
   The axis position is sent in the following format:
   (< Space > or < - >) < 10 Digits > < CR >

   ↑   ↑
   | |
   | |

   Positive   Negative

S. PRINTING DIRECTORY LISTING

A listing of the programs in the Unidex 1 directory as well as the number of bytes remaining in memory may be obatained by entering **PD** < CR >.

T. PRINTING A PROGRAM

To print one program, send the command **P**, the program number "nn", and < CR >. For example:

   P10 < CR >

The above command will cause program #10 to be printed.

U. PRINTING ALL PROGRAMS

To print all programs, send the command "P", two zeros (00) and < CR >. Sending **P00** < CR > will cause all programs in memory to be printed.

V. PRINTING STATUS BYTES

To print the status bytes listed in Section 8-6, send **PS** **< CR >**.

W. PRINTING VERSION OF SOFTWARE

To print the version of software that uou are currently using send the command **PF**. If using a computer interface, the reply will be sent in the following format:

SOFTWARE USI_xx
(where xx represents the software level)

X. QUERY (SERIAL POLL)

The host device may Serial Poll (Query) Unidex 1 by sending **Q** **< CR >**. In response to a query, Unidex 1 returns its status (see Section 8-5).

Y. REMOTE MODE

The system command **R** **< CR >** will enable Unidex 1 to be driven via the auxiliary clock and direction controls. The host controller may then signal an external device to take control of Unidex 1. (See Section 2-9.)
Unidex 1 keeps track of the axis position during external control.

Z. TRIGGER

To execute the program that is suspended with a Hold command (H), send **T** **< CR >**. In multiple axis operation, this will allow the simultaneous program execution of multiple Unidex 1s.

AA. RESETTING UNIDEX 1

To Reset Unidex 1, you may send the hexadecimal number 7F or FF. Either is the ASCII code for <DEL>. You may also send the <CTRL> D character (hex code 04) to reset Unidex 1. Any of these resets will take Unidex 1 back to power up conditions and will reset all of the units that are connected in daisy chain, even if they are not in the active mode.

The soft reset will reset only the active Unidex 1s (in-progress motion) and is initiated by sending the <CTRL> A character (hex code 01). This reset will stop motion (decel to stop) and program execution in all active Unidex 1s. All units that have responded to this reset will still be active and ready to accept a command.

The command <CTRL>B (hex code 02) will deactivate all active Unidex 1s on the daisy chain line.

BB. XON/XOFF TRANSMISSION PROTOCOL

The XON/XOFF protocol regulates the transfer of information between two devices. This is required for the reliable transfer of information. The XOFF character <CTRL>S (hex 13) instructs a device to halt transmission. The XON character <CTRL>Q (hex 11) instructs a device to resume transmission.

Unidex 1 responds to XON/XOFF protocol at all times when it is active and operating from within the computer interface mode. This implies that Unidex 1 will suspend transmission to the user upon receipt of the XOFF character. Transmission will resume upon receipt of the XON character. Unidex 1 may also send XON/XOFF characters to request transmission be suspended until it is ready to accept more commands.

SECTION 8-8   MOTION PROGRAM COMMANDS

These are the user program blocks in a motion program that Unidex 1 executes when running a program in the auto run or block run mode. These commands are valid only if entered in the Immediate or Edit mode.

A. END OF BLOCK

An end-of-block command terminates a block of a program. It may be one of two characters, * or /. For example:

X F10000 D150000 * (or /)

B. AXIS MOTION COMMANDS

The axis must be specified by an axis command (X). (The X axis designation is used to maintain consistency with the Unidex 11 Series of controllers.)

The speed with which the axis travels must be specified by a feedrate command (F). The distance which it is to travel (or the position it is to reach, if in the absolute mode) is specified with a distance command (D).

An example of a program block utilizing the above commands is:

X F10000 D-150000 *

The above command would send the X axis a distance of -50000 system units at a feedrate of 10000 system units/second.

> NOTE: When programming via Computer Interface communication Port A, the feedrate need only be entered with the first index block. After that, the feedrate need be entered only if it is to be changed.

1. Axis Free-Run

The axis is commanded to free-run by the command R and a " + " or "-" sign to signify CW (+) or CCW (-). For example:

X F10000 R+ *

The above command tells the axis to free-run in the CW direction at a speed of 10000 system steps/second.

C. DWELL

A program dwell can be entered into your program with a DW command, followed by the duration of the dwell in tenths of seconds. For example:

DW 10 *
DW 1.0 *

Either of the above commands will cause a 1 second dwell within your program.

D. HOME

Send the axis Home with command H followed by the axis and an end-of-block character. The command **H X *** will send the axis home.

E. OUTPUT STATUS

To establish the output as a 1 (true), a 0 (false) or an X (don't care), send the command "OT" followed by a 1, 0 or X. For example:

OT 10XX *

In the above example, O1 is to be programmed to a 1, O2 to a 0, O3 is a "don't care" and O4 is also a "don't care". "Don't care" leaves the status of an output unchanged.

F. INPUT STATUS

To set up the status you wish the inputs to reach before the program continues, program an "IT" command, followed by the desired statuses and an end-of-block character. For example:

IT X001 *

The above command states that the program should wait until I2 is a 0, I3 is a 0 and I4 is a 1. The state of input I1 does not matter since it is programmed as a "don't care". (See Section 2-8 for input signal specifications.)

G. OUT/STOP STATE

To put out values to the outputs when the program is stopped via a feedhold, enter the command "OS" followed by the desired values and an end-of-block character. For example:

OS 0011 *

When the program is stopped, a zero will be output to O1 and O2, and a 1 will be output to O3 and O4. (See Section 2-8 for output signal specifications.)

H. OUT/RUN

To output values to the outputs when the program is allowed to run again, release the feedhold key (after it has been pressed), and program "OR", followed by the desired values and an end-of-block. For example:

OR XXXX *

In the above example, when the program run is allowed to continue, the outputs will remain unchanged (all have been programmed as "don't care").

I. REPEAT LOOP START

The command to start a repeat loop in your program and the number of times the loop executes is established with a "RS" command, followed by the number of times to repeat and an end-of-block (9999 maximum). For example:

RS 8 *

The above example marks the beginning of the repeat loop and says it will repeat 8 times. A maximum of eight nested loop commands are permitted. An unlimited number of un-nested loop commands are permitted.

J. REPEAT LOOP END

To mark the end of the repeat loop (started as discussed in the above subsection), program command **RE ***.

Repeat loops may be nested eight levels deep.

K. CONDITIONAL REPEAT LOOP END

To end the repeat loop based on input conditions, prior to completing the specified number of loops, program **RC** followed by the required input state and an end-of-block. For example:

RC 10XX *

The above example states that the repeat loop will end when the inputs are as follows: I1 is a 1, I2 is a 0. I3 and I4 are "don't cares" and have no control over the program block.

L. STARTING FREE RUN AFTER A STOP FREE RUN

After a free run has been stopped (discussed in the next subsection), programming an "RX" will start the axis again. For example:

RX *

M. STOP AXIS

To stop the axis, program **SX ***.

N. REPEAT PROGRAM

To repeat the entire program from the start, enter command "RP" and an end-of-block. Remember, any commands following **RP *** within your program will not be executed.

O. LOAD POSITION REGISTER

You may load the axis position register with an **LX** command, followed by a distance and an end-of-block. The value, which is in system units, may be a positive or negative number or may be a zero. For example:

LX 0 *

In the above example, the position register is loaded with zeros. This command may be used to establish an absolute reference position. The axis may be moved to this reference position by programming, in the absolute mode, an Index block with distance values equal to the reference position.

P. INCREMENTAL MODE/ ABSOLUTE MODE

In the incremental mode, (established with a **IN ***), a distance command tells Unidex 1 how much further to move the axis. For example:

X F10000 D1000 *

The above command will move the axis 1000 steps in the positive direction each time it is executed.

In the absolute mode (established by entering **AB ***) a distance command is an absolute position. For example:

X F10000 D1000 *

When in the absolute mode, the above example tells Unidex 1 to send the axis to the position 1000. Once there, the re-execution of the above command will not move the axis any further since it is already at the position commanded.

Q. LABEL (LB)

A label (0 to 99) labels a block of program as the place to which the program goes when a GOSUB (go to subroutine) or a GOTO command is encountered. It is programmed with a "LB" command, followed by the number and an end-of-block. For example:

LB 55 *

R. GOTO (GT)

This command directs program flow to a label. Enter "GT" and a label number, followed by an end-of-block. Example:

GT 20 *

The above command tells Unidex 1 to continue program execution at label 20.

S. GOSUB

The command "GS", followed by the block label number and an end-of-block, tells Unidex 1 to execute a subroutine at label #nn. For example:

GS 15 *

The subroutine to be executed is located at label #15. A maximum of 8 nested subroutines are permitted. An unlimited number of un-nested subroutines are permitted.

T. SUBROUTINE RETURN

This command causes Unidex 1 to return from the subroutine execution to the program block immediately after the **GS nn** block that called the subroutine. Every subroutine should end with an **SR ***.

Subroutines may be nested 8 levels deep.

U. PROGRAM STOP

Program stop marks the place in the program at which program execution ends. Subroutines should be placed after the **PS *** block.

V. CONDITIONAL GOTO

The command CT, followed by a label number, an **I** and four input values, states that the program should go to a specific block if the input statuses match the specified values. For example:

CT 22 I 10X0 *

The above command tells Unidex 1 to go to the program block labeled "22" when I1 is a 1, I2 is a 0, and I4 is a 0. If the inputs are not these values, continue with the next program block.

W. CONDITIONAL GOSUB

The command to send the program to a subroutine if the input statuses match specified values is CS, followed by the label number, an **I** and the desired input values. For example:

CS 33 I 110X *

The above command tells Unidex 1 to go to the subroutine labeled "33" when the value of I1 is 1, I2 is 1, and I3 is 0. If these input conditions do not exist, continue with the next program block. If conditions are met, the subroutine will execute, then return to execute the next instruction.

Conditional subroutines may be nested in combination with regular subroutines to 8 levels deep.

X. REMOTE MODE

The command to send Unidex 1 into the remote mode if input conditions are met is :

RI 0X10 *

The unit will go into remote when the input conditions match those programmed, and will remain there as long as the input conditions stay the same.

Y. ACCELERATION/DECELERATION RAMP TIME

The Accel/Decel ramp time can be programmed in milliseconds by the command "AD" followed by the desired time and an end-of-block character. For example:

AD 250 *

In the above example, the acceleration ramp time as well as the deceleration ramp time will be 250 milliseconds. The maximum value is 9999.

(For more information on Accel/Decel, see Chapter 9.)

Z. BRANCH ON MARKER

This command will cause the program to go to a specified block if the marker is present (1) or continue with the next block if the marker is not present (0).

MT 13 *

The above command tells the Unidex 1 to go to the program block labeled 13 if the marker is present (1). If the marker is not present (0), the program will continue with the next block.

AA. GOSUB ON MARKER

This command will cause the program to go to the subroutine specified if the marker is present (1), or continue with the next block if the marker is not present. The subroutine will return program execution to the next instruction upon completion (with Subroutine Return SR.)

MS 17 *

The above command tells the Unidex 1 to go to the subroutine labeled 17 if the marker is present (1).

BB. ENABLE INTERRUPT

This command will enable interrupt capability. Either a GoTo (BI) or GoSub (SI) on Interrupt must have previously been programmed. Interrupts are monitored as often as possible. However, certain program blocks require longer periods of time in which interrupts must be present (Example: Move blocks). Interrupt conditions present and stable for over 60 milliseconds, should prevent missing interrupts.

The command EI * would enable the interrupt command and is valid until a disable interrupt block is executed or an interrupt occurs.

CC. DISABLE INTERRUPT

This command will disable interrupts, if already enabled. The **DI** * command disables the interrupt.

DD. BRANCH ON INTERRUPT

The branch on interrupt command sets the conditions for an interrupt. The interrupt branch block is specified by the label portion and the conditions for interrupt are

specified by the I portion (same as Conditional GoTo). An Enable Interrupt command is required to enable the interrupt.

BI 31 I XXX1 *

When the interrupt is enabled, the inputs will be monitored and compared with the I conditions. If the I conditions are met, the program will go to block label 31. Special action is taken if an interrupt occurs while executing any of the following blocks.

Index, Home:	Interrupt will branch to a block with motion still in operation. However, if any type of axis move is attempted before the axis has completed its move, the present move will be stopped and the new move will be executed immediately.
Dwell:	Dwell is terminated
Wait on Input:	Input is terminated
Remote on Input:	Remote is terminated

EE. GOSUB ON INTERRUPT

The GoSub on Interrupt command sets the conditions for an interrupt. For example:

SI 24 I X1X0 *

The interrupt subroutine block is specified by the label portion and the interrupt conditions by the I portion (same as conditional GoSub). An Enable Interrupt command is required to enable the interrupt. Once interrupted, the interrupt cannot be enabled again until the return from Interrupt (Return from Subroutine) occurs.

When the interrupt is enabled, the inputs will be monitored and compared with the I conditions. If the I conditions are met, the program will go to subroutine label (label 24 in the previous example). Special action is taken for interrupts that occur during the execution of the following blocks.

Index, Home:	Interrupt will branch to block with motion still in operation. Note that moves (Index or Home moves) initiated in the interrupt subroutine will cause previously initiated Indexes and Homes to be aborted if still in progress. However, if the interrupt subroutine contains no motion commands, the interrupted move (Index or Home) will continue while the interrupt is serviced. The Return from Subroutine will occur when the move is completed.
Dwell:	Dwell is terminated.
Wait on Input:	Wait on Input is terminated. Program will return to next block.
Remote on Input:	Remote is terminated

FF. SET POSITIVE LIMIT

To load the positive limit absolute position register, enter command LP followed by the (CW) limit position and an end-of-block. The value is in system steps (maximum 10 digits) and may be a positive, negative or zero number. For example:

LP -10000 *

In the above example, the (CW) limit position is loaded with the position value -10000. When this limit is enabled by either an EP (Enable Position Limit) or an EL (Enable Limits) command, moves which would or could potentially result in a **more**

positive position than the limit value specified above, will not be executed. Values for the LP command can be positive (+) or minus (-). If a limit is encountered, the program will be terminated. The Unidex 1 checks for a potential limit overrun *BEFORE* actually making a given move. This command applies only to auto (or block) executed programs.

GG. SET MINUS LIMIT

To load the negative limit absolute position register, enter the command LM followed by the (CCW) limit position and an end-of-block. The value is in system steps (maximum 10 digits) and may be a positive, negative or zero number. For example:

LM -50000 *

In the above example, the minus (CCW) limit position is loaded with the position value -50000. When this limit is enabled by either an EM (Enable Minus Limit) or an EL (Enable Limits) command, moves which would or could potentially result in a **more minus** position than the limit value specified above, will not be executed. If a limit is encountered, the program will be terminated. The Unidex 1 checks for a potential limit overrun *BEFORE* actually making a given move. This command applies only to auto (or block) executed programs.

HH. ENABLE POSITIVE LIMIT

To enable the positive (CW) limit, enter the command EP, followed by an end-of-block. For example:

EP *

In the above example, the set positive (CW) limit will be enabled. This block will check for a present or possible positive limit condition. If any limit condition exists, the program will be terminated and the motion will be stopped. All moves following this block will be checked before the moves are executed. Positive free run and home commands **will not be started** and the program will be terminated. Moves which will exceed the positive limit will cause program termination and will not be executed. Either a DP (disable positive limit) or a DL (disable limits) command will disable the positive limit checks.

II. ENABLE MINUS LIMIT

To enable the minus (CCW) limit, enter the command **EM**, followed by an end-of-block. For example:

EM *

In the above example, the previously set minus (CCW) limit will be enabled. This block will check for a present or potential minus limit condition. If any limit condition exists, the program will be terminated and the motion will be stopped. All moves following this block will be checked before the moves are executed. Minus Free Run and Home commands will not be started and will cause the program to terminate as will any move which will exceed the minus limit . Either a **DM** (disable minus limit) or **DL** (disable limits) command will disable the minus limit checks.

JJ. ENABLE LIMITS

To enable both the positive (CW) and minus (CCW) limits, enter the command **EL** followed by an end-of-block. For example:

EL *

In the above example, the previously set positive and minus limits will be enabled. This block will check for a present or potential limit condition. If any limit condition exists, the program will be terminated and the motion stopped. All moves following this block will be checked for a limit condition before the moves are executed. All free run and home commands **will not be started** and will result in the termination of the program. Moves which will exceed the positive or minus limits will not be executed and will cause the program to be terminated. A **DL** (disable limit) command will disable all limit checks. A **DP** (disable positive limit) or **DM** (disable minus limit) command can be used to disable one or both of the limits.

KK. DISABLE POSITIVE LIMITS

To disable the positive limit check, enter the command **DP** followed by an end-of-block. For example:

DP *

In the above example, the positive limit check will be disabled. The minus limit enable will not be effected.

LL. DISABLE MINUS LIMITS

To disable the minus limit check, enter the command DM, followed by an end-of-block. For example:

DM *

In the above example, the minus limit check will be disabled. The positive limit enable will not be effected.

MM. DISABLE LIMITS

To disable the positive and minus limit check, enter the command DL followed by an end-of-block. For example:

DL*

In the above example, both the positive and minus limit checks will be disabled.

NN. END EDIT

The character that is placed at the end of a downloadable file is the percent sign (%). Place it at the end of your file without an end-of-block character.

When downloading a program, this character takes Unidex 1 out of the Edit mode and back to the System Command mode after the download.

00. PROGRAM COMMENTS

Comments may be placed within a program by preceding them with a semicolon (;).
Except for the characters listed below, anything following the semicolon will be ignored
and will not be stored in Unidex 1's memory. The command field is terminated by a
<CR> or a <LF>.

The characters that may not be used in the comments are:

1. #, < or >
2. Control codes <CTRL>A, <CTRL>B, <CTRL>D
3. Hex code 7F or FF.

SECTION 8-9   COMPUTER INTERFACE COMMANDS

A few brief samples will help demonstrate the commands discussed in the previous
Section.

Example Immediate Commands

```
> > <device number> <CR>          ; Interface active
I H X * <CR>                       ; Send home axis
I X F10000 D10000 * <CR>          ; Axis move
I X F100 D1000 * <CR>             ; Axis move
```

Example Motion Program

```
> > <device number> <CR>          ; Interface active
E 01 *                            ; Select program 1
H X *                             ; Send X axis home
X F10000 D10000 *                 ; X axis move
DW .2 *                           ; Dwell for 2/10 second
%                                 ; End edit mode
```

Send **F** <CR> to set Unidex 1 to the block number printing mode. The command
P01 <CR> will now cause program #1 to be printed with block numbers.

Command **G** <CR> will cancel the numbering command.

The command to run program #1 in the block mode is **B01** <CR>. For each successive block send another <CR>.

To run program #1 in the auto run mode, send **A01** <CR>.

To delete program #1, send **E $ 01 ***. (Check your directory with a **PD** command to verify that program #1 has been deleted.)

The position register may be read by sending **PX** <CR>.

Send **J** <CR> to put Unidex 1 in the Service Request mode. (You may enter a character of your own choosing or use the default Service Request character, %.) When this character is sent by Unidex 1, acknowledge it with a **Q** <CR> (query) before continuing. If running the program in the auto mode, the Service Request will come after the program execution. If running a program block by block, it will follow each block.

Send command **K** <CR> to cancel the Service Request mode.

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CHAPTER 9: PROGRAMMABLE ACCEL/DECEL

Programmable Accel/Decel increases the performance of the motion control system by providing the ability to achieve higher motion speeds. The ramp time (the time to attain a programmed feedrate) is programmable from 50 milliseconds to 9999 milliseconds. The acceleration/ deceleration profile may be set up to be linear or parabolic. The start/stop feedrate is also programmable. (The start/stop setting is used as a default speed for very short moves where Accel/Decel cannot be used.)

Once the user has set (in the set up mode) the desired ramp time, start/stop feedrate and the profile for acceleration/deceleration (linear or parabolic), the values are stored in the battery backed memory. The system default values for these parameters are:

Accel/Decel Ramp Time: *250 Milliseconds*
Start/Stop Feedrate: *500 Steps/Second*
Accel/Decel Profile: *Linear*

These parameters are modal, which is to say that they stay in effect in both the Program Run (Auto or Block) and Immediate modes of Unidex 1. However, Unidex 1 can be programmed (in the Auto or Block mode) to change the Accel/Decel ramp time during program execution. (Start/stop feedrate and Accel/Decel profile can only be changed in the Set Up mode, see Chapter 6.) If the Accel/Decel ramp time is changed during program control, that value becomes the new modal Accel/Decel parameter.

SECTION 9-1 MANUAL PROGRAMMING OF RAMP TIME

Acceleration and deceleration parameters are programmed in the Set Up mode (Chapter 6). (See Chapter 7 for the Hand Held terminal operation and Chapter 8 for the Computer Interface operation.)

The required ramp time may now be programmed. This value may be from 50 to 9999. Any value below 50 will be entered in the system as zero and this will turn acceleration and deceleration OFF.

User memory (battery backed) will be updated as a result of manually programming the ramp time.

SECTION 9-2 START/STOP FEEDRATE PROGRAMMING

The start/stop speed is also programmed in the set up mode.

Feedrate values from 1 to 500000 units/sec may be entered here (in this case, 0 to 500000 steps/sec). Start/stop speed is the speed to which the axis defaults when a programmed move is too short to implement acceleration and deceleration (see Section 9-5). If the time for the move is less than 16.384 milliseconds, acceleration/ deceleration is temporarily turned off and the move is executed at the start/stop feedrate.

SECTION 9-3 ACCEL/DECEL PROFILE SET UP

The Accel/Decel profile is set up as linear or parabolic, using the set up mode (Chapter 6).

SECTION 9-4 RAMP TIME PROGRAMMING

The motion command for entering the ramp time when downloading a program is:

AD nnnn *

where "nnnn" is the ramp time in milliseconds. To turn off acceleration/deceleration, program 0 milliseconds.

The ramp time may be programmed as many times as required within a program. At the end of program execution, the value of the most recently programmed ramp time will be the new value. If programmed manually in setup before running a program, this value will be effective at the start of the program. The last ramp-time block executed from a program becomes modal to the system, but is NOT retained in the battery-backed user memory after power down.

SECTION 9-5 WHEN ACCEL./DECEL. IS NOT IMPLEMENTED

The conditions under which Accel./Decel. is not implemented are:

1. Ramp time programmed is less than 50 mSec.
2. Feedrate for the move is less than 16 steps/second.
3. Total time for the move is less than 16.384 mSecs.

SECTION 9-6 ACCEL./DECEL. IN OPERATION

Acceleration and deceleration velocity profiles in Unidex 1 are achieved by updating the clock rate from the indexer at fixed intervals, pre-computed from the programmed ramp time. The minimum clock-rate-update interval is 1 mSec. and the maximum number of updates is 250. If the ramp time programmed is 250 mSecs., the controller increments the clock rate from 0 to the programmed feedrate in 250 steps of a 1 mSec. interval. For ramp times less than 250 mSecs. but greater than 125 mSecs., the number of updates is 125 and the interval is accordingly computed. For ramp times between 125 and 50 mSecs., the number of updates is 50. The following table illustrates this:

RAMP TIME	NUMBER OF UPDATES	UPDATE INTERVALS (mS)
5000	250	20.0
400	250	1.6
200	125	1.6
80	50	1.6
30	*No Accel./Decel.*	

In LINEAR Accel./Decel. mode, the clockrate is updated linearly. In PARABOLIC mode, the clock rate update is a parabolic function of time. In the following description, N stands for the number of updates computed from the programmed ramp time as explained above, Fn represents feedrate at interval number n, and Fp represents programmed feedrate.

The feedrate as a function of an update interval number during acceleration is shown below.

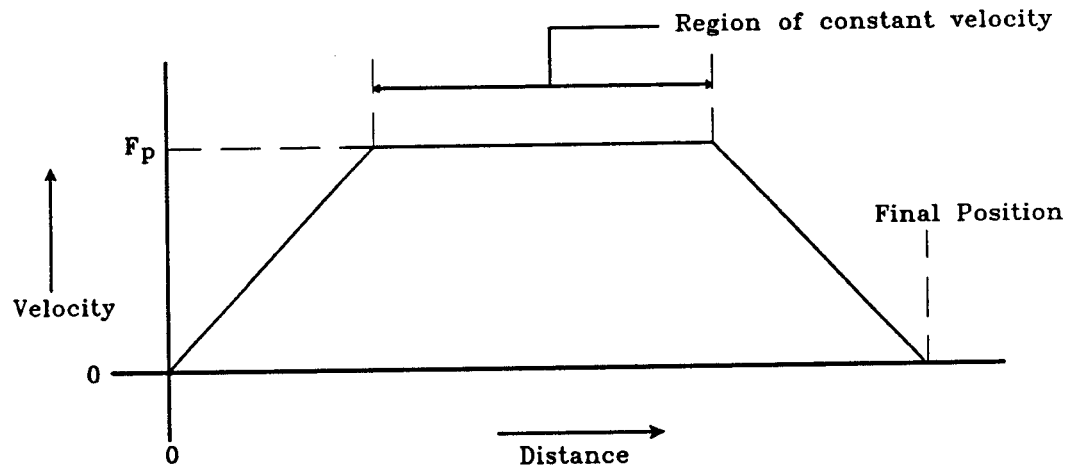The feedrate as a function of an update interval number during acceleration is shown below.

Linear

$$F_n = (F_p/N) * n \qquad n < N$$

$$6.1$$

$$F_n = F_p \qquad n > = N$$

Parabolic

$$F_n = (F_p/N) * [N - (n-N)/N] \qquad n < N$$

$$6.2$$

$$F_n = F_p \qquad n > = N$$

In the linear Accel/Decel mode, when the programmed move is longer than the ramp time, a trapezoidal velocity profile is achieved. When the move is shorter, (but greater than 16.384 mSec.), a triangular velocity profile results and the axis does not attain the programmed feedrate. Parabolic profile is truncated when the programmed move is not long enough to attain programmed feedrate.

Figure 9-1 and 9-2 illustrate some examples of linear and parabolic ramping in both full and truncated profiling modes.
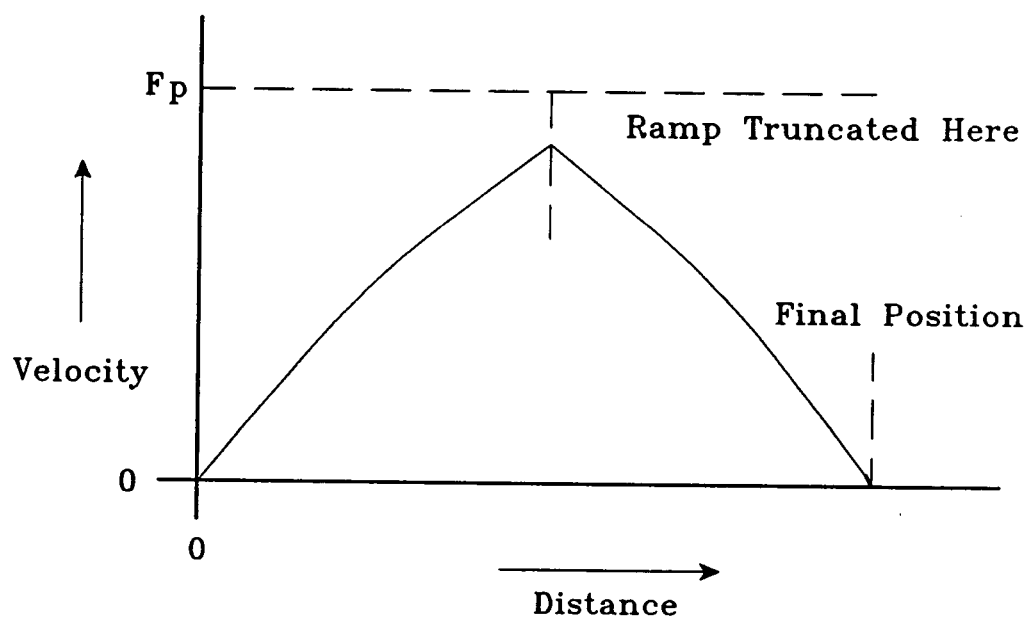
Figure 9-1: Full Ramp Profiles for Linear and Parabolic Ramping

Fp ------ Ramp Truncated Here

Velocity

Final Position

0

0

Distance

A) Linear Ramping

Fp ------ Ramp Truncated Here

Final Position

Velocity

0

0

Distance
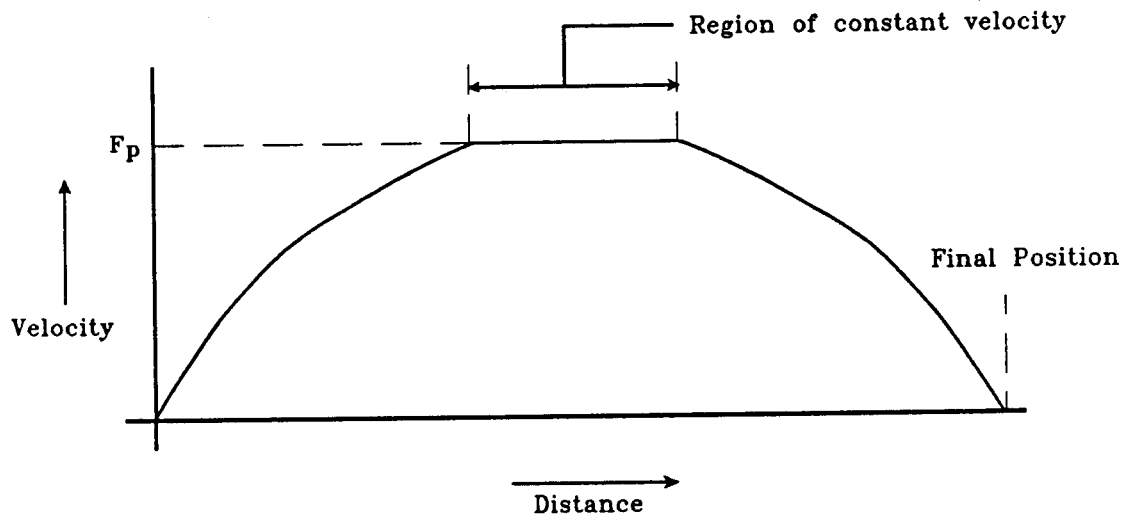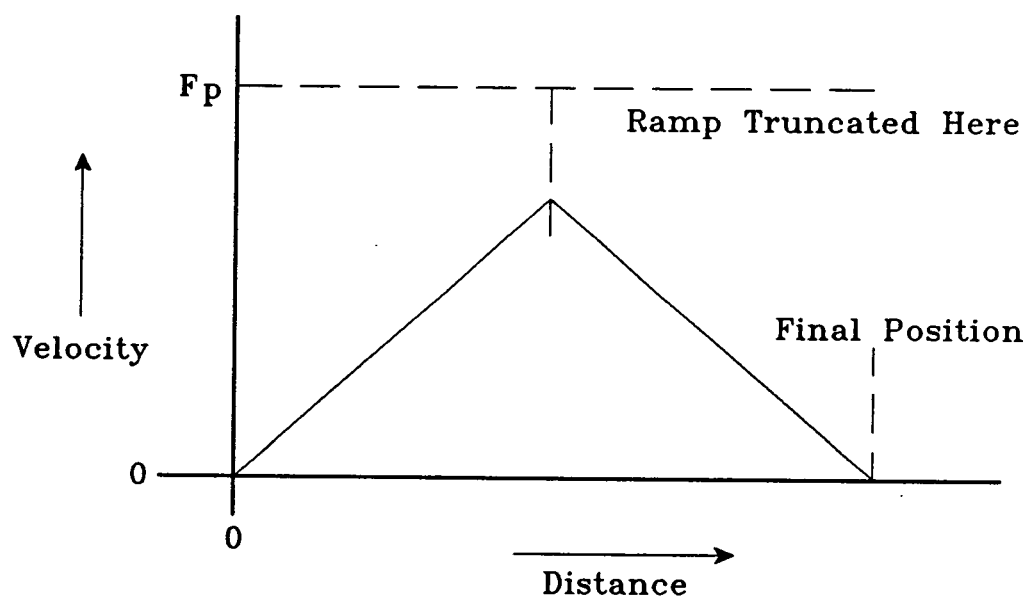
B) Parabolic Ramping

Figure 9-2: Truncated Ramp Profiles for Linear and Parabolic Ramping

SECTION 9-7 RAMPING LIMITATIONS

The system hardware imposes certain restrictions on the performance of the programmable Accel/Decel. The maximum axis feedrate with Accel/Decel is 125000 steps/sec. The period resolution of the clock pulses from the indexer is 8 microseconds. To compensate for this, the number of update intervals (ramp time) is modified.

Example:

Programmed feedrate:	50000 Units/Sec.
Required system clock period:	20 μSec. (reciprocal of feedrate)
Number of updates (N):	250
Closest feedrate of which the system is capable:	16 μSec or 62500 Units/Sec.
Modified number of updates (N):	250 * 16/20 = 200
Modified ramp time:	Ramp Time * 16/20
Feedrate at end of Accel:	62500 * 16/20 = 50000 Units/Sec.

Computations for ramp time modification of a parabolic ramp is based on the computation of an equivalent linear Accel/Decel ramp, as shown above. In the parabolic mode, with a similar computation as done above, the parabolic ramp profile becomes "clipped" at the top. Also, the feedrate attained at the end of acceleration is higher than the programmed feedrate.

For the above example, the modified number of update intervals is 200.

NOTE: When decelerating at the end of a move, the feedrate "levels off" at the programmed start-stop value in order to mask any nonlinearities of the system. If desired, the user may set up his system for optimum performance by changing the stop/start feedrate parameter.

For an equivalent parabolic ramp with the same programmed feedrate shown in the previous example:

Feedrate Attained (F_N)

$$= (62500/250) * [250 - ((200-250)^2/250)]$$
$$= 62500/250 * 240$$
$$= 60000 \text{ steps/sec.}$$

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CHAPTER 10: APPLICATION PROGRAM

This section provides a sample program (Figure 10-2) to demonstrate some of the programming capabilities of Unidex 1. Included also are an Application Summary and a Flow Chart (Figure 10-1).

Review Section 8-8 for a description of commands listed in Figure 10-2.

SECTION 10-1 SAMPLE PROGRAM DESCRIPTION

Application

A manufacturer of precision widgets wants to automatically inspect them at the output point of the widget production line.

Solution

A single-axis Unidex 1 motion controller is used to control the motion of a linear stage to position the widgets for inspection and fault processing. The controller, through its discrete inputs and outputs, also controls the other devices used in the inspection process. The process progresses basically as follows:

a) Initially, the axis is sent Home, all outputs are initialized and an initial reference, or starting point, is established.

b) Normal inspection operation commences when the presence of a widget is sensed. It is then moved to the Inspection/Fault processing position.

c) If, during positioning, the product sensor senses that the widget has been skewed, an indicator will light and the process will stop.

d) A subroutine (#50), is used to process the faulty widgets. One hundred tries are attempted, but if the fault is still present, the widget is ejected.

The Flow Chart and Program Code for the example are provided on the following pages. Note the power of the Unidex 1 programming language exhibited by its ability to branch on interrupt, conditionally branch and repeat loops.
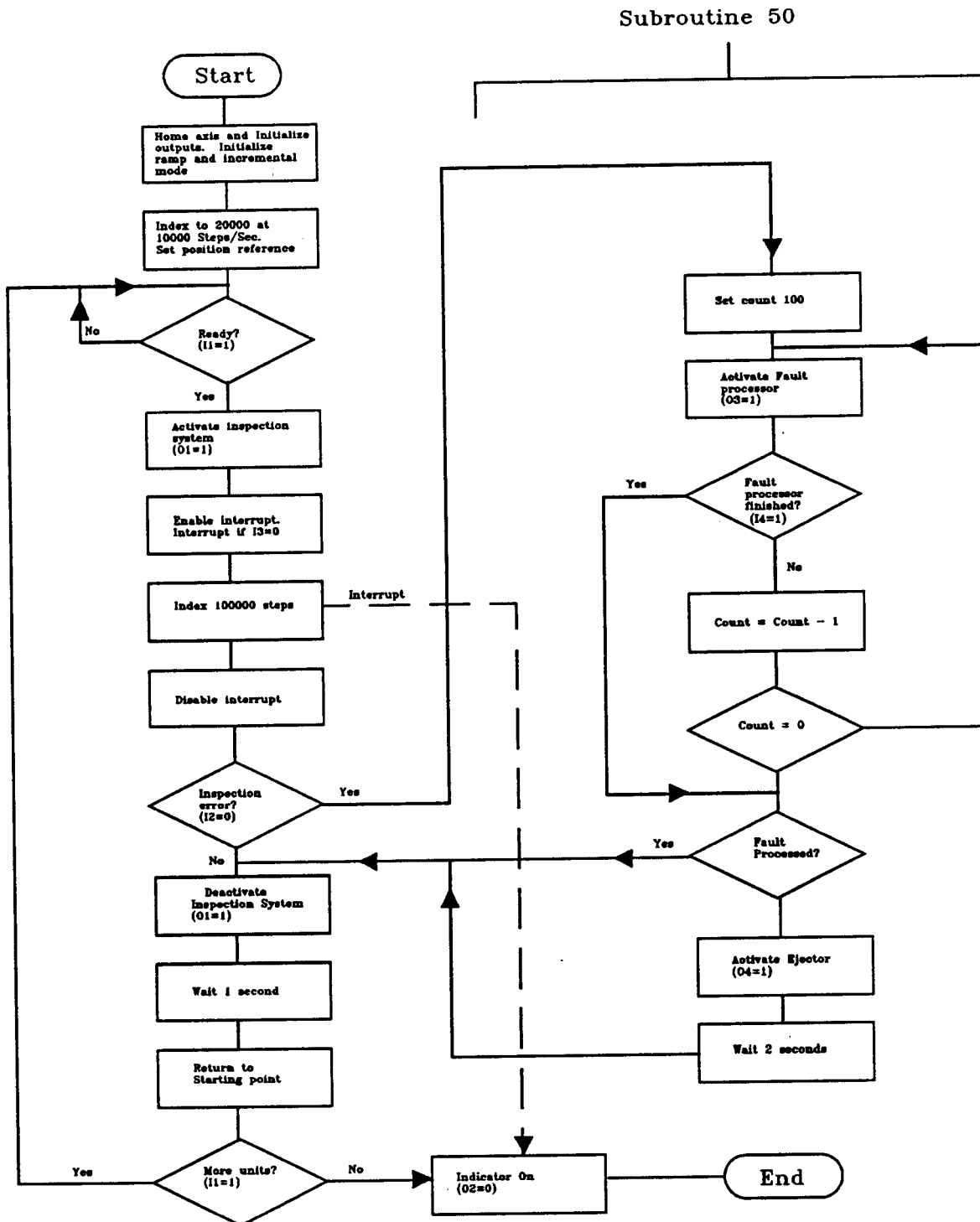
Figure 10-1: Flow Chart of Example Program Shown In Figure 10-2

Example Program
-UNIDEX 1 CODE-

```
HX *                    ; Home axis
OT 1111 *               ; Initialize outputs to 1
AD 100 *                ; Accel/decel time = 100 mS
IN *                    ; Incremental mode
XF10000 D20000          ; Home offset

LX 0 *                  ; Set position to zero
LB 90 *                 ; Label
IN *                    ; Incremental mode
IT 1XXX *               ; Wait for input I1 = 1
OT 0XXX *               ; Output O1 = 0
EI *                    ; Enable interrupt
BI 10 I XX0X *          ; Branch to label 10 if I3 = 0
X D 100000 *            ; Index 100,000 steps
DI *                    ; Disable interrupt
CS 50 I X0XX *          ; If input I2 = 0, do subroutine 50
OT 1XXX *               ; Output O1 = 1
DW 10 *                 ; 1 second wait
AB *                    ; Absolute mode
X D 0 *                 ; Index back to zero
CT 90 I 1XXX *          ; If input I1 = 1, repeat process
LB 10 *                 ; Label 10
OT X0XX *               ; Else output O2 = 0
PS *                    ; End of program

LB 50 *                 ; Subroutine 50
RS 100 *                ; Repeat 100 times or until I4 = 1
OT XX0X *               ; Output O3 = 0
DW 01 *                 ; Dwell 0.1 second
OT XX1X *               ; Output O3 = 1
RC XXX1 *               ; If input I4 = 1, quit loop
```

```
CT 60 I XXX1 *          ; If I4 = 1, go to 60
OT XXX0 *               ; Output O4 = 0
DW 05 *                 ; Dwell 0.5 second
OT XXX1 *               ; Output O4 = 1
DW 20 *                 ; Wait 2 seconds
LB 60 *                 ; Label 60
SR *                    ; Return from subroutine
```
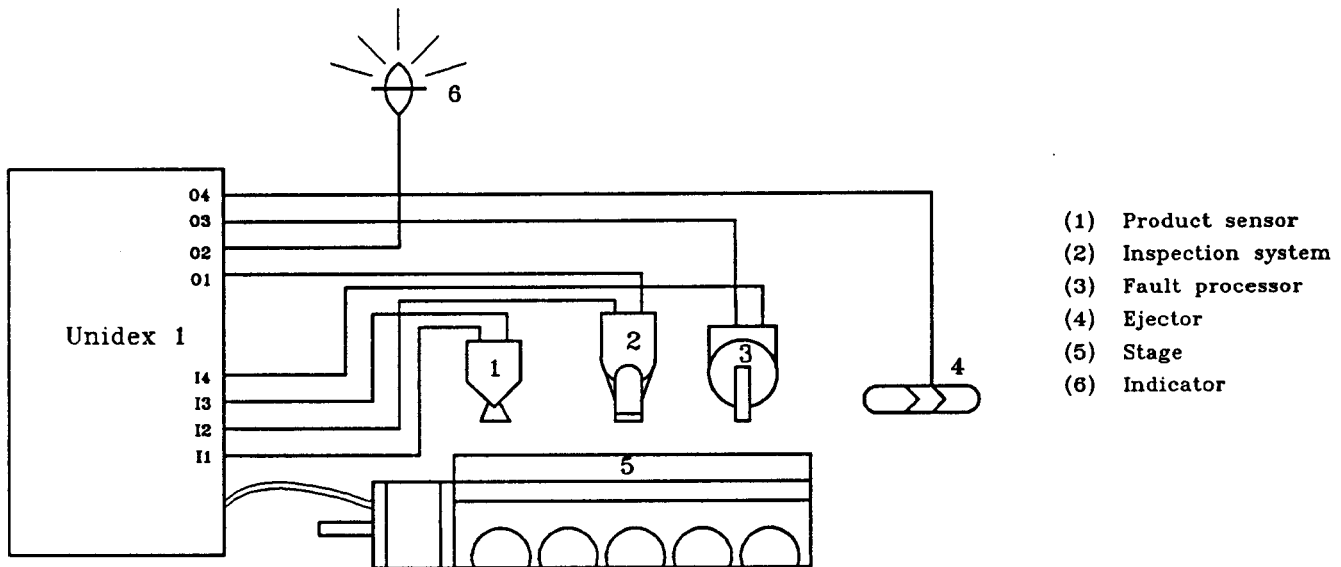

(1)   Product sensor
(2)   Inspection system
(3)   Fault processor
(4)   Ejector
(5)   Stage
(6)   Indicator

Figure 10-2: Example Program for Unidex 1

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Troubleshooting the Unidex 1 consists of reviewing the check list of possible software and hardware (Sections 11-1 and 11-2) malfunctions and performig the suggested solutions. Error codes, for the RS-232 Computer Interface mode, are listed in Section 9-6. For the Hand Held terminal mode, they are listed in Section 8-1, Subsection B(b) (*Status display*), which describes the procedure for polling error status messages.

WARNING: CUSTOMER TROUBLESHOOTING AND REPAIR MUST BE LIMITED TO THE PROCEDURES OF SECTION 11-1 AND 11-2. ANY ATTEMPT TO REPAIR THE ELECTRONICS WITHOUT THE SUPERVISION OF AN AEROTECH TRAINED FIELD REPRESENTATIVE MAY VOID THE WARRANTY.

SECTION 11-1 SOFTWARE MALFUNCTIONS, STATUSES

POWER UP

Status Code	Possible Cause And Solution
System check fail: User memory checksum error. (Status Byte 2, Bit 4) *	A check sum verification is performed on the RAM upon power up. At the end of program editing or manual mode parameter changes, Unidex 1 modifies the checksum register. When Unidex 1 is powered up again, a sum of all bytes in the RAM is done. This sum is then compared to the check sum register. If they do not match, one or more bytes in RAM has been altered. **Note that a checksum error may not necessarily mean a damaged RAM. In some instances, battery backed RAM may be altered by a system software malfunction or a power failure during editing.**

* Information in parentheses is status-code polling, associated with the Computer Interface mode (Chapter 9). Status code descriptions are polling-associated with the Hand Held terminal mode (Chapter 6).

PROGRAM EDITING

Status Code	Possible Cause And Solution
Blk Not saved, Mem full. (Status byte 2, bit 1)	If an attempt to enter an additional block of statements is made after an End of Memory warning is encountered, and the block size is larger than the available remaining memory space, a "Block not saved" status will occur. Note that some block sizes are larger than others, depending on the statement being entered, so it is possible that small blocks (such as GoTo, GoSub,etc.) may be entered without being truncated.
	If the Memory Full warning is encountered after entering a block which exceeds the amount of memory available, the block will be ignored.
Memory Altered. (Status byte 2, bit 4)	When an existing program is accessed in the Edit mode, Unidex 1 performs a checksum on the entire contents of program memory.
	Unidex 1 also evaluates the statements of each program block as they are pulled for editing purposes. Each

PROGRAM EDITING (Con't)

Status Code

Possible Cause And Solution

statement is analyzed for the proper format.

If in either of the two cases above, a Memory Altered status occurs, Unidex 1 automatically performs a Memory Repair™ on the program which has been accessed. If undefinable statements of a given block of the program are encountered, the entire block containing the statements is deleted.

What is left is a program with missing blocks. The user need only scan this program and replace the missing blocks.

Memory Repair™ is a very important feature because it reduces the possibility of Unidex 1 "locking up" if a faulty program is executed.

A Memory Altered warning can only exist due to faulty RAM or some unrecoverable transient power glitch on the input power supply. In both cases, the occurrence is rare.

Format Warning. (Status byte 2, bit 3)	A character was entered that did not conform to the required format during a command or program block entry.

RUN MODE

Status Code

Possible Cause And Solution

Illegal byte in memory. (Status byte 3, bit 4)	If, during manual or program execution, a user memory byte cannot be identified by Unidex 1, an illegal byte in memory status will occur. This detection mechanism monitors on a block by block basis, unlike the checksum and block verification mechanisms described in the previous sections on Power Up and the Editing Mode. These mechanisms "scan" the entire user memory before execution takes place.
Exceeded 8 repeat loops. (Status byte 4, bit 3)	Unidex 1 programming mode allows only a maximum of eight "nested" repeat loops (i.e., a loop within a loop, eight times). A possible user-stack overload condition exists if the level of loop nesting exceeds eight levels.

RUN MODE (con't)

Status Code	Possible Cause And Solution
	Remember, an unlimited amount of unnested repeat loops are allowed.
	The "Exceeded 8 Repeat Loops" error is detected during program execution.
Invalid repeat loop end. (Status byte 4, bit 1)	This status declares that a repeat loop "End Repeat" statement was encountered without a preceding "Start Repeat" statement.
	This error is detected during program execution.
Incomplete repeat loops. (Status byte 4, bit 2)	This status declares that a "Start Repeat" statement was encountered without a following "End Repeat" statement.
	This error is detected at the End of Program execution.
Incomplete subroutines. (Status byte 4, bit 5)	This error status is similar to an "Incomplete Repeat Loop" error status in that a "GoSub" statement was detected without a following "Subroutine Return" statement.
	This error is detected at the End of Program execution.

RUN MODE (con't)

Status Code	Possible Cause And Solution
Missing Label. (Status byte 4, bit 7)	This status declares that a program label does not exist for a label number specified in a given GoTo, GoSub, Conditional GoTo, Conditional GoSub or similar statement.
	This error is detected during program execution.
Exceeded 8 subroutines. (Status byte 4, bit 6)	This error status is similar to an "Exceeded 8 Repeat Loops" error status in that a maximum number of 8 "nested" subroutines has been exceeded.
	A possible user stack over-load exists if the level of subroutine nesting exceeds eight levels.
	Remember, up to 99 un-nested subroutines are al-lowed (i.e., up to 99 available labels per program).
	This problem is detected during program execution.
Invalid return-from-sub. (Status byte 4, bit 4)	This status declares that a "Subroutine Return" state-ment exists without a cor-responding "GoSub" statement.

RUN MODE (con't)

Status Code	Possible Cause And Solution
	This error is detected during program execution.
No programs in memory. (Status byte 3, bit 6)	This status declares that no programs exist in user memory as indicated by the directory command.
Invalid program #. (Status byte 3, bit 5)	This status declares that a specific program number does not exist in user memory or it cannot be used for the requested function.
Axis in limit. (Status byte 3, bit 0)	If a CW or CCW limit is encountered during manual, block or auto run modes, an "Axis in Limit" status will occur. Motion will be stopped and program execution will be terminated.
Illegal Program Exit. (Status byte 3, bit 3)	This status declares that a program has been exited during an Index or Home operation. (The move is stopped when the program is exited.)
Program Limit. (Status byte 3, bit 1)	A program limit has occurred during program execution. Program has been terminated and axis has stopped.

CHAPTER 12: SERVICING THE UNIDEX 1 AERODRIVE

SECTION 12-1   SERVICE AND REPAIR

It is strongly recommended that Customer repair of Aerotech equipment be limited to the items listed in Chapter 11, Troubleshooting.

WARNING: WHILE THE EQUIPMENT IS UNDER WARRANTY, REPAIRS OF DEFECTIVE ELECTRICAL COMPONENTS OF THE UNIDEX 1 SHOULD NOT BE ATTEMPTED, SINCE TO DO SO MAY VOID THE WARRANTY.

On-site service should be performed by an experienced electronics technician, preferably one trained by Aerotech, Inc.

When calling for service, **PLEASE HAVE THE UNIDEX 1 SERIAL NUMBER (UNIT U1RA THROUGH U1RK) AVAILABLE.**

SECTION 12-2   SHIPMENT

The procedure for shipping equipment to Aerotech, described below, pertains to warranty as well as non-warranty repairs.

1. Before returning any equipment a "Return Authorization Number" must be obtained from Aeortech. (Have your equipments serial number available when calling.)

2. The equipment being returned must be encased in a proper cushioning material and enclosed in a cardboard box.

Call for a "Return Authorization Number" if it is necessary to ship any part to the factory.

Warning: Damage to the equipment due to improper packaging may void warranty!

Aerotech Sales and Service offices are listed on the following pages. For service and information, contact the office servicing your area.

AEROTECH, INC. SERVICE CENTERS

World Headquarters
AEROTECH, INC.

101 Zeta Drive
Pittsburgh, PA 15238

Phone (412) 963-7470
FAX (412) 963-7459
TWX (710) 795-3125

AEROTECH LTD.	**AEROTECH GMBH**
3 Jupiter House, Calleva Park	Neumeyerstrasse 90
Aldermaston	8500 Nuernberg 10
Berkshire RG7 4QW England	West Germany
Phone (07356) 77274	Phone (0911) 521031
TLX 847228	TLX 622474
FAX (07356) 5022	FAX (0911) 521235

ADDENDUM ONE
UNIDEX 1 TEST PROGRAM

Unidex 1 Test Program

This program can be run on any IBM compatible computer. The program was written using Microsoft QuickBASIC 4.0 software. This program is available on disk in 2 versions. The one version requires the QuickBASIC software (UN-1TEST.BAS). The other version may be executed from DOS (UN-1TEST.EXE). There is a batch file to load all needed files to run this program from DOS. To run the Setup file, run "U1SETUP.BAT" from the floppy disk drive.

This program allows you to become familiar with the Aerotech Unidex 1 controller using the RS-232 communications port. If you have not read the manual on the Unidex 1 controller, it is advisable to get acquainted with the manual at this time.

The test program has 3 communication functions for the Unidex 1 controller. The first function allows you to change the parameters in the "SETUP" mode of the Unidex 1 controller. The program prompts for the communication parameters, such as Baud Rate, Parity, Bit Size, and Stop Bits. Other setup parameters can be changed, after the Unidex 1 controller has been powered with the setup jumper installed in Port B. The program will instruct you on the proper procedure for preparing the Unidex 1 controller for altering the setup parameters. In the program, there are Help screens available to assist you in programming the setup parameters. If the Default parameters are being used, then the program will proceed with the next function after selecting the default values.

The second function is the immediate mode. You must enable the communication port by typing "> >" and the address number of the Unidex 1. Since the default address is "01", you would, for example, type "> >01" and < ENTER >. To reset the Unidex 1 controller, use [Ctrl]-D and < ENTER >. The reset LED will blink momentarily. After this reset command, you must enable the port again. All system and programming commands can be output in the immediate mode. It is recommended that after enabling the port, that the command "N" is output, so that the serial poll status byte requested by the "Q" command and the "PS" print status bytes command will be output by the Unidex 1 controller in hexadecimal format.

NOTE: The "PS" command (Print Status Bytes) and the "PS *" command (Program Stop) are not the same commands. "PS" is a system command, while the "PS *" is a program command. Refer to manual for additional information on these commands.

There are commands to assist you while in the immediate mode. Two of the commands are for help screens. "HS" command will display help screens for the Unidex 1 system commands, while "HP" will display the program commands. The command "EX" will exit you from the immediate mode. All commands will be executed when the < ENTER > key is pressed.

The final function of this program is to transfer files from the Unidex 1 controller to either a disk file or the parallel printer (LPT1). Files can be input from disk and output to the Unidex 1 controller. When the file is transferred from the Unidex 1 to the disk or printer, all of the output of the Unidex 1 will be stored in the file or printed on the printer. You can edit the program by using any text editor that is available.

Programs stored on disk that were created by a text editor do not require any of the data in the header or the termination characters at the end of the text file. This test program will handle the necessary output to the Unidex 1.

You can store the Unidex 1 program under any valid filename and extension. This program will permit you to copy from file to a new filename on the disk. A disk file can be output directly to the printer. After any file transfer has been completed, the program will return to the main selection screen. You must remember the names of the files on disk, since this program does not have the Display Directory Command, "DIR".

To exit the program, either press "3" when in the main selection screen, or press [Ctrl]-Break. If the program hangs up, which can happen if the "*" is not output after a program command, you may need to reset the host computer.

```
'     UNIDEX 1 TEST PROGRAM by Edward R. Burk    MAY 1988
CLS
CR$ = CHR$(13)
GOSUB 8000
SETUP$ = "COM1:9600,E,7,1"              'DEFAULT PARAMETERS ON UNIDEX 1
LOCATE 8, 1
PRINT "Are you using default communication values: 9600,E,7,1? (Yes or N
GOSUB 8200
IF A$ = "Y" THEN 100
IF A$ = "N" THEN 10

'   GET NEW BAUD RATE

10 LOCATE 10, 1
20 PRINT "Enter baud rate 110,150,300,600,1200,2400,4800, or 9600
LOCATE 10, 57
INPUT BR$
IF LEN(BR$) < 3 OR LEN(BR$) > 4 THEN 10
FOR I = 1 TO LEN(BR$)
IF ASC(MID$(BR$, I, 1)) < 48 OR ASC(MID$(BR$, I, 1)) > 57 THEN 10
NEXT I
N = VAL(BR$)
SELECT CASE N
CASE 110, 150, 300, 600, 1200, 2400, 4800, 9600
GOTO 30
CASE ELSE
GOTO 10
END SELECT
30 SETUP$ = "COM1:" + BR$

'  GET PARITY TYPE

40 LOCATE 12, 1
PRINT "Enter parity type:   (E)ven    (O)dd    (N)o parity
DO
DO
P$ = INKEY$
LOOP WHILE P$ = ""
P$ = UCASE$(P$)
IF P$ = "E" OR P$ = "O" OR P$ = "N" THEN EXIT DO ELSE GOTO 40
LOOP
50 SETUP$ = SETUP$ + "," + P$

'  GET NUMBER OF DATA BITS

60 LOCATE 14, 1
PRINT "Enter number of data bits  7 or 8 ?          "
DO
N$ = INKEY$
IF N$ = "7" OR N$ = "8" THEN 70
LOOP
GOTO 60
70 SETUP$ = SETUP$ + "," + N$

'  GET NUMBER OF STOP BITS
```

```
80 LOCATE 16, 1
PRINT "Enter number of stop bits  1 or 2 ?        "
DO
S$ = INKEY$
IF S$ = "1" OR S$ = "2" THEN 90
LOOP
90 SETUP$ = SETUP$ + "," + S$
100 SETUP$ = SETUP$ + ",RB17000,OP5000"           ' SET TIMEOUT FOR 5 SECO
                                                  ' SET RECEIVE BUFFER TO

IF A$ = "Y" THEN GOTO 110
LOCATE 19, 1
PRINT "Does the UNIDEX 1 need to be set for communication parameters"
PRINT "other than the default parameters ?  (Yes or No)"
GOSUB 8200
IF A$ = "Y" THEN GOSUB 7000

110 OPEN SETUP$ FOR RANDOM AS #1           'OPEN COM1 PORT.

120 GOSUB 8000                             'SELECT MODE OF OPERATION.
LOCATE 8, 20
PRINT "(1) Immediate Mode"
LOCATE 10, 20
PRINT "(2) File Mode"
LOCATE 12, 20
PRINT "(3) End Program"
LOCATE 24, 1
PRINT "Select? ";
DO
A$ = INKEY$
IF A$ = "1" THEN 200                       'DIRECT COMMANDS TO UNIDEX 1
IF A$ = "2" THEN 500                       'TRANSFER OF FILES TO DISK OR PRINTER
IF A$ = "3" THEN 600                       'EXIT PROGRAM
LOOP
200 CLS
GOSUB 8000
LOCATE 8, 33
PRINT "Immediate Mode"
LOCATE 10, 5
PRINT "    Immediate mode allows you to output any system or program comm

PRINT "    the UNIDEX 1 control.  You are limited to 255 characters per l

PRINT "    need help, type HS for System commands and HP for Programming

PRINT "    If you use  'P'  print commands such as PX * then the X axis p

PRINT "    be displayed.  Use File Mode to store and retrieve programs fr

PRINT "    File Mode is also use to print programs to your LPT1 port.  Us

PRINT "    commands to redirect I/O from LPT1 to COM1.  Type EX to exit t

Time = 5                                   'TIME IN SECONDS TO .CLEAR COMMAND.
210 GOSUB 8100
```

```
215 GOSUB 8000
LOCATE 8, 33
PRINT "Immediate Mode"
LOCATE 20, 1
INPUT "Command"; A$
IF LEN(A$) = 1 THEN 220
IF LEFT$(A$, 2) = "EX" THEN 120
IF LEFT$(A$, 2) = "HS" THEN 225
IF LEFT$(A$, 2) = "HP" THEN 225

220 PRINT #1, A$
DELAY = .05                            ' DELAY TO ALLOW COMMAND TO BE EXECUTED.
225 SELECT CASE A$

CASE "HS", "HP"                        ' DISPLAY HELP SCREENS.
GOTO 300

CASE ">>00" TO ">>31"                  ' CHECK FOR DEVICE ADDRESSING.
A$ = INPUT$(5, #1)
GOTO 215

CASE "Q"                               ' SERIAL POLL OF UNIDEX 1.
DO
A$ = INPUT$(1, #1)
PRINT A$;
IF A$ = CHR$(10) THEN 210
LOOP

CASE "PX", "PX*"                       ' READ X POSITION.
A$ = INPUT$(13, #1)
PRINT "X AXIS POSITION IS "; A$
GOTO 210

CASE "PS*"                             ' PROGRAM STOP COMMAND.
GOTO 210

CASE "PS"                              ' READ STATUS BYTES.
PRINT "STATUS = ";
DO
A$ = INPUT$(1, #1)
PRINT A$;
IF A$ = CHR$(10) THEN 210
LOOP

CASE "PD", "P00" TO "P99"             ' PRINT TO SCREEN OF DIRECTORY OR PROGRAM
250 CLS
GOSUB 8000
LOCATE 8, 1
DO
A$ = INPUT$(1, #1)
IF A$ = CHR$(3) THEN 210
IF A$ = "%" THEN 250
PRINT A$;
IF A$ = CHR$(10) THEN GOSUB 8300
```

3

```
LOOP

CASE ELSE
END SELECT

GOSUB 8300
GOTO 210


300 IF A$ = "HP" THEN 310
H$ = "UN1SYS"
HELP = 5
N = 1
GOTO 320
310 H$ = "UN1PRG"
HELP = 6
N = 1
320 CLS
HELP$ = H$ + RIGHT$(STR$(N), 1) + ".HLP"
ON ERROR GOTO 400
OPEN HELP$ FOR INPUT AS #2
330 HP$ = INPUT$(1, #2)
IF HP$ = CHR$(10) THEN 330
IF HP$ = CHR$(27) THEN 340
PRINT HP$;
GOTO 330
340 A$ = INPUT$(2, #2)
CLOSE #2
LOCATE 23, 1
PRINT "PRESS KEY:     ESC- exit      UP ARROW- next screen      DOWN ARROW- p
DO
HP$ = INKEY$
IF HP$ = CHR$(27) THEN 215
IF HP$ = CHR$(0) + CHR$(72) THEN 350
IF HP$ = CHR$(0) + CHR$(80) THEN 360
LOOP
350 N = N + 1
IF N > HELP THEN N = 1
GOTO 320
360 N = N - 1
IF N < 1 THEN N = 1
GOTO 320
400 LOCATE 23, 1
PRINT "Help screens are not available."
DELAY = 5
GOSUB 8300
RESUME 120



500 CLS
GOSUB 8000
LOCATE 8, 35
PRINT "File Mode"
LOCATE 12, 20
PRINT "(1) Output file to Printer"
```

```
LOCATE 14, 20
PRINT "(2) Output file to Disk"
LOCATE 16, 20
PRINT "(3) Output file to UNIDEX 1"
LOCATE 23, 1
PRINT "Select";

DO
B$ = INKEY$
IF B$ = "1" OR B$ = "2" OR B$ = "3" THEN 510
LOOP

510 SELECT CASE B$
CASE "1"
OUTPUT$ = "Printer"

CASE "2"
OUTPUT$ = "Disk"

CASE "3"
OUTPUT$ = "UNIDEX 1"

CASE ELSE
END SELECT

CLS
GOSUB 8000
LOCATE 8, 35
PRINT "File Mode"
LOCATE 12, 20
PRINT "(1) Input from Disk"
LOCATE 14, 20
PRINT "(2) Input from UNIDEX 1"
LOCATE 23, 1
PRINT "SELECT"

DO
B$ = INKEY$
IF B$ = "1" OR B$ = "2" THEN 520
LOOP

520
SELECT CASE B$
CASE "1"
INPPUT$ = "Disk"
CASE "2"
INPPUT$ = "UNIDEX 1"
CASE ELSE
END SELECT

CLS
GOSUB 8000
LOCATE 8, 35
PRINT "File Mode"
LOCATE 12, 5
```

```
PRINT "OUTPUT- ";
SELECT CASE OUTPUT$
CASE "Disk"
GOSUB 1000
OUTFILE$ = DISKFILE$
CASE "UNIDEX 1"
GOSUB 1100
OUTFILE$ = UN1PRG$
CASE ELSE
END SELECT
LOCATE 16, 5
PRINT "INPUT- ";
SELECT CASE INPPUT$
CASE "Disk"
GOSUB 1000
INFILE$ = DISKFILE$
CASE "UNIDEX 1"
GOSUB 1100
INFILE$ = UN1PRG$
CASE ELSE
END SELECT
LOCATE 20, 5
PRINT "Input from   "; INPPUT$; ":   "; INFILE$; "      Output to   "; OUTPU
LOCATE 22, 5
PRINT "Has the UNIDEX 1 addressed? (Y)es or (N)o"
GOSUB 8200
IF A$ = "N" THEN 120


CLS                                      ' Input of File.
GOSUB 8000
LOCATE 8, 35
PRINT "File Mode"
Time = 0
LOCATE 12, 1
PRINT "INPUT OF "; INFILE$
SELECT CASE INPPUT$

CASE "Disk"                              ' Input of Disk File

ON ERROR GOTO 537
OPEN INFILE$ FOR INPUT AS #2
OPEN "TTTTEMP.TXT" FOR OUTPUT AS #3

530 TEMP$ = INPUT$(1, #2)
PRINT #3, TEMP$;
PRINT TEMP$;
IF TEMP$ = CHR$(3) THEN 535
GOTO 530
535 DELAY = 2
CLOSE #3, #2
GOSUB 8100
GOTO 550

537 IF ERR = 62 THEN 538
```

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```
            LOCATE 23, 1
            PRINT "File does not exist"
            DELAY = 5
            GOSUB 8300
            RESUME 120
            538 PRINT #3, "%"; CHR$(13); CHR$(10);
            PRINT #3, CHR$(3);
            RESUME 535



            CASE "UNIDEX 1"                          ' Input of UNIDEX 1 Program

            OPEN "TTTTEMP.TXT" FOR OUTPUT AS #2
            PRINT #1, UN1PRG$; CHR$(13)
            540 TEMP$ = INPUT$(1, #1)
            PRINT #2, TEMP$;
            PRINT TEMP$;
            IF TEMP$ = CHR$(3) THEN 545
            GOTO 540
            545 CLOSE #2
            GOSUB 8100

            CASE ELSE
            END SELECT

            550 CLS                                  'Output of File
            GOSUB 8000
            LOCATE 8, 35
            PRINT "File Mode"
            LOCATE 12, 1
            PRINT "OUTPUT OF "; OUTFILE$
            SELECT CASE OUTPUT$

            CASE "Disk"                              ' Output of File to Disk

            OPEN "TTTTEMP.TXT" FOR INPUT AS #2
            OPEN OUTFILE$ FOR OUTPUT AS #3
            560 TEMP$ = INPUT$(1, #2)
            PRINT #3, TEMP$;
            PRINT TEMP$;
            IF TEMP$ = CHR$(3) THEN 565
            GOTO 560
            565 CLOSE #3, #2
            GOSUB 8100
            GOTO 590

            CASE "UNIDEX 1"                          ' Output of Program to UNIDEX 1

            OPEN "TTTTEMP.TXT" FOR INPUT AS #2
            PRINT #1, "E"; RIGHT$(OUTFILE$, 2); "*"; CHR$(13)
            570 TEMP$ = INPUT$(1, #2)
            PRINT #1, TEMP$;
            PRINT TEMP$;
            IF TEMP$ = CHR$(3) THEN 575
```

```
GOTO 570
575 CLOSE #2
GOSUB 8100
GOTO 590

CASE "Printer"                              ' Output to Printer

OPEN "TTTTEMP.TXT" FOR INPUT AS #2
580 TEMP$ = INPUT$(1, #2)
LPRINT TEMP$;
PRINT TEMP$;
IF TEMP$ = CHR$(3) THEN 585
GOTO 580
585 CLOSE #2
DELAY = 2
GOSUB 8300

CASE ELSE
END SELECT

590 KILL "TTTTEMP.TXT"
GOTO 120

600 PRINT #1, CHR$(127)
CLOSE #1
END

1000 INPUT "File Name.Ext "; DISKFILE$
RETURN

1100 INPUT "UNIDEX 1 Program number "; UN1PRG$
UN1PRG$ = "0" + UN1PRG$
UN1PRG$ = RIGHT$(UN1PRG$, 2)
SELECT CASE UN1PRG$
CASE "00" TO "99"
UN1PRG$ = "P" + UN1PRG$
CASE ELSE
LOCATE 16, 5
PRINT "                                                    "
LOCATE 16, 5
GOTO 1100
END SELECT
RETURN

7000 '    SUBROUTINE TO CHANGE COMMUNICATION PARAMETERS
CLS
GOSUB 8000
LOCATE 7, 18
PRINT "PROCEDURE to change COMMUNICATION PARAMETERS"
LOCATE 10, 1
PRINT "          STEP 1:    With Unidex 1 powered down, remove the TFX c
PRINT "                     from Port A."
PRINT ""
PRINT "          STEP 2:    Connect the RS232 cable from your computer t
PRINT "                     Unidex 1 Port A"
```

```
PRINT ""
PRINT "          STEP 3:     Connect a jumper between pin 6 and pin 8 on
PRINT "                      I/O connector Port B."
PRINT ""
PRINT "          STEP 4:     Power up the Unidex 1 and press any key to"
PRINT "                      continue."
Time = 0
GOSUB 8100
CLS
GOSUB 8000
LOCATE 7, 32
PRINT "SETUP PARAMETERS"
OPEN "COM1:9600,E,7,1" FOR RANDOM AS #1
PRINT #1, ">>00"; CR$;
INPUT #1, A$
7010 PRINT #1, "PV"; CR$;
LOCATE 7, 15
PRINT "ORGINAL"
FOR I = 1 TO 11
INPUT #1, A$
LOCATE 9 + I, 15
PRINT A$;
NEXT I
GOSUB 8100
SELECT CASE N
CASE 110
A$ = "BR 03*"
CASE 150
A$ = "BR 05*"
CASE 300
A$ = "BR 06*"
CASE 600
A$ = "BR 07*"
CASE 1200
A$ = "BR 08*"
CASE 2400
A$ = "BR 10*"
CASE 4800
A$ = "BR 12*"
CASE 9600
A$ = "BR 14*"
CASE ELSE
A$ = "BR 14*"
END SELECT
PRINT #1, A$; CR$;
IF N$ = "7" THEN A$ = "WL 7*" ELSE A$ = "WL 8*"
PRINT #1, A$; CR$;
IF S$ = "1" THEN A$ = "SB 1*" ELSE A$ = "SB 2*"
PRINT #1, A$; CR$;
A$ = "PY " + LEFT$(P$, 1) + "*"
PRINT #1, A$; CR$;
FOR I = 1 TO 4
LOCATE 19 + I, 1
PRINT "
NEXT I
```

```
7100 LOCATE 22, 1
PRINT "Enter any other parameter changes
PRINT "Type E to exit or H for help"
LOCATE 22, 35
INPUT A$
IF UCASE$(LEFT$(A$, 1)) = "E" THEN 7110
IF UCASE$(LEFT$(A$, 1)) = "H" THEN GOSUB 7500
IF LEN(A$) < 4 OR LEN(A$) > 11 THEN 7100
PRINT #1, A$; CR$:
GOTO 7100
7110 CLS
GOSUB 8000
CLOSE #1
LOCATE 10, 1
PRINT "          STEP 5:     To activate parameter changes , power"
PRINT "                      down the Unidex 1."
LOCATE 13, 1
PRINT "          STEP 6:     Remove the jumper between pin 6 and"
PRINT "                      pin 8 of Port B of the Unidex 1."
LOCATE 16, 1
PRINT "          STEP 7:     Apply power to Unidex 1 and press a key"
PRINT "                      to continue."
LOCATE 20, 1
PRINT "Perform steps 5 and 6 before continuing this program."
GOSUB 8100
RETURN


7500 CLS
LOCATE 1, 20
PRINT "UNIDEX 1      HELP      setup  parameters"
LOCATE 3, 1
PRINT "     E. ACCEL/DECEL    (AD)    AD nnnn*      nnnn = 0 TO 9999
PRINT ""
PRINT "     F. DEVICE ADDRESS (DA)    DA nn*        nn = 2 TO 31"
PRINT "        Device address 0 and 1 not recommmend since 0 is used"
PRINT "        in setup mode and 1 is the default address."
PRINT ""
PRINT "     G. BOOT PROGRAM   (BP)    BP nn*        nn = 1 TO 99"
PRINT "        If nn = 00 then BOOT PROGRAM is disabled."
PRINT ""
PRINT "     H. START/STOP     (SS)    SS nnnnnn*    nnnnnn = 1 TO 1
PRINT ""
PRINT "     I. RAMP PROFILE   (RP)    RP x*     x = L (linear)  P (pa
PRINT ""
PRINT "     J. OUTPUT STATE   (OT)    OT x*     x = H (active high)
PRINT ""
PRINT "     K. MOTOR CURRENT  (EH)    EH x*     x = Y (YES) or N (NO)
PRINT ""
PRINT "     L. LOAD DEFAULT   (LD)    LD *      loads default values"
GOSUB 8100
RETURN


8000 CLS
LOCATE 4, 28
```

```
PRINT "UNIDEX 1 TEST PROGRAM"
LOCATE 5, 28
PRINT "------------------------"
RETURN

8100 LOCATE 23, 1
PRINT "Press any key to continue..."
T = 1
DO
T = T + 1
IF Time = 0 THEN T = 1
IF T = Time * 1000 THEN 8110
LOOP WHILE INKEY$ = ""
8110 RETURN

8200 DO
A$ = INKEY$
A$ = UCASE$(A$)
IF A$ = "Y" OR A$ = "N" THEN RETURN
LOOP

8300 FOR I = 1 TO DELAY * 1000
NEXT I
RETURN
```

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products which are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Laser Product Warranty

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than (30) days after the issuance of a return authorization number will be subject to review.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warrantied defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an air freight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Returned Product Non-Warranty Determination

After Aerotech's examination, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-Site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies.

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special service rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-Site Non-Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies.

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.