UNIDEX®

STEPPING MOTOR
MOTION CONTROLLER
USER’S MANUAL

PN: EDU100
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 Stepping Motor Motion Controller. Information pertaining to Unidex 1 programming as well as motor, input power, and external control interconnections is provided.

TRADEMARKS:

Unidex is a registered trademark of Aerotech, Inc.
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SERVICE AND REPAIR
CHAPTER 1: INTRODUCTION

SECTION 1-1 GENERAL DESCRIPTION

The single axis Unidex 1 Micro-Stepping Driver is a microprocessor-based motion controller most applicable for low and medium power programmable positioning. A variety of models are available providing adaptability to a wide range of applications. The Unidex 1 is packaged in three configurations; 1) Low power panel/desktop mount 2) High power panel mount, and 3) Low power 6U Euro Cardrack mount (Figure 1-1).

The Unidex 1 may receive 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).

Unidex 1 Micro-Stepping Motion Controller User specifications are provided in Tables 1-1 and 1-2 and 1-3.

Figure 1-1: Unidex 1 Programmable Motion Control Family of Stepping Motor Control
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
- Start/stop 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 for up to 99 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)
- Immediate command execution.
- 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.

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 0.09 (4000 steps/rev.)
Optional: 1.8 to 0.0072 (200 to 50,000 steps/rev.)
Accuracy +/- 5 arc min. typical unloaded, bidirectional
Repeatability +/- 5 arc min. typical unloaded, unidirectional
Hysteresis 3 arc min. unloaded, bi-directional

MOTIONS
Position Range +/- 1,999,999,999 counts (Range with standard resolution.
No limit in free run mode.
Speed Range 0.00025 to 108 rev/sec (0.015 to 6500 rpm)
Acceleration Ramp 50 to 6500 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

Table 1-1: Specifications
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
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 (used with H option), encoder
Connect 25 pin, female, type-D
Indicators 7 LEDs, front panel, indicate status and help in diagnosis

ENVIRONMENTAL
Ambient Temperature
Operating 0 to 50 C (32 to 122 F)
Storage -30 to 85 C (122 to 185 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.

Table 1-1: Specifications Con’t
<table>
<thead>
<tr>
<th></th>
<th>LOW POWER PANEL/DESKTOP MOUNT CONFIGURATION</th>
<th>HIGH POWER PANEL MOUNT CONFIGURATION</th>
<th>LOW POWER 8U CARDRAKE MOUNT CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPUTER PACKAGE P/N</td>
<td>U1A  U1B  U1C  U1D  U1E  U1F  U1P  U1R  U1S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Translator P/N</td>
<td>DM4001  DM4005  DM6006  DM8010  DM8010  DM16008  DM4001  DM4005  DM6006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEPPING MOTOR P/N</td>
<td>50S 5SM  101SM  300SM  310SM  510SM  1010SM  50SM  101SM  300SM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STATIC TORQUE</td>
<td>38     90     350     370     520     1050     38     90     350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTOR SPEED</td>
<td>1000   1875   1500    1875    1500    1500    1000   1875   1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAXIMUM MOTOR</td>
<td>12     53     100     250     220     380     12     53     100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT POWER</td>
<td>1.66E3  5E9   26.5E3  26.5E3  55E9   114E3   1.66E3  5E9   26.5E3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATTS</td>
<td>11.8E9  35E9   187E9  187E9   368E9  805E9   11.8E9  35E9   187E9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTOR ROTOR INERTIA</td>
<td>23     23     34      34      42      42      23     23     34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA FRAME</td>
<td>2-PHASE HYBRID PERMANENT MAGNET, 1.8 DEGREE/\ FULL STEP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTOR TYPE</td>
<td>2-PHASE HYBRID PERMANENT MAGNET, 1.8 DEGREE/\ FULL STEP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSLATOR</td>
<td>40     40     60      80      80      160      40     40     60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOLTS (DC)</td>
<td>1 UNIPOLAR 5 UNIPOLAR 6 BIPOLAR 6 BIPOLAR 8 BIPOLAR 8 BIPOLAR 1 UNIPOLAR 5 UNIPOLAR 6 BIPOLAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHTS</td>
<td>2.3    3.6    8.1      8.1     14     20      2.3     3.6    8.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTOR (LBS)</td>
<td>1.05   1.64   3.68     3.68    6.36    9.09    1.05   1.64   3.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KGF</td>
<td>12.00  14.00  20.00    34.00   40.00   36.00   12.00  14.00  20.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTOR DRIVE (LBS)</td>
<td>5.45   6.36  9.09     13.45   18.17   17.26   5.45   6.36   9.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(KGF)</td>
<td>(Includes all interconnecting cables)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMPS</td>
<td>.5     1     1.5     3       3       4       .5     1     1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Allowable voltage tolerance ± 10%, Max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1-3: Torque vs. Speed Characteristics for Unidec 1 Model U1A Through U1S
Unidex 1 is available in three packaging styles: 1) Unidex 1 Low Power 6U version, 2) Unidex 1 Low Power Panel/Desktop Mount version, and 3) High Power Panel Mount version. The Computer Interface Connector (Port A), I/O Connector (Port B), and Limit Connector (Port C) are the same for all three packaging versions. The AC INPUT POWER connections and motor wiring differ and therefore will be described separately in this section.

SECTION 2-1  INPUT POWER CONNECTION

(Low Power Panel/Desktop Mount, Models U1A, U1B, U1C, U1G, U1H, and U1J)

The Unidex 1 U1A, U1B, U1C, U1G, U1H, and U1J Low Power Panel/Desktop packages may be factory wired for either a 115 VAC 60 Hz or 220-240 VAC 50/60 Hz input. Figure 2-1 shows an outline of the INPUT POWER receptacle and ON/OFF switch for the Low Power Panel/Desktop configuration.

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.
NOTE: Mating cable is supplied with unit.

Refer to Table 1-2 for current ratings.

Figure 2-1: AC INPUT POWER Connector and POWER SWITCH
Figure 2-2: Unidex 1 Low Power Panel/Desktop Package Outline (Models U1A, U1B, U1C U1G, U1H, U1J)
SECTION 2-2  INPUT POWER CONNECTION

(All Models packaged in the 6U Eurocard Format including U1P, U1R and U1S)

The Unidex 1 6U Eurocard package configuration may be field wired for either 115 VAC 60Hz or 220-240 VAC 50/60Hz. Figure 2-2A shows an outline (as well as motor power connections) of the 6U Eurocard package version of Unidex 1. AC power is connected to the Translator Board Power Connector J3. An outline of the mating connector for J3 (shipped with the unit) is outlined in Figure 2-2B. The pinout connections for both 115 VAC or 220-240 VAC of connector J3 are shown below.

**AC Power Wiring**

<table>
<thead>
<tr>
<th>115 VAC</th>
<th>220-240 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 - AC Line</td>
<td>28 - AC Line</td>
</tr>
<tr>
<td>32 - (Jumper To 28)</td>
<td>32 - Neutral</td>
</tr>
<tr>
<td>24 - Neutral</td>
<td>24 - (no Connection)</td>
</tr>
<tr>
<td>22 - Gnd (earth Ground)</td>
<td>22 - Gnd (earth Ground)</td>
</tr>
</tbody>
</table>

⚠️ **DANGER:** The 6U Eurocard package configuration has been designed to be used in a totally enclosed cardrack only. To minimize the possibility of electrical shock and bodily injury, voltage must not be applied to the Unidex 1 Controller prior to cardrack mounting.

Refer to Table 1-2 for current specifications.
LED INDICATOR DESCRIPTION

- **MARKER** LED is on when marker signal is present
- **ZERO** LED is on when motor is in low 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 LIM** LED is on when in CCW limit
- **CW LIM** LED is on when in CW limit

**NOTE:** User supplied fan cooling required here (30CFM minimum)

**Figure 2-2A: Unidex 1 6U Eurocard Package Outline**
A. Mounting holes as per DIN 41612 specifications
B. .25" quick-connect lugs (typical)

Figure 2-2B: Mating Connector for Connector J3 (Shown In Figure 2-2A)
SECTION 2-3 INPUT POWER CONNECTIONS

(High Power Panel Mount, Models U1D, U1E, U1F)

The Unidex 1 High Power Panel Mount Models U1D and U1E (see Figure 2-3) may be factory wired for either 115 VAC or 220-240 VAC 50/60 Hz input power. The High Power Panel Mount Model U1F is available with a 115 VAC 50/60 Hz input power connection only (this unit incorporates off-line isolated drive control). Note the specification label on the side of the unit for appropriate input voltage connections. Input power specifications for this unit are summarized below:

AC Power Wiring

<table>
<thead>
<tr>
<th>Unit U1D, U1E</th>
<th>Unit U1F</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE</td>
<td>115 OR 220 THROUGH 240 VAC</td>
</tr>
<tr>
<td>NEUTRAL</td>
<td>0 VAC</td>
</tr>
</tbody>
</table>

Refer to Table 1-2 for current specification.
LED INDICATOR DESCRIPTION

Marker  LED is ON when a marker signal is present.
Zero    LED is ON when motor is in low 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 Lim LED is ON when in CCW Limit.
CW Lim  LED is ON when in CW Limit.

Figure 2-3: Unidex 1 High Power Panel Mount Package Outline
SECTION 2-4 MOTOR POWER CONNECTIONS

(Low Power Panel/Desktop Mount, Models U1A, U1B, U1C, U1G, U1H, and U1J)

The motor power receptacle outline (see Figure 2-1) is shown below:

![Motor Power Receptacle Diagram]

**NOTE:** Pins 9 through 14 are not used.

**NOTE:** Mating connector (or cable, depending upon application) is supplied with unit.

See Figure 2-4 for the appropriate Stepping Motor connections of the Motor Power connector shown above.
Figure 2-4: Unidex 1 Low Power Panel/Desktop Mount Motor Connections
SECTION 2-5 MOTOR POWER CONNECTIONS

(Low Power 6U Eurocard Configuration, including Models U1P, U1R, U1S)

Motor Power Receptacle J3 (see Figure 2-2) is shown below (refer to:

![Diagram of Connector J3]

Rear View of Connector J3

See Figure 2-5 for an outline of the appropriate Stepping Motor connections for the J3 connector.
Figure 2-5: Unidex 1 Low Power 6U1 Eurocard configuration Motor Connection Outline

Connectors J3

1. (C.T. for "A" phase)
2. (C.T. for "B" phase)
3. B Phase B
4. Phase A
5. A
6. Connect earth ground here
7. Input power connections
8. (See Section 2-2)
9. (All other pins are left disconnected)
10. Unipolar Stepping Motor Connections
11. UNIT U1P AND U1R ONLY
12. (See Table 1-2 for motor specifications)

Connectors J3

1. No connection
2. B Phase B
3. Phase A
4. A
5. Connect earth ground here
6. Input power connections
7. (See Section 2-2)
8. (All other pins are left disconnected)
9. Bipolar Stepping Motor Connections
10. UNIT U1S ONLY
11. (See Table 1-2 for motor specifications)
The Motor Power receptacle outline (see Figure 2-4) is shown below:

See Figure 2-6 for an outline of the appropriate Stepping Motor connections of the Motor Power connector shown above.
BIPOLAR STEPPING MOTOR CONNECTIONS MODELS U1D, U1E AND U1F
(See Table 1-2 for Motor specifications)

Figure 2-6: Unidex 1 High Power Panel Mount Motor Connection Outline
SECTION 2-7 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 2-1 (Desktop/Panel Mount version), Figure 2-2 (6U Eurocard version), and Figure 2-3 (High Power Panel Mount version). See Figure 2-7 for a description of each connector and its mate.

Port A

\[
\begin{array}{cccccc}
5 & 4 & 3 & 2 & 1 \\
\bullet & \bullet & \bullet & \bullet & \bullet \\
9 & 8 & 7 & 6 \\
\end{array}
\]

(Female, 9 pin "D" type)

Port B and Port C

\[
\begin{array}{cccccccccccccc}
13 & 12 & 11 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \\
\bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\
25 & 24 & 23 & 22 & 21 & 20 & 19 & 18 & 17 & 16 & 15 & 14 \\
\end{array}
\]

(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))

Molding 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))

Molding 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 2-7: Outline and Mating Connector Description for Unidex 1 Control Connectors (Ports A, B and C)
2-7-1  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 7 for details.)

COMPUTER INTERFACE (PORT A)

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

2-7-2  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 2-7 for outline drawing).
**CHAPTER 2: SYSTEM LAYOUT/EXTERNAL CONNECTIONS**

**INPUT/OUTPUT CONNECTOR (PORT B)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FAULT (Opto Isolated)</td>
</tr>
<tr>
<td>2</td>
<td>OUTPUT 03 (Opto Isolated)</td>
</tr>
<tr>
<td>3</td>
<td>OUTPUT 01 (Opto Isolated)</td>
</tr>
<tr>
<td>4</td>
<td>INPUT I3 (Opto Isolated)</td>
</tr>
<tr>
<td>5</td>
<td>INPUT I1 (Opto Isolated)</td>
</tr>
<tr>
<td>6</td>
<td>/SETUP</td>
</tr>
<tr>
<td>7</td>
<td>EXT CLK</td>
</tr>
<tr>
<td>8</td>
<td>COMMON</td>
</tr>
<tr>
<td>9</td>
<td>INPUT COMMON</td>
</tr>
<tr>
<td>10</td>
<td>CW LIMIT (Opto Isolated)</td>
</tr>
<tr>
<td>11</td>
<td>SPARE</td>
</tr>
<tr>
<td>12</td>
<td>SPARE</td>
</tr>
<tr>
<td>13</td>
<td>SPARE</td>
</tr>
<tr>
<td>14</td>
<td>OUTPUT 04 (Opto Isolated)</td>
</tr>
<tr>
<td>15</td>
<td>OUTPUT 02 (Opto Isolated)</td>
</tr>
<tr>
<td>16</td>
<td>INPUT I4 (Opto Isolated)</td>
</tr>
<tr>
<td>17</td>
<td>INPUT I2 (Opto Isolated)</td>
</tr>
<tr>
<td>18</td>
<td>/FEEDHOLD (Opto Isolated)</td>
</tr>
<tr>
<td>19</td>
<td>EXT DIR</td>
</tr>
<tr>
<td>20</td>
<td>+ 5 VDC</td>
</tr>
<tr>
<td>21</td>
<td>OUTPUT COMMON</td>
</tr>
<tr>
<td>22</td>
<td>CCW LIMIT (Opto Isolated)</td>
</tr>
<tr>
<td>23</td>
<td>SPARE</td>
</tr>
<tr>
<td>24</td>
<td>SPARE</td>
</tr>
<tr>
<td>25</td>
<td>SPARE</td>
</tr>
</tbody>
</table>

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

**NOTE:** External use of the +5V is not recommended. Total +5V current must not exceed 30 mA for all Ports.
2-7-2-1 INPUT (I1, I2, I3, I4) CONFIGURATION

The four condition inputs (see Section 7-8 for conditional input description) are Opto Isolated as shown in the following configuration.

![Diagram of input 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).
2-7-2-2 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
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:

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

\[
W_{\text{watts}} = .015 \times (\text{Voltage} - 5V)
\]

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

1) \[
R = \frac{[(12 - 5)]}{.015}
\]

\[
R = \frac{7}{.015}
\]

\[
R = 467 \text{ Ohms (Select nearest value)}
\]

(Use 470 Ohm resistor.)

2) \[
W = .015 \times (\text{Voltage} - 5V)
\]

\[
W = .015 \times 7
\]

\[
W = .105 \text{ Watt}
\]

(Use 1/4 Watt or 1/2 Watt resistor.)
2-7-2-3 OUTPUT (O1, O2, O3, O4) CONFIGURATION

The four programmable outputs (see Section 7-8 for Programmable Output description) are opto isolated with the following 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
2-7-2-4 FEEDHOLD CONFIGURATION

The feedhold input (see Section 7-8 for commands associated with feedhold) is an opto isolated input with the following configuration:

![Diagram of feedhold configuration]

NOTE: Input common (Pin 9) is used for all opto isolated inputs.

The feedhold input specifications are the same as the opto isolated inputs. (See Sub-Section 2-7-2-2 of this section for specifications.)

The feedhold input is designed to bring to a controlled stop, any of the 99 programs executed by the Unidx 1 Indexer. The motion is allowed to continue when the switch is reopened.
2-7-2-5 CW/CCW LIMIT CONFIGURATION

The CW/CCW limit connections described in Section 2-7-3 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 2-7-2-2 of this section for specifications.)

Following is a typical opto isolated Limit application:

![Diagram of CW/CCW Limit Configuration]

NOTE: Input common is used for all opto isolated inputs.
2-7-2-6 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 7-7-4). 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 2-7-2-5.

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

2-7-2-7 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

2-7-2-8 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.
Specifications for the Fault interface are the same as the Output specification (see Subsection 2-7-2-3 of this section). The Fault Output configuration is shown below:

![Fault Output Configuration Diagram]

2-7-3 LIMITS CONNECTOR (PORT C)

The Port C Limit Connector provides for the termination of the basic control interface signals between the Stepping Motor and the 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).

**LIMITS CONNECTOR (PORT C)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,16</td>
<td>+5 VDC</td>
</tr>
<tr>
<td>6</td>
<td>Marker (in)</td>
</tr>
<tr>
<td>7</td>
<td>Marker (in)</td>
</tr>
<tr>
<td>1,8,9,20,21</td>
<td>Common</td>
</tr>
<tr>
<td>12</td>
<td>/CW Limit (in)</td>
</tr>
<tr>
<td>22</td>
<td>/Home Limit (in)</td>
</tr>
<tr>
<td>24</td>
<td>/CCW Limit (in)</td>
</tr>
</tbody>
</table>

All other pins are spares. Shield termination is made through the two strain relief screws of the connector.
Form "A" connections are shipped standard, and are connected at pins 12, 24 and 22.

Form "B" contacts can be accommodated for all three Limit Inputs (consult your Aerotech Representative). Both configurations are outlined below (CW Limit is used as the 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 motor stops rotating, ending the Home cycle.

Before continuing, it should be noted that the terms CW and CCW rotation are relative to Aerotech Stepping Motors shipped with the Unidex 1. Direction of rotation is directly related to the Stepping Motor phase wiring. Phase wiring on a user-supplied Stepping Motor may require manipulation to provide the correct rotation (CW or CCW) as referred to within this manual.

If desired, Homing to a high accuracy marker reference can be achieved by using the Differential Marker Inputs (pin 6 and 7).
The basic Home reference is still in respect to the Home Limit switch as described above. However, if the sum of the polarities of the Marker, /Marker inputs remain negative after the Home switch is closed, the motor will continue to rotate CW after the Home switch is again opened. The motor will stop (Home will complete) when the sum of the polarities of Marker, /Marker becomes positive.

In actuality, there is a -1 volt bias associated with the Marker threshold described above. This is illustrated in the circuit which follows. This bias is used to "force" a marker condition when the user does not require a Marker reference.

It is important to note that the voltage threshold on the Marker and /Marker inputs is ignored until the closure of the Home switch during a Home cycle. This allows the use of a "once per Rev" motor shaft Marker pulse to be referenced to the Home Limit switch.
All Limit Input configurations are internally buffered as 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 total for all Ports.

The presence of a visual indication for acknowledge CW Limit, CCW Limit and Marker can be made by viewing the LED indicators on the front panel of the Unidex 1 (see Figures 2-1, 2-2, 2-3). The optional Hand Held Terminal also provides an indication of the presence of a Limit or Marker (see Chapter 6).
CHAPTER 3: MOTOR CONNECTIONS

SECTION 3-1  MOTOR TYPE U1A, U1B & U1H SPECIFICATIONS

Rotational Characteristics

" + " Command  CW Rotation
" - " Command  CCW Rotation
Home direction is initiated in CCW direction

Model A

<table>
<thead>
<tr>
<th>Model</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1A</td>
<td>2.00''</td>
</tr>
<tr>
<td></td>
<td>50,8</td>
</tr>
<tr>
<td>U1B</td>
<td>4.00''</td>
</tr>
<tr>
<td></td>
<td>101,6</td>
</tr>
<tr>
<td>U1H</td>
<td>2.225''</td>
</tr>
<tr>
<td></td>
<td>57,2</td>
</tr>
</tbody>
</table>

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)
SECTION 3-2 MOTOR TYPE U1A-HM, U1B-HM & U1H-HM SPECIFICATIONS

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

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)

4. Input not applicable to Unidex 1.
5. Consult factory for normally closed limits.
6. CCW/CW limit signal can be used in place of separate Home Limit Signals by inserting jumper.
SECTION 3-3  MOTOR TYPE U1C & U1D SPECIFICATIONS

Rotational Characteristics

"+" Command  CW Rotation
"-" Command  CCW Rotation

Home direction is initiated in CCW direc-

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)

AEROTECH, INC.  3-3  UNIDEX 1 MOTION CONTROLLER
SECTION 3-4 MOTOR TYPE U1C-HM AND U1D-HM SPECIFICATIONS

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

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)

4. Input not applicable to Unidx 1.
5. Consult factory for normally closed limits.
6. CCW/CW limit signal can be used in place of separate Home Limit Signals by inserting jumper.
SECTION 3-5 MOTOR TYPE U1E & U1F SPECIFICATIONS

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)

Model A

5.44"
U1E  138,2

7.56"
U1F  192,1
SECTION 3-6 MOTOR TYPE U1E-HM & U1F-HM SPECIFICATIONS

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

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)
4. Input not applicable to Unidex 1.
5. Consult factory for normally closed limits.
6. CCW/CW limit signal can be used in place of separate Home Limit Signals by inserting jumper.
CHAPTER 4: POWER UP

SECTION 4-1 POWER UP

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

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, 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 4-5).

SECTION 4-2 INITIALIZATION

The Unidex 1 operates in one of two modes; the Computer Interface mode (Chapter 5) or the optional Hand Held Input mode. Both are activated in a similar fashion. 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 4-3).
### Mode | Activation Command
--- | ---
Computer Interface | >> nn <CR>
Hand Held Terminal | ## nn <ENTER>

**Thumbwheel**
Program Control | << <CR> *
Thumbwheel | @@ <CR> *
Index Control |

**NOTE (1):** The TP and TI Controllers generate these codes automatically. No input is required (See Chapter 6 for details).

**NOTE (2):** "nn" denotes the device and 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 ( > > ), wait at least two character times, then send the device number of the Unidex 1 (shown above as nn). If the device number is unknown, it can be checked and set (see in Chapter 5, Set Up). (The default address is 01.) Follow the device number with a <CR> (carriage return). Wait at least two character times before sending another character.

**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.

**Time (seconds) = 24/Baudrate**
For example, the wait time required for 9600 baudrate would be calculated as follows:

\[ T = \frac{24}{9600} = .0025 \text{ seconds (or 2.5 milliseconds)} \]

(Wait time must be equal to or greater than .0025 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 4-3 DEACTIVATING UNIDEX 1

To deactivate a Unidex 1 Unit, send the \(<\text{CTRL}>B\) character (hex code 02). This will deactivate all active Unidex 1s and put them in the echo mode. Following the \(<\text{CTRL}>B\), a short wait is required before sending another character (see Section 4-2).

SECTION 4-4 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.

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

To activate more than one axis at a time, enter a comma or space between each two-digit device code, and enter a \(<\text{CR}>\) after the last device number. Following the \(<\text{CR}>\) a short wait is required before sending another character. To activate (in the Computer Interface mode) units 02, 05, 11, 21 and 30, enter the following code:

\[02,05,21,30,11 <\text{CR}>\]

It is not required that device numbers be entered in numerical sequence.
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 7-1 for "Daisy Chain" Specifications of Unidex 1.

SECTION 4-5 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 5). 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.
CHAPTER 5: SETUP

SECTION 5-1 DESCRIPTION

The Setup mode allows the configuration of certain Unidx 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 5-2 SETUP MODE SELECTION

To enter the Setup mode, the Unidex 1 must be powered down and a jumper connection must be made between the Setup input (pin 6 of the Input/Output connector, Port B; 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.

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 Computer Interface mode will give no indication of being in the Setup mode unless the host device sends a print setup command (PV < CR >).
The TFX Hand Held terminal should display the following screen when activated:

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

If the TFX display is as above, the TFX does not require initialization. Proceed to Section 5-4 for further setup procedures. If the TFX does not display the above screen, proceed to Section 5-3 for initialization procedures.

SECTION 5-3 TFX HAND HELD TERMINAL INITIALIZATION

The TFX Hand Held Terminal must be initialized to the Setup Communication protocol of the Unidex 1. 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 requiring the terminal to be re-initialized.

Depending on the Model Number of the TFX Hand Held Terminal being used, the re-initialization procedure is done in one of two ways. The following sections provide the procedure for each of the models.

**NOTE:** The TFX Model Number is located on the lower rear of the terminal.

5-3-1: TFX HAND HELD TERMINAL (MODEL NUMBER ESK 164)
The Unidex 1 provides a special Hand Held terminal Initialization mode to initialize the Hand Held terminal Model ESK - 164.

Power down the 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 the Unidex 1. After power has been applied for at least 10 seconds, disconnect the Setup to Signal Common jumper. The Hand Held terminal will begin 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:** Power must remain "On" to the Unidex 1 until the "Terminal Set" screen is present on the TFX Hand Held Terminal.

Power down the Unidex 1 to exit the TFX initialization mode.

**5-3-2: TFX HAND HELD TERMINAL (MODEL NUMBER ESK 166)**
The TFX Hand Held terminal Model ESK - 166 may be initialized as follows:

Power down the Unidex 1. Remove the Setup to Signal jumper (if previously installed) and then power up the Unidex 1.

Press the SHIFT key and then the CTRL and SPACE keys of the TFX Hand Held Terminal. The TFX Setup Menu will appear. The current Baud Rate will be displayed.

Press the F1 key to step through the selections for this setting. Select a Baud Rate of 9600 Baud by pressing the F5 key.

The current Parity setting is displayed. Press the F1 key to step through the selections for this setting. Select Even Parity by pressing the F5 key.

The current Character Display mode is displayed. Press the F1 key to step through the selections for this setting. Select the 32 Character Display mode by pressing the F5 key.

Press F3 to exit the TFX Setup Menu.
Power down the 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 the Unidex 1. After power has been applied for at least 10 seconds, disconnect the Setup to Signal Common jumper. When the Hand Held terminal has been initialized, it will display the following screen.

```
TERMINAL SET
9600 BAUD, EVEN
```

**NOTE:** Power must remain "On" to the Unidex 1 until the "Terminal Set" screen is present on the TFX Hand Held Terminal.

Power down the Unidex 1 to exit the TFX initialization mode.

**SECTION 5-4 HAND HELD TERMINAL: DISPLAY/SETUP**

After the Hand Held terminal has been placed in the Setup Mode and activated (as described previously in Section 5-2) 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 5-7.
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 5-7). 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 5-5 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 5-7.

### SECTION 5-6 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 5-7.

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 the Unidex 1 is powered down and the Set-up jumper is removed.
CHAPTER 5: SETUP

SECTION 5-7 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.

5-7-1 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 5-2.)

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.)

<table>
<thead>
<tr>
<th>CODE</th>
<th>BAUD</th>
<th>CODE</th>
<th>BAUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>50</td>
<td>09</td>
<td>1800</td>
</tr>
<tr>
<td>02</td>
<td>75</td>
<td>10</td>
<td>2400</td>
</tr>
<tr>
<td>03</td>
<td>109.92</td>
<td>11</td>
<td>3600</td>
</tr>
<tr>
<td>04</td>
<td>134.58</td>
<td>12</td>
<td>4800</td>
</tr>
<tr>
<td>05</td>
<td>150</td>
<td>13</td>
<td>7200</td>
</tr>
<tr>
<td>06</td>
<td>300</td>
<td>14</td>
<td>9600</td>
</tr>
<tr>
<td>07</td>
<td>600</td>
<td>15</td>
<td>19200</td>
</tr>
<tr>
<td>08</td>
<td>1200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

5-7-2 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.
5-7-3 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.

5-7-4 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.

5-7-5 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.

5-7-6 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.
5-7-7 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.

5-7-8 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.

5-7-9 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.

5-7-10 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.
5-7-11 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.
5-7-12 LOAD DEFAULT

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

**LD** *

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

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

5-7-13 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.
CHAPTER 5: SETUP

5-7-14 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 nnnnnn
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.
CHAPTER 6: UNINDEX 1 OPTIONS

Aerotech provides three control interface options for the Unindex 1 Controller. These are the TFX Hand Held terminal, the Thumbwheel Programmer (TP) and the Thumbwheel Indexer (TI). These options are outlined in Figures 6-1, 6-2, 6-3 and 6-4 respectively.

The TFX Hand Held terminal option provides the user with the ability to enter both manual and program command instructions to the Unindex 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 Unindex 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/feederate 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 6-1 TFX HAND HELD TERMINAL

6-1-1 INTERFACE CONNECTIONS

The TFX Hand Held terminal (Figures 6-1 and 6-2) is supplied with a cable that is designed to plug into the Communication Interface Connector, Port A, of the Unindex 1 (see Item 2-3-1). No additional interconnect wiring is required. The TFX Hand Held terminal receives its power directly from Unindex 1.

WARNING: To minimize the possibility of electrical shock and bodily injury, prior to making any electrical connections or disconnections, make certain that all electrical power switches are in the OFF position.

It should be noted that the TFX Hand Held terminal cable can be altered for "daisy chaining" 2 to 30 Unindex 1 Controllers to one TFX Hand Held terminal (see Figure 6-3). Pin out definitions for the TFX Hand Held terminal are shown in Figure 6-3.
6-1-2 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 6-1 and 6-2).

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 5-3).

NOTE 1:  If it is necessary 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 5-3 ).

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: #### nn).

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, the following is displayed:

```
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 6-1: Outline of the TFX Hand Held Terminal Option (S/N EFK164) for Unidex 1**
Figure 6-2: Outline of the TFX Hand Held Terminal Option (S/N EFK166) for Unidex 1
The following sections will explain each of these modes.

6-1-2-1 EDIT
Press F1, EDIT, from the main menu screen, to enter the Edit mode. The display will be:

```
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 may not always be displayed on the menu screen but still may be used to return to the previous menu.

The following subsections will describe each Edit menu.

6-1-2-1-1 INPUT PROGRAM
Press F1, PRG, the display will be:

```
INPUT PROGRAM
00 ENTER
```

Enter the new program number. The display will then be:

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

Press F1, CONTINUE, the display will be:

```
INPUT BLK CMD
```

Program commands may now be entered. (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.

6-1-2-1-2 ALTER PROGRAM

Once several blocks of commands are entered, it may be 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, the display will be:

```
INPUT PROGRAM
00 ENTER
```

Enter the program number to be edited, the display will be:

```
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. Press F3, the display will be:

```
INPUT BLK CMD
```

A command block may now be inserted.

**NOTE:** F5 is not valid at this time. To exit without entering a command, enter an End-Of-Block character (*) to return to the program. If an invalid command is entered, the display will be:

```
FORMAT WARNING
1 CONTINUE
```

Press F1 to re-enter the program then press F5 to exit.
Commands may also be inserted by pressing F2, **GET BLK**, from the ALTER Program menu. The display will be:

```
ENTER BLOCK #  0000 ENTER
```

Enter a block number, such as 2. That program block will be displayed, it cannot be directly changed by overwriting it. Instead F5 may be pressed to return to the ALTER Program menu:

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

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.

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

**6-1-2-1-3 DELETE PROGRAM**
Press F5, **BK**, to return to the main Edit menu. The main **EDIT** menu will be displayed:

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

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

```
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.

**6-1-2-1-4 RETURN**

Pressing F5, RTN, from the main EDIT menu returns you to the main menu.

**6-1-2-2 DISPLAY**

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

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

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

**6-1-2-2-1 POSITION DISPLAY**

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

```
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.
6-1-2-2-2 PROGRAM DISPLAY
Press F2, PRG, the display will be:

INPUT PROGRAM
00 ENTER

When a program number is entered that exists in memory, the display will be:

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 program editing can only be accomplished in the EDIT mode—see Section 6-2.)

Press F5 to return to the main display.

6-1-2-2-3 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:

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:

PROGRAM # 01 00035 BYTES
05961 FREE BYTES 5 RTN

Press F5 to return to the main DISPLAY menu.
6-1-2-2-4 ETC

Press F4, ETC, the display will be:

1 SETUP 2 STATUS
3 INPUT 5 RTN

6-1-2-2-4-1 Setup Display

Press F1, SETUP, to see the setup parameters chosen. (For detailed information on the Setup parameters, see Chapter 5, Setup.)

The first setup displayed is the Baud Rate:

<table>
<thead>
<tr>
<th>BR 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CONT 5 RTN</td>
</tr>
</tbody>
</table>

Press F1 to continue. The Word Length setup will be displayed:

<table>
<thead>
<tr>
<th>WL 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CONT 5 RTN</td>
</tr>
</tbody>
</table>

Press F1 to continue. The Stop Bits setup will be displayed:

<table>
<thead>
<tr>
<th>SB 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CONT 5 RTN</td>
</tr>
</tbody>
</table>

Press F1 to establish Odd, Even or No Parity:

<table>
<thead>
<tr>
<th>PY E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CONT 5 RTN</td>
</tr>
</tbody>
</table>
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):

```
OTL
1 CONT  5 RTN
```

Accel/Decel time (0-9999 mS) (see Chapter 8):

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

Start/Stop frequency (default speed if move is too short for Accel/Decel rate; see Section 8-2 and 8-5).

```
SS 0000500
1 CONT  5 RTN
```

Accel/decel Ramp Profile (linear or parabolic) (see Chapter 8):

```
RPL
1 CONT  5 RTN
```
Enable (Yes) or Disable (No) high motor operating current:

```
EHY
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.

### 6-1-2-2-4-2 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:
(\(xx\) represents the software level).

```
SOFTWARE USI xx
5 RTN
```

### 6-1-2-2-4-3 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 DISPLAY menu.
6-1-2-2-5  RUN MODE
Press F3, RUN, from the main menu, the display will be:

```
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.

6-1-2-2-5-1  IMMEDIATE MODE
Press F1, IMD, the display will be:

```
INPUT BLK CMD
```

Enter a block of commands, such as:

```
HX*
```

the display will be:

```
AXIS IN HOME
  CYCLE
```

When the Unidex 1 has completed the execution of the command, the main RUN menu is again displayed.

6-1-2-2-5-2  AUTO MODE
Press F2, AUTO, of the Run menu, the display will be:

```
INPUT PROGRAM
  00  ENTER
```
When the program number has been entered, the display will be:

```
WAIT FOR TRIGGER
1 YES 2 NO
```

If execution of the program is to be suspended until the Unidex 1 receives a Trigger, press F1, YES. The display will be:

```
WAIT FOR TRIGGER
PRESS T
```

Press T to begin program execution. The tracking display is displayed as programs are executed. When complete, the main RUN menu will be displayed. The Trigger function may be used with multiple Unidex 1s (daisy chain). The Unidex 1s may be enabled to listen and all begin to execute the same program simultaneously 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. At this point, multiple Unidex 1s may be enabled to listen, and all begin to execute the same program simultaneously when T is pressed.

6-1-2-2-5-3 BLOCK MODE

Press F3, Block, of the RUN menu, the display will be:

```
INPUT PROGRAM
  00 ENTER
```

Enter the program number, the first command block will execute. The display will be:

```
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.
This message will continue 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.

6-1-2-2-6 ADDITIONAL MODES
Press F4, ETC, of the Main menu to see:
The following subsections will describe each of the ETC menus.

6-1-2-2-6-1 STOP
Press F1, Stop, to stop axis motion. When this mode is accessed, pressing F1 will halt the axis move. (This command is useful in resetting a "free-run" command.)

1 STOP 2 INDEX
3 HM 4 RMT 5 RTN

6-1-2-2-6-2 INDEX
Press F2, Index, the display will be:

1 EXECUTE 2 INC
3 FD 4 DST 5 RTN

From within the INDEX mode, the Feedrate (F3) and Distance (F4) at which to Execute (F1) the move may be established. 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. The display will be:

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.
6-1-2-6-2 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 stay the same after a reset, or power down.)

Present if Marker Input is Active

Indicates CW Position ("-" indicates CCW)

Absolute Position

Indicates "Index" Mode

Indicates polarity from Absolute Position of Zero

i+mX:-0000061482

Pressing F1, EXECUTE, you will see a display similar to the example shown above.

When execution of the move is complete, a display will appear 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: The previous screen is displayed 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.
6-1-2-2-6-3 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.

6-1-2-2-6-4 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.

6-1-2-2-6-5 Distance or Position
Press F4, DST, (when in the Incremental mode), the display will be similar to:

```
DST = 00000020000
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.

Press F4, POS, (when in the Absolute mode), the display will be similar to:

```
POS = -0000020000
ENTER
```
When an index is executed in the Absolute mode, the axis will move to the Absolute position (-20000 steps in the previous example).
6-1-2-2-6-3  HOME
Pressing F3, HM, of the ETC menu, will send the axis home, the display will be:

AXIS IN HOME
CYCLE

When "Home" is reached, the display will be:

AXIS AT HOME
1 HM  5 RTN

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

6-1-2-2-6-4  REMOTE
Press F4, RMT, the display will be similar to:
Indicates REMOTE mode

\[ \text{rt X:0000000000 5 RTN} \]

The REMOTE display monitors any pulses coming in from the Translator (External Clock and Direction Inputs, Input/Output connector; see Section 2-7).

SECTION 6-2  THUMBWHEEL PROGRAMMER(TP)

6-2-1  INTERFACE CONNECTIONS
The Thumbwheel Programmer (TP) (Figure 6-3) is supplied with a molded interconnect cable designed to plug directly into the Communications Interface Connector, Port A of the Unidex 1 (see Section 2-7). No additional interconnect wiring is required by the User. The TP derives its power directly from the Unidex 1.
WARNING: To minimize the possibility of electrical shock and bodily injury, prior to making any electrical connections or disconnections, make certain that all electrical power switches are in the OFF position.

Unlike the Hand Held terminal option (Section 6-1), the Thumbwheel Programmer option cannot be "Daisy-chained" to other Unidex 1 Controllers.

6-2-2 OPERATION

The Unidex 1 Thumbwheel Programmer Option will call and execute any of 99 possible programs from the Unidex 1 memory. The programs must have previously been entered into the 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.

The use of the Unidex 1 Thumbwheel Programmer requires that the Unidex 1 be set to the following specifications (see Section 5-7 for a description of these codes):

- Baud Rate : 9600
- Stop Bits : 1
- Word Length : 7
- Parity : even
9 Pin "D" Connector (to port A of Unidx 1)

Program Select (1 through 99)

"Execute" Push-Button

Figure 6-3: Thumbwheel Programmer (TP) Option
6-2-3 THUMBWHEEL PROGRAMMER POWER UP

The Unidex 1 and Unidex 1 Thumbwheel Programmer must be connected prior to power up to insure that the Thumbwheel Programmer is recognized. When the Unidex 1 is powered up, the READY LED should come ON and the ERROR LED should go OFF.

To verify Thumbwheel Programmer operation, 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 one 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 is damaged or not connected properly.

3. Communication parameters (see Section 5-7) not as required.

To execute a program using the Unidex 1 Thumbwheel Programmer, move the Thumbwheels to indicate the desired program number, 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 an error signal will be sent. The error signal will cause the READY and ERROR LEDs to be 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 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 6-3  THUMBWHEEL INDEXER (TI)

6-3-1 INTERFACE CONNECTIONS

The Thumbwheel Indexer (TI) (Figure 6-4) 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 2-7). No additional interconnect wiring is required by the User. The TI derives its power directly from the Unidex 1.

⚠️ WARNING: To minimize the possibility of electrical shock and bodily injury, prior to making any electrical connections or disconnections, make certain that all electrical power switches are in the OFF position.

Like the Thumbwheel Programmer (Section 6-2), the Thumbwheel Indexer cannot be "Daisy-chained" to other Unidex 1 Controllers.

6-3-2 OPERATION

The Unidex 1 Thumbwheel Indexer option is similar to the Thumbwheel Programmer option discussed in Section 6-2, 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 Chapter 7.)

- **Mode 1/ Index**: Move the 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 5-7). (Similar to RS-232 command "Index"; see Chapter 7.)

- **Mode 2/ Feedrate**: Set Axis Feedrate to be used with all subsequent Indexes. (Similar to RS-232 command "Index"; see Chapter 7)
<table>
<thead>
<tr>
<th>Mode 3/ Accel/Decel</th>
<th>Set Axis Accel/Decel rate to be used with all subsequent Indexes. (Similar to RS-232 command &quot;Accel/Decel&quot;; see Chapter 7.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode 4/ Absolute / Incremental</td>
<td>Set Index mode so that the Index length set in &quot;data&quot; Thumbwheel is relative to preset point (Absolute) or with respect to last move (Incremental). (Similar to RS-232 command &quot;INC/ABS&quot;; see Chapter 7.)</td>
</tr>
<tr>
<td>Mode 5/ Load Position</td>
<td>Set Axis position Tracking Register (limited to 7 digits). (Similar to RS-232 command &quot;Load Position Register&quot;; see Chapter 7.)</td>
</tr>
<tr>
<td>Mode 6/ Run Program</td>
<td>Execute specific Unindex 1 program (1 through 99). (Similar to RS-232 command &quot;Auto Run&quot;; see Chapter 7.)</td>
</tr>
<tr>
<td>Mode 7/ Output</td>
<td>Set the four Output Control signals to 1 (true) or 0 (false) as designated by the first four digit positions of the &quot;data&quot; Thumbwheel. Values 2 through 9 for the given digit specify the &quot;don't care&quot; state. (Similar to RS-232 command &quot;Output State&quot;; see Chapter 7.)</td>
</tr>
<tr>
<td>Mode 8/ Slew</td>
<td>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 &quot;Execute&quot; push-button controls the Slew (or jog) process.</td>
</tr>
<tr>
<td>Mode 9/ Reset</td>
<td>Reset the Unindex 1 (equivalent to a Ctrl-A &quot;soft reset&quot;). The &quot;EXECUTE&quot; push-button performs the reset. (Similar to RS-232 command &quot;Reset&quot;; see Chapter 7.)</td>
</tr>
</tbody>
</table>

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.
When using 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 values 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.

When using 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 5-7 for a description of these codes):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud Rate</td>
<td>9600</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Word Length</td>
<td>7</td>
</tr>
<tr>
<td>Parity</td>
<td>Even</td>
</tr>
</tbody>
</table>
Figure 6-4: Thumbwheel Indexer (TI) Option
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 7-1 REQUIRED HARDWARE

The Port A Computer Interface port (see also Section 7-10) is a 9 pin "D" type female connector implementing the following signal lines:

<table>
<thead>
<tr>
<th>PIN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN 1</td>
<td>Not used</td>
</tr>
<tr>
<td>PIN 2</td>
<td>Receive Data (RX)</td>
</tr>
<tr>
<td>PIN 3</td>
<td>Send Data (TX)</td>
</tr>
<tr>
<td>PIN 4</td>
<td>Data Terminal Ready (DTR)</td>
</tr>
<tr>
<td>PIN 5</td>
<td>Signal Common (SG)</td>
</tr>
<tr>
<td>PIN 6</td>
<td>Data Set Ready (DSR)</td>
</tr>
<tr>
<td>PIN 7</td>
<td>Request To Send (RTS)</td>
</tr>
<tr>
<td>PIN 8</td>
<td>Clear To Send (CTS)</td>
</tr>
<tr>
<td>PIN 9</td>
<td>+5V</td>
</tr>
</tbody>
</table>

Figures 7-1, 7-2 and 7-3 show three examples of Communication Interfaces. The first two show interface connections required for RS-232 devices. Figure 7-3 shows a multi-axis Hand Held Terminal interface example (the Hand Held Terminal is described in Chapter 5).

The daisy chain configuration can be used for up to 30 Unidex 1s. When adding more units, repeat Unidex 1 connections as shown in Figures 7-2 and 7-3.
NOTE: RS-232C Interface cable must be shielded

Figure 7-1: Single-Axis RS-232C Interface
Figure 7-2: Multi-Axis (Daisy Chain) RS-232C Interface

NOTE: RS-232C Interface
cable must be shielded
Figure 7-3: Multi-Axis (Daisy Chain) Hand Held Terminal Interface

NOTE: RS-232C Interface cable must be shielded
SECTION 7-2 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 the Unidx 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. Unidx 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. Unidx 1 may be set up for ODD or EVEN or DISABLED parity.

Unidx 1 defaults to the following values upon power-up if there is no battery backed 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, Unidx 1 must be put in the Set-up Mode as described in Chapter 5.
SECTION 7-3 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 5. (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 7-4 TYPES OF COMMANDS

Commands sent to Unidex 1 via the Computer Interface may be classified into two types, System commands and Program commands. Subsection 7-4-1 and 7-4-2 provide a summary of these two command sets.

7-4-1 SYSTEM COMMANDS

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

>>nn<CR> : Activate RS-232C interface (where "nn" = device address)
A nn<CR> : 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 >
I (string)* < CR > : Execute program block (string) in the Immediate mode ("string" 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

NOTE: The line feed < LF > is optional and is not required to execute any command.
7-4-2 SYSTEM COMMANDS

* or / : End of block (terminates the block commands listed below)

XF ffffff Dvdddddddddd * (see note 1)
  : X axis move at feedrate ffffff steps/sec a distance of
    ddddddddddd steps, CW (v = " + ") or CCW (v = " - ")

XF ffffff Rv * : X axis free run at feedrate ffffff steps/sec, CW (v = " + ")
  or CCW (v = " - ")

DW nnn.n * : Dwell nnn.n seconds

HX * : 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 11XXX * (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 ddddddddddd * (see note 2)
    : Load positive limit with ddddddddddd
LM ddddddddddd * (see note 2)
    : Load minus limit with ddddddddddd
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 Unidx 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 the 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 7-7.

**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 7-8.

**SECTION 7-5 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:

<table>
<thead>
<tr>
<th>BIT 0</th>
<th>BIT 1</th>
<th>BIT 2</th>
<th>BIT 3</th>
<th>BIT 4</th>
<th>BIT 5</th>
<th>BIT 6</th>
<th>BIT 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incre</td>
<td>Not r</td>
<td>Block</td>
<td>(Not</td>
<td>Commu</td>
<td>Inact</td>
<td>No s</td>
<td>No e</td>
</tr>
<tr>
<td>mental mode</td>
<td>unning a program</td>
<td>run mode</td>
<td>not used</td>
<td>cation disabled</td>
<td>inactive - not executing a command in immediate mode</td>
<td>service request signal sent</td>
<td>errors detected</td>
</tr>
<tr>
<td>Absolute mode</td>
<td>Running a program</td>
<td>Auto run mode</td>
<td>(Not used)</td>
<td>Communication enabled</td>
<td>Active - executing a command in immediate mode</td>
<td>Service request signal sent, waiting for Q</td>
<td>Error detected</td>
</tr>
</tbody>
</table>
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.)
SECTION 7-6 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 7-5). 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 the Unidex 1. They are described as follows:

BYTE 1 Same as Serial poll status byte described in Section 7-5.

BYTE 2 Editor Error Status

<table>
<thead>
<tr>
<th>ZERO</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 0</td>
<td>No illegal character during download</td>
</tr>
<tr>
<td>BIT 1</td>
<td>Memory not full during download</td>
</tr>
<tr>
<td>BIT 2</td>
<td>No user memory checksum error</td>
</tr>
<tr>
<td>BIT 3</td>
<td>No command format error</td>
</tr>
<tr>
<td>BIT 4</td>
<td>No memory repair</td>
</tr>
<tr>
<td>BIT 5 - 7</td>
<td>Not used</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>ZERO</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 0  Axis not in hardware limit</td>
<td>Axis in hardware limit</td>
</tr>
<tr>
<td>BIT 1  No axis software limit</td>
<td>Axis software limit</td>
</tr>
<tr>
<td>BIT 2  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 3  No illegal program exit</td>
<td>Illegal program exit</td>
</tr>
<tr>
<td>BIT 4  No illegal byte in memory</td>
<td>Illegal byte in memory</td>
</tr>
<tr>
<td>BIT 5  Program number valid</td>
<td>Invalid program called out for run (does not exist)</td>
</tr>
<tr>
<td>BIT 6  Memory not clear</td>
<td>No programs in memory (memory clear)</td>
</tr>
<tr>
<td>BIT 7  No user memory checksum error</td>
<td>User memory checksum error</td>
</tr>
</tbody>
</table>

### BYTE 4  Run Time  Error Status 2

<table>
<thead>
<tr>
<th>ZERO</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 0  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 1  No &quot;Repeat Loop End Invalid&quot; error</td>
<td>&quot;Repeat Loop End&quot; error (no Repeat Loop Start command)</td>
</tr>
<tr>
<td>BIT 2  No &quot;Repeat Loop Incomplete&quot; error</td>
<td>Repeat loop incomplete (no repeat loop end command)</td>
</tr>
<tr>
<td>BIT 3  Eight nested repeat loops not exceeded</td>
<td>Eight nested repeat loops exceeded</td>
</tr>
<tr>
<td>BIT 4  No &quot;Return from Subroutine Invalid&quot; error</td>
<td>&quot;Return from Subroutine&quot; invalid (no GoSub command)</td>
</tr>
<tr>
<td>BIT 5  No &quot;Incomplete subroutine&quot; error</td>
<td>Incomplete subroutine (no Sub Return command)</td>
</tr>
<tr>
<td>BIT 6  Eight nested subroutines not exceeded</td>
<td>Eight nested subroutines exceeded</td>
</tr>
<tr>
<td>BIT 7  No &quot;Missing Label&quot; error</td>
<td>Missing label</td>
</tr>
</tbody>
</table>
### BYTE 5  Communication Status 1

<table>
<thead>
<tr>
<th>ZERO</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 0  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 1  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 2  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 3  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 4  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 5  No Serial Poll initiated</td>
<td>Serial poll initiated by sending Q. Wait</td>
</tr>
<tr>
<td>BIT 6  Not in SRQ mode</td>
<td>In SRQ mode</td>
</tr>
<tr>
<td>BIT 7  Not in Hold mode</td>
<td>In Hold mode</td>
</tr>
</tbody>
</table>

### BYTE 6  Communication Status 2

<table>
<thead>
<tr>
<th>ZERO</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 0  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 1  Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>BIT 2  In Hold mode, but no Trigger command received</td>
<td>In Hold mode, and Trigger command received</td>
</tr>
<tr>
<td>BIT 3  Unidex 1 &quot;receive buffer&quot; not full</td>
<td>Unidex 1 &quot;receive buffer&quot; full</td>
</tr>
<tr>
<td>BIT 4  X on received during transmit</td>
<td>X off received during transmit</td>
</tr>
<tr>
<td>BIT 5  Not in program download mode</td>
<td>In program download mode</td>
</tr>
<tr>
<td>BIT 6  Status bytes printed in binary format</td>
<td>Status bytes printed in Hex-ASCII format</td>
</tr>
<tr>
<td>BIT 7  Not used</td>
<td></td>
</tr>
</tbody>
</table>
### BYTE 7  Axis Motion Status

<table>
<thead>
<tr>
<th>BIT 0</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>X axis not moving</td>
<td>X axis moving</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 1 to BIT 7</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not used</td>
<td>Not used</td>
</tr>
</tbody>
</table>

### BYTE 8  Free Run Mode Status

<table>
<thead>
<tr>
<th>BIT 0</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>X axis not in free run mode</td>
<td>X axis in free run mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 1 to BIT 7</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not used</td>
<td>Not used</td>
</tr>
</tbody>
</table>

### BYTE 9  I/O Status

<table>
<thead>
<tr>
<th>BIT 0</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 1 is a 0 (I1)</td>
<td>Input 1 is a 1 (I1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 1</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 2 is a 0 (I2)</td>
<td>Input 2 is a 1 (I2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 2</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 3 is a 0 (I3)</td>
<td>Input 3 is a 1 (I3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 3</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 4 is a 0 (I4)</td>
<td>Input 4 is a 1 (I4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 4</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 1 is a 0 (O1)</td>
<td>Output 1 is a 1 (O1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 5</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 2 is a 0 (O2)</td>
<td>Output 2 is a 1 (O2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 6</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 3 is a 0 (O3)</td>
<td>Output 3 is a 1 (O3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIT 7</th>
<th>ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 4 is a 0 (O4)</td>
<td>Output 4 is a 1 (O4)</td>
</tr>
</tbody>
</table>
SECTION 7-7 SYSTEM COMMANDS

System commands interact with the Unidex 1 and perform operations such as resetting the 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 the Unidex 1. Each system command must be entered as an upper case letter.

7-7-1 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>

A non-activated Unidex 1 will echo back > >01 <CR>.

7-7-2 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 7-5), 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.
7-7-3 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*.

7-7-4 REMOTE RESET

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

C < CR >

This stops 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.
7-7-5 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.

7-7-6 DOWNLOADING A PROGRAM FROM HOST
The E command, followed by a program number ("nn") and an end-of-block character (* or /), will put the 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 the 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.

7-7-7 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 *)

7-7-8 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.

7-7-9 BLOCK NUMBERING
If it is desired that the programs be printed with block numbers, send F <CR>.
Block numbering may make editing the program easier.

After this command is sent to the Unidex 1, any program printed will contain block numbers.
7-7-10 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 Unidx 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 7-2).

7-7-11 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 Unidx 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. Unidx 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)

7-7-12 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 7-8.) 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, Unidx 1 will send a Service Request and wait for a Serial Poll after the command is executed. After being polled, Unidx 1 is ready to execute another block of commands.
7-7-13 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> <LF> under conditions described in Section 7-5. 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 7-5.

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.

7-7-14 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.)

7-7-15 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.

7-7-16 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.

7-7-17 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).
7-7-18 PRINT AXIS POSITION

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> <LF>

Positive Negative

7-7-19 PRINTING DIRECTORY LISTING

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

Following the Directory listing a <CTRL> C (ETX) (Hex 03) is sent to signify the end of the file.

7-7-20 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.

Following the Directory listing a <CTRL> C, (ETX, Hex 03) is sent to signify the end of the file.

7-7-21 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.

Following the printing of all programs a <CTRL> C, (ETX, Hex 03) is sent to signify the end of all programs.

7-7-22 PRINTING STATUS BYTES

To print the status bytes listed in Section 7-6, send PS <CR>.
The return will terminate with a <CR> <LF>.

UNINDEX 1 MOTION CONTROLLER

AEROTECH, INC.
7-7-23 PRINTING VERSION OF SOFTWARE
To print the version of software that you 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)

The return will terminate with a <CR> <LF>.

7-7-24 QUERY (SERIAL POLL)
The host device may Serial Poll (Query) Unidx 1 by sending Q <CR>. In response to a query, Unidx 1 returns its status (see Section 7-5).

The return will terminate with a <CR> <LF>.

7-7-25 REMOTE MODE
The system command R <CR> will enable Unidx 1 to be driven via the auxiliary clock and direction controls. The host controller may then signal an external device to take control of Unidx 1. (See Section 2-7.) The Unidx 1 keeps track of the axis position during external control.

7-7-26 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 Unidx 1s.

7-7-27 RESETTING UNIDEX 1
To Reset Unidx 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 Unidx 1. Any of these resets will return the Unidx 1 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.

NOTE: Sending the <CTRL>D command will cause the <CTRL>D to be echoed back.
A 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.

### 7-7-28 XON/XOFF TRANSMISSION PROTOCOL

The XON/XOFF protocol regulates the transfer of information between two devices. This is required for 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.

The 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 the 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 7-8 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.

#### 7-8-1 END OF BLOCK

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

\[
\text{X F10000 D150000 * (or /)}
\]

#### 7-8-2 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:

\[ X \text{ F10000 D-150000} \]

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. Thereafter, the feedrate need be entered only if it is to be changed.

### 7-8-2-1 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:

\[ X \text{ F10000 R+} \]

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

### 7-8-3 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:

\[ \text{DW 10} \]
\[ \text{DW 1.0} \]

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

### 7-8-4 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.
7-8-5 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.

7-8-6 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 2-7 for Input signal specifications.)

7-8-7 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 2-7 for output signal specifications.)
7-8-8 OUT/RUN

To output values when the program run is permitted to continue, release the feed-
hold 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 permitted to continue, the outputs
will remain unchanged (all have been programmed as "don't care").

7-8-9 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 indicates it will
repeat 8 times. A maximum of eight nested loop commands are permitted. An un-
limited number of un-nested loop commands are permitted.

7-8-10 REPEAT LOOP END

To mark the end of the repeat loop (see above subsection), program command
RE *.

Repeat loops may be nested eight levels deep.

7-8-11 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 fol-
low: I1 is a 1, I2 is a 0. I3 and I4 are "don't cares" and have no control over the pro-
gram block.
7-8-12 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 *

7-8-13 STOP AXIS FREE RUN
To stop the axis free run, program SX *.

7-8-14 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.

7-8-15 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 an Index block with distance values equal to the reference position while in the Absolute mode.

7-8-16 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.

7-8-17 LABEL (LB)
A label (1 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 *

7-8-18 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.

7-8-19 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.

7-8-20 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.
7-8-21 PROGRAM STOP
The Program Stop command marks the place in the program at which program execution ends. Subroutines should be placed after the PS * block.

7-8-22 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.

7-8-23 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 the 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.

7-8-24 REMOTE MODE
The command to send the 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.
7-8-25 ACCELERATION/DECELERATION RAMP TIME
The Accel/Decel ramp time can be programmed in milliseconds by using 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 8.)

7-8-26 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.

7-8-27 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).
7-8-28 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 the missing of interrupts.

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

7-8-29 DISABLE INTERRUPT
This command will Disable Interrupts, if already enabled. The DI * command disables the interrupt.

7-8-30 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.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index, Home:</strong></td>
<td>Interrupt will branch to a block while motion is 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.</td>
</tr>
<tr>
<td><strong>Dwell:</strong></td>
<td>Dwell is terminated.</td>
</tr>
<tr>
<td><strong>Wait on Input:</strong></td>
<td>Wait on Input is terminated. Program will return to next block.</td>
</tr>
<tr>
<td><strong>Remote on Input:</strong></td>
<td>Remote is terminated.</td>
</tr>
</tbody>
</table>

**7-8-31 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.
7-8-32 SET POSITIVE LIMIT
To load the Positive Limit Absolute Position Register, enter the 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.

7-8-33 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.
7-8-34 ENABLE POSITIVE LIMIT

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

\[ \text{EP *} \]

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 \textbf{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.

7-8-35 ENABLE MINUS LIMIT

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

\[ \text{EM *} \]

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.
7-8-36 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.

7-8-37 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.

7-8-38 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.

7-8-39 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.
7-8-40 END EDIT

The character that is placed at the end of a downloadable file is the percent sign (%). The end-of-block character is not needed with this command.

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

7-8-41 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 7-9 COMPUTER INTERFACE COMMANDS

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

Example Immediate Commands

```plaintext
>> < 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 the 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.
CHAPTER 8: 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 established the desired ramp time, start/stop feedrate and the profile for acceleration/deceleration (linear or parabolic), (see Chapter 5) 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 means 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.) If the Accel/Decel ramp time is changed during program control, that value becomes the new modal Accel/Decel parameter.

SECTION 8-1 MANUAL PROGRAMMING OF RAMP TIME

Acceleration and Deceleration parameters are programmed in the Set Up mode (Chapter 5). (See Chapter 6 for the Hand Held terminal operation and Chapter 7 for the Computer Interface operation.)

A required ramp time may be pre-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 8-2 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 (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 8-5). 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 8-3 ACCEL/DECEL PROFILE SET UP

The Accel/Decel profile is set up as Linear or Parabolic, from the Set Up mode (Chapter 5).

SECTION 8-4 RAMP TIME PROGRAMMING WITHIN PROGRAM

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

\[ \text{AD nnnn} \ast \]

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 8-5 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 8-6 ACCEL/DECEL IN OPERATION

Acceleration and deceleration velocity profiles in Unindex 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., 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 provides an illustration:

<table>
<thead>
<tr>
<th>RAMP TIME</th>
<th>NUMBER OF UPDATES</th>
<th>UPDATE INTERVALS (mS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>250</td>
<td>20.0</td>
</tr>
<tr>
<td>400</td>
<td>250</td>
<td>1.6</td>
</tr>
<tr>
<td>200</td>
<td>125</td>
<td>1.6</td>
</tr>
<tr>
<td>80</td>
<td>50</td>
<td>1.6</td>
</tr>
<tr>
<td>30</td>
<td>No Accel/Decel</td>
<td></td>
</tr>
</tbody>
</table>

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:

**Linear**

\[ F_n = \left( \frac{F_p}{N} \right) * n \quad n < N \]

\[ F_n = F_p \quad n = N \]

**Parabolic**

\[ F_n = \left( \frac{F_p}{N} \right) * n \left( 2 - \frac{n}{N} \right) \quad n < N \]

\[ F_n = F_p \quad n = N \]

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.

Figures 8-1 and 8-2 prove examples of linear and parabolic ramping in both full and truncated profiling modes.
Figure 8-1: Full Ramp Profiles for Linear and Parabolic Ramping
Figure 8-2: Truncated Ramp Profiles for Linear and Parabolic Ramping
SECTION 8-7 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 Indexer’s clock pulses 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 configure 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:

\[
\text{Feedrate Attained (FN)} = \frac{62500}{250} \times [250 - ((200-250)^{\frac{2}{250}})] \\
= 62500/250 \times 240 \\
= 60000 \text{ steps/sec.}
\]
SECTION 8-8 OTHER LIMITATIONS

Accel/Decel control in Unidex 1 is implemented with individual hardware VCO (V-Voltage Control Oscillator) circuitry. Hardware VCOs are used because of the need for feeding back electronic damping control signals from the Aerotech Stepping Translators when the Unidex 1 is used to control Stepping Motor systems. Since these VCOs are analog drivers, and operate asynchronously with respect to the indexing circuitry of Unidex 1, the actual programmed velocity when running in the Accel/Decel mode may be off as much as 5%.

This limitation is not considered a flaw in Unidex 1 performance, since the basic design criterion is one of point to point motion control.
CHAPTER 9: APPLICATION PROGRAM

This section provides a sample program (Figure 9-2) to demonstrate some of the programming capabilities of the Unidex 1. Also included is an Application Summary and a Flow Chart (Figure 9-1).

Review Section 7-8 for a description of commands listed in Figure 9-2.

SECTION 9-1 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) 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, if the fault remains, 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 9-1: Flow Chart of Example Program Shown In Figure 9-2
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
XD 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
XD 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

---

Figure 9-2: Example Program for Unidex 1

(1) Product sensor
(2) Inspection system
(3) Fault processor
(4) Ejector
(5) Stage
(6) Indicator
Troubleshooting the Unidex 1 consists of reviewing the check list of possible software and hardware (Sections 10-1 and 10-2) malfunctions and performing the suggested solutions. Error codes, for the RS-232 Computer Interface mode, are listed in Section 7-6. For the Hand Held terminal mode, they are listed in Section 6-1.

**WARNING:** Customer troubleshooting and repair must be limited to the procedures of Section 10-1 and 10-2. Any attempt to repair the electronics without the supervision of an Aerotech trained field representative may void the warranty.
SECTION 10-1 SOFTWARE MALFUNCTIONS, STATUSES

10-1-1: POWER UP

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Possible Cause And Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>System check fail: User memory checksum error. (Status Byte 2, Bit 4) *</td>
<td>A check sum verification is performed on the RAM upon power up. At 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.</td>
</tr>
</tbody>
</table>

* Information in parentheses is status-code polling, associated with the Computer Interface mode (Chapter 7). Status code descriptions are polling-associated with the Hand Held terminal mode (Chapter 6).
### 10-1-2: PROGRAM EDITING

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Possible Cause And Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blk Not saved, Mem full. (Status byte 2, bit 1)</td>
<td>If an attempt is made to enter an additional block of statements after an End of Memory warning is encountered, and the block size is larger than the available remaining memory space, a &quot;Block not saved&quot; 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.</td>
</tr>
<tr>
<td>Memory Altered. (Status byte 2, bit 4)</td>
<td>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 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 &quot;locking up&quot; if a faulty program is executed.</td>
</tr>
</tbody>
</table>
10-1-2: PROGRAM EDITING (con’t)

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.

10-1-3: RUN MODE

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Possible Cause And Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illegal byte in memory. (Status byte 3, bit 4)</td>
<td>If, during manual or program execution, a user memory byte cannot be identified by the Unidx 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 the Power Up and Editing Mode. These mechanisms &quot;scan&quot; the entire user memory before execution takes place.</td>
</tr>
<tr>
<td>Exceeded 8 repeat loops. (Status byte 4, bit 3)</td>
<td>The Unidx 1 Programming Mode allows only a maximum of eight &quot;nested&quot; 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. Remember, an unlimited amount of unnested repeat loops are permitted. The &quot;Exceeded 8 Repeat Loops&quot; error is detected during program execution.</td>
</tr>
</tbody>
</table>
10-1-3: RUN MODE (con't)

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.

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 overload exists if the level of subroutine nesting exceeds eight levels.
### 10-1-3: RUN MODE (con't)

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Possible Cause And Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid return-from-sub. (Status byte 4, bit 4)</td>
<td>This status declares that a &quot;Subroutine Return&quot; statement exists without a corresponding &quot;GoSub&quot; statement. This error is detected during program execution.</td>
</tr>
<tr>
<td>No programs in memory. (Status byte 3, bit 6)</td>
<td>This status declares that no programs exist in user memory as indicated by the directory command.</td>
</tr>
<tr>
<td>Invalid program #: (Status byte 3, bit 5)</td>
<td>This status declares that a specific program number does not exist in user memory or it cannot be used for the requested function.</td>
</tr>
<tr>
<td>Axis in limit. (Status byte 3, bit 0)</td>
<td>If a CW or CCW limit is encountered during manual, block or auto run modes, an &quot;Axis in Limit&quot; status will occur. Motion will be stopped and program execution will be terminated.</td>
</tr>
<tr>
<td>Illegal Program Exit. (Status byte 3, bit 3)</td>
<td>This status declares that a program has been exited during an Index or Home operation. (The move is stopped when the program is exited.)</td>
</tr>
<tr>
<td>Program Limit. (Status byte 3, bit 1)</td>
<td>A program limit has occurred during program execution. Program has been terminated and axis has stopped.</td>
</tr>
</tbody>
</table>
## SECTION 10-2 HARDWARE MALFUNCTIONS

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause And Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Reset&quot; LED blinks ON and OFF after power is applied.</td>
<td>A system RAM Read/Write error caused by a memory byte failure somewhere within the 8K RAM chip of the Unidex 1 control board. On power up, Unidex 1 checks all byte locations of the RAM by writing a value back for verification. The user area (program area) is not tested.</td>
</tr>
<tr>
<td>&quot;Reset&quot; LED stays on continuously after power is applied.</td>
<td>Input AC voltage supplies are below minimum operating level (see Table 1-2). Short circuit condition in Stepping Motor wiring (see Chapter 2).</td>
</tr>
</tbody>
</table>
SERVICE AND REPAIR

Customer repair of the equipment is limited. Control Board(s) may be removed and replaced if necessary, however, component level repair must not be attempted.

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

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 Aerotech. (Be prepared to give the serial number of the equipment being returned.)

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 equipment to the factory.

WARNING: DAMAGE TO THE EQUIPMENT DUE TO IMPROPER PACKAGING MAY VOID WARRANTY!
Aerotech Sales and Service offices are listed below. For service and information, contact the office servicing your area.

AEROTECH, INC. SALES OFFICES

WORLD HEADQUARTERS
AEROTECH, INC.
101 Zeta Drive
Pittsburgh, Pa. 15238

AEROTECH, LTD.
Aldermaston
Berkshire RG7 4QW, England

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

Phone (07356) 77274
TLX 847228
FAX (07356) 5022

AEROTECH GMBH
Neumeyerstrasse 90
8500 Nuernberg 10
West Germany

Phone (0911) 521031
TLX 622474
FAX (0911) 521235
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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 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 warranted 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.