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THE UNIDEX® 31/U600 USER'S MANUAL

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AEROTECH, Inc. • 101 Zeta Drive • Pittsburgh, PA. 15238-2897 • USA
Phone (412) 963-7470 • Fax (412) 963-7459
Product Service: (412) 967-6440; (412) 967-6870 (Fax)

www.aerotechinc.com

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PREFACE

This section gives you an overview of topics covered in each of the sections of this manual as well as conventions used in this manual. The UNIDEX 31/UNIDEX 600 User's Manual contains information on the following topics:

CHAPTER 1: INTRODUCTION

This chapter contains an introduction to the U31/U600 Motion Controller as well as documentation references and a list of options and accessories. This chapter also contains precautionary notes about installing and using the U31/U600 system.

CHAPTER 2: GETTING STARTED

This chapter contains a brief overview of information intended to familiarize you with how the U31/U600 system may be used. This chapter also contains information about the initialization process, initial setup and system verification.

CHAPTER 3: THE MAIN SCREEN

This chapter discusses the opening screen of the "MAINMENU" software application program. Screen components, conventions and an overview of menu options are discussed.

CHAPTER 4: THE PASSWORD MENU

This chapter discusses the optional password menu and provides a complete list of all related menu options that are provided through the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu. If the U31/U600 is ordered without the password option, then this section may be ignored.

CHAPTER 5: THE SETUP MENU

This chapter discusses the setup menu and provides a complete list of all related menu options that are provided through the Setup menu option of the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu.

CHAPTER 6: THE DIAGNOSTICS MENU

This chapter discusses the diagnostics menu and provides a complete list of all related menu options that are provided through the Diagnostics option of the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu.

CHAPTER 7: THE RUN SCREEN

This chapter discusses the run screen and provides a complete list of all related menu options that available through the run screen. Sample screens are illustrated for all menu options.

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CHAPTER 8: THE MANUAL OPERATION MENU

This chapter discusses the manual operation menu and provides a complete list of all related menu options that are provided through the Manual option of the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu.

CHAPTER 9: TEACH PENDANT

This chapter discusses the use, setup, and operation of the teach pendant. A brief description of the accessories and their functions is also given.

CHAPTER 10: THE PARTS PROGRAM EDITOR

This chapter discusses the parts program editor and provides a complete list of all related menu options for the editor. Sample screens are illustrated for all menu options.

CHAPTER 11: THE VIEW MENU

This chapter discusses the view menu and provides a complete list of all related menu options that are provided through the View option of the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu.

CHAPTER 12: THE COMMUNICATIONS MENU

This chapter discusses the communications menu and provides a complete list of all related menu options that are provided through the Communications option of the "MAINMENU" software application program. Sample screens are illustrated for all options of this menu.

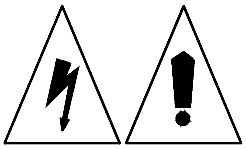
APPENDIX A: WARRANTY and FIELD SERVICE

Appendix A contains the warranty and field service policy for Aerotech products.

APPENDIX B: OPTIONAL OPTIONS

Contains information on two optional options available on the System Option screen.

Throughout this manual the following conventions are used:



- The terms UNIDEX 31/U600 and U31/U600 are used interchangeably throughout this manual
- Danger and/or Warning symbols (see left) appear in the outer margins next to important precautions. Failure to observe these precautions could result in serious injury and/or damage to the equipment.
- Keys such as Shift, Ctrl, Alt and Enter are enclosed in brackets (e.g., <Shift>, <Ctrl>, <Alt> and <Enter>) to distinguish them from individual keystrokes.
- Hexadecimal numbers are listed using a preceding "0x" (for example, 0x300, 0x12F, 0x01EA, etc.,) to distinguish them from decimal numbers.
- The terms <Enter> and <Return> are used interchangeably throughout this document when referring to the keyboard.
- This manual uses the symbol "∇ ∇ ∇" to indicate the end of a chapter.
- Function keys are denoted as [F1], [F2], etc.

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CHAPTER 1: INTRODUCTION

In This Section:

- System Overview 1-1
- Options and Accessories 1-2
- Documentation References 1-2
- Safety Procedures and Warnings 1-3

1.1. System Overview

The UNIDEX 31/U600 is a 16-axis machine controller that is designed to provide high-performance control for special machine applications where standard computerized numerical control (CNC) and robotic controls are inadequate. The U31/U600 hardware consists of four VME plug-in modules (a 486-based main computer with 8 MB of RAM, an 80960 RISC-based axis servo processor, a mass storage module including a 40 MB hard drive and a 3.5" floppy drive, and a 250 watt power supply), a drive output module and a position feedback module that are all supplied in a rugged chassis. The U31/U600 software package consists of the OS/2 operating system plus an extensive library of over 350 motion , control, communications and I/O functions providing flexibility and customized, application-specific programming. The U31/U600 system provides outstanding performance in a wide variety of demanding applications that require capabilities such as:

- Synchronous coordination of many axes
- High-speed, complex shape generation
- Simultaneous control and data acquisition
- Control of multiple processes or multiple machines
- Integration of third-party hardware/software into a control process.

The U31/U600 hardware chassis is illustrated below in Figure 1-1.

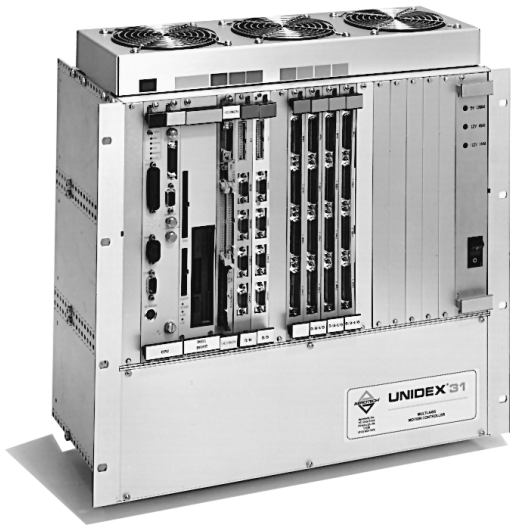


Figure 1-1. The UNIDEX 31/U600 Hardware Chassis

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1.2. Options and Accessories

The UNIDEX 31/U600 system has several standard and optional accessories to complement its operation. A list of the most common options and accessories is shown in Table 1-1. For descriptions and details of these hardware options and accessories, please refer to the UNIDEX 31/U600 Hardware Manual (part number EDU121).

Table 1-1. Hardware Options/Accessories for the UNIDEX 31/U600 Machine Controller

Option/Accessory Description	Part Number
Four-channel Encoder Interface Module	4EN
Four-channel Resolver Interface Module	4RD
Four-channel Axis Drive Interface Module	4DA
Analog I/O Interface Card	8AD
Digital I/O Interface Card	32IO
Modicon I/O Interface Module	MOD-A, MOD-V
Resolver, Encoder and Drive Wiring Modules	RDW, EDW, DAW
Laser Firing Board Option	PSO
Teach Pendant	TEA

1.3. Documentation References

Technical documentation for the UNIDEX 31/U600 system is divided into three basic manuals: The U31/U600 Hardware Manual (EDU121), the U31/U600 Programming Manual (EDU152) and the U31/U600 User's Manual (this manual) (EDU138). Refer to the appropriate manuals for questions concerning hardware, programming or general operation. In addition to the three basic manuals, the U31/U600 System Utilities Manual (EDU145) is also available to describe software utility programs PLOT, STATUS and DEBUG960.

This document describes the "MAINMENU" application software package that is provided with the UNIDEX 31/U600 integrated motion controller. The various features of the "MAINMENU" software are described in this manual, in addition to descriptions of how to accomplish various tasks. This document assumes that you have some familiarity with the following concepts:

- Operating System 2, Version 2.0 or newer (OS/2)
- Computerized Numerical Controls (CNC)
- UNIDEX 31/U600 integrated motion controller (U31/U600).

The "MAINMENU" software is actually a subset of the complete software structure of the U31/U600 package. The complete software structure of the U31/U600 machine controller is illustrated in Figure 1-2. The "MAINMENU" application program is described in detail in subsequent chapters of this manual.

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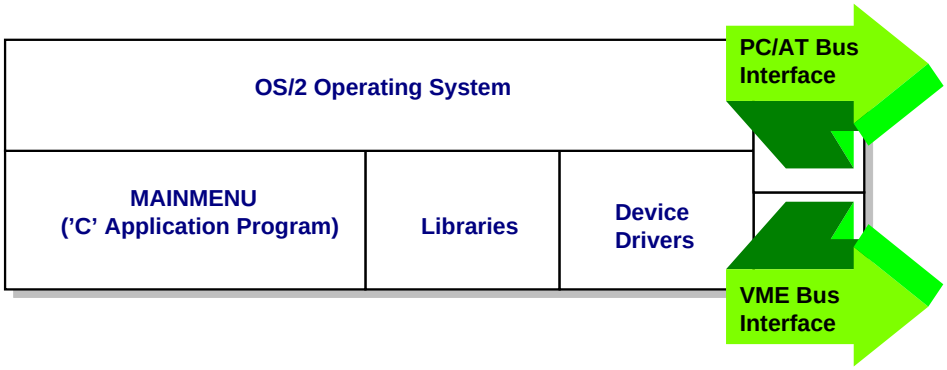


Figure 1-2. The Software Structure for the U31/U600 Machine Controller

1.4. Safety Procedures and Warnings

The following statements apply wherever the Warning or Danger symbol appears within this manual. Failure to observe these precautions could result in serious injury to those performing the procedures and/or damage to the equipment.

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



To minimize the possibility of electrical shock and bodily injury when any electrical circuit is in use, ensure that no person comes in contact with the circuitry.



When this controller is installed within a system, mechanical motion will occur. Care must be exercised that all personnel remain clear of any moving parts.



To minimize the possibility of bodily injury, make certain that all electrical power switches are in the off position prior to making any mechanical adjustments.



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CHAPTER 2: GETTING STARTED

In This Section:

- Operation Overview 2-1
- Initialization Process 2-1
- Initial Setup 2-3

2.1. Operation Overview

The "MAINMENU" application provides a graphical user interface (GUI) to the UNIDEX 31/U600 integrated motion controller. It provides a user friendly method of performing functions such as specifying the characteristics of the machine, performing diagnostics, manually jogging axes, and editing/running parts programs. The interaction mechanisms, used by the UNIDEX 31/U600, conform with the *Common User Access Guide to User Interface Design* provided by IBM with version 2.1 of OS/2. This manual notes any deviation from this specification on an individual basis.

2.2. Initialization Process

Once an operator invokes "MAINMENU", the UNIDEX 31/U600 performs a series of initialization processes that permit communication and synchronization with the axis processor. These initializations include items such as opening the device driver used to communicate with the axis processor, setting up various semaphores (or status flags) within that device driver, and starting threads to monitor these semaphores. The details of these operations are beyond the scope of this document. However, if the initialization is unsuccessful, the UNIDEX 31/U600 displays a System Failure dialog box as shown in Figure 2-1.

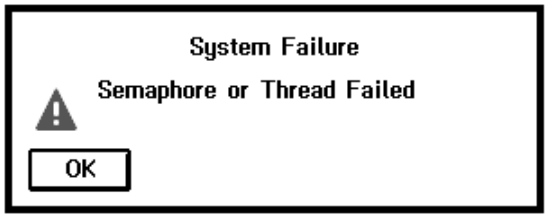


Figure 2-1. System Failure Dialog Box

Once the system establishes communication with the axis processor card, "MAINMENU" polls the card and determines if the firmware is currently executing. If so, the application continues with the next stage of initialization. Otherwise, the system displays a Downloading Axis Firmware dialog box (see Figure 2-2) while the image file (\U31\DMR.IMG) gets transferred to this card.

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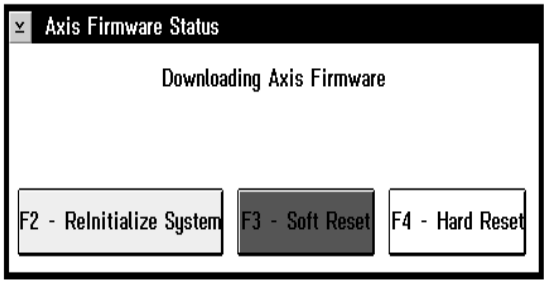


Figure 2-2. Downloading Axis Firmware Dialog Box

In the event that the download fails, the system displays a Downloading Axis Firmware Failure dialog box to notify the user of the error (see Figure 2-3).

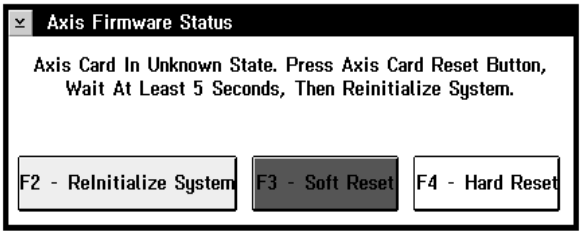


Figure 2-3. Downloading Axis Firmware Failure Dialog Box

Once the system confirms a successfully initialized axis processor card, the application program begins to configure the axis processor as specified in the initialization files. These initialization files are in binary format, and can be modified only by the "MAINMENU" application program.

The initialization process involves the use of several initialization (.INI) files. These files are stored in the \U31\INI subdirectory. The system processes the initialization files in the following order:

- Axis Parameters (AXIS.INI)
- Axis Configuration (CONFIG.INI and CONFIGM.INI)
- Machine Parameters (MACHINE.INI and MACHINE2.INI)
- Axis Correction Tables
- CNC Parameters (CNC.INI)
- Virtual I/O System.

If the system detects an invalid value in any one of the initialization files, a dialog box containing an error message is displayed to notify the user of the type of error that occurred.

Once the system successfully initializes the axis processor, it activates the pull-down menus located in the title bar. You may then select the desired option from these menus.

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The "MAINMENU" application also contains an optional password protected mode of operation. For details on this mode of operation, please refer to the Chapter 4, The Password menu.



2.3. Initial Setup

In most cases, the initial setup of your system will be minimal. The bulk of the setup process is completed at the factory before your system is shipped. Setup information is provided in this section for reference. If you have purchased a complete system from Aerotech, you may want to refer to the system specification sheet that is shipped with your system. This sheet contains important information about your system including maximum speeds, programming and machine resolutions.

2.3.1. Supplying Power to the System

Power is supplied to the UNIDEX 31/U600 using a power cord that is supplied with the controller. The power cord connects to a 15-pin AMP connector located at the top left of the equipment rack. For additional information, refer to the UNIDEX 31/U600 Hardware Manual (part number EDU121).

2.3.2. Getting Started

After unpacking and inspecting your UNIDEX 31/U600 system, connect the keyboard, mouse and monitor to it. UNIDEX 31/U600 will boot the OS/2 operating system and display the OS/2 desktop. Open the UNIDEX 31/U600 folder by double-clicking on it if it's not already open and double click on the "MAINMENU" icon. This will start Aerotech's CNC application, MAINMENU.EXE. The 80960 axis card will be initialized and configured according to the system parameters.

2.3.3. Configuring Axes

To configure axes, select the Configure option of the Setup menu.

If you purchased a complete system from Aerotech, then the system axes have already been configured for you at the factory. System specifications including maximum speeds, machine and program resolutions are found in the documentation package that is included with your system.



Encoder Feedback

Each axis must be configured for the type of motor and feedback device that is present. The axis to be configured may be selected by the scroll bar at the bottom of the screen. Next, select the radio button for the type of primary feedback that is present for the axis and then fill in appropriate parameter values for that feedback type. The two most common feedback devices are encoders and resolvers. Configuration of these feedback devices is discussed below. Configurations of less common feedback devices (including secondary [velocity] and master feedback) are discussed later in this document.

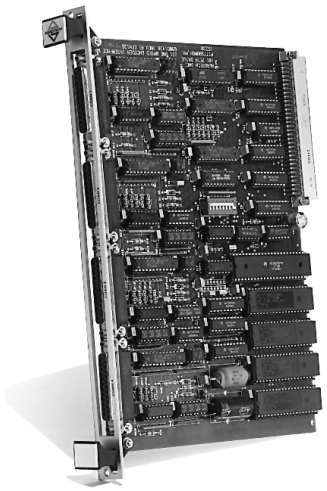
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Selecting the NULL FEEDBACK option gives you the opportunity to perform a dry run of the program. In this case, no motion occurs. Also, the axis command is used as feedback for that channel.

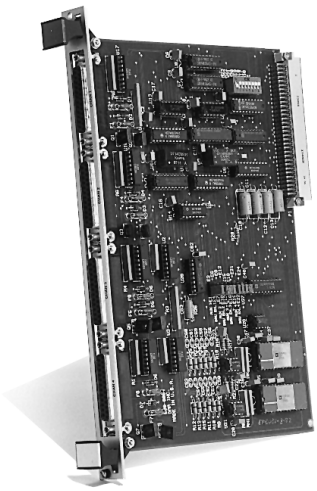
An axis with optical encoder feedback requires a channel number from which it will receive encoder feedback pulses. The valid channel numbers range from 1-16. Each VME encoder card (see Figure 2-4) contains four axis channels labeled 1-4. Note that the labeling is local to each encoder card. On systems with more than four axes of encoder feedback, axes 1-4 are on the leftmost card, axes 5-8 on the next card will follow (but are labeled 1-4), etc.

WARNING

Encoder and D/A cards both use 25-pin, D-style connectors. Be sure to connect cables to the appropriate cards, otherwise damage could result. Encoder cards have an orange tag on the top of the VME card ejector, while D/A cards have a blue tag. Refer to the UNIDEX 31/U600 Hardware Manual (EDU121) for connection information.



4EN Encoder Board (Orange Tag)



4DA Axis Drive Board (Blue Tag)

Figure 2-4. The Encoder Interface and D/A Interface Boards

The number of lines (pulses per revolution) on the encoder is required for system scaling. This is the actual line count of the encoder including the "times 4" multiplication done by the UNIDEX 31/U600 on the feedback pulses.

D/A Converter

For the drive interface, a digital-to-analog (D/A) converter channel number is required. The valid channel numbers range from 1-16. Each VME D/A card (refer to Figure 2-4) contains four axis channels labeled 1-4. Note that channel labeling is local to each D/A card. Axes 1-4 are on the leftmost card, axes 5-8 will follow (but are labeled 1-4), etc.

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Encoder and D/A cards both use 25-pin, D-style connectors. Be sure to connect cables to the appropriate cards, otherwise damage could result. Encoder cards have an orange tag on the top of the VME card ejector, while D/A cards have a blue tag. Refer to the UNIDEX 31/U600 Hardware Manual (EDU121) for connection information.

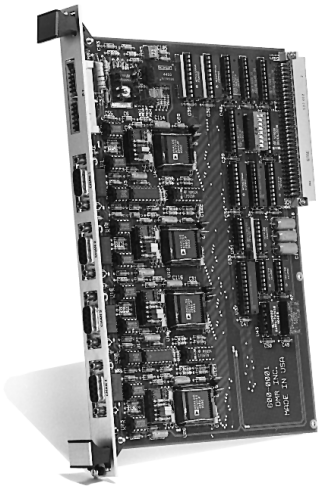


Resolver Feedback

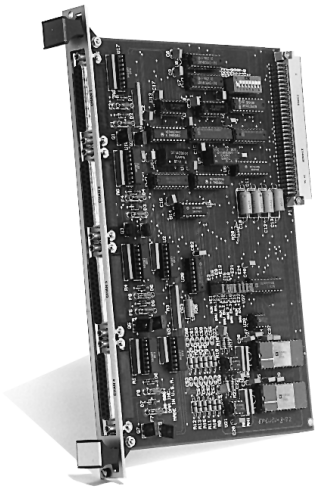
A resolver axis requires a resolver-to-digital (R/D) converter feedback channel. The valid channel numbers range from 1-16. Each VME R/D board (illustrated in Figure 2-5) contains four axis channels. Axes 1-4 are on the leftmost card, axes 5-8 follow (but are labeled 1-4), etc. The desired resolution must be set to 10, 12, 14 or 16. These numbers are powers of 2 (e.g., 2^{10}, 2^{12}, 2^{14} and 2^{16}) which correspond to the number of steps per motor revolution, respectively (e.g., 1924, 4096, 16384 and 65536). Changing this resolution also requires changing a personality module on the R/D board. This module is used to set the band width and maximum tracking rate of the converter.

In addition to entering a resolution for resolver applications, the number of poles for brushless type motors (0 [for DC brushless], 4, 6 or 8, typically) must also be entered so that the motor is properly commutated. An optional commutation offset may be entered to electrically align the resolver to the motor without requiring any mechanical alignment.

Finally, a digital-to-analog (D/A) converter channel number must be assigned to the axis. The valid channel numbers range from 1-16. Each VME D/A card contains four axis channels (therefore, up to four cards). Axes 1-4 are on the leftmost card, axes 5-8 will follow (but are labeled 1-4), etc.



4RD Resolver-to-Digital Board (Green Tag)



4DA Axis Drive Board (Blue Tag)

Figure 2-5. The R/D Interface and D/A Interface Boards

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2.3.4. Machine Parameters



If you purchased a complete system from Aerotech, then the machine parameters have already been configured for you at the factory. System specifications including maximum speeds, machine and program resolutions are found in the documentation package that is included with your system.

Scaling information for each axis is entered in the machine parameter selection found in the setup menu. Scaling is accomplished by setting the appropriate English/Metric radio button for the desired units, and entering the distance moved per motor revolution. This can be entered directly from the pitch (lead) of your drive screw unless there is a gear box being used. In the case of a gear box configuration, you must calculate the actual distance moved from the gear ratio. Note that this number, along with either the Lines/Rev parameter (for encoder axes) or 65,536 lines/rev (for resolver axes) is used to calculate the ratio between machine steps (encoder or resolver counts) and user steps (in or mm).

2.3.5. Assigning Axes to the CNC System and Modal G Code Setup



If you purchased a complete system from Aerotech, then the axis assignments and G code setup have already been configured for you at the factory. System specifications including maximum speeds, machine and program resolutions are found in the documentation package that is included with your system.

The assignment of an axis to a CNC is controlled from the setup menu of the CNC software. Within the setup menu is a selection for CNC parameters. This selection contains a subsection for CNC general parameters and displays the CNC initialization screen. Choose the Axis_Select selection from the menu and click on each axis that is to be associated with this corresponding CNC. Repeat the process once for each CNC using the CNC radio buttons to select.

Modal G codes may have their default values set from within the G codes menu selection. These include absolute/incremental selection, English/Metric mode selection and others.

Optional configurations such as thread cutting and spindle axes are discussed later in this manual (refer to Chapter 5: Setup Menu Options).



Ramp times (or ramp rates) used for contouring operations and min/max feedrates should be set to match the performance capabilities of your system.

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In order for changes in the machine menu screen or CNC screen to take effect, the system must be re-initialized. Please refer to the Diagnostic/Axis Firmware Status menu documentation section in this manual.



2.3.6. Axis Plane Selection

If you purchased a complete system from Aerotech, then axis plane selection has already been configured for you at the factory. System specifications including maximum speeds, machine and program resolutions are found in the documentation package that is included with your system.



An axis may be assigned to a particular plane (X, Y or Z) from within the Plane Initialization selection of the Setup menu's CNC Parameters option. For additional information, refer to Chapter 5: Setup Menu Options.

2.3.7. Axis Testing and Tuning

Your axis configuration may be tested and tuned using options in the axis test section of the Setup menu. Refer to Chapter 5 for more information.

The UNIDEX 31/U600's axes may be enabled/disabled under program control by using the SETPARM command. For example, SETPARM X Y DRIVE 1 can be used to enable both the X and Y axes. Likewise, SETPARM Z DRIVE 0 can be used to disable the Z axis.



2.3.8. Directory and File Structure

In a typical configuration, all files relevant to the operation of the UNIDEX 31/U600 get placed on the disk in the directory \U31 or its subdirectories. The \U31 directory contains the axis processor firmware image (DMR.IMG), the device driver used to communicate with the axis processor (MOTION.SYS), and the MAINMENU.EXE program.

The \U31 directory also contains several subdirectories. These subdirectories (along with their contents) are listed in Table 2-1.

When you run the "MAINMENU" program, certain files are created and placed into the \U31 directory. In some cases, the "MAINMENU" program may create additional subdirectories for other application specific files.



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Table 2-1. Subdirectories of the U31 Software

Subdirectory	Description/Contents
\U31\CORRECT	This is an optional subdirectory that is included only if axis correction/calibration information is supplied by Aerotech.
\U31\DLL	This subdirectory contains the dynamic link libraries (DLLs) used by the utility programs in \U31\UTILITY.
\U31\HELP	This subdirectory contains application help files.
\U31\INI	This subdirectory contains initialization files used by the UNIDEX 31/U600.
\U31\PROGRAMS	This subdirectory is where you store CNC programs that you create.
\U31\UTILITY	This subdirectory contains Aerotech utility programs such as MAINMENU, PLOT, STATUS, and DEBUG960.

2.3.9. Environment Variables

The software directory and file structure discussed in the previous section is a typical configuration for the UNIDEX 31/U600. However, you may choose to modify this directory structure by altering the appropriate OS/2 environment variables found in the CONFIG.SYS file. These environment variables tell the operating system where to look for such things as executable programs, DLL's, and help files. Table 2-2 lists environment variables that you may alter in order to customize the operation of your UNIDEX 31/U600 system. These variables are located in the CONFIG.SYS file.

Table 2-2. U31 Environment Variables Used in Customizing Your System

Environment Variable	Default Variable Setting in the CONFIG.SYS File	Description
PATH	SET PATH=C:\U31;C:\U31\UTILITY	The PATH variable must include the directory paths in which all utility programs and MAINMENU reside.
LIBPATH	SET LIBPATH=C:\U31\DLL	The LIBPATH variable must include the directory path that contains the dynamic link libraries (DLLs) supplied with the utility programs.
HELP	SET HELP=C:\U31\HELP	The HELP variable must include the directory path that contains all U31 help files.
HELPFILES	SET HELPFILES=C:\U31\HELP*.HLP	The HELPFILES variable must include the full path (include filename extension) for all U31 help files.



If your system uses multiple directories for similar information files (e.g., help files are located on C:\U31\HELP and D:\HELP), then you can add multiple entries to your environment variables by separating the entries with a semicolon (for example, SET HELP=C:\U31\HELP;D:\HELP).

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CHAPTER 3: THE MAIN SCREEN

In This Section:

- Introduction 3-1
- Components of the Main Screen..... 3-1
- Using a Mouse..... 3-4
- Alternate Keyboard Commands..... 3-5

3.1. Introduction

The key user interface of the "MAINMENU" software program is the main screen. From this main screen you can access the control, setup and diagnostic functions necessary to operate the UNIDEX 31/U600. The main screen is displayed after you double click on the "MAINMENU" icon on the OS/2 desktop.

3.2. Components of the Main Screen

The main screen of the UNIDEX 31/U600 MAINMENU.EXE software is illustrated in Figure 3-1. In this illustration, the key components of the main screen are identified. These key components are explained in the sections that follow.

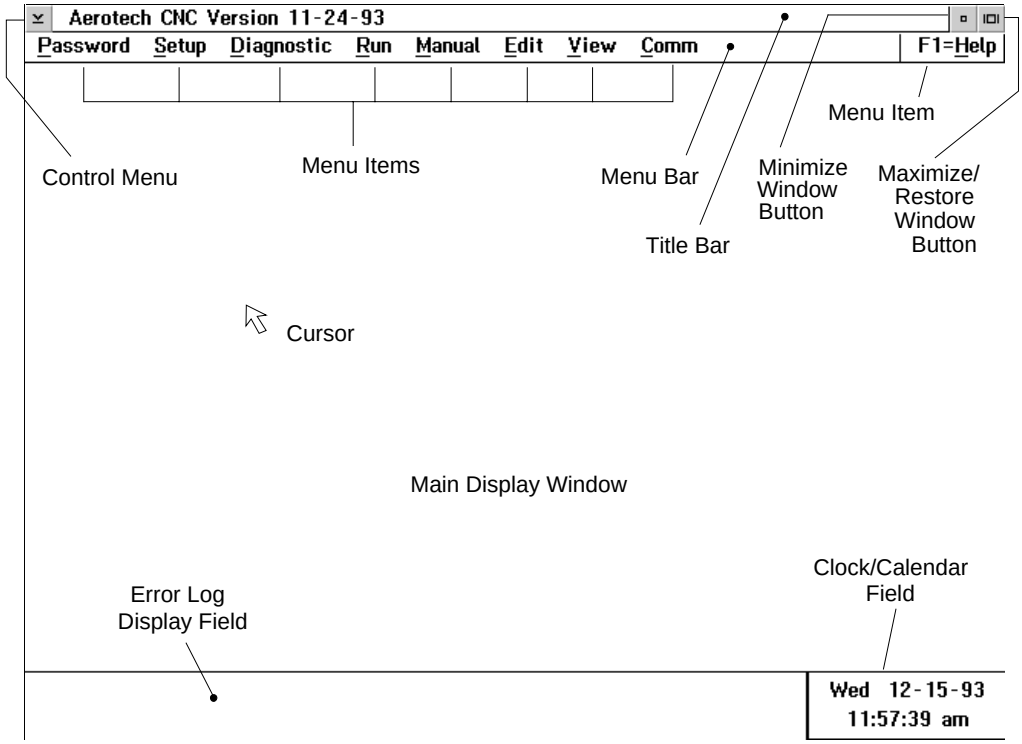


Figure 3-1. Key Components of the MAINMENU Startup Screen

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3.2.1. The Title Bar

The title bar is located at the top of the main display screen. It shows the name of the software that is being used (for example, Aerotech CNC Version as shown in Figure 3-1) and the release date of the software (11-24-93 as shown in Figure 3-1). The version number in your display may differ than the version number shown in Figure 3-1.

3.2.2. The Control Menu

The control menu is a pull-down menu that contains window control functions. To display the selections available in the control menu, you must click the left mouse button after selecting the control menu icon. This icon appears as a small arrow ( ) in the upper left corner of the main screen.

The control menu's pull-down menu contains the following options: Restore, Move, Size, Minimize, Maximize, Hide, Close and Window List. These functions are explained briefly in Table 3-1. This table also contains a list of the alternate keyboard commands associated with each menu option.

Table 3-1. Control Menu Options

Control Menu Option	Keyboard Commands	Description / Function
Restore	+	Restore is used to restore the maximized window or an icon to its original size after you have changed it
Move	+	Move is used to reposition the software window to a different location on the screen using the arrow keys (rather than using the mouse).
Size	+	Size is used to change the size of the display window.
Minimize	+	Minimize is used to change the software window to an icon on the screen.
Maximize	+	Maximize is used to change the size of the software window to its maximum size.
Hide	+	Hide is used to place the display window in the background on the screen, i.e., hiding it from view.
Close	+	Close is used to exit the "MAINMENU" software.
Window List	+	Window is used to open the list of currently active tasks on the computer and switch to a different task.

A second set of alternate keyboard commands may also be used. This second set is used by opening the control menu (by pressing and spacebar simultaneously) followed by pressing the underlined letter of the menu item that you want to select.

If a menu item is shown in a lighter font (e.g., Maximize as opposed to Maximize), then that menu option is not available.

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3.2.3. The Minimize and Maximize Window Buttons

The minimize (▪) and maximize (☐) window buttons are used to change the size of the "MAINMENU" display window. The minimize button appears as a small square in the upper right corner of the "MAINMENU" screen. This button is used to reduce the size of the window to an icon. The maximize button appears as a large square in the upper right corner of the "MAINMENU" screen. This button is used to enlarge the current window to its maximum size on the screen. The minimize and maximize window buttons have the same effect as using the Minimize and Maximize options of the control menu.

When the main screen is in its maximized state, the maximize button changes to the restore button. The restore button looks like the maximize button, but it adds two vertical lines surrounding the small square (i.e., ⧉). This button has the same effect as the Restore option of the control menu, that is, changing the size of the display window to its previous size.

3.2.4. The Menu Bar

The menu bar is a horizontal area that stretches across the main screen and contains keywords used to access pull-down menus. The keywords used in the menu bar are listed and described in Table 3-2. The alternate keyboard commands used to open each pull-down menu are also included. Refer to the chapters that follow for detailed information about the options available in each pull-down menu.

Table 3-2. Menu Bar Options

Menu Bar Option	Keyboard Command	Description / Function
Password	❍ + ☞	Password is an optional menu item that must be configured for your system at the factory. Passwords can be used for security by giving system access privileges authorized personnel only.
Setup	❍ + ♦	The Setup option is used to configure/modify axis, machine, CNC, system, and data acquisition parameters, in addition to others.
Diagnostic	❍ + ☜	The Diagnostic option provides status and control diagnostic options that are helpful during the setup, customization and operation of the system.
Run	❍ + ☼	The Run option is used to select and initiate a CNC parts program that you would like to execute.
Manual	❍ + ✹	The Manual option allows you to manually interact with the CNC by permitting such functions as jogging, homing, RS-274 command entry, and general purpose input/output control.
Edit	❍ + ☜	The Edit option activates a text editor through which you can create and/or modify parts programs.
View	❍ + ✞	The View option allows you to select whether or not you want to display the clock/calendar information and/or the error log display information.
Comm	■ + ♍	The Comm option gives you the ability to perform RS-232 and Ethernet file transfer communications.

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3.2.5. Clock/Calendar Field

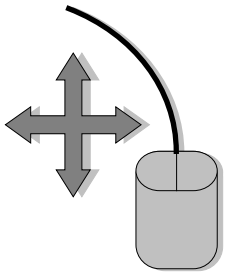
The clock/calendar field is located in the lower right corner of the main display screen. This field contains the current day of the week, date and time based on system settings. The display of this information field can be toggled using the Clock Calendar... option of the View menu. If the Clock Calendar... option is selected (i.e., a check mark appears next to the option), then the clock/calendar field is displayed. If the Clock Calendar... option is not selected (i.e., a check mark does not appear next to the option), then the clock/calendar field is not displayed. Refer to Figure 3-1 on page 3-1.

3.2.6. Error Log Display Field

The error log display field is located in the lower left corner of the main display screen. This field contains a log of the most recent error messages that have occurred. The display of this information field can be toggled using the Error Log... option of the View menu. If the Error Log... option is selected (i.e., a check mark appears next to the option), then the error log field is displayed. If the Error Log... option is not selected (i.e., a check mark does not appear next to the option), then the error log field is not displayed. Refer to Figure 3-1 on page 3-1.

3.3. Using a Mouse

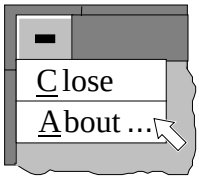
The "MAINMENU" software interface of the U31 uses a standard 2-button mouse (in conjunction with a keyboard) for selecting options, displaying information and maneuvering around the main software screen in a Windows-like fashion.



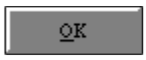
The mouse is used to move an icon called the *cursor* around the main screen. The cursor appears as a small arrow on the main screen (see Figure 3-1 on page 3-1). To move the cursor up, down, left or right, you must move the mouse forward, backwards, left or right, respectively. Items on the main U31 screen are selected by moving the cursor so that it touches (that is, it is in front of any portion of) the option that you want to select. When the cursor is in place, the item can be selected by clicking the left mouse button.

The results of the selection process vary based on the item that is actually selected on the screen. UNIDEX 31/U600 screens contain four basic types of fields:

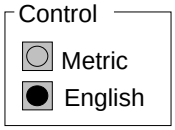
- pull down menus
- buttons
- check boxes
- text windows.



When a pull down menu icon is selected, a window appears below the icon. This window lists options that can be chosen by the operator. To choose an option from a pull down window, simply move the mouse so that the cursor slides down the list until the desired option is highlighted, and then click the left mouse button. The "MAINMENU" software performs the selected option.



Buttons usually appear as outlined rectangles with an action label. The action shown on a large, rectangular button can be initiated by moving the cursor over the large rectangle and clicking the left mouse button. These types of buttons are typically used to proceed, accept, or cancel some process.

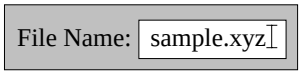


Check boxes usually appear as small circles or boxes (that are filled or unfilled) next to some defining text. If the circle is filled (•) or the box is checked (☒), then the option is selected or active. If the circle is not filled (o) or the box is not checked (☐), the

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option is inactive or not selected. To toggle these buttons, simply move the cursor over the desired circle or box and click the left mouse button.

Text windows usually appear as white rectangles. These windows allow the operator to enter text directly from the keyboard. To select a text window (so that you can enter keyboard text), you move the cursor to the text window and click the left mouse button. In text boxes that already contain text, the text cursor will appear where the mouse was clicked. If there is no text in the text window, the text cursor will appear at the beginning of the field by default. The text cursor (**I**) shows the current insertion point for text. In some cases when the "MAINMENU" software is expecting a text response, the text window box will already have a text cursor in place.



3.4. Alternate Keyboard Commands

Although the "MAINMENU" software is designed to be used with a mouse, you are able to perform certain functions by using keystroke sequences from the keyboard. Some alternate keyboard commands use function keys (e.g., F1, F2, F3, etc.) while others use mnemonic sequences (e.g., Alt-S for Save, Alt-T for Teach, etc.). Most alternate keyboard sequences are either listed to the right of a menu selection (e.g., the alternate keyboard command combination "Alt+F5" appears after the Restore option of the control menu) or are denoted by a menu name that has an underlined letter (e.g., Setup). In the latter case, the underline letter is used in conjunction with the ALT key (usually) to open the desired menu. For selections within a menu, the underlined letter represents the shortcut key to press in order to perform the associated function (provided the menu itself is currently opened or "pulled down"). For some common alternate keyboard commands, refer back to Table 3-1 and Table 3-2.

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CHAPTER 4: THE PASSWORD MENU

In This Section:

- Introduction 4-1
- Logging On and Logging Off the System 4-1
- The Password Editor 4-3
- Adding Passwords 4-4
- Deleting Passwords 4-5
- Modifying Access Privileges 4-6
- File Control 4-6

4.1. Introduction

The UNIDEX 31/U600 has a password feature that permits the user to password protect each mode of operation. The user can access particular modes upon "logging on", based upon the password specified, and may not change these privileges. A user granted access to the password mode may modify the privileges associated with a given password.

Each password may be up to 8 alpha-numeric characters in length, and is case sensitive. Initially, the default password is MASTERPW, which grants access to all protected modes of operation.

4.2. Logging On and Logging Off the System

A Password Log On dialog box appears as soon as the initialization process is complete. This is illustrated in Figure 4-1.

At this point, the user must type his password into the Password Entry Field just below the "Enter Password" prompt. When finished, the user may press the **<Enter>** key or click on the **OK** button. The system then compares the password entered with a list of valid passwords. If the password is valid, the prompt message changes to "Log On Successful" and displays a list of accessible modes (see Figure 4-2).

If the password specified is not valid, the prompt message then changes to "Password Not Recognized !", as shown in Figure 4-3. The user must then enter a valid password to continue.

Once the user completes using the controller, they may log off using the "Log Off" option of the Password Menu (refer to Figure 4-5). Selecting this option displays the Log Off Current Password dialog box shown in Figure 4-4.

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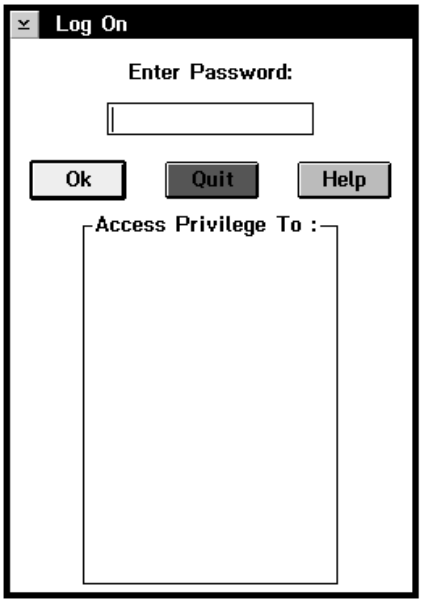


Figure 4-1. "Log On" Dialog Box

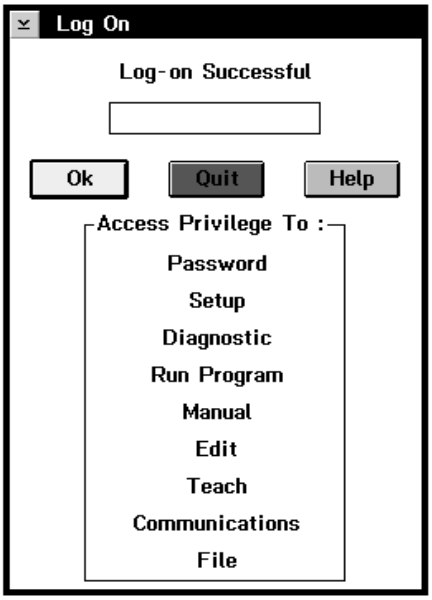


Figure 4-2. "Log On Successful" Dialog Box

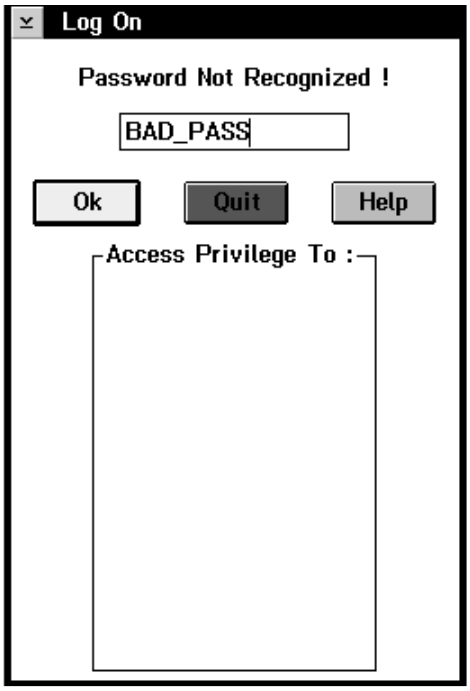


Figure 4-3. "Password Not Recognized !" Dialog Box

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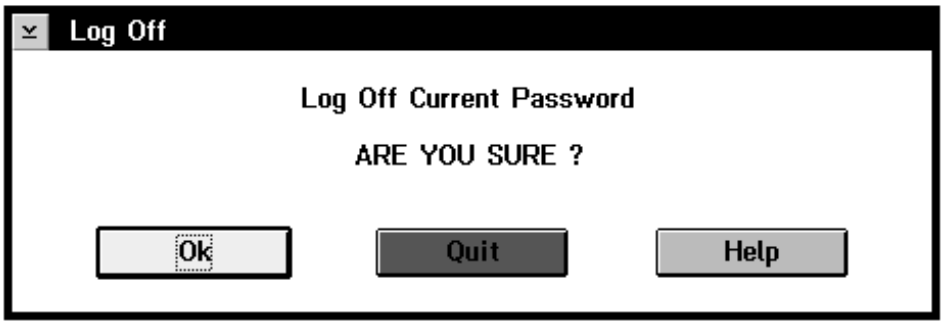


Figure 4-4. "Log Off Current Password" Dialog Box

Selecting the **Ok** button clears all user privileges, in which case, the user may not access the protected modes unless he logs on again using a valid password.

In the event that the user inadvertently enters this screen, the "Quit" control aborts the log-off process. That is, by selecting "Quit" the current user remains logged on and doesn't lose any of their current privileges.

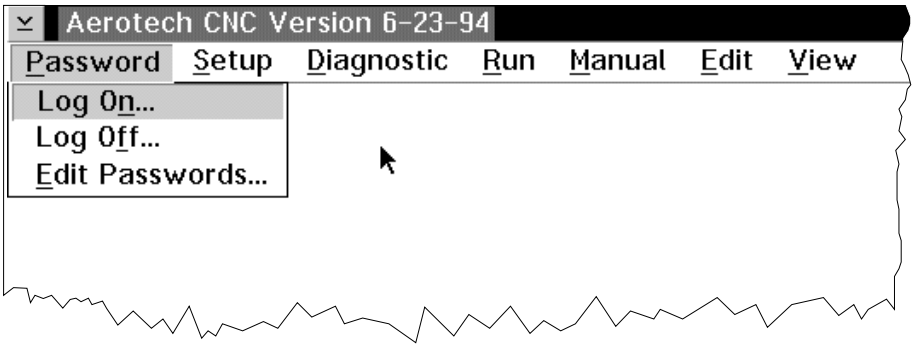


Figure 4-5. Selections of the Optional Password Menu

4.3. The Password Editor

The password editor permits the user to modify the list of valid passwords and the privileges associated with each. The password editor is activated by selecting the Edit Passwords... option from the Password menu. Refer to Figure 4-5. After selecting the Edit Passwords... option from the Password menu, the "MAINMENU" software program displays the Password Editor screen. This is illustrated in Figure 4-6.

As can be seen from Figure 4-6, the screen has several different groups of controls. These controls permit the user to select, add and delete passwords, as well as modify the access privileges associated with them. Each of these functions is discussed in the sections that follow.

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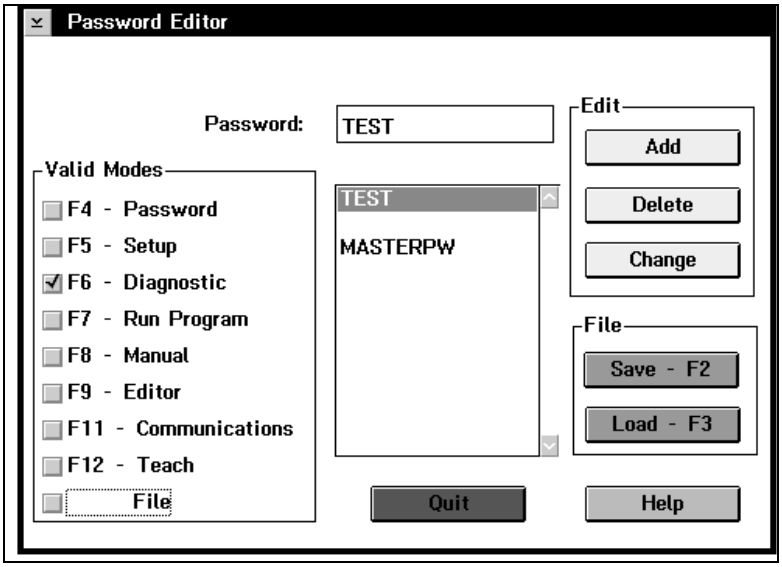


Figure 4-6. Password Editor Dialog Box

4.4. Adding Passwords

To add a password to the system, the user must manually enter the new password into the "Password" entry field (see Figure 4-6). As mentioned, this password may be up to 8 alphanumeric characters in length, and is case sensitive.

Once the user enters the new password, he must specify the mode for which that password applies. The user may do this by using the check boxes found in the Valid Modes group box. An enabled mode contains a check mark in the check box associated with that mode.



Many of the check boxes in the Password Editor screen are directly accessible through the [F4] - [F12] function keys.

Once the user defines the access privileges for the new password, he may add it to the system using the **ADD** button. The system then displays the new password at the top of the Valid Parameter List box just below the "Parameter" entry field.

By adding a password with no characters or spaces (i.e., a blank password), the logon procedure can be reduced to hitting the ENTER key when prompted for a password. This feature can be used as a default password so that no password would be need to be entered for normal operation.

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4.5. Deleting Passwords

To delete a password from the system, the user must first select it from the Valid Parameter List box. The system displays the newly selected password in the "Password" entry field, as well as highlight it in the Password List box.

Once the user selects the password he wants to delete, the **DELETE** button removes it from the valid password list. The password editor then removes this password from the Password List box, and the system no longer permits access to protected modes based upon this password.

To avoid password lockout, the system requires that at least one password have access to the password editor at all times. In the event that the user attempts to delete the last password with this privilege, the system displays an error message (see Figure 4-7).

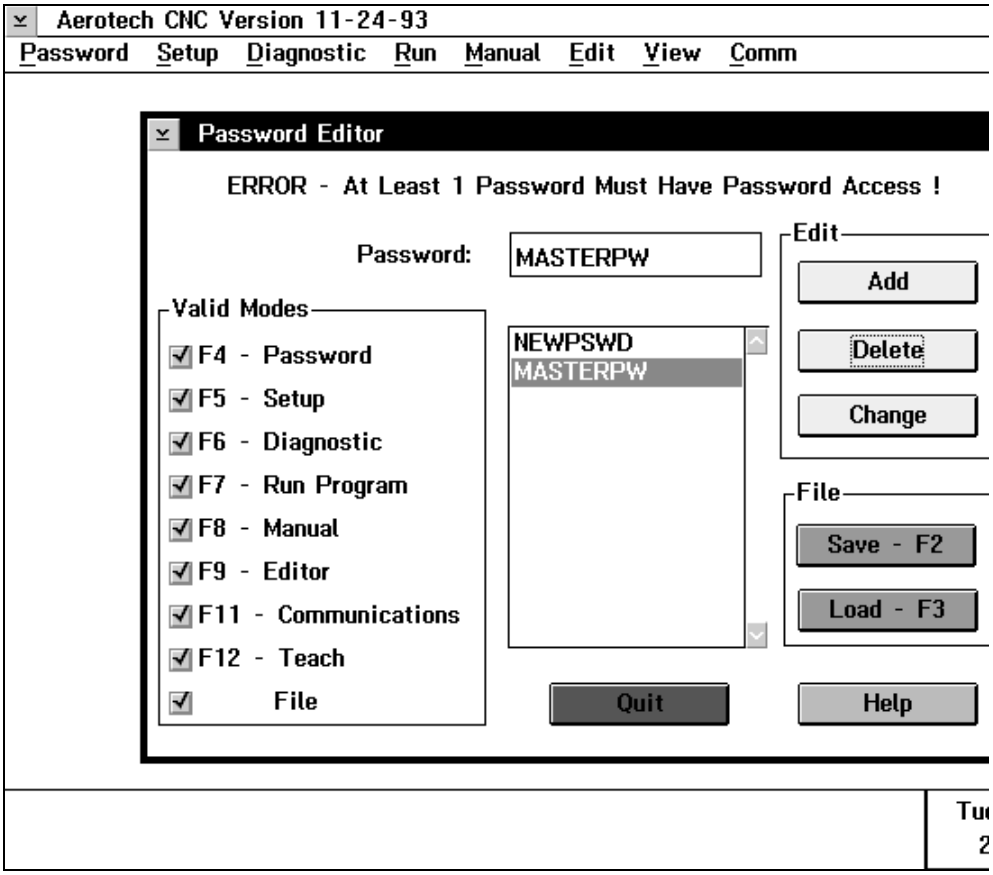


Figure 4-7. Password Editor Error Message Screen

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4.6. Modifying Access Privileges

To modify the access privileges associated with a password, the user must first select the password from the Valid Parameter List box. Remember, the currently selected password is the one displayed in the "Password" entry field as well as highlighted in the Password List box.

Once the user selects a password, the Valid Modes group box changes so that it reflects the access privileges associated with the new password. The user may modify these privileges using the check boxes associated with each mode. An enabled mode contains a check mark in the associated check box.



Many of these check boxes are directly accessible via the [F4]-[F12] function keys.

Once the user specifies the new access privileges, he can enable them using the **CHANGE** button. Therefore, all users who log on with that password may access the privileges specified.

4.7. File Control

To activate the changes made from within the password editor for the current and future "MAINMENU" sessions, it is necessary to update the hidden password file. To update the hidden password file, use the **SAVE-F2** button of the File Control group box, or the [F2] function key.

The **LOAD-F3** button or the associated [F3] function key, serves to restore the password list to the state in which the user last saved it. This is useful should the user accidentally delete a password.

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CHAPTER 5: THE SETUP MENU

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5.1. Introduction

By accessing the Setup menu, the user can configure various types of parameters. As can be seen in Figure 5-1, the available options allow the user to modify axis, machine, CNC, system configuration, and data acquisition parameters. The user may also perform additional functions such as enable optional features, configure the position display, and describe and enable error correction. The "Axis Test" option invokes a utility designed to simplify axis tuning.

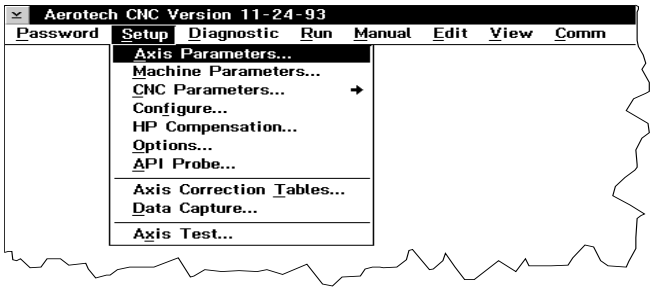


Figure 5-1. Setup Menu

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5.2. Axis Parameter Editor

The "Axis Parameters" option invokes the Axis Parameter Editor (see Figure 5-2) to allow the user to view or modify the values for the axis parameters. The values displayed correspond to the settings upon invocation of "MAINMENU". This does not necessarily correspond with the current value of a parameter. However, changes made to the displayed value of a parameter also changes the current value of that parameter.



Aerotech strongly recommends that the user make a backup copy of the Default Parameter Settings (AXIS.INI) file before altering any parameter values.

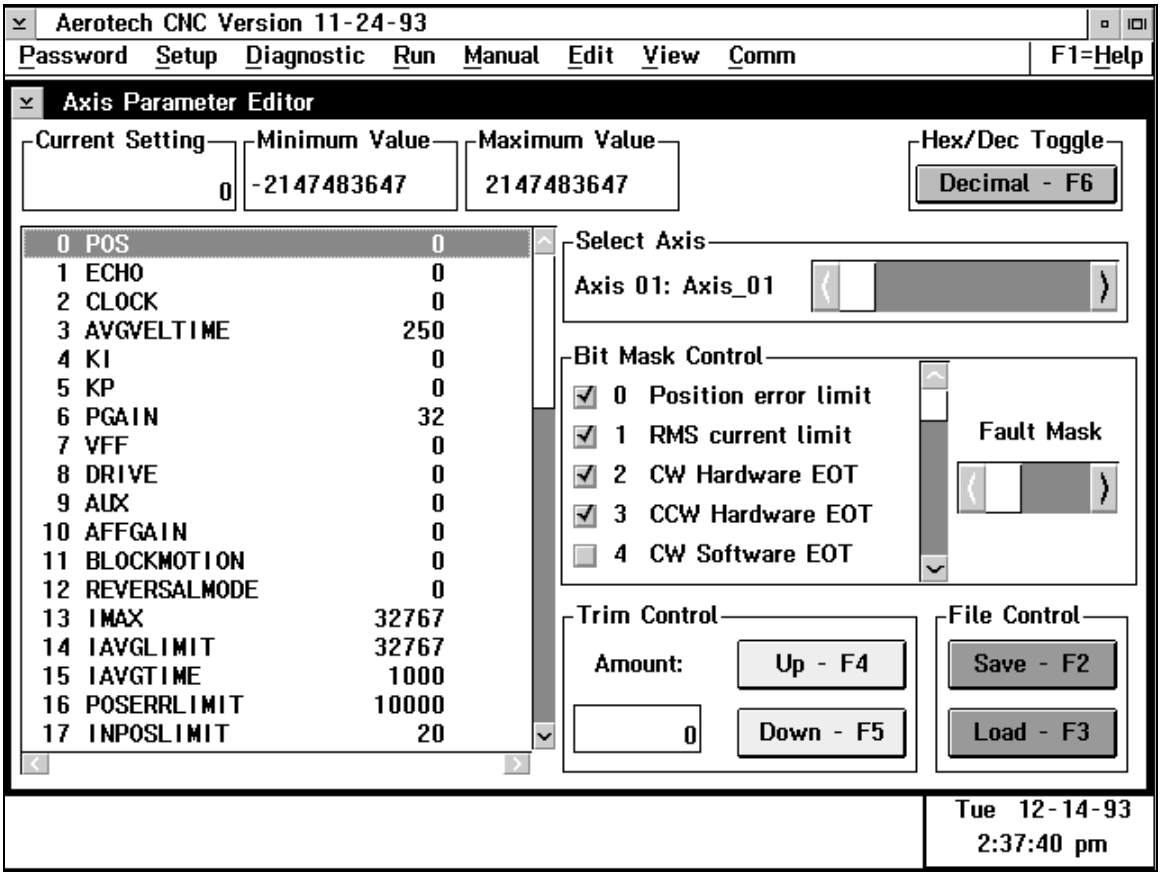


Figure 5-2. Axis Parameter Editor Screen

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5.2.1. Axis Parameter List Box

A list box to the left of the screen, shown in Figure 5-2, displays the applicable axis parameters. To the left of the parameter name, found in this list box, is the parameter number and to the right is the current value of that parameter. The user may scroll through these parameters using the scroll bar to the right of the window, as well as with the page up, page down and arrow keys. To select a parameter the user must highlight it.

5.2.2. The Current Setting, Min and Max Boxes

In addition to the parameter value that appears to the right of the parameter name this value also appears in the Current Setting List Box just above the Parameter List Box. Appearing to the right of this list box is a Minimum Value List Box and a Maximum Value List Box. These boxes provide the user with minimum and maximum values for each parameter. Each time the user changes the value of a "currently selected" parameter, the system updates the value contained in this box.

5.2.3. Base Selection

The user may display the values on this screen in two ways: a decimal (base 10) or a hexadecimal (base 16) view. A **Hex/Dec** Toggle push button exists so that the user may choose the format in which they wish to display their data. The **Hex/Dec** push button also notifies the user of what format is currently in use.

A convenient equivalent to the **Hex/Dec** push button is the [F6] Function Key.



5.2.4. Axis Selection

Each parameter that appears on this screen is only applicable to one axis. Therefore, the user must have a method to indicate what axis applies to each of the displayed parameters. To select the axis the user must use the Select Axis List Box. This box indicates the currently selected axis by both name and number, as well as a scroll bar to permit axis selection. The user can sequentially scroll through the axes using the arrows at the ends of the scroll bar. Mouse users may move directly to a given axis number by dragging the scroll bar until the desired axis name/number appears on the display.

5.2.5. Parameter Modification: Direct Entry

The user may modify all parameters displayed within the Parameter List Box. There are several ways in which the user may modify the current settings: Direct Entry, Trim Control, and Bit Mask Control. The direct entry method of parameter modification allows the user to explicitly change the value of a highlighted parameter. To do this the user must first select the desired parameter within the Parameter List Box. Following this selection, the user must move to the Current Setting Box and enter the new value. Upon pressing the **<Enter>** key, the UNIDEX 31/U600 evaluates this new value. If this value is within range, it is sent to the axis processor and updates the Parameter List Box.

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Otherwise, the screen displays an Invalid Entry of Parameter Value dialog box to notify the user of the error. This dialog box is illustrated in Figure 5-3.

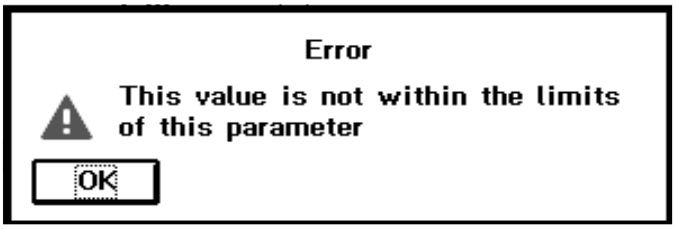


Figure 5-3. "Invalid Entry of Parameter Value" Dialog Box

5.2.6. Parameter Modification: The Trim Control Box

Another method for modifying the value of a parameter is through the Trim Control Box. This box contains controls that permit the user to specify an amount by which he can increment and/or decrement the current value. To modify the amount field, position the cursor in the Amount Box, and explicitly specify the new value. This value takes effect when the user presses the **<Enter>** key. Using the **Up-F4** push button or the associated [F4] Function Key, the user may add this amount to the current parameter value. Conversely, that amount will be subtracted from the current parameter value each time the user presses the **Down-F5** push button or the associated [F5] Function Key.

5.2.7. Parameter Modification: The Bit Mask Control Box

The user may also modify several parameters from within the Bit Mask Control Box. Certain parameters such as FAULTMASK, DISABLEMASK, INTMASK, AUXMASK, and HALTMASK define the actions taken upon the detection of various types of faults. Refer to the parameter descriptions for additional information on these parameters. This box provides a list of the fault types, and a check box to enable or disable a particular action for each specific fault type. Placing a check mark in the check box enables the action. The action that is being controlled depends on the parameter being edited. A vertical scroll bar allows the user to scroll through the various fault types. However, the horizontal scroll bar permits the user to move through the various parameters.

5.2.8. The File Control Box

Any changes made while in the Axis Parameter Editor affect the parameters currently in use. The user must save the newly entered parameters so that future invocations of "MAINMENU" reflect the new values. The File Control Box provides push buttons that permit the user to save the new values to a file, and restore the old values from a file. These buttons are labeled "Save-F2" and "Load-F3". The user may also access these functions using the associated [F2] and [F3] function keys. These parameters are saved in the AXIS.INI file. This file is in a binary format and by no means should the user modify it.

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5.3. Axis Parameters

The following sections contain detailed information on each of the UNIDEX 31/U600 parameters.

5.3.1. POS

This parameter specifies the observed position for a selected axis. This parameter is a signed 32-bit integer having a range of $\pm 2^{31}$ -1 (approximately +/- 2.1 billion). Upon initialization, the system sets the current observed position equal to the POS parameter value.

5.3.2. ECHO

This parameter allows the user to set a "dummy" parameter. It has no effect on the operation of the controller, but may be used to test communications with the axis processor, or as a temporary holding area.

5.3.3. CLOCK

This parameter allows the user to set the starting count of a user clock using 1 millisecond resolution. The clock starts counting from the specified time. This is available for application programs that require a general purpose timer. Use of this parameter has no effect on the operation of "MAINMENU".

5.3.4. AVGVELTIME

The Axis Processor Card of the UNIDEX 31/U600 maintains a read-only parameter called AVGVEL that reports the average velocity for a given axis. This average has no effect on the operation of the controller, but is maintained for the benefit of the application program. This parameter specifies the time period over which the velocity is averaged. The units for this parameter are given in milliseconds and must range from 10 to 1,000 milliseconds (in 10 msec increments).

5.3.5. KI

This parameter sets the integral gain of the velocity loop for the selected axis. Refer to the *UNIDEX 31/U600 Hardware Manual* for a description of how this parameter functions in the servo loop. The valid range of this parameter is 0 to 10,000. The default value is 2,000.

5.3.6. KP

This parameter sets the proportional gain of the velocity loop for the selected axis. Refer to the *UNIDEX 31/U600 Hardware Manual* for a description of how this parameter functions in the servo loop. The valid range of this parameter is 0 to 100,000. The default value is 10,000.

5.3.7. PGAIN

This parameter determines the position gain of the position loop for the selected axis. Refer to the *UNIDEX 31/U600 Hardware Manual* for a description of how this parameter functions in the servo loop. The valid range of this parameter is 0 to 1,000. The default value is 10.

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5.3.8. VFF

This parameter enables or disables the Velocity Feed Forward function. Once enabled, this function minimizes the position following error. A value of 1 enables this function, while a value of 0 disables it.

5.3.9. DRIVE

This parameter enables and disables the motor's torque associated with an axis. A zero disables the drive, while a one enables it.

5.3.10. AUX

This parameter controls the auxiliary output of a selected axis. A one asserts the output, while a zero de-asserts it. Typically, this output may be used to activate a motor brake. The user may configure the FAULTMASK and AUXMASK parameters to cause this output to change state on an axis fault.

Therefore, each time a fault condition occurs, the system would apply a brake to the motor.

5.3.11. AFFGAIN

This parameter sets the Acceleration Feed Forward Gain used in the acceleration loop of the selected axis to minimize velocity error. However, too large of a value may cause noise in the servo loop. The range for this parameter is -1,000,000 to 1,000,000. The default value is 0.

5.3.12. BLOCKMOTION

This parameter causes the axis to ignore motion commands. The only exception is when the axis is currently under the control of a sync table. While the system blocks motion, the axis accepts commands to stop. A value of zero causes the system to process motion commands, while a one causes the system to ignore them.

There are many reasons why the user may desire to use this feature. For example, if an axis must remain stationary throughout a process, an application program may temporarily block axis motion to prevent another concurrently executing application from initiating motion on that axis.

5.3.13. REVERSALMODE

To provide greater positioning accuracy, this parameter allows the user to specify the number of machine steps required to compensate for any backlash present in the system. Backlash occurs when the ball screw changes direction and moves a fixed distance before the stage begins to move in the new direction. This parameter specifies the length of this distance in machine steps. The valid range for this parameter is 0 to 1,000. The default is for zero backlash compensation (0 machine steps).

5.3.14. IMAX

This parameter sets the peak commanded output current. This is done by limiting the maximum output voltage of the current command signal, which is in turn translated into a proportional motor current by the drive module.

The range of this parameter is from 0 to 32,767, where 10 volts is represented by the number 32,767. To calculate the appropriate IMAX value, first determine the maximum

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input command voltage that your amplifier requires to produce the maximum desired motor current. Use this information in the formula below to get the appropriate value for IMAX.

$$IMAX = \frac{\text{Drive Module Max Input Voltage}}{10} * 32767$$

The default value of this parameter is 32,767. This default value produces a 10 volt command signal which would command the maximum current from the drive module.

5.3.15. IAVGLIMIT

This parameter detects an over current condition based on the setting of the IAVGTIME parameter. The value specified in the IAVGTIME parameter determines the time period over which the instantaneous currents are averaged. An RMS current limit fault occurs if the RMS average exceeds the limit set by this parameter. As with the IMAX parameter, the range of this parameter is from 0 to 32,767, where 10 volts is represented by the number 32,767. To calculate the appropriate IAVGLIMIT value, first determine the maximum input command voltage that your amplifier requires to produce the desired average current. Use this information in the formula below to get the appropriate value for IAVGLIMIT.

$$IAVGLIMIT = \frac{\text{Drive Module Input Voltage that Produces the Desired Average Current}}{10} * 32767$$

The default value of this parameter is 32,767. This default value produces a 10 volt command signal which would command the maximum current from the drive module.

5.3.16. IAVGTIME

This parameter defines the time period over which the system will average the instantaneous current. The IAVGLIMIT parameter is dependent on the setting of this parameter to detect an over-current condition. The unit of measure for this parameter is milliseconds and can range from 10 to 4,000 (msec). The default is 10 msec.

5.3.17. POSERRLIMIT

This parameter determines the maximum position error that can occur on an axis before it generates a position error limit fault. The unit of measure for this parameter is machine steps, and can range between 0 and 10,000,000. The default value is 65,535 counts.

5.3.18. INPOSLIMIT

This parameter allows the user to define the in-position band. If the axis has completed its move and the observed position error is within the range (plus or minus) determined by the in-position limit set by this parameter, then the axis' in-position status bit becomes active.

To set this parameter, the user must enter the value in machine steps. This value can range between 0 and 65,636. The default value is 65 counts.

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5.3.19. CWEOT

This parameter determines the clockwise end of travel limit. The Axis Processor Card will not move to a position that exceeds this value. Instead, a CW_FAULT occurs each time the user attempts to command a position beyond this value. The user must enter the CW end of travel position in machine steps from the home position. The value of this parameter must not exceed the default value of 2^{31}-1 (approximately 2.1 billion).

5.3.20. CCWEOT

This parameter determines the counter-clockwise end of travel limit. The Axis Processor Card will not move to a position that exceeds this value. Instead, a CW_FAULT occurs each time the user attempts to command a position beyond this value. The user must enter the CCW end of travel position in machine steps from the home position. The value of this parameter must not exceed the default value of -2^{31}-1 (approximately -2.1 billion).

5.3.21. VELTRAP

This parameter specifies the maximum instantaneous speed at which an axis may move. A velocity trap occurs if the observed velocity exceeds the amount specified by this parameter. The units for this parameter are machine steps per second and can range from 0 to 65,536,000. The user may enter a zero to disable the velocity trap detection.

5.3.22. VELCMDTRAP

This parameter determines the maximum commanded velocity at which an axis may move. A command trap occurs if the commanded velocity exceeds the amount specified in this parameter. The units for this parameter are in machine steps per second and can range between 0 and 65,536,000. The user may enter a zero to disable the commanded velocity trap detection.

5.3.23. FBWINDOW

While processing motion commands, the axis processor integrates both the velocity command and the velocity feedback. This parameter permits the user to specify the maximum amount by which these two velocities may differ. A FEEDBACK fault occurs if the difference exceeds the amount specified in this parameter. The units for this parameter are in machine steps and can range from 0 to 1,000,000. A value of zero disables the FEEDBACK fault monitoring.

5.3.24. SAFEZONECW

This parameter allows the user to specify the clockwise boundary of the safe zone associated with an axis. The user may use a safe zone to designate a boundary in which the axis can travel, or one in which the axis can not travel. To enable or disable these zones the user must properly set the SAFEZONEMODE parameter.

When setting this parameter it is necessary to know that its distance starts at the hardware home position. The units for this parameter are machine steps with a valid range from -2^{31} -1 to 2^{31} -1 (approximately -2.1 billion to +2.1 billion).

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The user may also specify safe zone parameters from within a parts program with the G36 command.



5.3.25. SAFEZONECCW

This parameter allows the user to specify the counter-clockwise boundary for the safe zone of an axis. Safe zones are useful for designating an area in which the axis can travel, or one in which the axis can not travel. To enable or disable the specified boundary, the user must adjust the setting of the SAFEZONEMODE parameter. The distance specified by this parameter begins at the hardware home position. The units are in machine steps and can be any one of the signed 32-bit integers. The default for this parameter is zero.

The user may also specify safe zone parameters from within a parts program with the G36 command.



5.3.26. SAFEZONEMODE

The value set by this parameter determines how the system interprets the SAFEZONECW and SAFEZONECCW parameter. Setting this parameter to zero disables the safe zone, while a one defines an area in which the axis may enter, and a two defines an area in which the axis may not exit.

A safe zone fault occurs each time the associated axis moves into an area that violates an active safe zone.

The user may also specify safe zone parameters from within a parts program with the G36 command.



5.3.27. SIMULATION

To facilitate easy debugging of parts programs, this parameter allows the user to place an axis into a simulation mode. While in this mode, the motor's torque remains steady, but no motion occurs. While executing a parts program on a simulated axis, the axis processor performs all calculations normally, but the torque command never reaches the motor. Instead, the torque serves as the feedback for this axis, effectively creating a system free from velocity error. All other features, such as data acquisition, continue to function normally. Setting this parameter to zero disables the simulation mode, while a one enables it. The default is to disable the simulation mode.

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5.3.28. ACCEL Time

This parameter controls the time needed to accelerate to a new velocity while the ACCELMODE parameter specifies time-based ramping. The units for this parameter are in milliseconds and can range between 0 and 100,000. The default value is for 0 (msec).



Acceleration refers to any increase in velocity.

The user may also specify acceleration mode parameters from within a parts program. Refer to the G60 and G67 commands.

5.3.29. DECEL Time

This parameter controls the time that it takes to decelerate the current velocity to a lesser velocity, while the DECELMODE parameter specifies time-based ramping. The units for this parameter are milliseconds and can range between 0 and 100,000. The default value is for 0 (msec).



Deceleration refers to any change in velocity which ends at zero.

The user may also specify deceleration mode parameters from within a parts program. Refer to the G61 and G67 commands.

5.3.30. ACCELMODE

This parameter permits the user to select the type of ramping during the execution of motion commands. This ramping may be time-based (using the ACCEL parameter) or rate-based (using the ACCELRATE parameter). Also, the user can configure the ramping to be either linear or sinusoidal (1-cosine). The following chart indicates how to set this parameter. The default for this parameter is zero for a time-based linear ramp.

0 - Linear Ramping - Time Based
1 - Sinusoidal Ramping - Time Based
2 - Linear Ramping - Rate Based
3 - Sinusoidal Ramping - Rate Based



The user may also specify acceleration mode parameters from within a parts program. Refer to the G63/G64 and G67/G68 commands.

5.3.31. DECELMODE

This parameter permits the user to select the type of ramping used during the deceleration of motion commands. This ramping may be time-based (using the DECEL parameter) or rate-based (using the DECELRATE parameter). Also, the user may configure the

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ramping to be either linear or sinusoidal (1-cosine). The following chart serves as an aid in setting this parameter. The default for this parameter is for a time-based linear ramp.

0 - Linear Ramping - Time Based
1 - Sinusoidal Ramping - Time Based
2 - Linear Ramping - Rate Based
3 - Sinusoidal Ramping - Rate Based

The user may also specify deceleration mode parameters from within a parts program. Refer to the G63/G64 and G67/G68 commands.



5.3.32. FEEDRATEMODE

This parameter determines if the axis is subject to feedrate override control. Setting this parameter to zero disables the feedrate override control, while a value of one makes the axis subject to feedrate override. The default value is zero (0).

5.3.33. ACCELRATE

This parameter sets the rate of acceleration, while the ACCELMODE parameter specifies rate-based ramping. The units for this parameter are machine counts per second squared. This parameter has a valid range of 1 to 10,000,000. The default value is 1,000,000 (1 count/msec^2).

The user may also specify acceleration parameters from within a parts program. Refer to the G65 and G67/G68 commands.



5.3.34. DECELRATE

This parameter sets the rate of deceleration, while the DECELMODE parameter specifies rate-based ramping. The units for this parameter are machine counts per second squared. This parameter can range from 1 to 10,000,000. The default value is 1,000,000 (1 count/msec^2).

The user may also specify deceleration parameters from within a parts program. Refer to the G66 and G67/G68 commands.



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5.3.35. HOMESWITCHTOL

To ensure the accuracy of a homing sequence, there must be a minimum distance between the Home Limit Switch and the Home Marker Pulse. Otherwise, the axis processor may miss the first marker pulse, and use the second marker as the home position (before the Home Offset). The required distance depends on two factors: feedback resolution and home feedrate.

This parameter specifies the minimum distance, in machine steps, that must exist between the home limit and the marker pulse. Failure to maintain this distance causes a HOME_SWITCH_TOLERANCE fault to occur. This parameter has a valid range of 0 to 16,384 machine steps. The default value is zero (0).

5.3.36. FAULT

This parameter allows the user to view axis faults and clear those that no longer exist. The parameter is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). When writing to this parameter, the axis processor card attempts to clear all faults corresponding to the bits set in this mask. Bits set to zero have no effect on the system.

5.3.37. FAULTMASK

This parameter determines which faults the system should detect. The parameter is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one enables monitoring of that particular fault type. Conversely, clearing a bit causes the system to ignore the fault.



The user may also edit this parameter using the Bit Mask Control Window.

5.3.38. DISABLEMASK

This parameter determines which faults should cause an axis to be disabled. The disable mask is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one disables the axis on that type of fault (assuming the corresponding bit in the FAULTMASK parameter is set).



The user may also edit this parameter using the Bit Mask Control Window.

5.3.39. INTMASK

This parameter allows the user to determine which faults will cause a system interrupt. Upon detection of an interrupt, "MAINMENU" automatically activates the axis fault and status screen (see Section 6.2.). This allows the user to determine the type of fault that occurred. This parameter is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one causes the system to generate an interrupt when that fault occurs (assuming the corresponding bit in the FAULTMASK parameter is set).

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The user may also edit this parameter using the Bit Mask Control Window.



5.3.40. AUXMASK

Through this parameter a user may designate which faults should turn off the auxiliary output associated with an axis. This parameter is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one turns on the auxiliary output when a particular fault occurs (assuming the corresponding bit in the FAULTMASK parameter is set).

The user may also edit this parameter using the Bit Mask Control Window.



5.3.41. HALTMASK

This parameter controls the faults that cause the axis to halt. If the system must halt motion, the axis will gracefully decelerate to zero velocity based on the time specified in the DECEL parameter. This parameter has no effect on the position error tracking

The value specified for this parameter is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one halts the axis when a particular fault occurs (assuming the corresponding bit in the FAULTMASK parameter is set).

The user may also edit this parameter using the Bit Mask Control Window.



5.3.42. IOLEVEL

This parameter permits the user to specify the active state for several of the I/O lines of the axis processor I/O lines. The user may configure any of the following lines.

0 - Drive Enable (Output)
1 - Aux Output Enable (Output)
2 - CW Limit Switch (Input)
3 - CCW Limit Switch (Input)
4 - Home Limit Switch (Input)
5 - Drive Fault (Input)

The value specified is a bit mask where only the six least significant bits are valid. These bits correspond with the list above, as well as the six least significant bits of the STATUS parameter (see Section 6.2.2.1. through Section 6.2.2.6.). Setting a bit to a one implies that the input/output is active high, and a zero means it is active low. The default for this parameter is 63 (03FH), and corresponds to all active high signals.

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5.3.43. AUXOFFSET

To understand how this parameter functions, the reader must be familiar with the operation of the synchronized auxiliary output tables on the UNIDEX 31/U600. In brief, each synchronized auxiliary output table entry specifies a master position and a corresponding state for the auxiliary output. When the observed master position becomes greater than or equal to that specified in the table entry, the output is set to the appropriate state. The only requirement is that the master positions constantly increase and never repeat.

This parameter refers to an offset applied to the master position of the auxiliary output table associated with an axis. The point at which the table begins and ends is: advanced or retarded. The user must be aware of the table's setup before setting the value of this parameter. The units for this parameter are machine steps within the range of , and can be any one of the signed 32-bit numbers. The default value is for zero (0) machine steps in the range of $-2^{31}-1$ to $2^{31}-1$ (approximately -2.1 billion to +2.1 billion).

5.3.44. ABORTMASK

This parameter controls the faults that cause an axis to abort motion. If the system is to abort motion it disregards the DECEL parameter setting and stops the axis immediately. This also sets the current position error to zero.

The value specified is a bit mask where each bit corresponds to a specific fault (see Section 6.2.3.). Setting a bit to a one causes the axis to abort motion when that particular fault occurs (assuming the corresponding bit in the FAULTMASK parameter is set).

5.3.45. MASTERPOS

To understand how this parameter works, the reader must be familiar with the operation of synchronized motion through the use of CAM tables on the UNIDEX 31/U600. While operating in this mode, axis motion relates directly to motion on the master axis (the axis designated by the user). The basis of this relationship is dependent on the currently active CAM table.

Each CAM table entry contains two position types: a master position and a slave position. As the master axis approaches the positions found within the CAM table, the slave axis moves to the corresponding slave position. Interpolation occurs between the CAM points. The first CAM table entry for the master position must be a zero. Two rules apply to all master positions following the first entry: they must always increase and they must never repeat.

This parameter relates to the current observed position of the master axis. Its primary purpose is to determine the current location within a CAM table, once activated. This parameter cannot be changed when a CAM table is active.

The units for this parameter are machine steps, and are in the range $-2^{31}-1$ to $2^{31}-1$ (approximately -2.1 billion to +2.1 billion). The default value is for zero (0) machine steps.



The user may set the master position of an axis without affecting the POS parameter of the master axis.

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5.3.46. MASTERLEN

To understand how this parameter works, the reader must be familiar with the operation of synchronized motion through the use of CAM tables on the UNIDEX 31/U600. For a brief discussion of this feature, refer to the discussion of the MASTERPOS parameter (Section 5.3.45.).

Setting this parameter to a specific value causes the master position to rollover to zero when the absolute position specified is reached. The most common/effective specified rollover point is the end point of the CAM table in use. This point causes the table execution to repeat in a circular manner, but is not required. The only restriction of the parameter's value is that it must be a positive integer. Therefore, the valid range for this parameter is 0 through 2,147,483,647 (2^{31}-1). The default value is for zero (0).

5.3.47. CAMOFFSET

To understand how this parameter functions, the reader must be familiar with the operation of the synchronized motion through the CAM tables on the UNIDEX 31/U600. For a brief discussion of this feature, refer to the MASTERPOS parameter (Section 5.3.45.).

This parameter offsets all master positions in the active CAM table based on a fixed amount. That is, the value of this parameter is added to each master position in the CAM table. Most often the user selects this parameter to permit execution of the slave profile without forcing the master position to zero (starting point of table).

The units for this parameter are machine steps, and can range from $-2^{31}-1$ to $2^{31}-1$ (approximately -2.1 billion to +2.1 billion). The default is for zero (0) machine steps.

5.3.48. SYNCSPEED

To understand how this parameter works, the reader must be familiar with the operation of the synchronized motion through the CAM tables on the UNIDEX 31/U600. For a brief discussion of this feature, refer to the discussion of the MASTERPOS parameter.

There are two modes in which the user can perform CAM table execution. In the first mode, the system assumes that the current slave position is the starting point of the CAM table. Also, the system assumes that all slave position entries are relative to that starting point.

The second mode of CAM table execution does not make that assumption. Instead, it interprets the slave positions found within the CAM table as absolute positions. With synchronization enabled, the system determines the current location within the CAM table based on the current master position. The slave axis then moves to the position that corresponds to the current master position.

This parameter defines the speed at which the slave axis is to move. The units for this parameter are machine steps per second. The default value is 1000. This parameter has a range from $-2^{31}-1$ to $2^{31}-1$ (approximately -2.1 billion to +2.1 billion).

5.3.49. VEL_SHIFT

Most often this parameter applies to dual-loop configurations where the velocity feedback resolution differs significantly from the position feedback resolution. The effect of this parameter is to scale the velocity feedback to the same resolution as the position feedback. The scale factor used is 2^n, where n is the current value of the vel_shift

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parameter. Therefore, specifying a positive value causes the velocity feedback to shift left, increasing its resolution by 2^n. Conversely, negative values cause the feedback to shift right, effectively decreasing the velocity feedback resolution by 2^n. The default value for this parameter is for zero (0) shift to occur in velocity feedback.

5.3.50. BASE_SPEED

This parameter (as well as the following two parameters) allows the speed torque characteristics of an AC brushless motor to be customized. Normally these parameters are only used with motors having a large back-EMF constant. This is done by adjusting each slope of a dual slope curve which determines the torque angle at various motor speeds. The base_speed determines the speed at which the motor will reach a 20° phase advance. The phase_speed parameter determines the speed at which the maximum phase advance will be reached, which is specified by the maximum phase parameter. Refer to Figure 5-4.

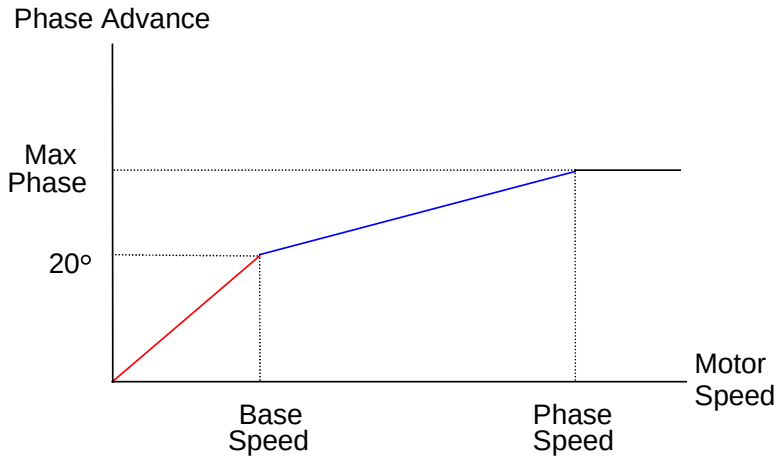


Figure 5-4. The Defined Slope of a Velocity Curve at a Specified Angle

As the motor velocity reaches the base speed, the phase advance reaches 20°. The phase_speed parameter specifies the motor velocity at which the phase advance reaches max_phase degrees.

5.3.51. MAX_PHASE

Refer to the base_speed parameter for a description of this parameter.

5.3.52. PHASE_SPEED

Refer to the base_speed parameter for a description of this parameter.

5.3.53. SOFTLIMITMODE

This parameter sets the active mode for the software limits (defined by the CWEOT and CCWEOT parameters), as well as the safe zones (defined by the SAFEZONECW, SAFEZONECCW, and SAFEZONEMODE parameters). In many systems, the current absolute position of an axis is unknown until after the axis reaches its home position. Therefore, the user should not activate a software limit or a safe zone until the system successfully completes the homing process.

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However, the mechanics of some systems do not permit execution of a normal homing sequence. Therefore, the user must use an alternate method to determine the absolute position. In this case, it may be logical to permit software limits and safe zones to be active at all times.

Setting this parameter to a one (1) causes these features to become active after successfully homing the axis. The default value is zero (0), and causes these features to always be active.

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5.4. Machine Parameter Editor

By selecting the "Machine Parameter" option, found within the Setup menu, the system invokes the Machine Parameter Editor (see Figure 5-5). This utility permits the user to specify the various aspects of the machine to which the UNIDEX 31/U600 interfaces. The displayed values relate to the settings upon invoking the "MAINMENU". This does not necessarily correspond with the current value of a parameter. However, changing this value also changes the current value of that parameter.



It is good practice to always keep a copy of the default parameter settings (MACHINE.INI) before altering any of the parameter values.

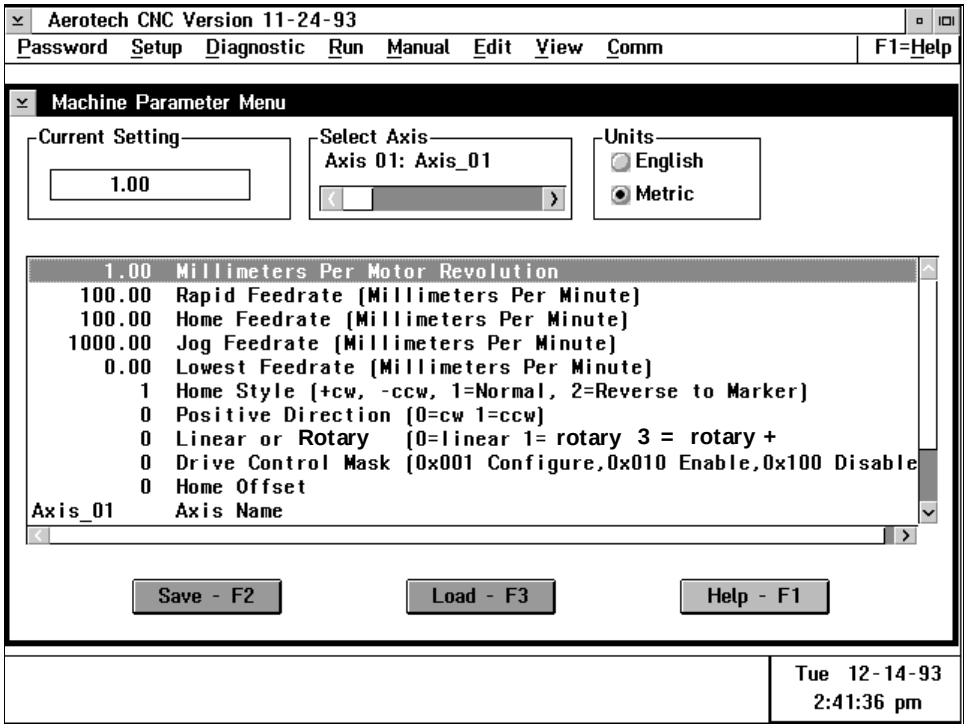


Figure 5-5. Machine Parameter Editor Screen

As can be seen in Figure 5-5, many of the fields of this screen are very similar to those found on the Axis Parameter Editor screen. In general, the functions of the Machine Parameter Editor are very much like those of the Axis Parameter Editor, except this editor operates on different parameters. "MAINMENU" uses the parameters modified from within this editor, while other Aerotech utility programs do not use them at all.

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5.4.1. Machine Parameter List Box

Referring again to Figure 5-5, note that all applicable machine parameters appear in a list box at the center of the screen. Each line of the list box contains the parameter value as well as the parameter name. Some parameters include additional information denoted by text enclosed in parenthesis.

The user may scroll through these parameters using the scroll bar to the right of the window, as well as with the arrow, page up, and page down keys. The highlighted parameter is the "currently selected" parameter.

5.4.2. Current Setting Box

The value of the "currently selected" parameter appears in two places: to the left of the parameter name in the list box, and in the Current Setting group box found on the upper left side of the screen. Each time the user changes the "currently selected" parameter, the value in this box also changes.

5.4.3. Axis Selection

Each parameter on this screen applies to only one axis. Therefore, the user must have some method of specifying the axis to which each parameter should apply. The user can do this from within the Select Axis group box. This box contains an indication of the currently selected axis, both by number and by name, as well as a scroll bar to permit axis selection. The user can sequentially move through the axes using the arrows at the ends of the scroll bar. Mouse users may move directly to a given axis number by dragging the scroll bar until the display shows the desired axis name/number.

5.4.4. Units Group Box

The radio buttons in the Units group box, found in the upper right-hand portion of the screen, permit the user to specify parameters in one of two systems of measure: English or Metric. All parameters, with the exception of display format, convert automatically between the two units of measure.

5.4.5. Parameter Modification

The user may modify all parameters displayed within the Parameter List Box. Unlike axis parameters, the only way a user can modify the value of a machine parameter is through direct entry. To change a parameter value, the user must select the parameter within the Parameter List Box, place the cursor into the Current Setting group box, and enter the new value. Upon pressing the **<Enter>** key, the new value is sent to the axis processor, and updates the Parameter List Box.

5.4.6. File Control

Changing parameter values within the Machine Parameter Editor will affect those currently in use. However, the user must save these parameters in order for the system to restore them upon future invocations of "MAINMENU". The lower portion of the screen contains push buttons that permit the user to save the new values to a file, and restore the old values from a file. To identify these push buttons, look for the labels "Save-F2" and "Load-F3". Another way to access these functions is through the [F2] and [F3] function keys. These functions affect the MACHINE.INI file (stored in a

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binary format); however, by no means should the user modify this file other than through "MAINMENU".

5.4.7. Machine Parameter Help Menu

The **Help-F1** button is for future use to display the Machine Parameter Help screen. Presently, this screen is not available.

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5.5. Machine Parameters

The following sections contain detailed information on each of the machine parameters.

5.5.1. Millimeters/Inches/Degrees Per Motor Revolution

The CNC uses this parameter along with the lines parameter for encoders to convert program units (in/mm/deg) into machine counts. (Note that if a resolver is used, the resolver axis lines default is 65,536). The number of program units (in/mm/deg) per motor revolution depends on the mechanical configuration of your system (e.g., ballscrew pitch, linear/rotary encoder/resolver, and gear ratios). For example, consider a system with a rotary encoder mounted directly to the motor that is coupled to a 4 mm pitch ballscrew. This example system would have this parameter set to 4 (i.e., 4 mm per motor revolution).



The system automatically converts the specified number into the units it requires.

5.5.2. Rapid Traverse Feedrate

This parameter defines the speed at which rapid traverse point-to-point moves occur. The CNC designates this type of move using the G0 command. The units for this parameter are in units per minute. The default value is 48,768,000 mm/min (1,920,000 in/min).

5.5.3. Home Feedrate

This parameter sets the speed that the selected axis should use to seek the home limit when responding to a HOME command. The user may also program this parameter in units per minute. The default value is 48,768,000 mm/min (1,920,000 in/min).

5.5.4. Jog Feedrate

This parameter defines the speed that the selected axis is to move while operating from the Manual Jog & Home Axes screen, as well as the hardware jog modes available from several other Aerotech applications. The user may program this feedrate in units per minute. The default value is 48,768,000 mm/min (1,920,000 in/min).

5.5.5. Lowest Feedrate

This parameter defines the lowest feedrate for the axis. The user must program this feedrate in units per minute. The default value is 1.0 mm/min (.04 in/min). Presently, this parameter is not accessible by the user.

5.5.6. Home Style

During a normal homing sequence, the axis first moves in the specified direction until it encounters the Home Limit Switch or the End of Travel Limit Switch. Upon encountering the Home Limit Switch, the axis continues to travel in the same direction until it encounters the next resolver null (or encoder marker). The axis position is then set to the value found in the Home Offset parameter. If the axis encounters the end of travel limit, it reverses direction and continues to look for the home limit. Once it reaches the home limit, it reacts as described above. A homing fault occurs if the axis finds the end of travel limit before it finds the home limit.

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However, in some systems it is advantageous to use the same limit switch for both the home limit and the end of travel limit. In this case, the user must slightly alter the homing sequence described above. Upon finding the home limit, the axis must reverse direction and begin to look for the resolver null (or encoder marker). All other actions are identical to those described above. During a homing sequence, the axis simultaneously encounters two limits: an end of travel limit and a home limit. In this case, the system ignores the end of travel limit.

This parameter serves a dual purpose. It specifies which of the two homing sequences described below applies to an axis, as well as the direction in which to begin searching for the home limit. To specify a "normal" homing sequence (described first), the user must set this parameter to a one (1). A value of two (2) associates the "Reverse to Marker" (described second) sequence with an axis. The sign of the parameter determines the direction in which an axis travels to find the home position. Positive values cause the axis to seek home in the clockwise direction while negative values occur in a counter-clockwise direction.

5.5.7. Positive Direction

This parameter specifies which direction an axis is to move when commanded to move in the positive direction. Specifying a value of zero causes positive move commands to occur in the clockwise direction, while a value of one causes positive move commands to occur in the counter-clockwise direction. The default for this parameter is for positive moves to travel in the clockwise direction.

5.5.8. Linear or Rotary

This parameter defines the type of stage that an axis is to use. The user may program linear axes in either inches or millimeters; but, must program rotary axes in degrees. The following table describes the significance of each valid value for this parameter.

0 - Linear Stage
1 - Bi-directional Rotary Stage
2 - Undefined
3 - Uni-directional Rotary Stage

The default value of this parameter associates a linear stage with the axis.

5.5.9. Drive Control Mask

This parameter is no longer used by "MAINMENU". It is included to maintain functional compatibility with older versions of "MAINMENU".

5.5.10. Home Offset

This parameter sets the number of machine steps at the end of the homing sequence once the system locates the resolver null (or encoder marker). The units for this parameter are in machine steps. The default value is zero (0). Specifying a positive value causes a clockwise offset, while a negative value signifies a counter-clockwise offset.

5.5.11. Axis Name

This parameter specifies an ASCII string used to refer to an axis. This string may be up to 8 alphabetic characters in length.

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5.5.12. Display Format

This parameter controls the number of decimal places displayed to the right of the decimal point on the position display. For additional information, refer to the Position Display found in Section 7.4.

The user must specify a separate display format for both English and Metric units. The displayed mode corresponds to the setting of the English/Metric radio button found in the Units group box.

5.5.13. CCW Software End of Travel in Inches/Millimeters/Degrees

This parameter sets a software end of travel limit for the counter-clockwise direction in either inches, millimeters or degrees (for English, Metric and rotary modes, respectively).

5.5.14. CW Software End of Travel in Inches/Millimeters/Degrees

This parameter sets a software end of travel limit for the clockwise direction in either inches, millimeters or degrees (for English, Metric and rotary modes, respectively).

5.6. CNC Parameters

If the user selects the "CNC Parameters" option from the Setup menu, a submenu appears to the right of the Setup menu (refer to Figure 5-6). This submenu contains a list of CNC general parameters and B axis parameters that a user may choose from. The B axis is a rotary axis that is used to maintain normalcy to another axis plane. Typically, the B axis holds a tool that must always be perpendicular to the part being cut.

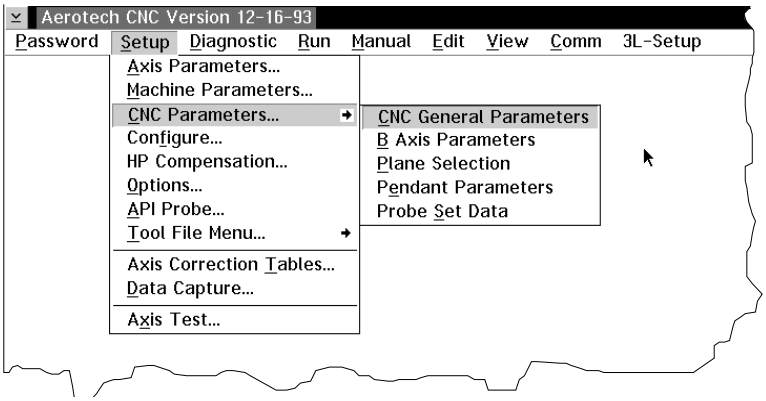


Figure 5-6. CNC Parameters Menu Options

5.6.1. CNC General Parameters Menu Selection

After selecting the "CNC General Parameters" option, the CNC initialization screen appears. This is illustrated in Figure 5-7. This utility permits the user to specify various aspects of the CNC processes currently in use.

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It is a good practice to make a backup copy of the default CNC configuration (CNC.INI) before altering any setting(s).

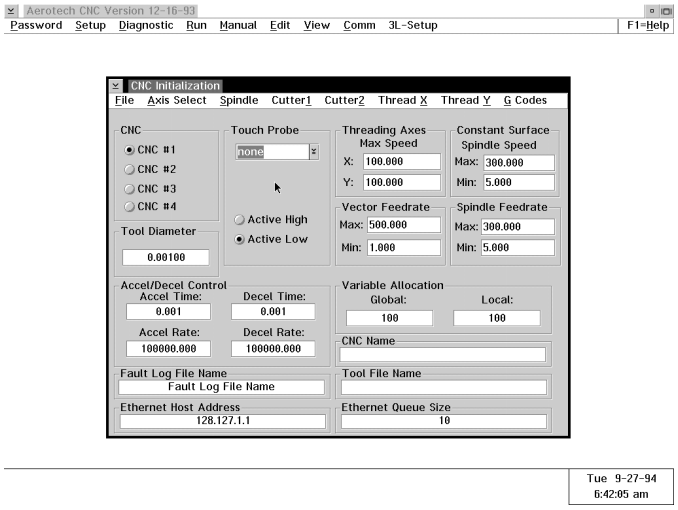


Figure 5-7. CNC Initialization Screen

5.6.1.1. Description of a CNC Process

From the perspective of the UNIDEX 31/U600, a CNC process is a group of axes controlled through a program written in a subset of the ANSI RS-274 programming language. This language permits synchronized motion of multiple axes with minimal intervention from the user.



The *U31/U600 Programming Manual* includes a brief description of the CNC programming language.

5.6.1.2. CNC Selection

The UNIDEX 31/U600 includes the ability to operate multiple CNC processes at the same time. For example, the CNC Select Group box allows the user to specify the CNC process to which these parameters apply.

5.6.1.3. Axis Selection

Once again, a CNC process refers to a group of axes commanded by the RS-274 parts program. The Axis Select menu, shown in Figure 5-8, permits the user to specify which axes are used with each CNC process. Each CNC process must have a mutually exclusive set of axes associated with it. A parts program may not command an axis that is associated with another CNC process. The "MAINMENU" program enforces this restriction by displaying the axes (in a half-tone attribute) already associated with a CNC process. The user may not select such axes.

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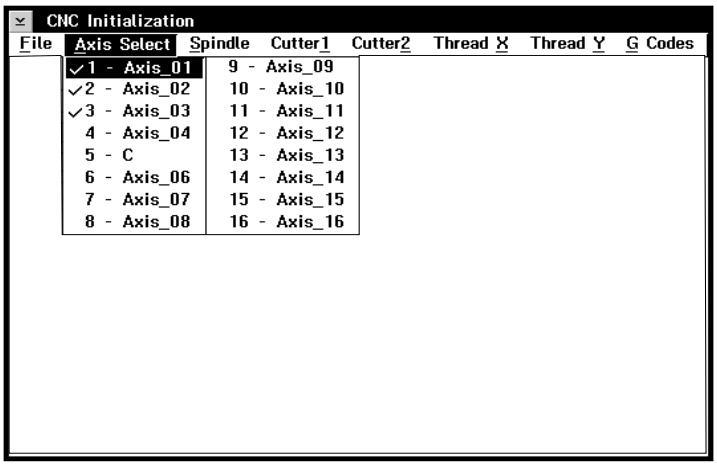


Figure 5-8. Axis Select Menu

5.6.1.4. Accel/Decel Control

There are two ways to define the characteristics of axis acceleration and deceleration for the CNC Processor of the UNIDEX 31/U600. In the first method, the user specifies a period of time in which the axes should change velocity. This method permits coordinated motion, in which all axes reach their respective commanded velocities and complete motion at the same time. The acceleration and deceleration rate may vary significantly between axes.

The Accel Rate method sustains a constant rate of acceleration and deceleration across the axes commanded to move. Since all axes may not be seeking the same velocity, the motion does not occur in a coordinated fashion. That is, all axes do not complete the

specified move at the same time. The CNC Processor waits until all axes complete their commanded move before it proceeds with the next program line.

To support both modes of operation, the Accel/Decel Control Group box contains a set of entry fields for each mode of operation. These entry fields appear in a tabular format such that the left column is for acceleration and the right column is for deceleration. The upper row operates on time-based parameters, and the lower row operates on rate-based parameters.

Each of the fields found within the Accel/Decel Control Group box operate in much the same way. The user may place the cursor in the appropriate entry field and edit the value displayed there. Pressing **<Enter>** causes the application to range check the new value. If the newly entered value is within range, the system immediately updates the old value. In the event that the user enters an invalid value, an Invalid Parameter Value dialog box notifies the user of the error and discards the new value (see Figure 5-9).

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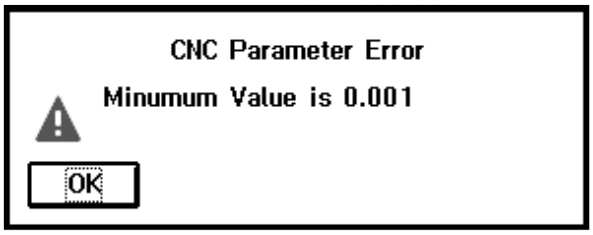


Figure 5-9. "Invalid Parameter Value" Dialog Box

The value entered for any time-based parameter must be in seconds. The resolution of each parameter is 1 millisecond (0.001 sec). The CNC Parameter Editor always rounds the specified value to the nearest millisecond. The value entered must be a positive number greater than zero. The default is for one second ramping to occur during both the acceleration and the deceleration.

The unit of measure for the rate-based parameters is user units (in/mm/deg) per second squared. That is, the value entered must correspond with the amount of velocity change that is desired each second, and must be greater than or equal to one (1.0). The default value is 100,000 units per second squared.

5.6.1.5. Vector Feedrate Limits

The Vector Feedrate Group box specifies the minimum and maximum feedrate that a CNC processor can command. A program translation error occurs if the user specifies a feedrate outside of the specified range.

The value specified is always in user units (in/mm/deg) per second, and must be a positive number greater than zero. By default, the minimum feedrate is 5.0 and the maximum is 300.0. The only restriction enforced by the CNC is that the maximum must be greater than the minimum.



The parameters used by the CNC parts program specify what values to use. After applying the manual feedrate override (MFO), the actual motor velocity may violate these constraints.

5.6.1.6. Spindle Axes: Designation and Feedrate Limits

This is a rotary axis. The user may command this axis to move at a feedrate different from the other axes associated with the CNC process. In many applications, the user mounts the part being cut onto the spindle, and the spindle rotates. The cutting tool then comes in contact with the spinning part and shaves the excess material from the outer edge.

Each CNC process may have only one spindle axis. The unit of measure associated with this axis is always in degrees. The S keyword indicates the feedrate associated with this axis.

To select a spindle axis for a given CNC process, first activate that axis using the Spindle Axis Assignment menu. "MAINMENU" displays all axes not associated with the CNC process in a half-tone (gray) color. A check mark next to a particular axis indicates a currently configured spindle axis. Refer to Figure 5-10.

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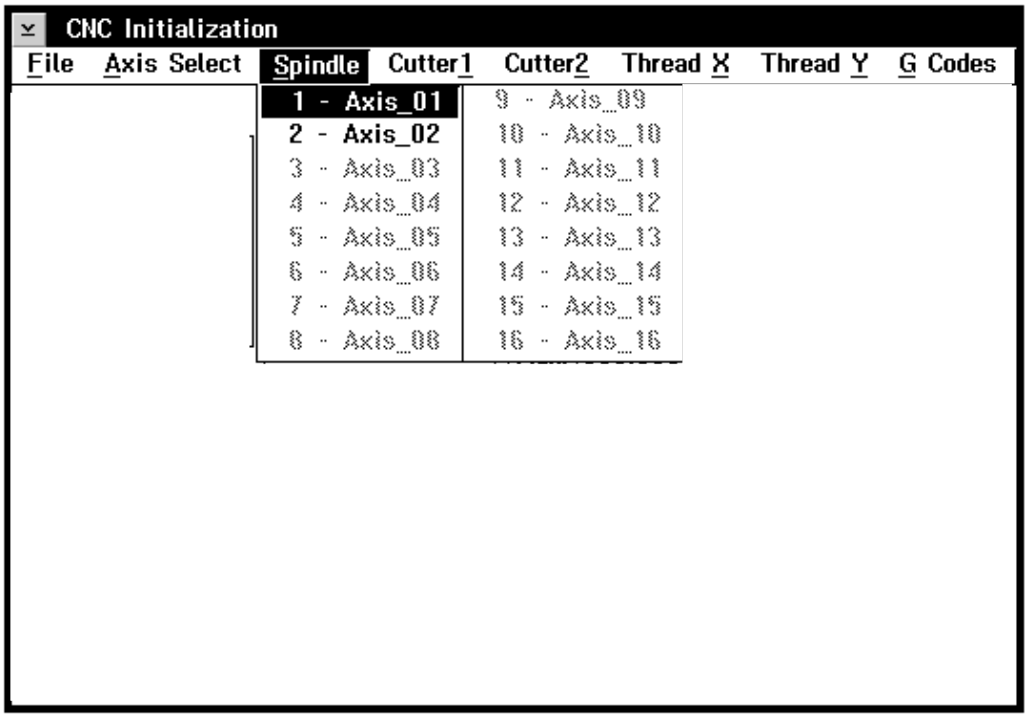


Figure 5-10. Spindle Axis Assignment Menu

To allow the Spindle Axis to function properly, the user must set the linear or rotary parameter found in the Machine Parameter Editor to "rotary".

Refer to the G codes sections 3.7. through 3.7.4. of the *UNIDEX Programming Manual* (e.g., G40 - G43, etc.) for information about setting the radius/diameter of the tool/part for constant surface speed operations.

The Constant Surface Spindle Speed group box and the Spindle Feedrate group box allow the user to specify limits on the feedrate commanded by the CNC parts program for a designated Spindle Axis. A program translation error occurs if the parts program attempts to command a feedrate outside of the permitted range.

The specified value is always in degrees per second and must be a positive number greater than zero. By default, both have a minimum of 5.0 and a maximum of 300.0. The only restriction enforced by the CNC editor is that the maximum must be greater than the minimum.

For more information on the operation and programming language of the Spindle Axis, refer to chapter 3, section 3.12. of the *UNIDEX 31/U600 Programming Manual.*

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The user may command a valid spindle feedrate that exceeds the parameter limits due to the spindle feedrate override.

5.6.1.7. Intersectional Cutter Radius Compensation (ICRC)

In cutting a work piece, the user must sometimes consider the radius of the cutting tool. For example, when an end mill cuts the sides of a work piece, the center of the end mill follows the programmed path. The outside edge of the end mill cuts around the actual work piece, offset from the programmed path by the radius of the tool.

Cutter Radius Compensation is an option that allows the operator to program the center of the cutter in such applications, so that the outside edge of the end mill cuts along the programmed path. Without this option, the operator would have to offset the actual piece dimensions based on the radius of the tool. If it becomes necessary to program angles other than 90°, it is no longer just a radius offset. Since this option handles all axis offsets, it decreases the programming effort. The "ICRC" option also allows the user to run the same program with tools of different diameters just by changing the tool diameter information found on this screen.

Implementing the Cutter Radius Compensation for the UNIDEX 31/U600 allows the user to associate a tool with two axes. Using the G-codes from within a parts program, the user can also enable or disable the compensation for the tool radius. This screen provides controls that permit the user to select the axes associated with each tool, as well as the tool's diameter.

The Cutter1 and Cutter2 menus specify which axes comprise the plane of motion that cutter compensation is applied to (see Figure 5-11). Through these menus, the operator may designate any axis for use with the ICRC control of the CNC processor, except those previously assigned (which appear in half-tone gray).



If the user designates only one axis under ICRC control, a CNC fault condition occurs upon activation of the CNC Processor. The fault type appears as a bad cutter compensation mask.

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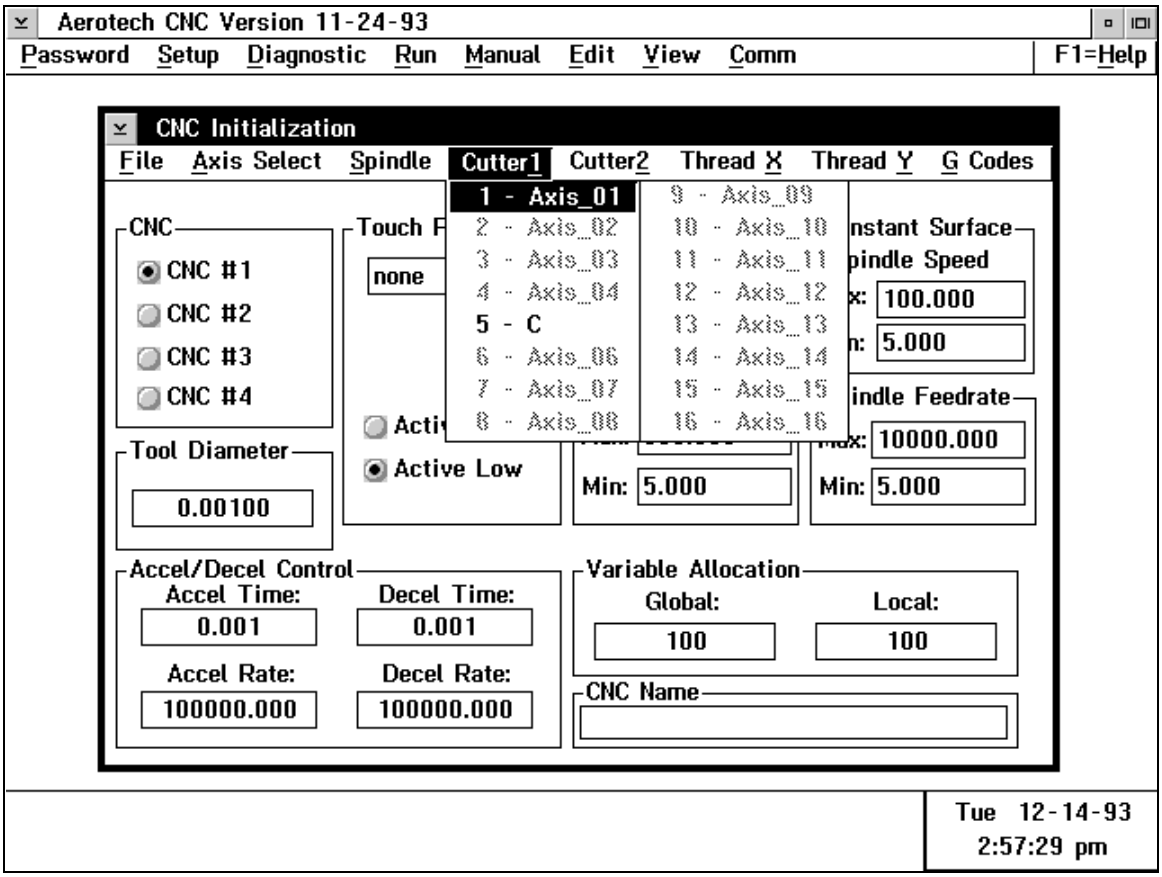


Figure 5-11. Axis Designation using the Cutter1 Menu

The Tool Diameter group box contains an entry field that permits the user to specify the diameter of the cutting tool for use on the axes being controlled by ICRC. A system that has no cutter compensation ignores the value of this parameter. To change this value, the user must place the cursor within this entry field, and edit the value. Upon pressing the **<Enter>** key the new value takes effect.

The unit of measure applicable to this diameter corresponds to the selection of G70/G71 from within the G Codes menu (see the *UNIDEX 31/U600 Programming Manual*).

Setting the tool diameter to zero causes a CNC fault condition to occur upon activation of the CNC Processor. The fault type appears as a bad cutter compensation radius.



Tool diameters may also be specified from within the parts program. Refer to the programming manual for more information.

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5.6.1.8. Threading Axes: Designation and Feedrate Limits

The CNC processor of the UNIDEX 31/U600 can perform thread cutting on a CNC turret lathe. The UNIDEX 31/U600 can cut constant lead tapered or non-tapered threads. Through the parts program, the user may specify the number of passes, the incremental depth per pass, thread lead, and taper.

The Thread X and Thread Y menus specify which axes apply to the cutting tool, where the Thread X axis runs parallel to the thread being cut (this cuts the lead of the thread) and Thread Y is perpendicular to the thread being cut (used for taper threads). Through these menus the user may select what axes to use with the CNC processor for threading control. All axes appearing with a full-tone attribute are valid, while those displayed in half-tone attributes are invalid. Refer to Figure 5-12.

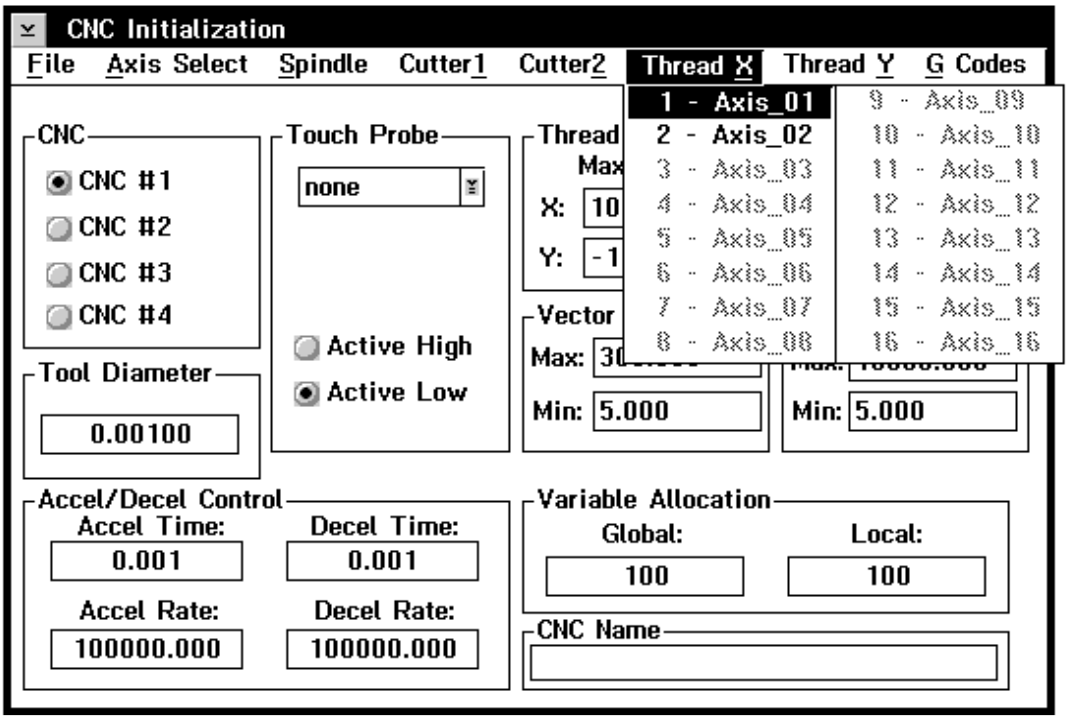


Figure 5-12. Thread Assignment Menu

The user must designate two axes as threading axes; one as Thread X and one as Thread Y.

The Threading Axes Max Speed group box permits the user to limit the feedrate attained on the cutting axes in a thread-cutting application.

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Thread cutting applications refer to an automated motion cycle designed to place threads into an outer edge of a part. Refer to the *UNIDEX 31/U600 Programming Manual* for additional information concerning thread cutting.

5.6.1.9. Initial G-code Selection

As noted in Appendix A, most of the RS-274 programming language, supported by the UNIDEX 31/U600, consists of modal G-codes. Each time the system encounters a modal G-code within a parts program, the CNC processor changes its mode of operation. The CNC remains in that mode until commanded to enter a different mode by a subsequent G-code.

The G Codes menu (illustrated in Figure 5-13), allows the user to define the initial operating modes of the CNC processor. The selected modes apply to all executed parts programs. Therefore, it is not necessary to clearly state the initial mode of operation for each program, unless it differs from what is defined here.

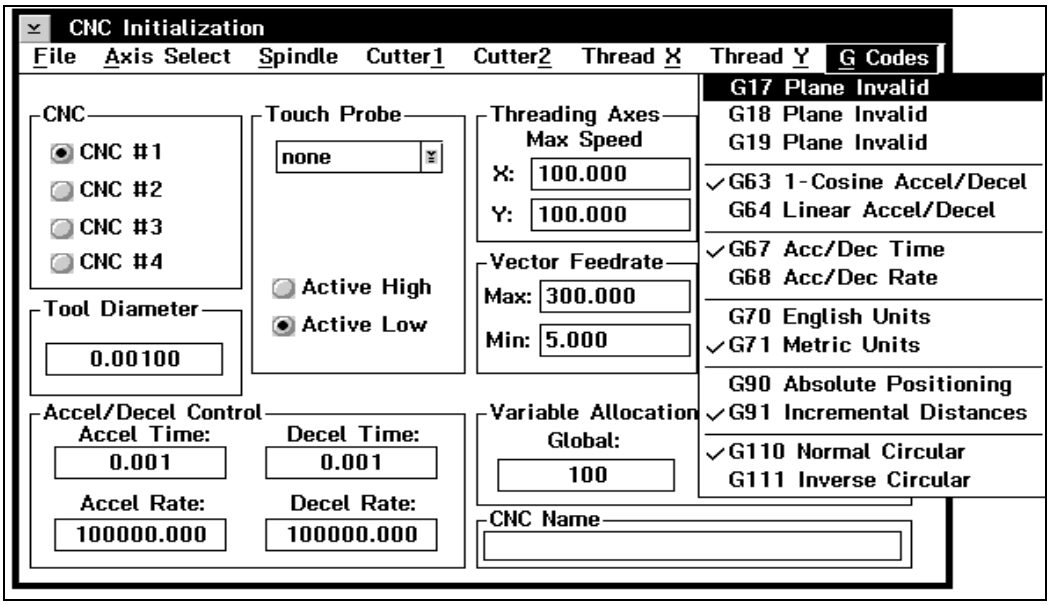


Figure 5-13. G Codes Menu

As can be seen from Figure 5-13, the items found within this menu have several divided groups. The user can select any one of these groups to configure a new operating mode for the CNC processor. A check mark found next to the mode, determines which mode to activate upon initializing the CNC processor.

5.6.1.10. Axes Plane Designation (G17/G18/G19)

All contouring commands supported by the RS-274 programming language apply to a pair of axes referred to as an axes plane. If these axes intersect and are perpendicular to each other, the user may use them to define a plane that contains all points accessible by

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these two axes. The user may easily identify each point by an ordered pair of coordinates (x,y).

The standard RS-274 language permits circular contouring on several axes planes. It also permits the program to select which axes to use when defining each plane. For example, G17 states that the first axes plane has both Axis #1 and Axis #2, while the second axes plane consists of Axis #3 and Axis #4, and so on. The G18 command designates Axis #3 and Axis #1 to define the first axis plane, and Axis #2 and Axis #4 to define the second. G19 implies that Axis #2 and Axis #3 define the first plane, while Axis #1 and Axis #4 define the second.

By selecting a G-code from the first group within this menu the user may designate the default axis plane. This axes plane represents the initial plane designation for use with a given CNC process. By default, the G17 command selects the initial plane designation.

5.6.1.11. Accel/Decel Type (G63/G64)

To maintain synchronization, all axes associated with a given CNC must use the same type of acceleration and deceleration. The types supported by the UNIDEX 31/U600 are sinusoidal (1-cosine) and linear. The user may select the desired mode from within the second group of fields within this menu. Choosing G63 enables sinusoidal type ramping, while G64 enables a linear type ramp. The default is to have sinusoidal ramping occur.

5.6.1.12. Accel/Decel Mode (G67/G68)

Through time-based or rate-based parameters the user may define the acceleration/deceleration rate for use with the CNC Processor of the UNIDEX 31/U600. The current G67/G68 state specifies which set of parameters to use for trajectory generation within the moves. With G67 as the active mode, the UNIDEX 31/U600 uses time-based parameters to compute the trajectory, while G68 uses the rate-based parameters. The default is to have the system use time-based parameters.

5.6.1.13. English/Metric Units (G70/G71)

Another feature of the UNIDEX 31/U600 CNC language is that the user may specify distances in two ways: inches or millimeters. The units for all axes associated with a given CNC process must be consistent.

The fourth group of G-codes, found in this menu, permit the user to specify the default unit of measure associated with each CNC process. G70 specifies programming in inches, while G71 specifies millimeters. By default, the initial unit of measure is inches.

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5.6.1.14. Absolute/Relative Positions

The last group of G-codes, from within this menu, defines how the CNC process interprets positions encountered within a parts program. The RS-274 programming standard supports two modes of operation: absolute and incremental programming. While operating in the absolute mode, the system interprets all positions as the distance from a fixed point (the fixed point being the software home). However, the incremental mode interprets these positions as relative to the current axis position.

To start the CNC processor in the absolute mode, the user should select the G90 option from this group. Choosing G91 causes the system to interpret all positions as incremental distances, which is the default.

5.6.1.15. Global and Local Variable Allocation

In addition to the RS-274 commands, Aerotech provides commands that define variables, labels, and subroutines. The user must allocate the memory for the variables prior to using them within the parts program. However, the user may not dynamically increase the allocated memory.

A Variable Allocation group box, found in the CNC Initialization screen, permits the user to select how many variables to allocate for the CNC processor. The user must select this number prior to executing the parts program.

The term global refers to variables which can be used by any program in any CNC. The "Global" entry field sets the limit on the number of global variables. Global variables are referred to by "global<n>" where n is an integer between zero and the allocated number minus one. For example, if 100 global variables are allocated, they would be referred to as global0 through global99.

The user must allocate memory for each variable prior to executing the parts program. Therefore, the user must specify the maximum number of variables that a parts program may use.

Local refers to the variables which apply to any program within one CNC. The user can change the number of local variables permitted by entering the new value into the "Local" entry field, and pressing **<Enter>**. Local variables can not be used across multiple CNCs.

5.6.1.16. Touch Probe

The CNC language of the UNIDEX 31/U600 also supports a touch probe. The CNC Processor must know that a touch probe exists and what the configuration for that probe is. The Touch Probe group box allows the user to configure the system for the touch probe.

This group box contains a drop-down list box that indicates the channel over which the system receives the touch probe input. The user may scroll through the channels and may select the one that corresponds to the configuration being used. The option "none" specifies that no touch probe is currently in use. Also in this group box are radio buttons that specify the polarity of the probe being used.

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5.6.1.17. File Control

Changes made from within the CNC Initialization screen affect the parameters currently in use. To allow future invocations of "MAINMENU" to reflect the new parameter values, save the parameters to a file. The File menu provides functions that permit the user to save the new values to a file, as well as restore the old values from this file. The options that permit these function are: **Save-F2** and **Load-F3**. As expected, the user may also access these functions using the [F2] and [F3] function keys. These functions affect the CNC.INI file (stored in a binary format) and should not be modified by the user.

5.6.2. B Axis Parameters

In the context of the UNIDEX 31/U600 CNC Processor, the term "B Axis" refers to a rotary axis that maintains a "normal" relationship to a particular axes plane. In a typical usage, there is a one sided cutting tool attached to this axis. The part being cut is within this axis' plane. As the part moves, the tool rotates to keep the cutting edge perpendicular to the part being cut.

For a listing of which parameters apply to each axis refer to the B Axis Initialization dialog box (Figure 5-14).

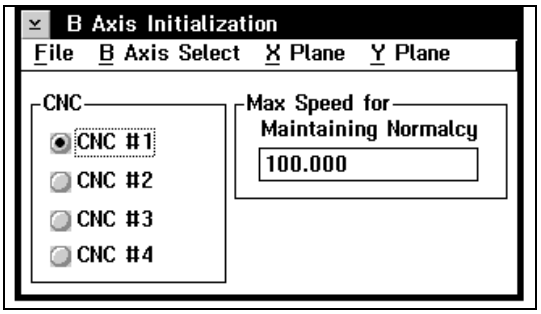


Figure 5-14. B Axis Initialization Dialog Box

5.6.2.1. CNC Selection

The UNIDEX 31/U600 supports the operation of multiple CNC processes concurrently. The CNC Select group box will allow the user to specify the CNC process to which these parameters apply.

5.6.2.2. B Axis Selection

The B Axis Select menu (see Figure 5-15) specifies which axis to use for holding the cutting tool. Through this menu the user can select which axis they want for the "B Axis", but it must be one of the axes associated with the selected CNC processor which will be displayed in normal text. If an axis is currently selected, it will have a check mark next to it.

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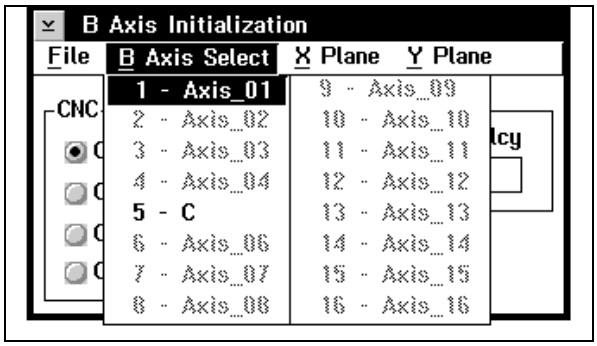


Figure 5-15. B Axis Select Menu

5.6.2.3. Axis Plane Designation

As mentioned, the purpose of the B axis is to maintain a "normal" relationship to some axes plane. The "X Plane" and "Y Plane" menus indicate which axes are to be used with the B axis. Like the B Axis Select menu, these menu's display valid selections as full-tone attributes, while the invalid selections contain only half-tone attributes. A check mark indicates which of the axes are current.

5.6.2.4. Limiting "B Axis" Velocity

The Max Speed for Maintaining Normalcy group box (see Figure 5-16) specifies the maximum speed that the B Axis may move to compensate for X/Y plane movements. The user must enter this value in degrees per second, and must be a positive number greater than zero. The default for this parameter is 100 degrees per second.

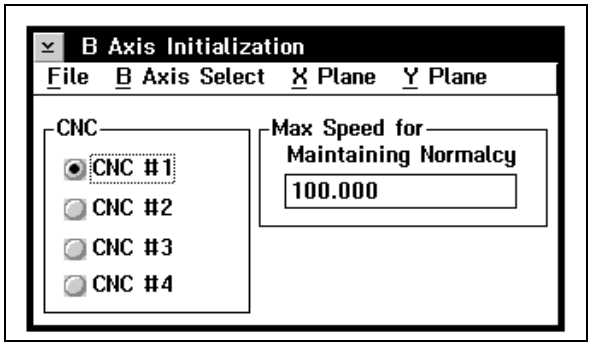


Figure 5-16. Max Speed for Maintaining Normalcy Group Box

5.6.2.5. File Control

Changes made through the B Axis Initialization screen affect all parameters currently being used. The user must save these parameters to a file for future invocations of "MAINMENU" to reflect the newly entered values. The File menu provides a way for the user to save the new values to a file, and restore the old values from this file. These options are **Save-F2** and **Load-F3**. As expected, the user may also access these functions using the [F2] and [F3] function keys. These functions affect the CNC.INI file (stored in a binary format) and should not be modified by the user.

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5.6.3. Plane 1 Selection

The next option under the CNC parameters is the plane selection. Figure 5-17 shows the Plane Initialization screen. This screen allows the user to select the axes to associate with the X, Y, and Z planes. These planes define which axes are to be used in circular moves. Refer to the *UNIDEX 31/U600 Programming Manual*, chapter 3 for additional information concerning the G-codes associated with circular moves (e.g., G2, G3, G17, G18, and G19).

Select the desired CNC process by clicking on the corresponding radio button. Only one CNC process can be selected at a time.

To select an axis, use the corresponding Plane Axis menu, see Figure 5-18. A check mark appears by the currently selected axis. This axis is also displayed in the Selected Plane Axes group box beside the appropriate plane. Invalid axes are shown in half-tone. These axes can not be selected for any plane.



Plane 2 axis selection is made via the G27/G28/G29 commands.

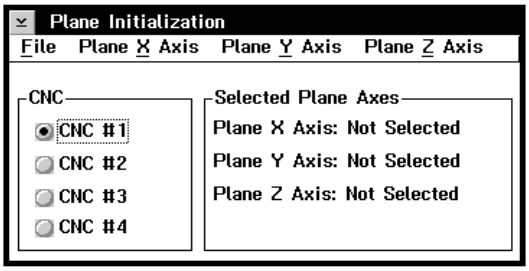


Figure 5-17. Plane Initialization Dialog Box

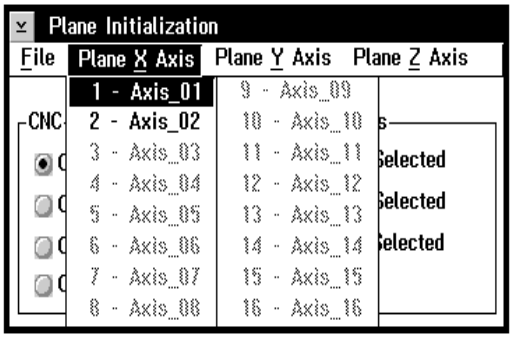


Figure 5-18. Plane Axis Menu

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5.6.4. Pendant Parameters

This is the last option under CNC parameters. Figure 5-19 shows the Pendant Initialization dialog box. This screen is used for associating a pendant to a particular CNC. To select a CNC process, click on the radio button beside the desired CNC process.

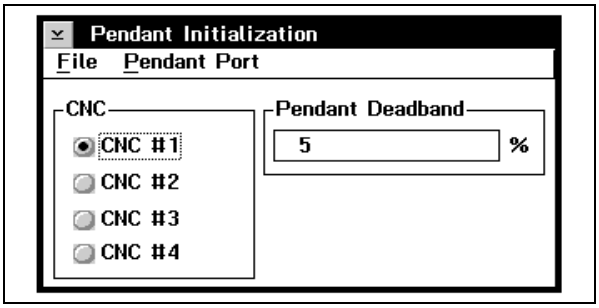


Figure 5-19. Pendant Initialization Dialog Box

The Pendant Port menu, as shown in Figure 5-20, allows the user to select which communication port to associate with the pendant. There are four available RS-232 ports on the Axis Processor. Select None if no pendant is being used.

The "Pendant Deadband" entry field allows the user to specify the stationary deadband range. This percentage creates a deadband region around the pendant center point. This is useful in eliminating unwanted motion caused by slight movements in the pendant.

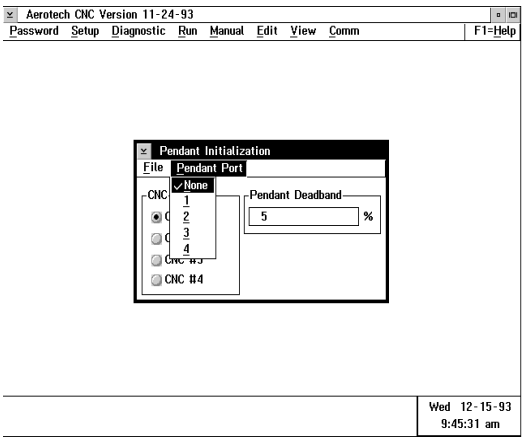


Figure 5-20. Pendant Port Menu

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5.6.5. Probe Set Data

The Probe Set Data option of the Setup CNC Parameters... menu causes the Probe Offset Data Initialization window to be displayed. This window is illustrated in Figure 5-21. This screen is used for touch probe configuration.

The CNC field contains radio buttons that select the CNC program that uses the touch probe. U axis and W axis offset values are displayed in separate fields, as is the probe tip radius.

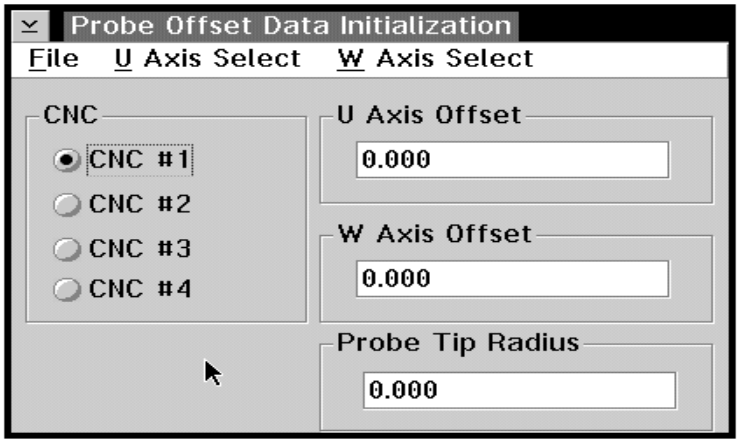


Figure 5-21. The Probe Offset Data Initialization Screen

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5.7. Axis Configuration Setup

After selecting the "Configure" option from within the Setup menu, the Axis Configuration Setup screen appears (See Figure 5-22). This utility permits the user to specify the hardware configuration of all axes in the system.

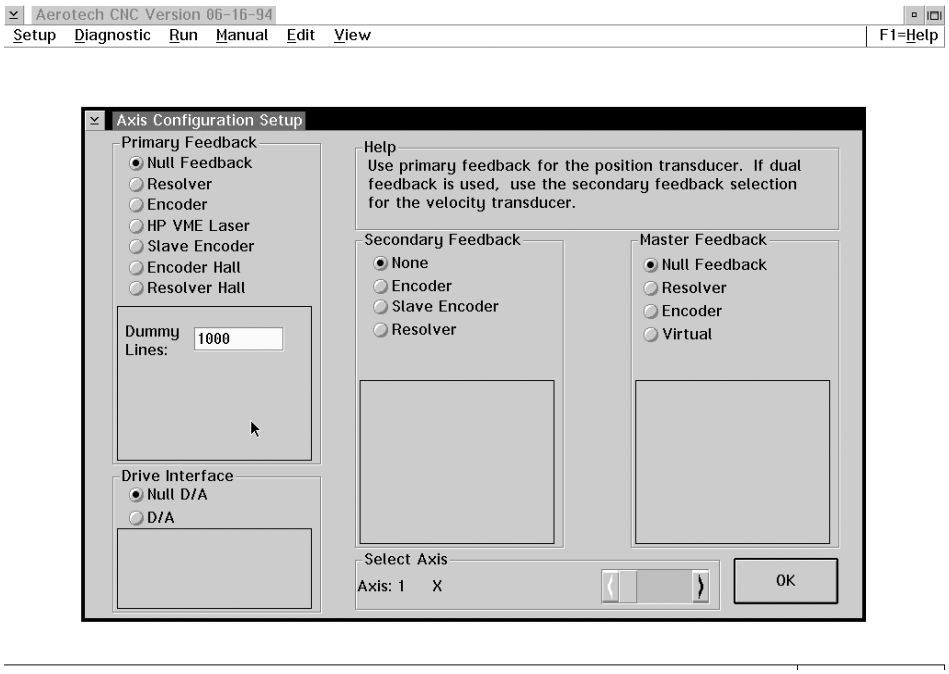


Figure 5-22. Axis Configuration Setup Editor

Notice in Figure 5-22 that each of the group boxes found on this screen contains a set of radio buttons used to select the type of hardware in the system. There is also a number of entry fields to describe the characteristics of that hardware. The entry fields displayed within the group box vary based upon the currently selected type of hardware.

5.7.1. Axis Selection

Each of the parameters available on this screen is only applicable to one axis. Therefore, the user must have some method of specifying the axis to which the displayed parameters are applicable. This method requires that the user access the Select Axis group box. This box contains an indication of the currently selected axis, both by name and number, as well as a scroll bar to permit axis selection. The user can sequentially move through the axes using the arrows at the ends of the scroll bar. Mouse users may move directly to a given axis number by dragging the scroll bar until the display shows the desired axis name/number.

5.7.2. Primary Feedback

This group box allows the user to select the type of position feedback device being used with the selected axis. The types of feedback devices supported as the primary feedback

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device include: null, resolver, encoder, HP VME laser interferometer, and slave encoder, encoder hall, and resolver hall. The system defaults to using a null feedback device.

5.7.2.1. Null Feedback and Dummy Lines

Selecting a null feedback device for a given axis implies that there will be no feedback device associated with that axis. The system treats the axis as a virtual axis. That is, the system performs all calculations normally, but uses the velocity command as the velocity feedback, canceling all motion. One of the advantages of using this feature is that the user may use it to debug programs before hardware availability.

In Figure 5-22, with Null Feedback selected as the type of primary feedback device to use, the "Dummy Lines" entry field appears within the Primary Feedback group box.

The value placed in the "Dummy Lines" entry field specifies the resolution of the virtual feedback device, and must be non-zero. Commonly used values include 500 and 1000. The default value is zero (0).

5.7.2.2. Resolver Feedback

A resolver is a two-phase, rotary electromagnetic transducer used to provide absolute positioning information over one electrical cycle (typically one motor revolution). This device is rugged and relatively noise insensitive, and can transmit position data over fairly long distances.

As with the selection of the Null feedback type, selecting the "Resolver" option changes the appearance of the group box located just below the radio buttons. To identify the entry fields that relate to the resolver feedback, see Figure 5-23 below.

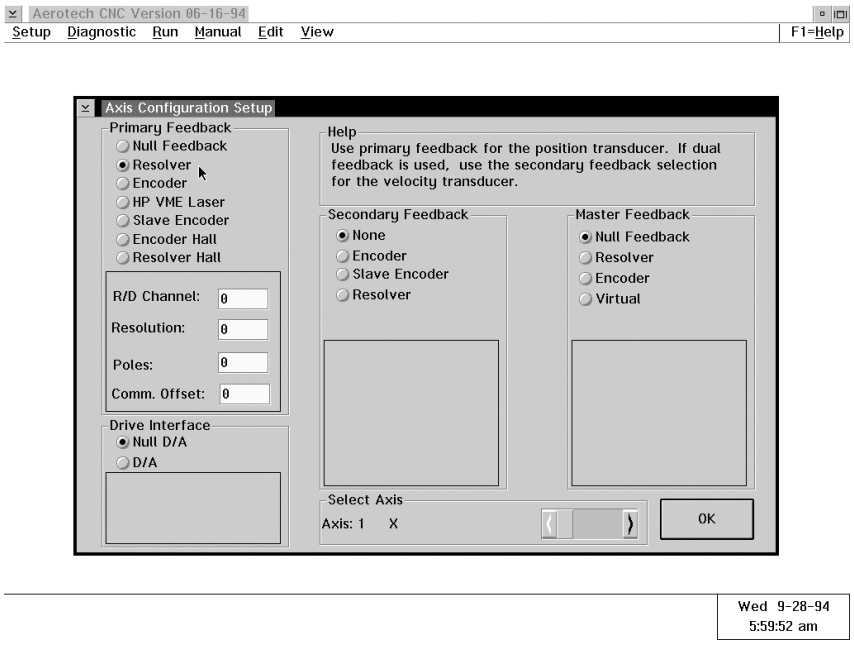


Figure 5-23. Resolver Feedback Configuration Parameters

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The "R/D Channel" entry field specifies the channel over which the system will receive the feedback. Valid channel numbers are 1-16, and typically correspond to axis 1 through 16. The default value is zero (0) and implies an invalid channel number.

The resolution entry field specifies the number of bits of resolution associated with the type of resolver being used. Valid settings for this parameter include 10, 12, 14, and 16. The default value is zero (0) and is invalid.

The value placed into the poles entry field corresponds to the number of poles found on the AC motor that is being commanded by this axis. To determine the correct value for this parameter refer to the documentation from the motor manufacturer.

The commutation offset value aligns the resolver with the rotor of an AC brushless motor. It specifies the difference in the angle of the motor shaft and the resolver.

5.7.2.3. Encoder Feedback

An encoder is a digital position measurement transducer that measures incremental position by counting the number of edges found on the feedback signal. The most common use for an encoder is in applications that use small to large printers and multi-axis machine tools.

As with the other feedback types, selecting the "Encoder" option changes the entry fields available within the group box. Figure 5-24 illustrates the entry fields relevant to encoder feedback.

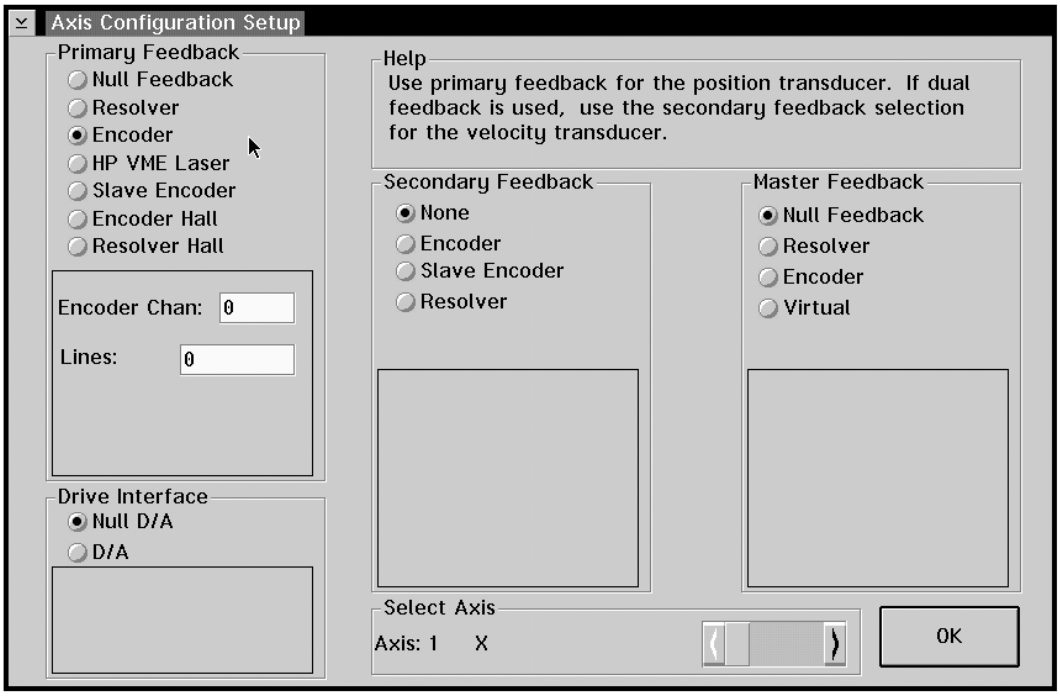


Figure 5-24. Encoder Feedback Configuration Parameters

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The encoder channel entry field specifies the channel over which the system receives the feedback. Valid channel numbers are 1-16, and typically correspond with axis 1 through axis 16. The default value is zero (0), and is invalid.

The lines entry field indicates the number of encoder pulses a system is to receive for one revolution of the motor. The valid range of this parameter includes all non-zero positive numbers. The default value, zero, is therefore invalid. To determine the appropriate setting for a particular motor/encoder refer to the documentation supplied by the motor manufacturer.

5.7.2.4. HP VME Laser

A laser interferometer is a feedback device that uses the wavelength of light in a laser beam as a basis for position measurement. It provides the highest inherent accuracy and resolution available for ultra high precision positioning.

Selecting the "HP VME Laser" option as the primary feedback source signifies that there is a VME based Hewlett Pakard laser interferometer interface card present in the system. To properly use this interface card, the user must define its characteristics. To determine which parameters to select, refer to Figure 5-25.

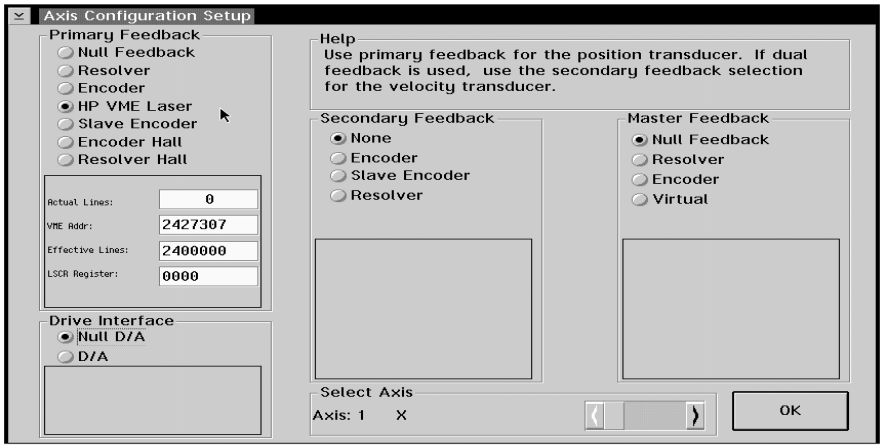


Figure 5-25. HP VME Laser Interferometer Configuration Parameters

To access the interface card, the user must know the exact location of the VME address within the VME memory map. The user must configure this VME address on the interface card itself. To properly set this parameter, consult the documentation included with the interface card.

The value placed in the Actual Lines parameter field corresponds with the number of feedback counts received from the interferometer for one revolution of the motor when the system is operating in a vacuum. This is typically a very large, precise number (i.e., 1,234,672). The system uses this number to calculate a scale factor for the conversion of

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actual feedback to effective feedback. The default value for this parameter is 808,865 counts/rev.

The value in the Effective Lines field (counts per motor revolution) corresponds to the feedback resolution used by the servo. Typically, this value is a rounded down version of the Actual Lines parameter (above) and the Environmental Compensation Factor (below). It may not exceed that product.

The laser source control register (LSCR), is used to configure the HP VME Laser. Information concerning this register can be found with the HP VME Laser documentation.

In summary, the servo uses the Actual Lines, Effective Lines, and Compensation Factor parameters in the following way:

Effective Position = Compensation * Actual Line

5.7.2.5. Slave Encoder

As mentioned, an encoder is a digital position measurement transducer that measures incremental position by counting the number of edges produced by the feedback signal.

The slave encoder refers to the encoder feedback which is monitored on a second axis processor. The parameters applicable to using a slave encoder are identical to those required for the primary encoder. Therefore the user should refer to the previous discussion of encoders for more information.

5.7.2.6. Encoder Hall

The Encoder Hall feedback option is used for encoders that use Hall effect sensor for their commutation. Where the Encoder setting is used strictly for DC motors, Encoder Hall is for encoder-based brushless motors. The Encoder Hall configuration screen is illustrated in Figure 5-26.

Encoder Channel entry field specifies the channel over which the system receives the feedback. Valid channel numbers are 1 through 16, and typically correspond with axes 1 through 16. The default value is zero (0) and is invalid.

The Lines entry field indicates the number of encoder pulses the system receives for one revolution of the motor. The valid range of this parameter includes all positive, non-zero numbers. The default value is zero (0) and is invalid. To determine the appropriate setting for a particular motor/encoder, refer to the documentation supplied by the manufacturer.

The Lines/Cycle entry field indicates the number of feedback counts per electrical commutation cycle.

The Commutation Offset entry field is used to align the commutation vector of the encoder Hall device with the rotor of an AC brushless motor. This field is given in counts per degree where 1024 counts represents 360 degrees. For example, a commutation vector of 180 electrical degrees would use a Commutation Offset of 512.

5.7.2.7. Resolver Hall

The Resolver Hall feedback option is used for resolvers with motors that use Hall effect sensors for their commutation. This option is typically used in application that have

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linear motors with Inductosyn feedback. The resolver Hall feedback configuration screen is illustrated in Figure 5-27.

The "R/D Channel" entry field specifies the channel over which the system will receive the feedback. Valid channel numbers are 1-16, and typically correspond to axis 1 through axis 16. The default value is zero (0) and implies an invalid channel number.

The Lines/Cycle entry field indicates the number of feedback counts per electrical commutation cycle.

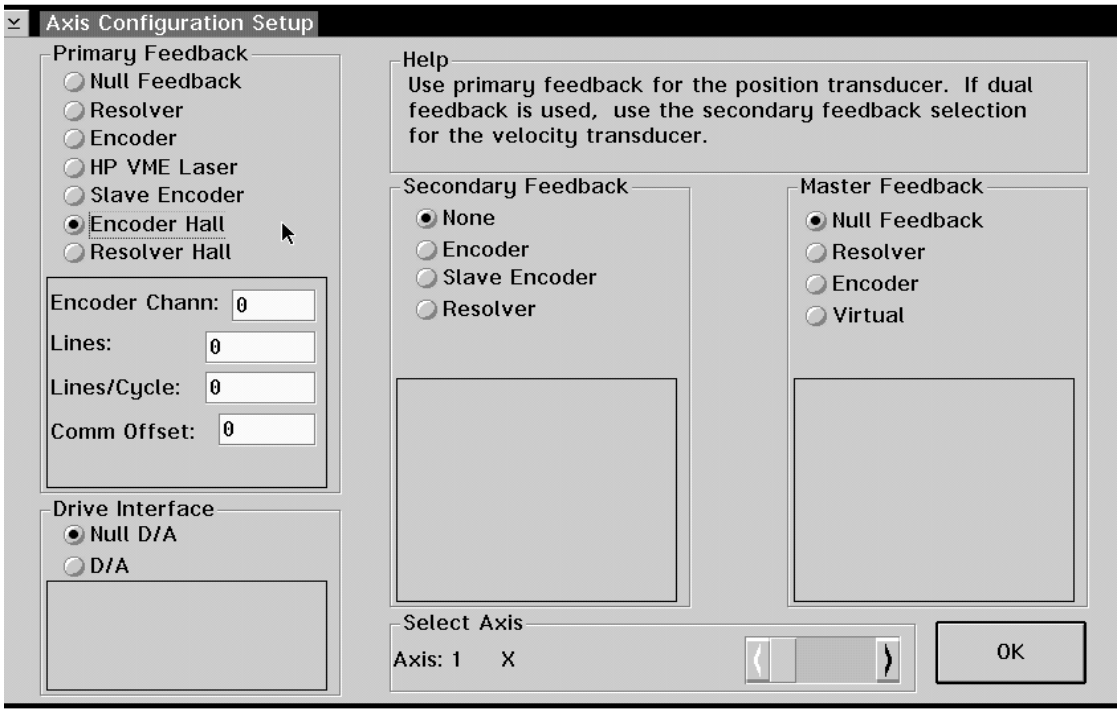


Figure 5-26. Encoder Hall Feedback Configuration Parameters

The Commutation Offset entry field is used to align the commutation vector of the resolver Hall device with the rotor of an AC brushless motor. This field is given in counts per degree where 1024 counts represents 360 degrees. For example, a commutation vector of 180 electrical degrees would use a Commutation Offset of 512.

The Hall Channel field specifies the encoder channel number where the Hall effect lines are read from.

5.7.3. Secondary Feedback

In a dual-loop configuration, the secondary feedback device supplies the servo with velocity feedback. The Secondary Feedback group box specifies the type of feedback and the parameters necessary for that device. As with the Primary Feedback group box, the

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radio buttons select the feedback types, and the entry fields displayed depend on the type of device selected.

5.7.3.1. The None Option

Select the None option when an axis has one feedback device associated with it. Since there is no secondary feedback device, it is unnecessary to select additional parameters.

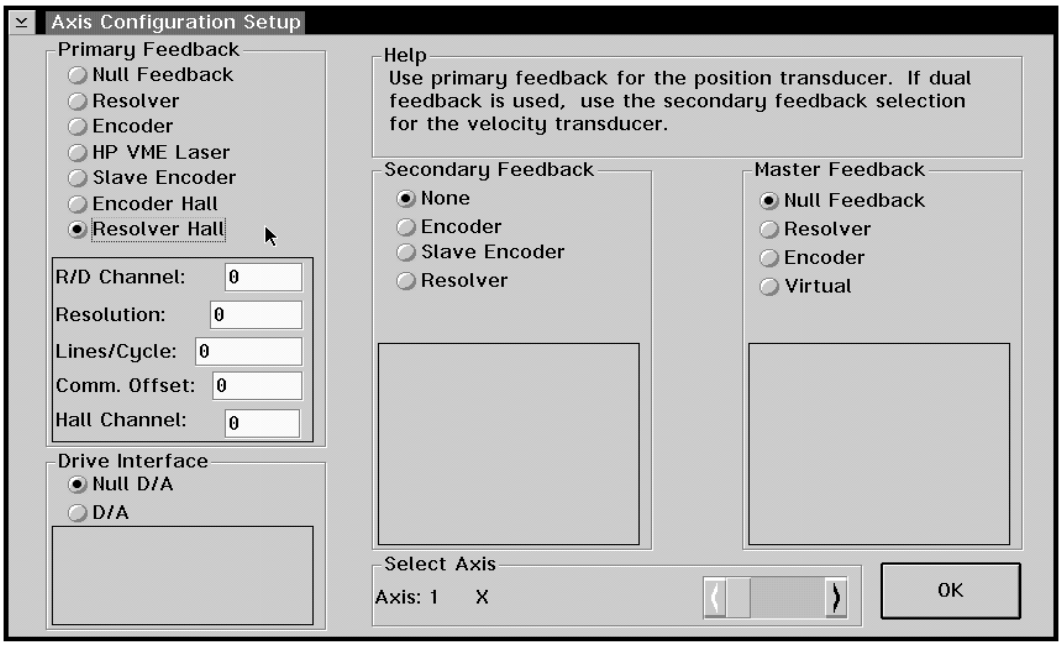


Figure 5-27. Resolver Hall Feedback Configuration Parameters

5.7.3.2. Resolver

As mentioned above, a resolver is a two-phase, rotary electromagnetic transducer used to provide absolute positioning information over one electrical cycle (typically one motor revolution). The parameters applicable to using a resolver as a secondary feedback device are identical to those specified when using it as the primary feedback device. Therefore, for more information on the settings of these parameters, please refer to the discussion of resolvers as primary feedback devices.

5.7.3.3. Encoder

As mentioned, an encoder is a digital position measurement transducer that measures incremental position by counting the number of edges found on the feedback signal. The parameters applicable to using an encoder as a primary feedback device are identical to those needed to use the device for secondary feedback. Therefore, the user should refer to discussion of encoders as primary feedback devices for more information.

The Use Velocity Marker field permits the user to specify which encoder marker to use during homing. A blank check box indicates use of a marker pulse from the primary

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(position) transducer. Conversely, setting this check box causes the system to use the secondary (velocity) transducer marker pulse.

5.7.4. Master Feedback

Select the Master Feedback group box when the axis being configured is to synchronize its motion with another axis, the "Master Axis". The most common use for this feature is with the CAM tables. Refer to the earlier description of the MASTERPOS parameter for a brief description of CAM table operation.

Like the Primary and Secondary Feedback group boxes, the radio buttons select the feedback types, and the entry fields depend on the type of device selected.

5.7.4.1. Null Feedback

Select this option in cases where there is no master associated with an axis. There is no need for additional parameters since there is no feedback device.

5.7.4.2. Resolver

As mentioned above, a resolver is a two-phase, rotary electromagnetic transducer that provides absolute positioning information over one electrical cycle (typically one motor revolution). The parameters applicable to using a resolver as a master feedback device are identical to those specified when the system uses the device as the primary feedback device. Therefore, for more information on the settings of these parameters, please refer to the discussion of resolvers as primary feedback devices.

5.7.4.3. Encoder

Again, an encoder is a digital position measurement transducer that measures incremental position by counting the number of edges found on the feedback signal. The parameters applicable to using an encoder as a master feedback device are identical to those needed to use the device for secondary feedback. Therefore, refer to the discussion of encoders as primary feedback devices for more information.

5.7.4.4. Virtual

Selecting a virtual feedback device for use as a master feedback device implies that there is no physical master feedback device associated with the axis. However, the user should synchronize motion on this axis to a virtual axis. That is, an axis that has its calculations performed normally, by the velocity command for that axis. The system also uses this axis as the velocity feedback. This effectively forms a zero following error system.

The most common use for this feature is to provide synchronization based upon time, rather than position of another physical axis. By commanding the axis to move a fixed distance at a fixed speed, the user may derive a ratio of counts per unit of time. The active CAM tables may then specify master positions in increments that directly correspond to units of time.

The Master Axis entry field specifies the axis number for use as the virtual master for this slave. Acceptable values range from 1-16, and must correspond to an unused axis.

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5.7.5. Drive Interface

This group box contains controls that permit the user to configure the Digital to Analog (D/A) interface to the drive. As with the other group boxes found on this screen, the entry fields depend upon the type of interface selected. The radio buttons in the upper portion of the box select the interface type.

Select the Null D/A interface type only when using the axis as a virtual axis. It signifies that there is no drive associated with the axis. It is unnecessary to set additional parameters, since there is no drive present.

Select the D/A type of interface when the axis has a drive associated with it. With this type selected, a D/A Channel Entry Field appears on the display (s**ee** Figure 5-28**).** The value entered into this field must correspond to the channel that the drive is attached to. Valid channel numbers are 1 through 16, and typically correspond to axis 1 through 16. The default value is zero (0), and is invalid.

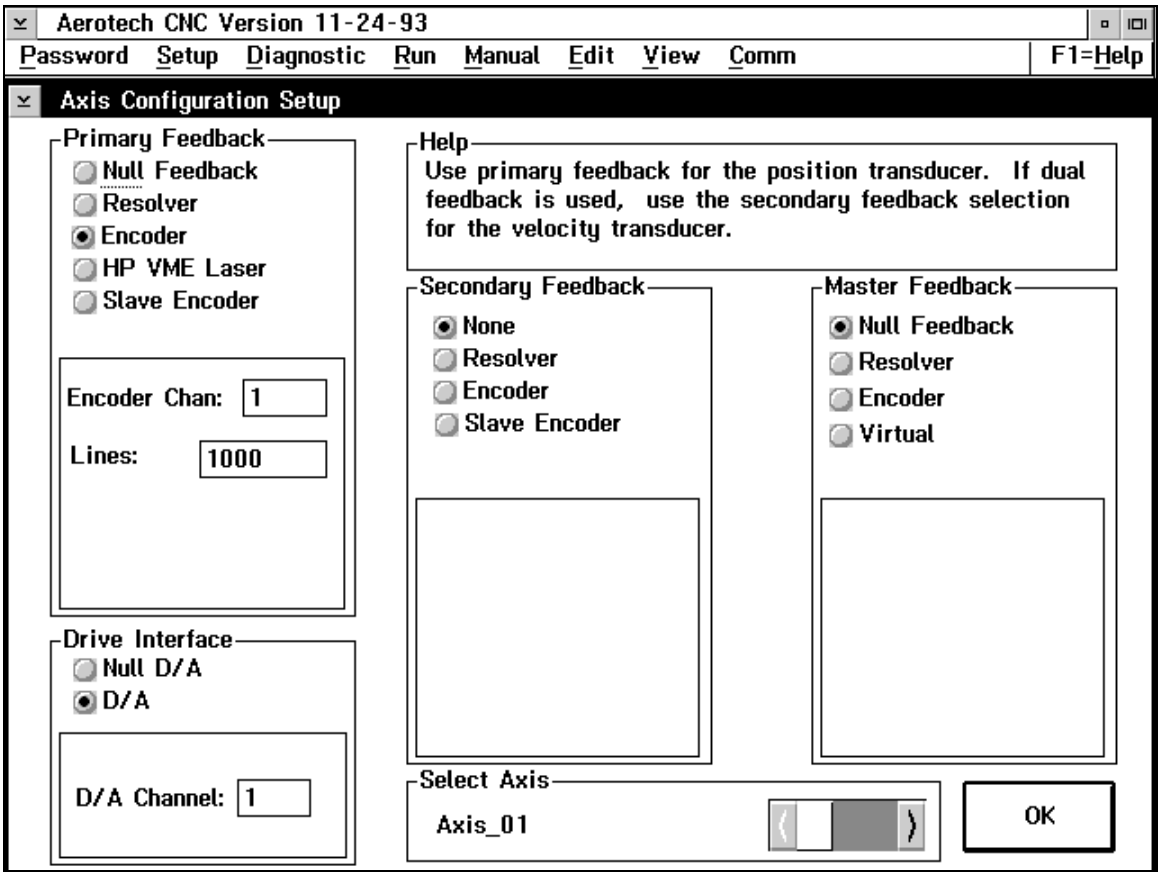


Figure 5-28. D/A Configuration Parameters

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5.7.6. Enabling Axis Configuration

Unlike the screens discussed thus far, the data entered into this screen does not immediately take effect. Upon exiting the screen, a message to the user appears along with the dialog box shown in Figure 5-29.

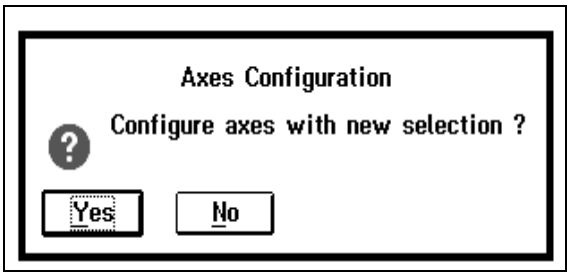


Figure 5-29. Enabling Axes Configuration Dialog Box

To enable the new configuration, select Yes. In doing so, the new configuration is downloaded to the axis processor. In the event that some or all of the configuration data entered is invalid, an Axes Configuration Error dialog box appears as notification (see Figure 5-30).

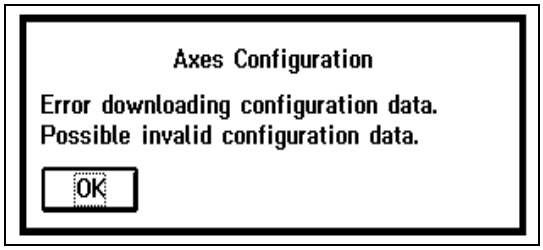


Figure 5-30. Axes Configuration Error Dialog Box

As long as no errors occur during configuration, the user may save the new configuration to a disk file using the Save Axes Configuration to Disk dialog box (see Figure 5-31).

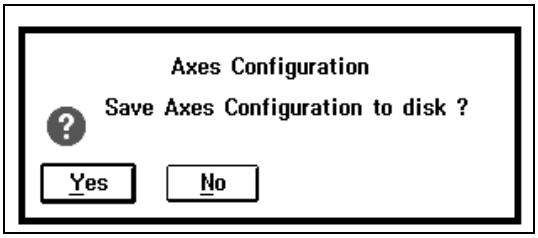


Figure 5-31. Save Axes Configuration to disk Dialog Box

Choosing the "Yes" option updates the \U31\INI\CONFIG.INI file so that it reflects the changes made to the configuration from within the editor.

5.7.7. Motor Set

The Motor Set option of the Setup menu displays the Motor Set screen. From this screen (Figure 5-32) you can align a resolver and a motor. This alignment process involves the

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commutation offset - the difference between the electrical orientation of the motor and the mechanical orientation of the resolver. A sample Motor Set screen is illustrated in the figure below.

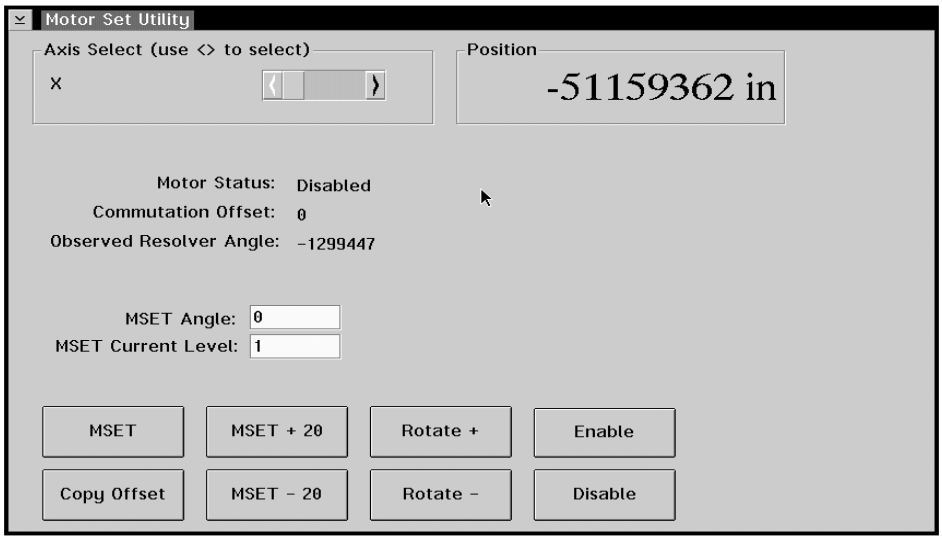


Figure 5-32. Sample Motor Set (MSET) Screen

Be sure that the motor is decoupled from the machine before using the Motor Set screen options. This will eliminate the effects of friction and/or gravity during the alignment/setup process.



5.8. Options

Selecting this item, from within the Setup menu, causes the System Options Editor to appear on the screen. Through this screen the user can specify any optional hardware that is present in the system, and the initial values for any applicable parameters. As can be seen from Figure 5-33**,** there are three options currently available: the Watchdog Timer, Analog Probe, and Miscellaneous options.

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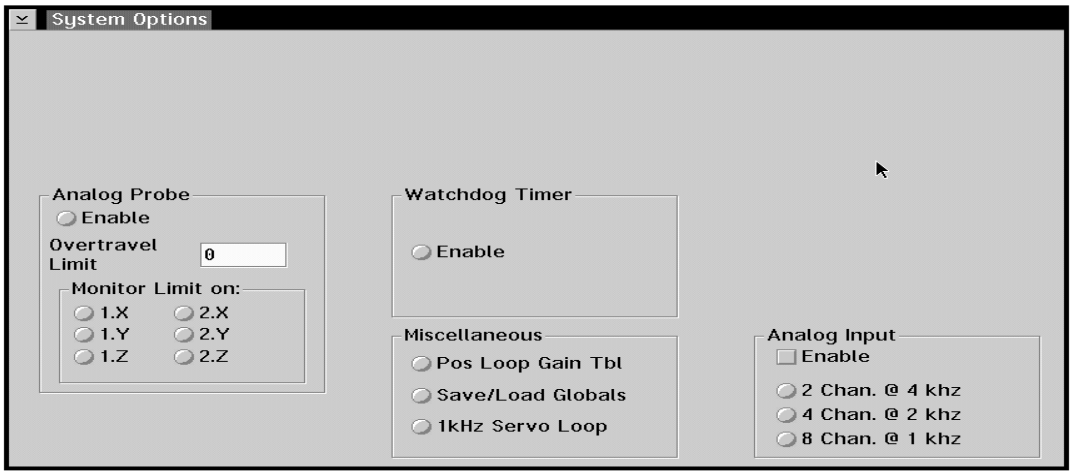


Figure 5-33. System Options Dialog Box

5.8.1. Watchdog Timer

The enable button in the group box enables or disables the watchdog timer. To enable the timer, click on the radio button. A black dot will appear in the button when it is enabled. No dot implies that the watchdog timer is disabled.

5.8.2. Analog Probe

In the event that the user attempts to configure the analog probe and encounters an error in doing so, or the system cannot locate the analog probe, an API Probe Failure Screen (Figure 5-34) appears as notification. As mentioned, upon acknowledgment of the failure, the system terminates "MAINMENU".

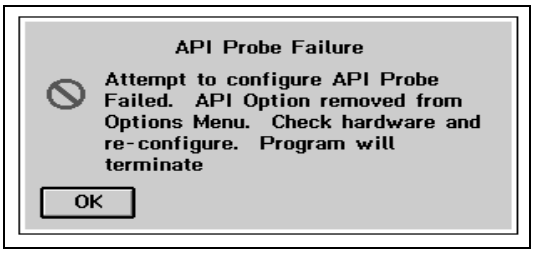


Figure 5-34. API Probe Failure Dialog Box

5.8.3. Miscellaneous

Future revisions may support other optional devices, as well as permit the user to enable or disable various software modes.

5.9. HP Compensation

Choosing this option from the Setup menu allows the user to set the Environmental Compensation Factor. This factor scales the actual feedback to compensate for environmental factors. Refer to Figure 5-35 for a display of the screen.

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To use the industry standard equations, select the "Use T, P, H" radio button (see Figure 5-35). The temperature, pressure, and humidity must be entered into the appropriate edit boxes. The Active VOL displays the current factor. The calculated factor is shown in the VOL edit box. The value entered must be less than or equal to 1.0. The default value 1.0 does not compensate for environmental factors.

To modify the current VOL in use, press the **Accept** push-button. A dialog box will appear verifying the change and instructing the user to re-home the axis. The **Cancel** push-button exits the screen without making any changes.

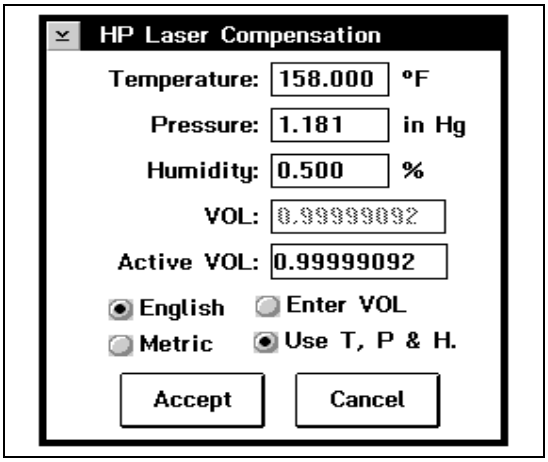


Figure 5-35. HP Laser Compensation Dialog Box

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5.10. API Probe

Choosing this option from the Setup menu allows the user to maintain the analog probe inputs, as shown in Figure 5-36, channels 1 and 2 are available with three (X, Y, Z) axis each. The display values can be set to either counts, volts, or units using the Display menu. The Time menu shown in Figure 5-37 allows the user to select the display update rate. A value of 50, 100, 250, 500, or 1000 milliseconds may be selected.

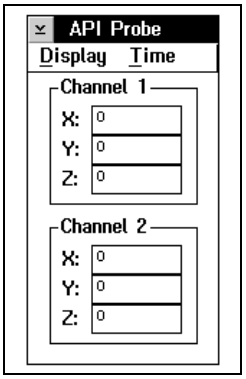


Figure 5-36. API Probe Dialog Box

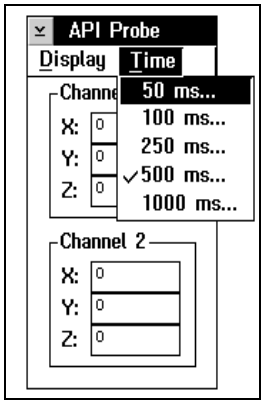


Figure 5-37. API Probe Time Menu

5.11. Tool File Menu

The tool handing feature of the UNIDEX 31/U600CNC is based on a file referred to as the tool file (TF). This file contains information on all the currently available tools in a machining station. Currently, a maximum of 18 tools may be present in any machining station. However, future releases will support the use of up to 30 tools per station. This tool information is used when Intersectional Cutter Radius Compensation is in effect.

The tool file contains one record for each tool currently available. Each tool record contains seventeen different fields. Four of these are reserved for future expansion. The information found in these fields will be read by the axis processor each time the cutting tool is changed (using the T keyword). Specifying tool T0000 deactivates all tools from the system.

The Tool File menu is used to select a tool file for the currently available machine tools. This menu is illustrated in Figure 5-38.

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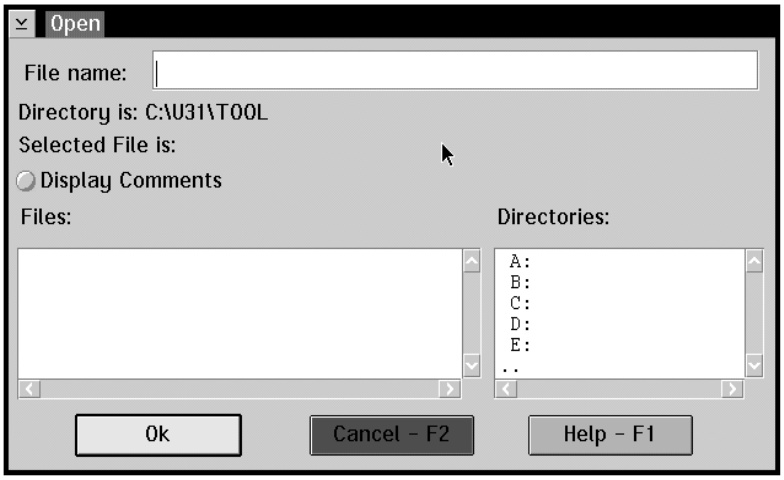


Figure 5-38. Open Tool File Screen

5.12. Axis Correction Table Configuration

This is another option available through the Setup menu. This feature permits the user to specify various points along an axis path, and the amount of error present at each point. Typical uses of this feature include axis calibration and geometric error correction.

When building these tables, the "MAINMENU" application expects the data files (***.TBL**) to appear within the \U31\CORRECT directory of the drive in which OS/2 boots. If this directory does not exist, an Invalid Directory during File Open dialog box appears on the display (see Figure 5-39).

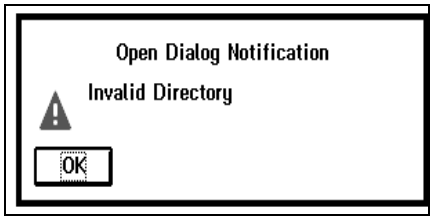


Figure 5-39. Invalid Directory during File Open Dialog Box

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5.12.1. Selecting The Axis Correction Table

"MAINMENU" provides a dialog box to aid the user in selecting which axis correction table they would like to edit. Figure 5-40 depicts this dialog box.

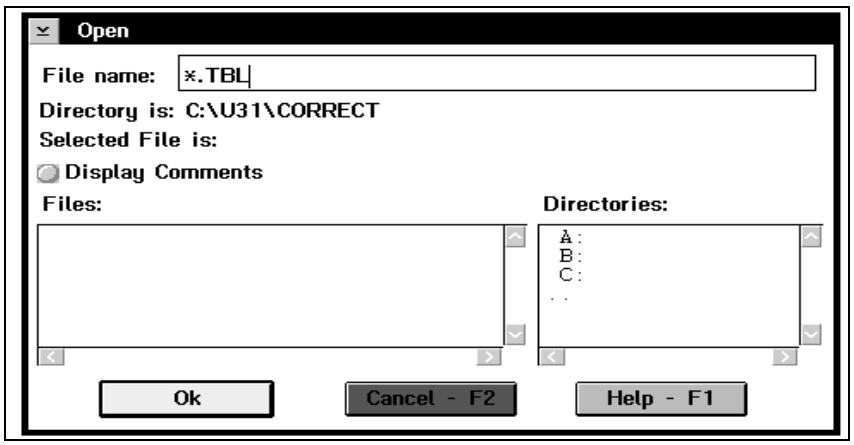


Figure 5-40. File Open Dialog Box

The various fields on this screen interact heavily with each other. For example, the data files found in the Files list box are the result of a scan of the directory displayed in the "Directory is" information field, filtered by any file specification found in the "File name" entry field.

To select a data file from the Files list box, place the cursor in this list box and scroll through the various options available. The currently selected filename appears on the display in reverse video, as well as in the "File name" entry field. The user may invoke the Axis Correction Editor on the currently selected data file by using the **Ok** Push-button.

The files currently displayed in the Files list box are not the only files that the user can select. The user may explicitly specify the name of the data file through the "File name" entry field. This is necessary if the user wishes to create a new correction table. The system accepts any valid OS/2 file specification. This includes the use of both absolute and relative path specifications. Wild card designations permit the user to alter the options available from within the Files list box. Specifying a directory path with a wild card file changes the current directory to the specified directory, and updates the Files list box with all the filenames that meet the file specification.

Another way of changing the current drive/directory is with the Directories list box. The options displayed in this list box correspond with all the disk drives found on the system, and all subdirectories of the current directory. The ".." option permits the user to move up one level in the directory tree. Selecting one of these options causes the selected directory to become the current directory, and updates the Files list box with all the filenames that meet the file specification found in the "File name" entry field.

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5.12.2. Axis Correction Table Editor

After selecting the axis correction data, the system invokes the Axis Correction Table Editor. To identify with this screen refer to Figure 5-41.

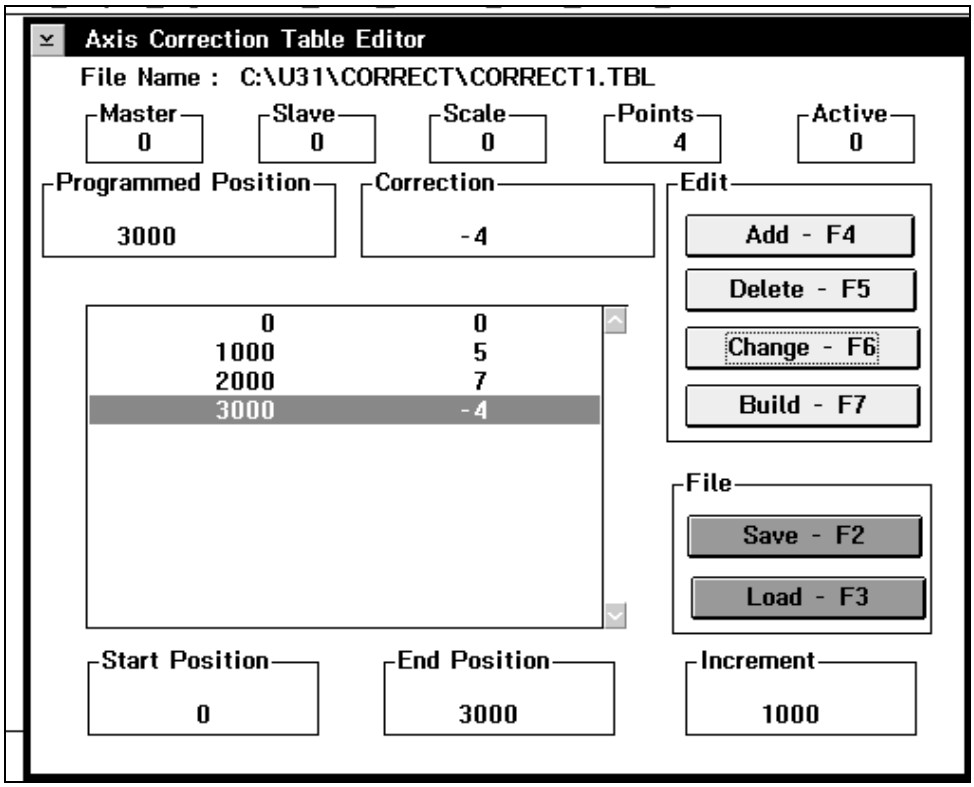


Figure 5-41. Axis Correction Table Editor Dialog Box

5.12.2.1. Usage of Axis Correction

To explain how the Axis Correction Table Editor functions, the user must have a general understanding of the UNIDEX 31/U600Axis Correction feature, and the requirements of an axis correction table. The Axis Correction function compensates for errors in the mechanics of the system (e.g., non-perpendicular stages or imperfections in the ball screw).

The general idea is that the user selects various points along the path of an axis, and determines the error at each point. Then, the axis processor adjusts the commanded position of the axis to compensate for this error. The axis being compensated does not have to match the axis whose position is being monitored.

The only restriction on the axis correction table is that the programmed positions must be ascending and non-repeating. The Axis Correction Table Editor does not enforce this restriction. Loading an invalid table into the axis processor card results in a programming error.

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The axis processor linearly interpolates the error value between the specified points.

The user must specify both the programmed position and the correction factor in machine steps. To do this, use the "Programmed Position" and "Correction" entry fields.

The system assumes that points outside the range specified in the table must have the same correction as the first/last point in the table.

5.12.2.2. Building An Axis Correction Table Template

There are several ways in which to build an axis correction table. The easiest of which is to use the **BUILD-F7** push-button to build a template, and then fill in the amount of correction necessary at each point. To accomplish this, the user must specify the starting and ending positions, as well as the increment between the points within the table. This requires using the "Start Position", "End Position", and "Increment" entry fields. To specify any of these values, place the cursor into the corresponding entry field, and explicitly type in the new value. Pressing the **BUILD-F7** push-button or the associated [F7] function key, causes the editor to: 1) generate points that begin at the start position, 2) add increment counts per point, and 3) end at a point greater than or equal to the end position. The system updates the "Points" information field to reflect the number of points generated.

5.12.2.3. Modifying the Axis Correction Table Template

To specify the amount of correction needed, the user must select each point and explicitly enter the number of machine steps of error expected to occur. The amount of error expected corresponds with the actual position minus the commanded position. Later, this error is added into the feedback for that axis during motion. Table 5-1 shows the differences between commanded and actual positions based on the sample correction data in Table 5-2.

Table 5-1. Sample Commanded Position Versus Actual Positions

Commanded Position	Actual Position
0	0
1000	1005
2000	2007
3000	2996

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Table 5-2. Sample Correction Table Data for

Commanded Position	Correction Data
0	0
1000	5
2000	7
3000	-4

As mentioned, the axis processor linearly interpolates the correction during intermediate positioning.

The user may select points in the template by placing the cursor within the list box and scrolling to the desired point. The current point appears on the display in reverse video, as well as in the "Programmed Position" and "Correction" entry fields. After selecting the point for modification, move the cursor into the "Correction" entry field, and type in the new value. Use the **CHANGE-F6** push-button or the associated [F6] function key to enter the changes.

5.12.2.4. Adding points to the Axis Correction Table Template

Within the axis correction table, it is not necessary to evenly distribute the programmed position points over the entire range of axis travel. The **ADD-F4** push-button or the associated [F4] function key inserts arbitrary points into the template.

To insert a point into the template, the user should enter the appropriate values in two places: the "Programmed Position" entry field and the "Correction" entry field. Then, they must activate the **ADD** function. The system then inserts the new point into the table before the currently selected point. Finally, the system updates the "Points" information field and shifts the remaining points down one position in the list.



To add a point beyond the last point in a table, Aerotech suggests the following procedure. (1) Select the last point in the list. (2) Use the **ADD** button to insert a copy of the last point. (3) Move down one element in the table. (4) Follow the CHANGE procedure to modify the position and correction parameters.

5.12.2.5. Deleting points from the Axis Correction Table

Since the user does not have to evenly distribute the programmed positions throughout the table he may delete unneeded points from the table to optimize memory usage. To do this, move the cursor into the list box and select the point to delete. Then, press the **DELETE-F5** push-button or the associated [F5] function key to delete the point.

5.12.2.6. Specifying the Affected Axes

The "Master" and "Slave" entry fields allow the user to select the axes to use in the correction. The "Master" entry field contains the number of the axis that corresponds to the positions placed into the correction table. The "Slave" entry field contains the number

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of the axis on which the correction is to occur. These fields do not necessarily need to specify the same axis.

For example, if using axis correction to compensate for non-perpendicular stages, each time the horizontal stage gets moved, the user must adjust the vertical stage to maintain a perpendicularity between the two. In this case, the master is the axis number of the horizontal stage, and the slave corresponds to the axis number of the vertical stage.

However, when using axis correction to compensate for imperfections in a ball screw, it is necessary to have the same master and slave axes designations. This is due to the fact that the error occurs only when the stage encounters the imperfection.

To specify a new value for either of these fields, place the cursor into the desired entry field and manually enter the new value. Press the **<Enter>** key to enter the value.

5.12.2.7. Scaling

The "Scale" entry field allows the user to select which axis, if any, to use as the scaling axis. Specifying a zero disables the scaling function. If a scale axis is selected, the correction factor will be equal to the result of the axis correction table lookup multiplied by the scale axis position.

For example, using the axis correction table from Section 5.8.2.3, if the master position is 1000 the slave correction is 5. If the scale axis position is 10 then the actual correction factor for the slave axis is 50.

To specify a new value for this field, place the cursor in the field and manually enter the new value. Press the **<Enter>** key to store the value.

5.12.2.8. Activation of Axis Correction

To activate an axis correction table, the value set in the "Active" entry field must be non-zero. This will activate axis calibration the next time the system gets initialized. Note that an axis can have more than one active axis correction table associated with it. Upon pressing the **<Enter>** key, the action takes place.

5.12.3. File Control

The system does not save the modifications made while in the Axis Correction Table Editor to the data file unless the user requests that it be done. To do this, the user must explicitly request it with the **SAVE-F2** push-button or the associated [F2] function key. The system saves the file in a binary format, and should not be modified by the user.

Also, within the File group box, there is a LOAD-F3 key that restores the correction table being edited to its last saved state.

5.13. Data Capture

Another available setup option is the Data Acquisition Parameter Editor. To enter this screen, select the "Data Capture" option under the Setup menu (see Figure 5-42). This feature permits the user to configure the default mode of operation for applications that use the data recording capabilities of the UNIDEX 31. An example of this type of application is the Plot Data Diagnostic utility (below). However, some applications may choose to change or ignore this configuration.

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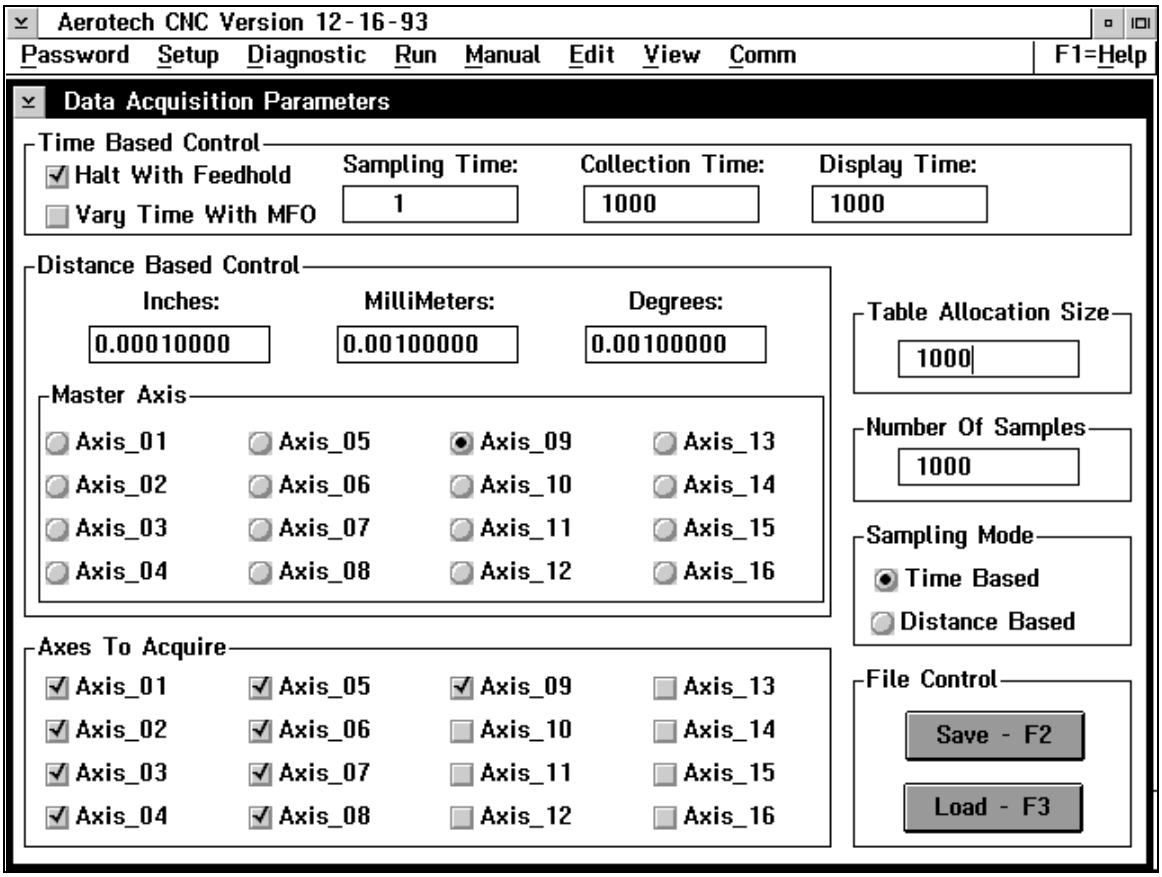


Figure 5-42. Data Acquisition Parameter Editor Dialog Box

The UNIDEX 31/U600supports two modes of data acquisition. The first mode is time based. That is, the system acquires its data over a specified time interval, with sampling to occur at a specified rate. The second mode of operation is distance based. That is, the system acquires data each time a given axis moves a specified distance. Figure 5-42 illustrates the Data Acquisition Parameter Editor dialog box.

5.13.1. Time Based Controls

As mentioned above, this mode of data acquisition causes the sampling to occur at a specified frequency for a specified period of time. The Time Based Controls group box provides entry fields that allow the user to specify these parameters. The time base for each of these fields is milliseconds.

Through the "Sampling Time" entry field the user can specify the number of milliseconds between acquisitions. The default is one, providing the maximum resolution of the system. The user may increase this to permit acquisition over an extended period of time, but with a decreased resolution.

The "Collection Time" entry field permits the user to specify the time interval over which the acquisition is to occur. The default value for this parameter is 1 second (1000 msec). The user may increase this parameter to permit acquisition over an extended period of

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time. However, it must not exceed the product of the table allocation size and the sampling time parameters.

Some applications use the Display Time parameter to scale the resolution of the data being displayed. It has no effect on the acquisition itself. An example of this is the PLOTDATA utility. This utility provides a graphical representation of the data acquired over the collection interval. Setting the value of this parameter less than the collection time causes this utility to zoom in on a smaller portion of the data. The user can then use the horizontal scroll bar to view the undisplayed acquisition data.

The Time Based Control group box also contains check box controls that permit the user to configure the data acquisition response to several controls found on the Run CNC Parts Program Screen. The Feedhold control permits Parts Program execution to be suspended at will. The Halt with Feedhold check box specifies if data acquisition is to be suspended with program execution, or if it is to be uninterrupted. For suspended acquisition, the check box must contain a check mark.

The Manual Feedrate Override (MFO) control found on several of the CNC screens varies the speed at which axis motion occurs when commanded by the CNC Processor. When specifying this speed, note that it is a percentage of the programmed speed, from 0 to 200 percent. Placing a check mark in the Vary Time with MFO check box causes the MFO to scale the data acquisition frequency by the feedrate override percentage.

5.13.2. Distance Based Controls

The distance based mode of data acquisition causes the sampling to occur each time the specified axis travels a given distance. This distance accumulates regardless of the direction in which the movement occurs. The user can specify this distance through the various entry fields in three ways: inches, millimeters, or degrees.

In this mode, the data acquisition depends on the feedback from a single axis. This axis is the Master Axis for data acquisition. To select a Master Axis use the radio buttons found in the Master Axis group box.

The "Number of Samples" entry field indicates how many acquisitions should occur before displaying the data. The default for this parameter is 1000, and may not exceed the table allocation size. The period of time over which the acquisition occurs depends directly on the movement of the Master Axis.

5.13.3. Selection of Acquisition Mode

The Sampling Mode group box contains radio buttons used to select the mode of data acquisition, once enabled by a particular application. The default sampling mode is time based.

5.13.4. Selection of Axes to Acquire

The data acquisition capabilities of the UNIDEX 31/U600permit acquisition of various parameters on a per axis basis. The user may also enable acquisition on multiple axes simultaneously. The Axes to Acquire group box provides check boxes so that the user may designate which axes from which to acquire data. A check mark in the check box indicates that the axes is enabled for data acquisition.

5.13.5. File Control

Through the Data Acquisition Parameter Editor, the user can configure many utilities. However, each of these utilities read the \U31\DATA.INI file for initial parameter values.

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"MAINMENU" allows the user to access this file by way of the File Control group box on this screen. The user may wish to write the current settings to that file. To do this, use the **SAVE-F2** push-button or the associated [F2] function key. To restore the previously saved values it is necessary to use the **LOAD-F3** push-button or the related [F3] function key.

Note that an application requiring data acquisition can use any/all of these parameters. However, there is no requirement to do so.



5.14. Axis Test Utility

This is the last option available through the Setup menu. This function performs real-time data acquisition based on certain parameters selected in the Data Acquisition Parameter Editor (discussed earlier). A very good use of this utility is for axis tuning.

5.14.1. Plot

Plot is a data acquisition application used to measure, adjust, and record the servo performance of each axis of motion. The axis processor card passes servo information to the AT front end through the VME backplane and the plot utility processes the information. The system presents this information in a graphical form that resembles both an oscilloscope and a strip chart recorder. In addition to showing servo performance in real time, the plot utility can save the data collection for later recall.

Once the plot utility executes the first screen a Plot "MAINMENU" dialog box appears on the display. This dialog box indicates that the selected axis is Axis 1 and that the status is idle in the title bar (see Figure 5-43).

The following sections cover all the available choices from within the Plot "MAINMENU" Screen.

5.14.1.1. File

Under this menu the user may load previously saved files, save the current data collection to a specific file, and inquire about the version of the plot program currently running, as shown in Figure 5-44.

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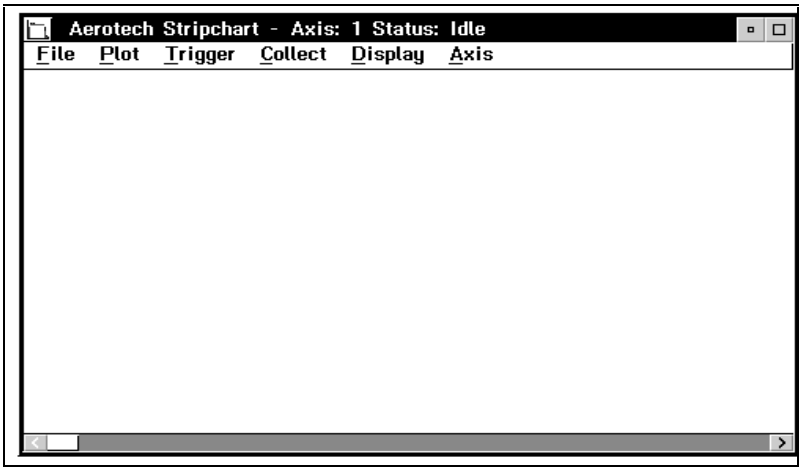


Figure 5-43. Plot MAINMENU Dialog Box

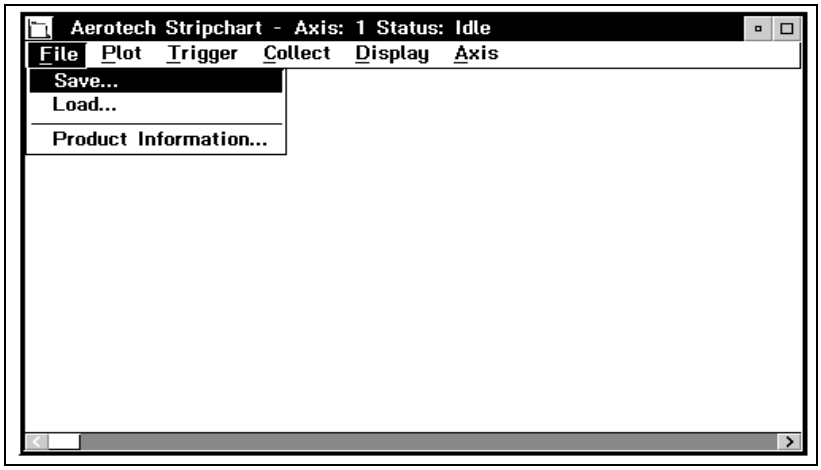


Figure 5-44. File Menu

Choosing the "Load" or "Save" option from within the File menu causes a File Selection dialog box to appear on the screen (see Figure 5-45). To enter the file name to load or save, position the cursor in the "Enter Filename:" entry field and manually enter the file name. Press the **<Enter>** key to execute this function.

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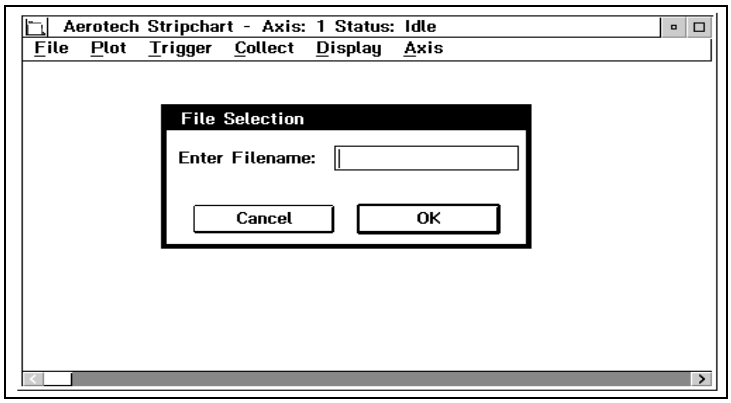


Figure 5-45. File Selection Dialog Box

5.14.1.2. Plot

This menu toggles on or off which channels of servo information to display. To determine the types of choices that exist, refer to Figure 5-46. These channels include "Actual Velocity", "Commanded Velocity", "Velocity Error", "Actual Position", "Commanded Position", "Position Error", "Torque" and a "Spare" channel. Selecting one of these channels causes the requested information to appear on the display. The information for channels not selected remains in memory and therefore the user can select it anytime data collection takes place. Each time the user saves a file, the system saves all other additional information linked to that file.

5.14.1.3. Trigger

There are five choices offered through this menu. For a list of these choices, refer to Figure 5-47. This menu behaves similar to the trigger control on an oscilloscope. The "Acquire 1 Set of Data" option performs the same function as the single sweep control on a scope. Using this control allows only one data acquisition to be performed. The "Acquire Data Continuously" option acquires data on a continuous basis and is the equivalent of putting an oscilloscope in the auto or freerun modes. The "Stop Data Acquisition" feature halts the data acquisition at the end of the current sample period.

The Set Trap Mode dialog box, shown in Figure 5-48, allows the user to set servo performance traps. The trap mode works in conjunction with the trigger control. After setting the trap, all triggering or data collection stops unless another motion command exists or the user selects either "Acquire 1 set of Data" or "Acquire Data Continuously". When using a trap to capture an event generated by an application outside of plot, the user must set the trigger to "Acquire Data Continuously".

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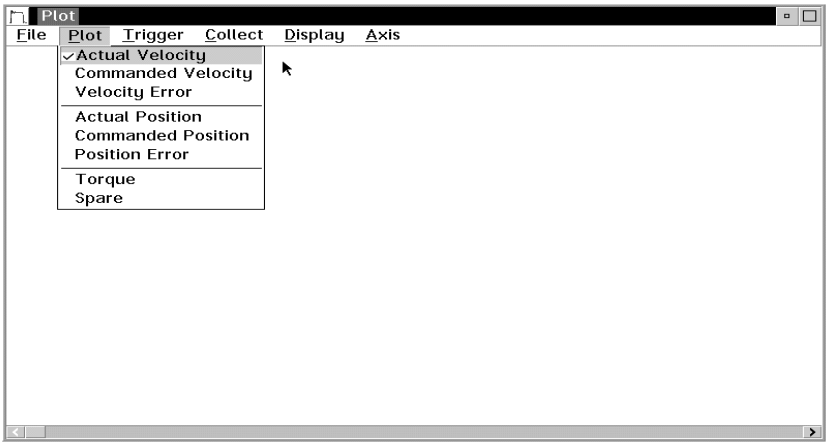


Figure 5-46. Plot Menu

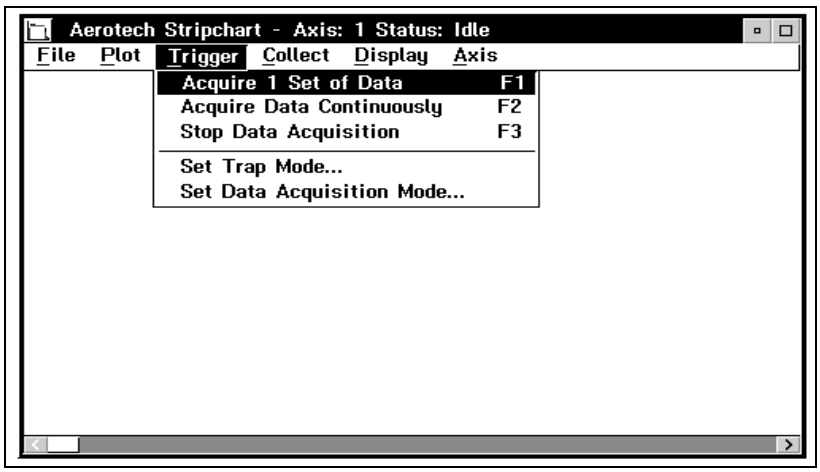


Figure 5-47. Trigger Menu

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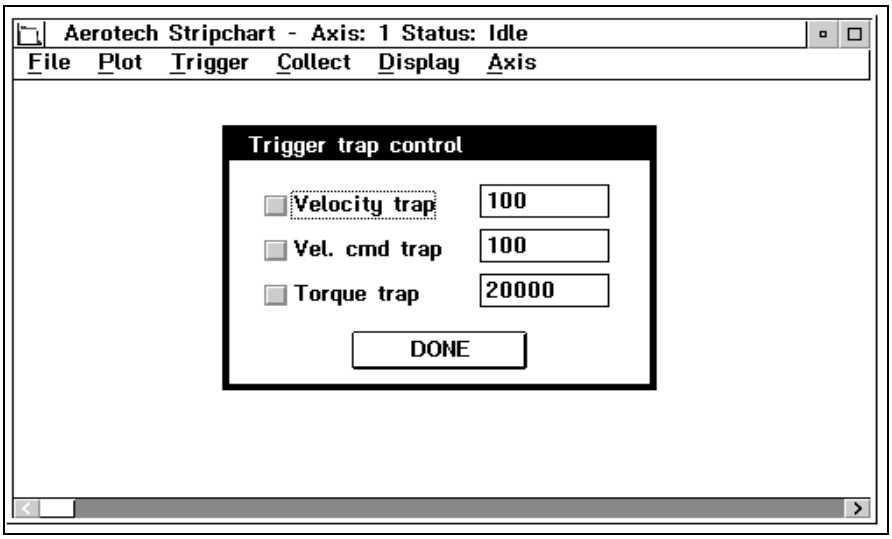


Figure 5-48. Set Trap Mode Dialog Box

There are three choices to choose from when in the trap menu. These choices include: "Velocity trap", "Velocity command trap", and "Torque trap". To set a trap it is first necessary to put a value in the box for the trap chosen and then check that trap. As an example, a value of 10000 in the "Torque trap" entry field sets this trap if the system exceeds that value while taking a data acquisition. The value put in the "Torque trap" entry field does not carry a sign and causes a trap to be set regardless of the sign of the actual velocity, velocity command, or torque command. If the plot utility generates the motion profile, the system halts the motion, but the axis enable line remains on. The data acquisition stops upon detection of a set trap, and a message indicates the sample point at which the system exceeded the trap value. If the generation of a motion profile occurred outside the plot utility, the data acquisition stops, indicating the sample point at which the trap was set, but does not halt the motion.

The final choice under the Trigger menu is the "Set Data Acquisition Mode". The mode is illustrated in Figure 5-49.

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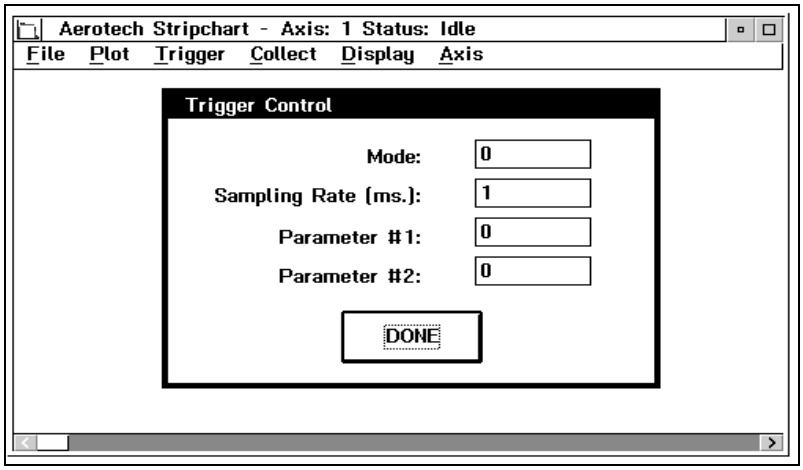


Figure 5-49. Set Data Acquisition Mode Dialog Box

This screen defines the start of the acquisition. The available modes are shown in Table 5-3.

Table 5-3. Available Data Collection Modes

Mode Number	Description
0	Starts the data acquisition at the same point as the motion profile began in plot.
1	Determines that the master position information is used to control the trigger.
2	Uses the beginning of the CAM table to control the trigger.
3	Uses the torque command information to control the trigger.
4	Used for an external software trigger source, such as an application program.

The following information describes the parameters associated with each mode.

There are two parameters associated with the trigger modes listed above: parameter #1 and parameter #2.

Parameter #1 is used with Mode 1 or Mode 3 to set the value of either the position or the torque. This acts as the trigger threshold.

Upon selecting Mode 1 or Mode 3, parameter #2 determines when to trigger the data acquisition. A value of zero allows the trigger process to occur when the "Position" or "Torque" entry field is less than or equal to the value entered in the "Parameter 1" entry field. A value of 1 in this field permits the trigger to begin when the position or torque is greater than the value entered in the "Parameter 1" entry field.

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The remaining choice in the Set Data Acquisition Mode is the "Sampling Rate". This value determines the sampling rate (in msec) for the data acquisition. The default value (which is the fastest sampling rate) is 1 millisecond. This setting along with the value chosen in the Collect menu determines the total sample time and the resolution of the sample.

5.14.1.4. Collect

Through this menu the user can set the number of samples they want to acquire. The number selected can be any one of the choices in Figure 5-50. The number of chosen samples multiplied by the selected "Sampling Rate" determines the total time that a given acquisition takes.

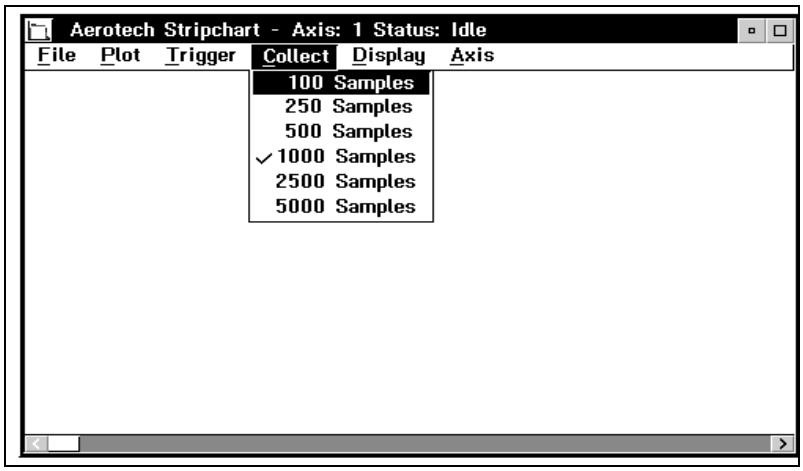


Figure 5-50. Collect Menu

5.14.1.5. Display

This menu allows the user to choose the resolution for the displayed data. It behaves similarly to adjusting the time base on a digital storage scope with a captured waveform. The user can choose a display time base that is much smaller than the acquisition time, allowing for a more detailed image of the sampled data. The user can control the position within the sampled data by using the horizontal scroll box located at the bottom of the screen. Figure 5-51 indicates the options available from within the Display menu.

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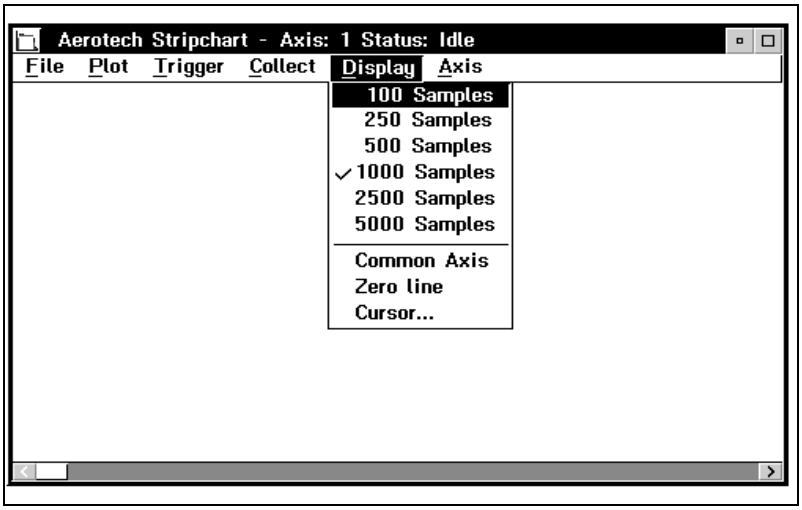


Figure 5-51. Display Menu

Also located under the Display menu is an option that allows the user to place a "Zero Line" on the display with the displayed data. Additionally, the user can toggle the screen format between a common axis and separate axis.

Selecting the "Cursor" option from the Display menu causes a Cursor Measurement Tool dialog box to appear in the lower right-hand corner of the screen (see Figure 5-52).

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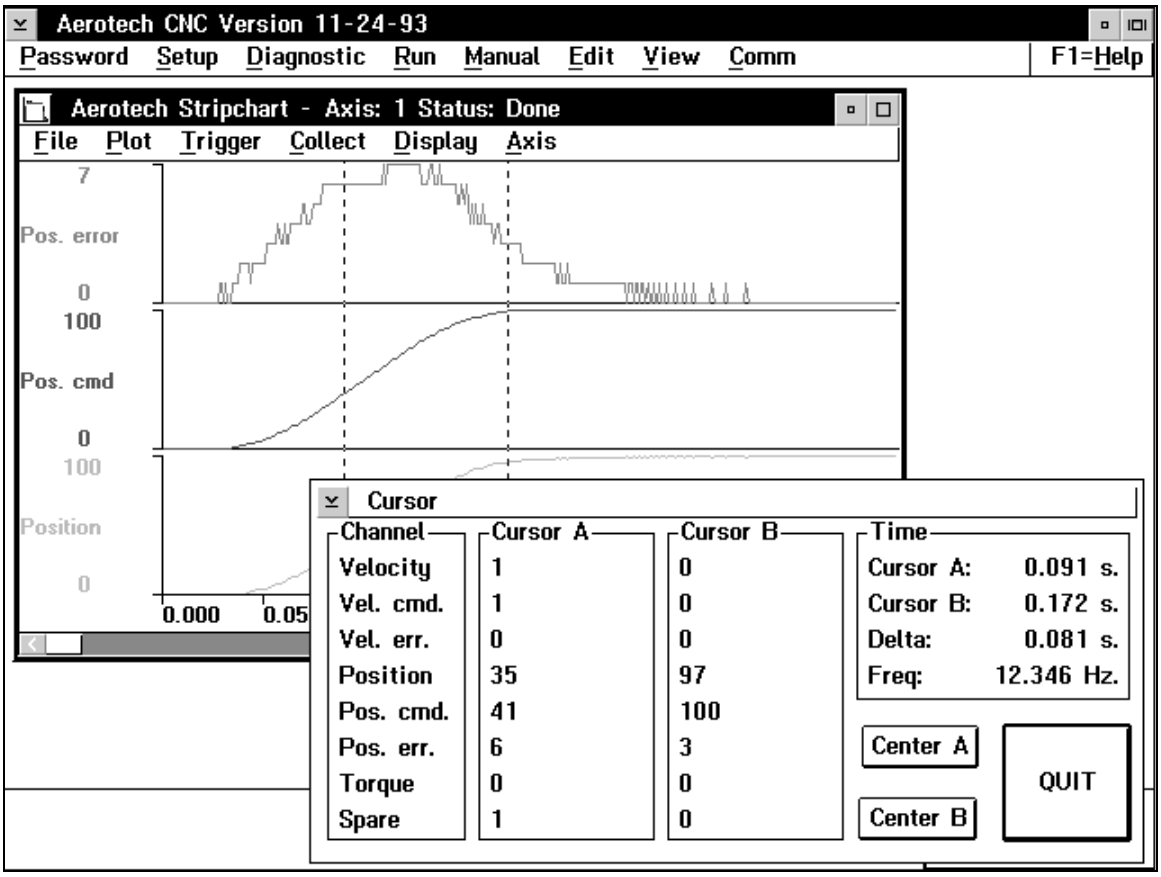


Figure 5-52. Cursor Measurement Tool Dialog Box

This tool measures the values of the sampled parameters at both cursor points. It is possible to move the cursors to a specific point within the display by clicking and dragging with the mouse. Also in this window are sample points indicating the location of each cursor, the time difference between the two cursors, and the frequency (one cycle) between the two cursors. "Center A" and "Center B" boxes allow the user to place either cursor at the center of the displayed screen. A very good use for this utility is the study of a periodic disturbance.

5.14.1.6. Axis

Selecting this menu option provides the user with many options (see Figure 5-53).

Selecting the "Select Axis" option permits the user to select or change an available axis (see Figure 5-54).

Choosing the "Set Speed/Distance" option from within the Axis menu brings about the dialog box shown in Figure 5-55.

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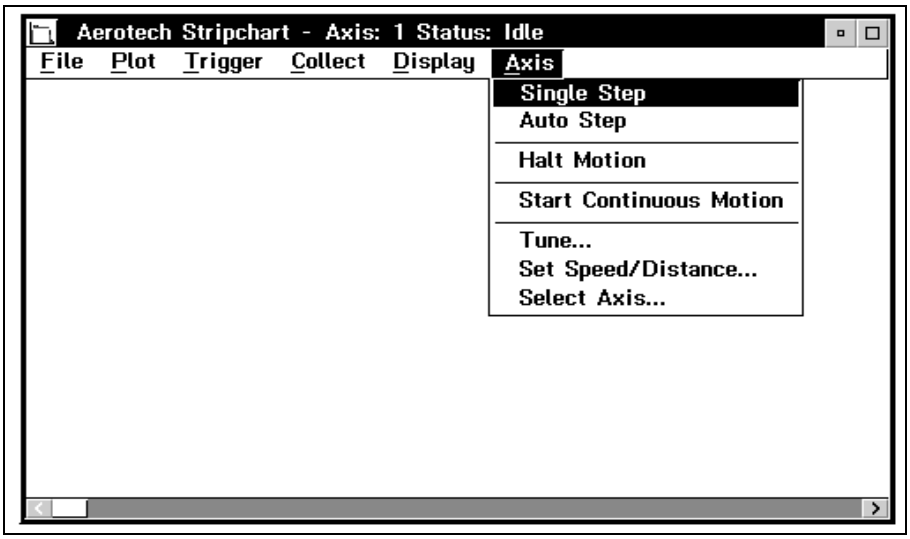


Figure 5-53. Axis Menu

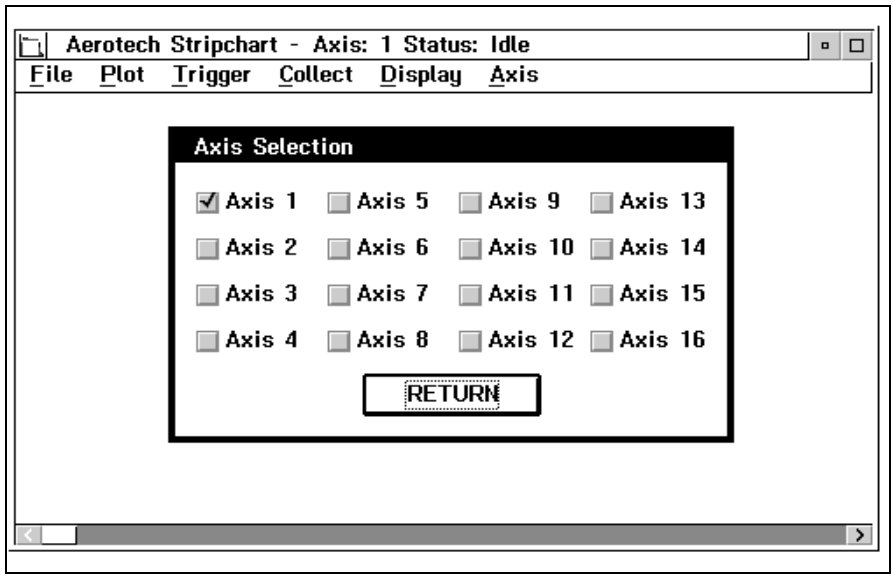


Figure 5-54. Axis Selection Menu

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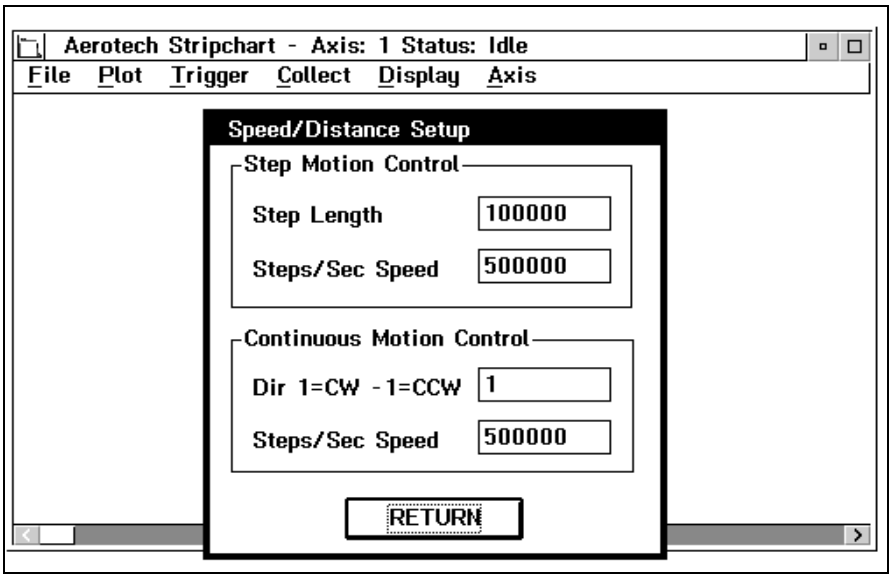


Figure 5-55. Speed/Distance Setup Dialog Box

Through this window the user can setup the step length and the step speed for the step motion control, and also the continuous motion direction and speed for the continuous motion control. The units of measure for this screen are the feedback devices resolution for the axis selected.

Selecting the "Tune" option causes a window showing the selected axis servo gain settings to appear on the screen (see Figure 5-56).

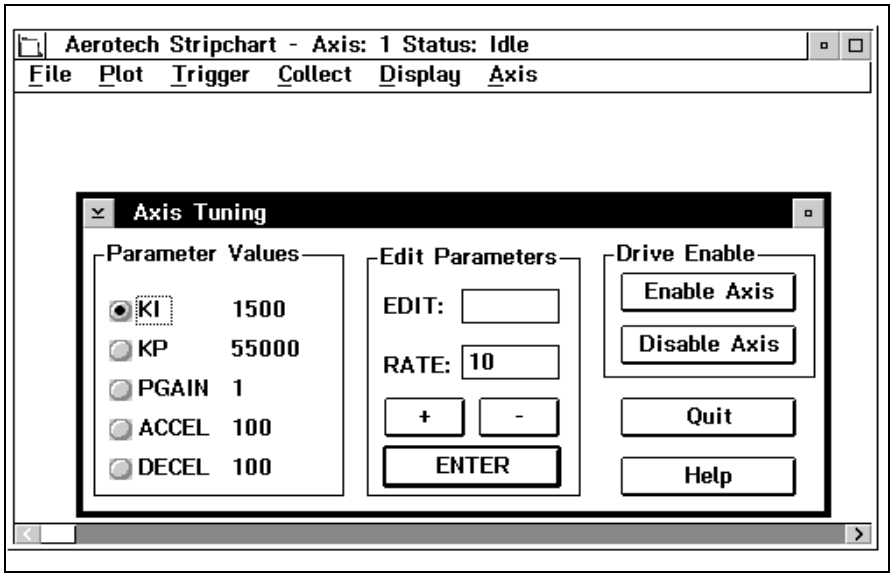


Figure 5-56. Axis Tuning Dialog Box

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Included in this window are the axis enable control boxes. It is possible to alter the servo gains in this screen while observing the effect on the motion profile on the main screen. The user can change the gains by using the edit box or the +/- increment boxes.

The motion commands shown in Figure 5-53 are explained in .

Table 5-4. Motion Commands and Descriptions

Motion Command	Description
Single Step	This command executes a single step using the lengths and speed values set in the Continuous Motion Control menu. A step begins when the data collection sample point is at zero. To insure this, set the Trigger Control to "Acquire 1 Set of Data".
Auto Step	This command executes a positive and negative motion profile using the length and speed values established in the Continuous Motion Control menu. The direction of motion alternates between positive and negative with each sample period. The speeds and lengths should be verified to make sure the motion profile time does not exceed the sampling time and the axis has no mechanical restrictions.
Halt Motion	This command stops any motion profile immediately.
Start Continuous Motion	This command starts motion in the direction and the speed set in the Continuous Motion Control menu.

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CHAPTER 6: THE DIAGNOSTIC MENU

In This Section:

- Introduction 6-1
- Axis Status & Fault Utility 6-2
- Axis Processor Firmware Status Display.....6-21
- Axis Processor Programming Error Status Display.....6-22
- Drive Enable Control.....6-25
- Emergency Stop Control.....6-25
- Digital Input/Output Status.....6-27
- Matrix Option Analog Input Status 6-28
- PLC Analog Input/Output Control 6-30
- Virtual I/O Utility.....6-31
- Plot Data Utility.....6-34
- Plot XY Utility 6-39
- Hexadecimal Calculator 6-46

6.1. Introduction

The user can access all diagnostics provided by "MAINMENU" via the Diagnostic menu. Figure 6-1 shows the options available from this menu.

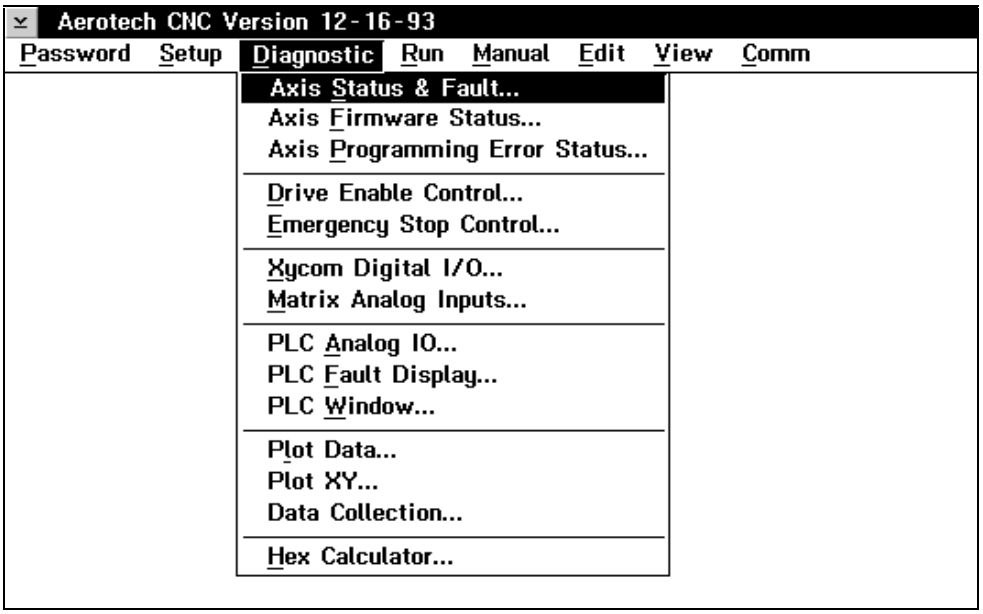


Figure 6-1. Diagnostic Menu

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6.2. Axis Status & Fault Utility

This diagnostic utility monitors the status of the axis processor. The user need only select the type of status to be monitored, and this utility polls the axis processor for that status and displays it several times per second.

All of the status available from within this screen are reflective of some condition (i.e., drive enabled, at home, faulted, etc.). This utility simply indicates to the user if a condition exists on each axis. As can be seen from Figure 6-2, each specific type of status appears within a group located vertically on the left side of the screen, and the axes names appear horizontally across the upper portion of the screen. The user may view undisplayed axis and status conditions using the scroll bars at the bottom and right side of the display.

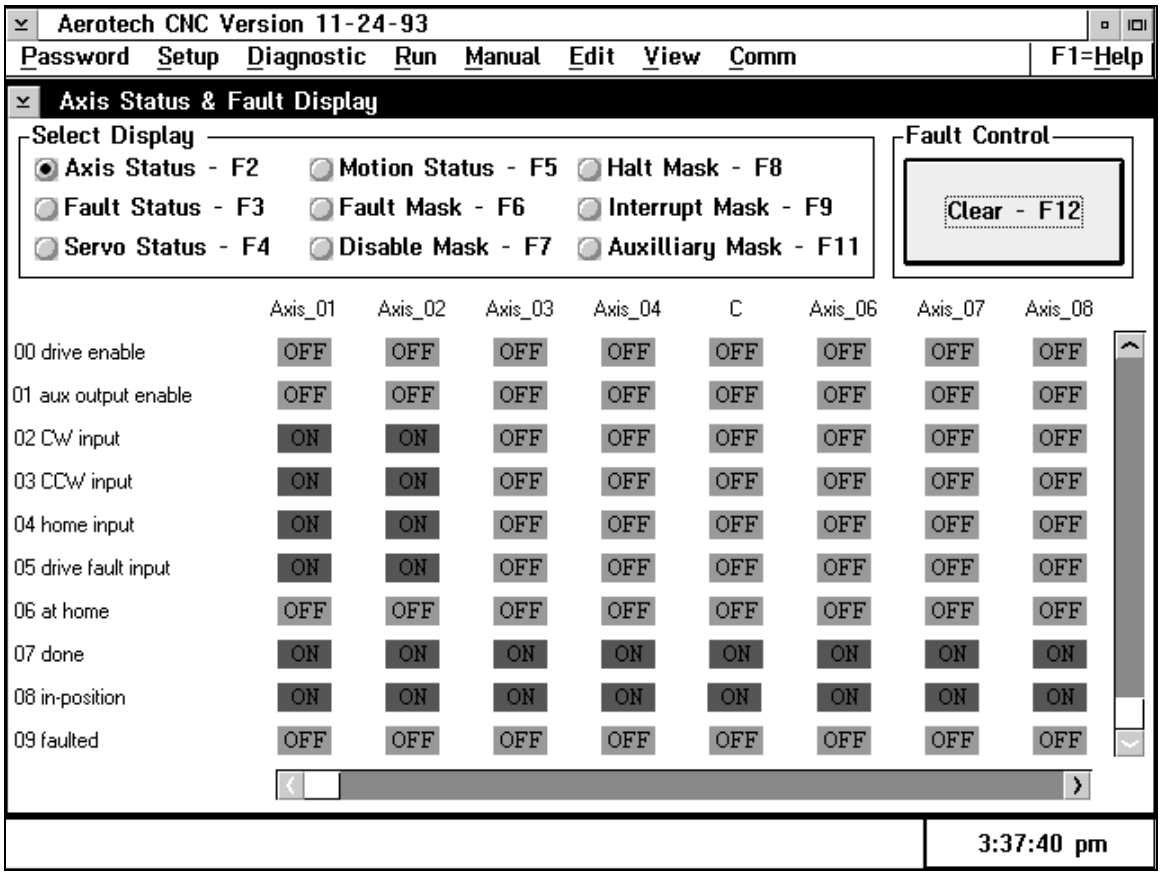


Figure 6-2. Axis Status And Fault Display Dialog Box

6.2.1. Selecting Status Type

Through the radio buttons located within the Select Display Group Box, the user may change the group of status conditions currently being monitored. These groups include Axis Status, Fault Status, Servo Status, and Motion Status. The user may also view the current value of the masks which define the action taken by the axis processor upon

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detection of the various faults. However, the user can not modify these masks from within this screen.

6.2.2. Axis Status Group

The Axis Status Display Group conveys information regarding the current state of the associated axis. This information pertains to the hardware status (Drive Fault present, Limit Switch active, etc.), as well as the current operational mode (Homing, Sync Mode Enabled, etc.). The following sections provide a brief description of the meaning associated with each field.

6.2.2.1. Drive Enable

This field indicates if the servo control loop has been enabled for the specified axis. When ON, the servo loop is active.

Related Parameter(s): DRIVE (Refer to section 5.3.9.)
IOLEVEL (Refer to section 5.3.42.)

The UNIDEX 31's axes may be enabled/disabled under program control by using the SETPARM command. For example, SETPARM X Y DRIVE 1 can be used to enable both the X and Y axes. Likewise, SETPARM Z DRIVE 0 can be used to disable the Z axis.



6.2.2.2. Aux Output Enable

This field specifies the current state of the auxiliary output associated with an axis. When ON, the output is currently asserted.

Related Parameter(s): AUX (Refer to section 5.3.10.)
IOLEVEL (Refer to section 5.3.42.)

6.2.2.3. CW Input

This field specifies the current state of the clockwise end-of-travel limit input to the axis processor for the associated axis. When ON, the limit is currently asserted.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.2.4. CCW Input

This field specifies the current state of the counter-clockwise end-of-travel limit input to the axis processor for the associated axis. When ON, the limit is currently asserted.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.2.5. Home Input

This field specifies the current state of the home limit switch input to the axis processor for the associated axis. When ON, the limit is currently asserted.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

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6.2.2.6. Drive Fault Input

This field specifies the current state of the drive fault input to the axis processor. When ON, a fault condition is present on the drive associated with the axis.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.2.7. At Home

This field specifies if the current position of the associated axis corresponds with the position upon completion of a home cycle. This does not imply, however, that a home cycle has just been completed. When ON, the current position is equal to the home position.

Related Parameter(s): NONE

6.2.2.8. Done

This field indicates when motion commands have completed execution. When this field displays "OFF", it signifies that trajectory generation is in progress on the associated axis. "ON" appears on the display after transferring the last velocity command to the servo loop.

Related Parameter(s): NONE

6.2.2.9. In-Position

This field specifies if the difference between the commanded position and the actual position of the associated axis is less than the amount specified by the In- Position Limit parameter. This field will display "ON" to signify that this difference is less than the specified amount.

Related Parameter(s): INPOSLIMIT (Refer to section 5.3.18.)

6.2.2.10. Faulted

This field alerts the user if a fault condition exists on the associated axis. If so, look to the Fault Status Screen to verify the present type of fault. ON signifies that a fault is present.

Related Parameter(s): FAULT (Refer to section 5.3.38.)

6.2.2.11. Probe Input

This field shows the current state of the axis processor input dedicated for the touch probe. ON signifies that the input is asserted.

Related Parameter(s): NONE

6.2.2.12. Marker Input

This field indicates when the marker pulse from the encoder associated with the axis is active. ON signifies the marker pulse is present.

Related Parameter(s): NONE

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6.2.2.13. Hall Input #1, #2, #3, and #4

These fields show the current state of each of the hall effect inputs associated with an axis. ON signifies that the input is currently asserted.

Related Parameter(s): NONE

6.2.2.14. Move Direction

This field indicates the direction in which the axis is currently moving. ON corresponds with the clockwise direction, and OFF signifies counter-clockwise. The state of this bit is undetermined unless the axis is in motion.

Related Parameter(s): NONE

6.2.2.15. Moving

This field alerts the user when the associated axis is currently in motion. ON signifies the axis is in motion. OFF appears on the display when the axis trajectory generation is complete (upon completion the bit is set).

Related Parameter(s): NONE

6.2.2.16. Accel Phase

This field indicates if the axis is currently within the acceleration portion of the motion command being executed. The acceleration phase is the period of time when the trajectory generator is changing the velocity from the current velocity to the commanded velocity. Therefore, if the current velocity is 10 counts/msec and the commanded velocity is 5 counts/msec, the value of the accel phase flag is on while the axis slows to the new velocity (5 counts/msec). This flag is off during the constant velocity portion of the move as well as during the deceleration portion of the move.

This bit has no significance if the corresponding axis is currently being controlled via a CAM table.



Related Parameter(s): NONE

6.2.2.17. Decel Phase

This field determines if the axis is currently within the deceleration portion of the motion command being executed. The UNIDEX 31's definition for this phase is the time period in which the axis is slowing from the commanded velocity to a complete stop. ON appears on the screen while the axis is decelerating. OFF appears if the axis trajectory generation is complete (when the Done Bit is set).

Controlling the corresponding axis through a CAM table causes this bit to have no significance.



Related Parameter(s): NONE

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6.2.2.18. Homing

This field determines if the associated axis is currently executing a homing sequence. ON signifies a home cycle is in progress.

Related Parameter(s): NONE

6.2.2.19. Feedrate Override

This field signifies if Manual Feedrate Override (MFO) controls are active for this axis. ON signifies that these controls are enabled for this axis.

Related Parameter(s): NONE

6.2.2.20. Profile Mode

This field shows if the associated axis is currently executing moves based on the data found in the profile queue for this axis. ON signifies that profile queue data is being executed.

Related Parameter(s): NONE

6.2.2.21. Sync Mode

This field indicates that the associated axis is being controlled by another (master) axis. This synchronization may be done by the CAM mode or ratio mode. ON signifies synchronization is enabled.

Related Parameter(s): NONE

6.2.2.22. CAM Table Enable

This field shows if the associated axis is synchronized with another axis by means of a CAM table. This bit is of no significance if the axis is not being controlled by another axis (see the Sync Mode Bit above). ON shows that a CAM table has been activated with this axis acting as the Slave Axis.

Related Parameter(s): NONE

6.2.2.23. Homing Direction

This field indicates the direction the associated axis is currently traveling. It is only valid while the axis is executing its homing sequence (Homing Bit). ON corresponds to CW direction, and OFF signifies CCW motion.

Related Parameter(s): NONE

6.2.2.24. Continuous Move

ON appears on the screen in this field when the axis is currently executing a continuous motion command. OFF appears in the display at all other times.

Related Parameter(s): NONE

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6.2.2.25. Queued Command

This field indicates if the associated axis is currently executing moves based on the data found in the motion queue for this axis. ON signifies that motion queue data is being executed.

Related Parameter(s): NONE

6.2.2.26. Hold Active

This field indicates if the associated axis is currently being withheld from movement. ON signifies the axis is being withheld.

Related Parameter(s): NONE

6.2.2.27. Aux Mode

This field indicates if there is currently an active synchronized auxiliary output table associated with the axis. ON appears on the display when an auxiliary output table is active.

Related Parameter(s): NONE

6.2.2.28. Block Motion

This field indicates whether all commands initiating motion are blocked from execution on an axis. ON signifies that the system is to ignore all motion commands.

Related Parameter(s): NONE

6.2.2.29. Hold Queue

This field shows if execution of queued motion commands has been temporarily suspended. ON signifies suspended execution.

Related Parameter(s): NONE

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6.2.3. Fault Status

This display monitors the faults present on the axis processor. These faults remain active until explicitly cleared by the user. "MAINMENU" displays ON in any field that has an active fault associated with it. A particular fault must first be enabled by setting its corresponding bit in the FAULTMASK parameter so that the axis processor will not ignore the fault. Refer to Figure 6-3.

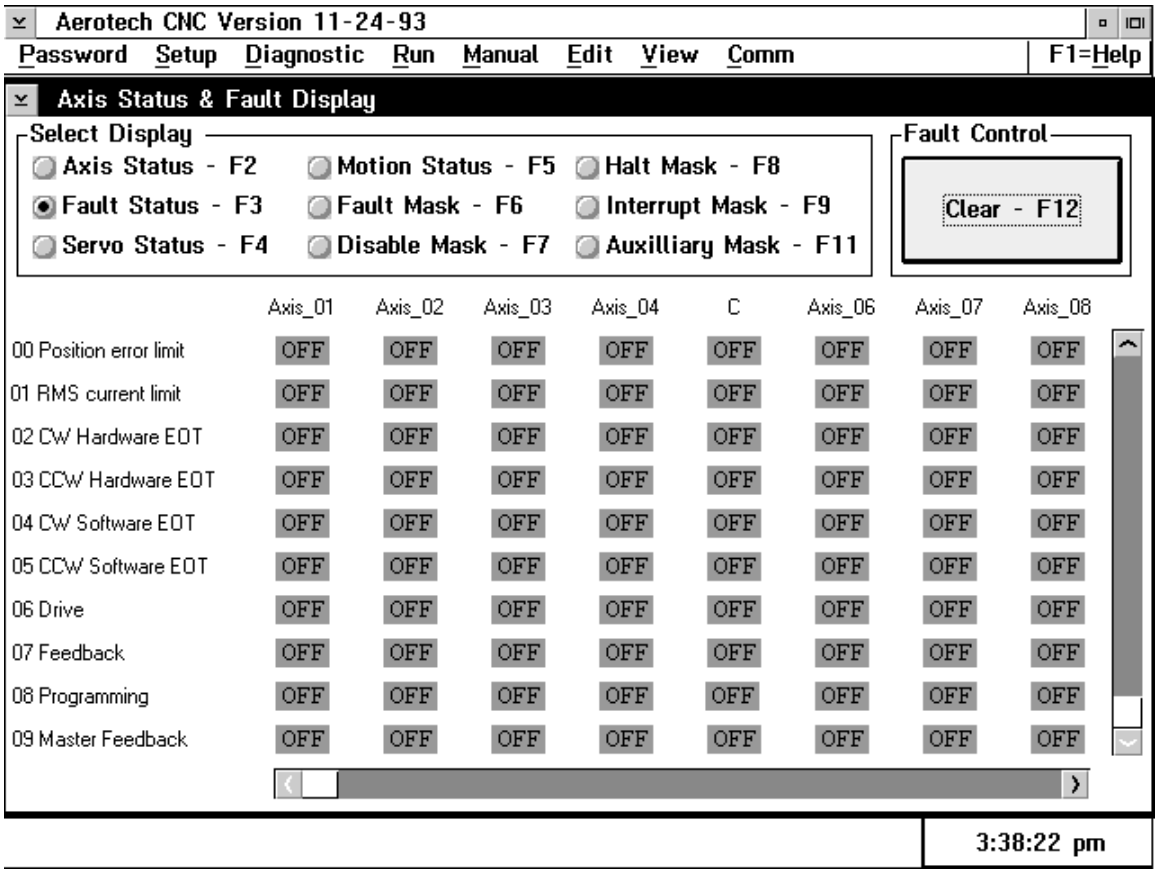


Figure 6-3. Fault Status Display Dialog Box

6.2.3.1. Position Error Limit

This error occurs when the difference between the instantaneous commanded position and the actual position is greater than the amount specified by the position error limit.

Related Parameter(s): POSERRLIMIT (Refer to section 5.3.17.)

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6.2.3.2. RMS Current Limit

This fault occurs when the average instantaneous current exceeds the amount specified by the RMS current limit parameter.

Related Parameter(s): IAVGLIMIT (Refer to section 5.3.15.)

6.2.3.3. CW EOT

This is the clockwise end of travel fault that occurs when the system encounters the clockwise limit switch.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.3.4. CCW EOT

This is the counter-clockwise end-of-travel fault that occurs when the system encounters a counter-clockwise limit switch.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.3.5. CW Software EOT

A clockwise software end-of-travel fault occurs when the user commands an axis to move beyond the position specified in the clockwise end of travel parameter.

Related Parameter(s): CWEOT(Refer to section 5.3.19.)

6.2.3.6. CCW Software EOT

A counter-clockwise software end of travel fault occurs when the user commands the axis to move beyond the position specified in the counter-clockwise end of travel parameter.

Related Parameter(s): CCWEOT (Refer to section 5.3.20.)

6.2.3.7. Drive

A fault of this type occurs when the drive fault input for the axis is asserted (see Section 6.1.2.5). However, after clearing the drive fault input, this bit continues to reflect the fact that the fault occurred.

Related Parameter(s): IOLEVEL (Refer to section 5.3.42.)

6.2.3.8. Feedback

This fault signifies that the feedback failure input from the R/D channel associated with the axis was asserted. This typically occurs when the feedback device is not functioning properly.

Related Parameter(s): NONE

6.2.3.9. Programming

This fault occurs when the axis processor receives an invalid command from the CPU card. Any programming error causes this fault to occur.

Related Parameter(s): NONE

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6.2.3.10. Master Feedback

This fault signifies that the feedback failure input from the R/D channel associated with the axis configured as a master was asserted. This typically occurs when the feedback device on the Master Axis is not functioning properly.

Related Parameter(s): NONE

6.2.3.11. Homing

This field provides an indication that the system encountered a fault while homing. This typically occurs when the system encounters an end of travel limit switch before the first resolver null.

Related Parameter(s): NONE

6.2.3.12. User

This fault signifies that an application has requested a fault be generated with the DMRSetUserFault() function. It provides a method of generating a VME bus interrupt from within an application program.

Related Parameter(s): NONE

6.2.3.13. Velocity Trap

This fault occurs when the actual velocity exceeds the value specified in the maximum velocity trap parameter.

Related Parameter(s): VELTRAP (Refer to section 5.3.21.)

6.2.3.14. Velocity Command Trap

This fault occurs when the instantaneous commanded velocity exceeds the value specified in the maximum commanded velocity parameter.

Related Parameter(s): VELCMDTRAP (Refer to section 5.3.22.)

6.2.3.15. Home Switch Tolerance

This fault occurs during a homing sequence when the time between detection of the home limit and the marker pulse is less than the value specified in the HOMESWITCHTOL parameter.

Related Parameter(s): HOMESWITCHTOL (Refer to section 5.3.35.)

6.2.3.16. Probe Input

This fault occurs each time the probe trigger latches the position. This is useful for notifying the application program that the position information is available.

Related Parameter(s): NONE

6.2.3.17. CNC

This fault indicates occurrence of an error in the CNC process to which this axis is assigned. This fault indicator is inclusive of all faults that the CNC Processor might generate.

Related Parameter(s): All CNC related parameters

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6.2.3.18. External Feedback

This fault occurs if the difference between the integration of the velocity command and velocity feedback is greater than the FBWINDOW parameter.

Related Parameter(s): FBWINDOW

6.2.3.19. Safe Zone

This fault occurs when the SAFEZONEMODE is active and the axis has violated a defined safe zone.

Related Parameter(s): SAFEZONECW
SAFEZONECCW
SAFEZONEMODE

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6.2.4. Servo Status Group

Most of the information found on the Servo Status Display Dialog Box (see Figure 6-4) is identical to the information found on the Axis Status Screen. However, the upper 16 fields of this display convey information that relates to the current operational state of the servo.

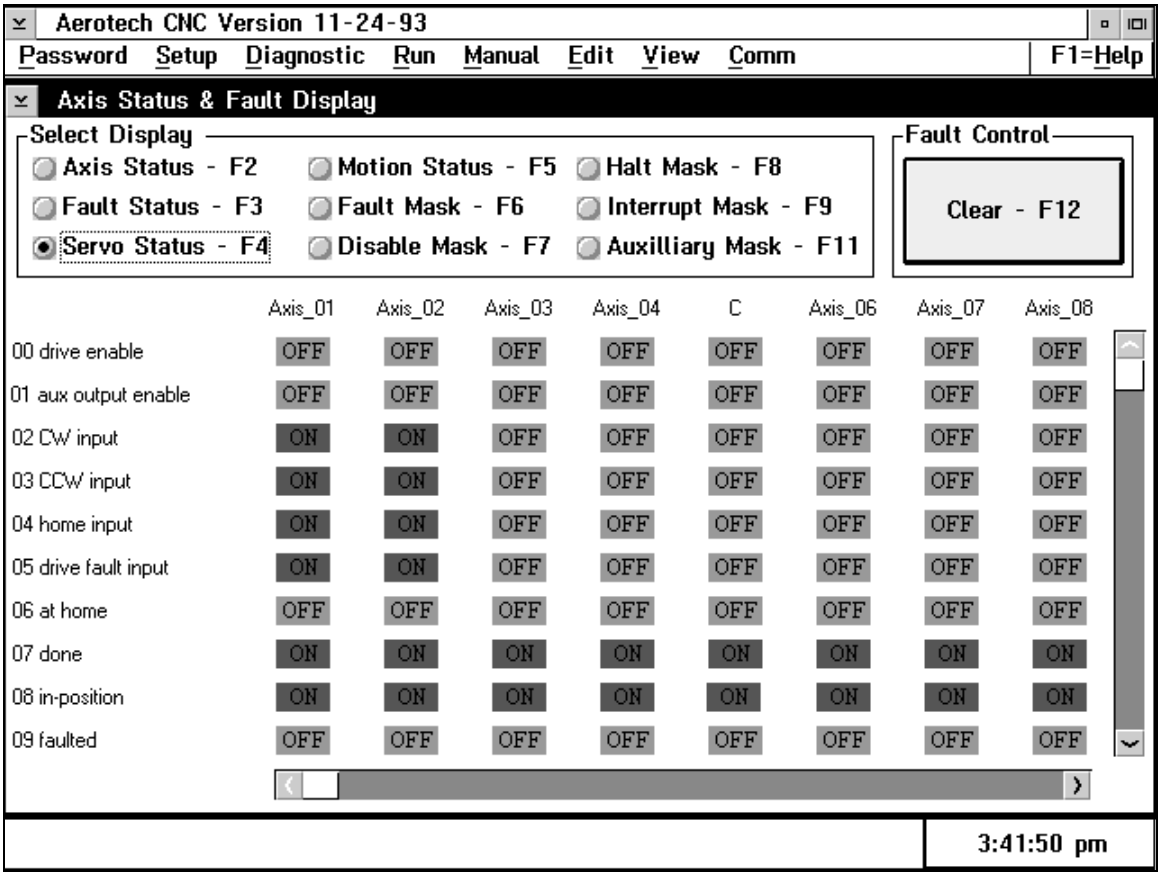


Figure 6-4. Servo Status Display Dialog Box

6.2.4.1. Drive Enable

Refer to Section 6.1.2.1 for information on this signal.

6.2.4.2. Aux Output Enable

Refer to Section 6.1.2.2 for information on this signal.

6.2.4.3. CW Input

Refer to Section 6.1.2.3 for information on this signal.

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6.2.4.4. CCW Input

Refer to Section 6.1.2.4 for information on this signal.

6.2.4.5. Home Input

Refer to Section 6.1.2.5 for information on this signal.

6.2.4.6. Drive Fault Input

Refer to Section 6.1.2.6 for information on this signal.

6.2.4.7. At Home

Refer to Section 6.1.2.7 for information on this signal.

6.2.4.8. Done

Refer to Section 6.1.2.8 for information on this signal.

6.2.4.9. In-Position

Refer to Section 6.1.2.9 for information on this signal.

6.2.4.10. Faulted

Refer to Section 6.1.2.10 for information on this signal.

6.2.4.11. Probe Input

Refer to Section 6.1.2.11 for information on this signal.

6.2.4.12. Marker Input

Refer to Section 6.1.2.12 for information on this signal.

6.2.4.13. Hall Input #1, #2, #3, and #4

These information fields are synonymous with the corresponding field in the Axis Status Group. Please refer to Section 6.1.2.13 for further information.

6.2.4.14. Integral - clamped

This field states that the system put a clamp on the integral error of the system at the maximum negative value.

Related Parameter(s): NONE

Related Command(s): NONE

6.2.4.15. Integral + clamped

This field indicates that the system limited the integral error of the axis at the maximum positive value.

Related Parameter(s): NONE

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6.2.4.16. VFF enable

This field indicates that velocity feed forward is enabled for the axis. The system uses velocity feed forward during velocity contouring to minimize velocity error**.** ON signifies that VFF is enabled.

Related Parameter(s): VFF

6.2.4.17. AFF enable

This field indicates that acceleration feed forward is enabled for the axis. An AFGAIN of zero disables this field. ON signifies that AFFGAIN is non-zero.

Related Parameter(s): AFFGAIN

6.2.4.18. alive

This field determines if the user has enabled and configured the associated axis. This bit remains ON as long as these two conditions are met.

Related Parameter(s): NONE

6.2.4.19. VFF or zero PGAIN

This bit indicates whether the servo loop is operating in the velocity feed forward mode, or if the position loop was disabled (by setting the PGAIN to zero).

Related Parameter(s): PGAIN (Section 5.1.7.6)

6.2.4.20. FB Failure input

This field corresponds with the current state of the feedback failure input on the R/D channel associated with the axis.

Related Parameter(s): NONE

6.2.4.21. Master FB failure

This field corresponds with the current state of the feedback failure input on the R/D channel associated with the axis configured as a master for this axis.

Related Parameter(s): NONE

6.2.4.22. HP VME Laser

This bit specifies that the type of feedback device associated with the axis is an HP VME Laser. This bit is set at configuration time and remains set until resetting the axis processor or re-configuring the axis.

Related Parameter(s): NONE

6.2.4.23. AC mode

This field indicates the type of motor for which the axis has been configured. ON signifies that it has been configured for an AC brush motor. OFF indicates that it has been configured for a DC brush motor.

Related Parameter(s): NONE

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6.2.4.24. Msetting

This field indicates that the axis processor is computing the commutation offset for use with the associated axis. Several Aerotech diagnostic utilities (such as debug960.exe) permit entry into this mode.

Related Parameter(s): Commutation Offset (Section 5.4.2.2.4)

6.2.4.25. Homed

This field specifies that the associated axis has completed a home cycle. This field is cleared when the home sequence is initiated and set when it is completed. This does not imply, however, that a home cycle has just been completed. When ON, the axis has been homed since power up or has been reset..

Related Parameter(s): NONE

6.2.4.26. Encoder Feedback

This bit specifies that the type of feedback device associated with the axis is an encoder. This bit is set at configuration time and remains set until resetting the axis processor or re-configuring the axis.

Related Parameter(s): NONE

6.2.4.27. Error Mapping Enable

This notifies the user that at least one axis correction table is active on the associated axis. This bit is set ON upon activation of the correction table, and remains ON as long as the table is active. For more information on axis correction tables, please refer to the discussion of the Axis Correction Table Editor (see Section 5.4).

Related Parameter(s): NONE

6.2.4.28. Position Loop Only

This field indicates that the Position Loop has been disabled by setting the PGAIN axis parameter to zero. This bit, used in conjunction with the VFF or zero PGAIN bit, determines if the system has the VelocityFeedForward parameter enabled.

Related Parameters: PGAIN (Section 5.1.7.6)

VFF (Section 5.1.7.7)

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6.2.5. Motion Status Group

Once again, many of the fields available on the Motion Status Display Dialog Box are also duplicated on other screens. However, the upper 16 fields contain unique information regarding the current state of the operational mode of the trajectory generator. refer to Figure 6-5.

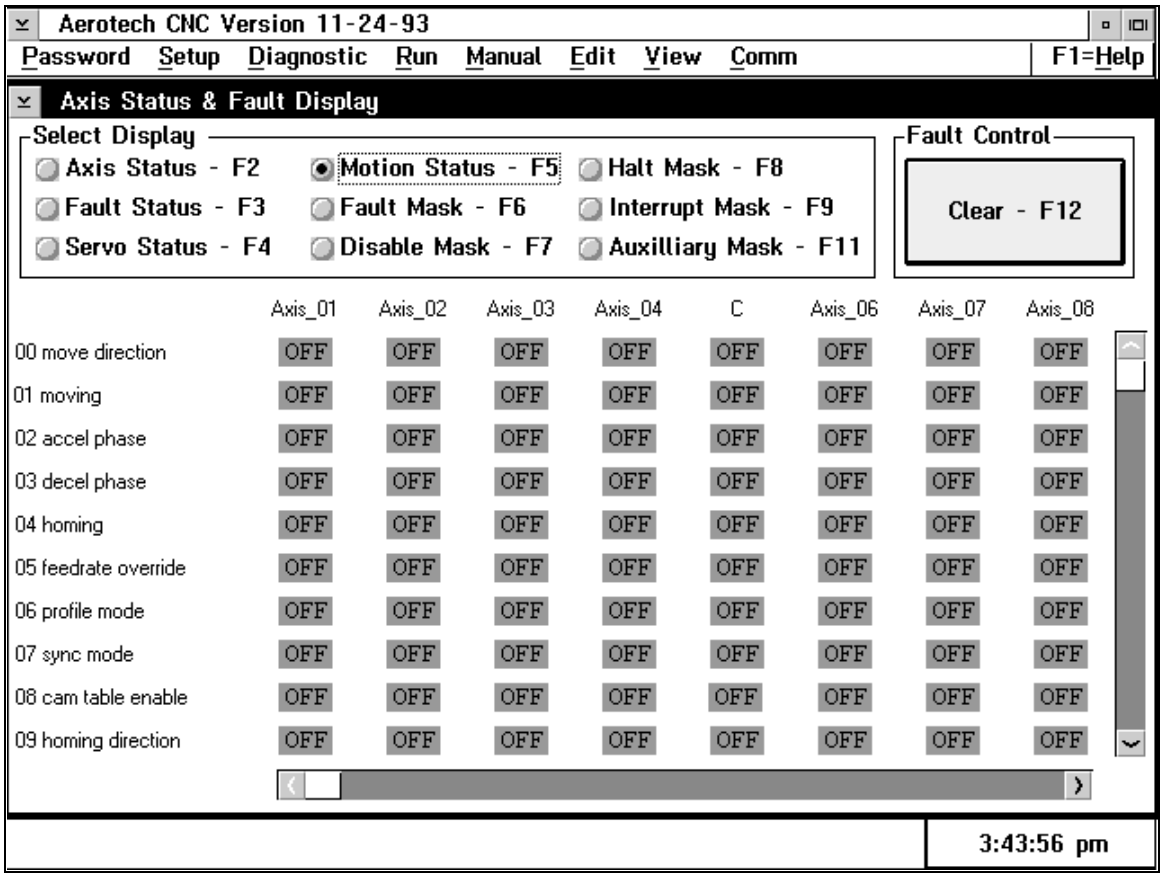


Figure 6-5. Motion Status Display Dialog Box

6.2.5.1. Move Direction

Refer to Section 6.1.2.14 for information on this status bit.

6.2.5.2. Moving

Refer to Section 6.1.2.15 for information on this status bit.

6.2.5.3. Accel Phase

Refer to Section 6.1.2.16 for information on this status bit.

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6.2.5.4. Decel Phase

Refer to Section 6.1.2.17 for information on this status bit.

6.2.5.5. Homing

Refer to Section 6.1.2.18 for information on this status bit.

6.2.5.6. Feedrate Override

Refer to Section 6.1.2.19 for information on this status bit.

6.2.5.7. Profile Mode

Refer to Section 6.1.2.20 for information on this status bit.

6.2.5.8. Sync Mode

Refer to Section 6.1.2.21 for information on this status bit.

6.2.5.9. CAM Table Enable

Refer to Section 6.1.2.22 for information on this status bit.

6.2.5.10. Homing Direction

Refer to Section 6.1.2.23 for information on this status bit.

6.2.5.11. Continuous Move

Refer to Section 6.1.2.24 for information on this status bit.

6.2.5.12. Queued Command

Refer to Section 6.1.2.25 for information on this status bit.

6.2.5.13. Hold Active

Refer to Section 6.1.2.26 for information on this status bit.

6.2.5.14. Aux Mode

Refer to Section 6.1.2.27 for information on this status bit.

6.2.5.15. Block Motion

Refer to Section 6.1.2.28 for information on this status bit.

6.2.5.16. Hold Queue

This information field is synonymous with the corresponding field in the Axis Status Group. Please refer to Section 6.1.2.29 for further information.

6.2.5.17. Disable Queued

This field indicates the current state of queued motion command execution. When ON appears on the display, the system ignores all queued motion commands. Otherwise, the system places the commands into the queue, and executes them as soon as possible.

Related Parameter(s): NONE

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6.2.5.18. Halt Queued

This field also provides information about the current state of the motion queue. ON appears on the display when the system halts execution of the motion queue. Upon halting the motion queue, the axis gracefully decelerates to zero velocity in the amount of time specified by the deceleration parameter. This has no effect on the position error tracking. The motion queue is flushed when the halt queue field is ON. The halt process is caused by an active fault which is enabled in the HALTMASK parameter.

Related Parameter(s): HALTMASK

6.2.5.19. Abort Queued

This field is similar to the Halt Queued indicator above. However, this indicates to the user that the system aborted execution of the motion queue. The motion queue is not flushed when this field is ON. The abort process is caused by an active fault which is enabled in the ABORTMASK parameter.

Related Parameter(s): ABORTMASK

6.2.5.20. Accel Enable

This field provides an indication of the amount of time spent during the acceleration phase of trajectory generation. ON indicates that the system is to use a non-zero time period.

Related Parameter(s): NONE

6.2.5.21. Decel Enable

This field provides an indication of the amount of time spent within the deceleration phase of trajectory generation. ON indicates that the system is to use a non-zero time period.

Related Parameter(s): NONE

6.2.5.22. Accel Sign

This field indicates the direction of the velocity change between subsequent move commands. ON signifies that the axis must increase in speed, and OFF signifies that the axis speed must decrease. The system does not consider the sign of the velocity.



This field is only valid if the accel phase bit is ON.

Related Parameter(s): NONE

6.2.5.23. Accel Mode

This field specifies the type of acceleration currently being used. ON signifies that system is to use sinusoidal acceleration, and OFF signifies linear acceleration.

Related Parameter(s): ACCELMODE (Refer to section 5.3.30.)

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6.2.5.24. Decel Mode

This field specifies the type of deceleration currently being used. ON signifies that the system is to use sinusoidal deceleration, and OFF signifies linear deceleration.

Related Parameter(s): DECELMODE (Refer to section 5.3.31.)

6.2.5.25. Bounded

This field indicates whether the axis is bounded by the end-of-travel limits. Spindle axes, for example, are "un-bounded" since they may travel an infinite amount without encountering a limit. ON specifies that there is a limit on the distance that the axis can travel.

Related Parameter(s): NONE

6.2.5.26. Setup Pending

The axis processor uses this field to indicate a pending setup. The field is cleared after setup is complete. ON appears while setup is pending. Under normal operating conditions, the user may ignore the state of this field.

Related Parameter(s): NONE

6.2.5.27. Checker Flag

The axis processor uses these fields for synchronization between the 4 kHz interrupt and the various foreground processing modules. Under normal operating conditions, the user may ignore the state of this field.

Related Parameter(s): NONE

6.2.5.28. Quick Home

This field provides an indication that the axis is seeking the home limit switch due to the DMRMoveQuickHome() function. ON appears on the display upon execution of this command.

Related Parameter(s): NONE

6.2.5.29. Interrupt Pending

This field is used for internal processing by the axis processor, and therefore the user may ignore it. It signifies the occurrence of an interrupt that requires servicing.

Related Parameter(s): NONE

6.2.5.30. Pendant Jog

This field specifies the operational mode of the UNIDEX 31/U600Teach Pendant. ON appears on the display when the axis processor is responsive to the joystick inputs on the Teach Pendant.

Related Parameter(s): NONE

6.2.5.31. Marker Armed

During a homing sequence this field shows when the axis processor is actively searching for an encoder marker pulse. This field turns ON when the system encounters the

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appropriate limit switch, reverses direction (and begins searching for the marker pulse), and gets cleared upon detection of the encoder marker pulse.

Related Parameter(s): NONE

6.2.5.32. Jog Enable

This field signifies that the axis processor is currently in one of the various jog modes.

Related Parameter(s): NONE

6.2.6. Fault Mask

Refer to Section 5.3.37. for information on these control bits.

6.2.7. Disable Mask

Refer to Section 5.3.38. for information on these control bits.

6.2.8. Halt Mask

Refer to Section 5.3.41. for information on these control bits.

6.2.9. Interrupt Mask

Refer to Section 5.3.39. for information on these control bits.

6.2.10. Auxiliary Mask

These fields permit the user to graphically view the current settings of the control bits which control the U31's response to faults. For additional information refer to Section 5.3.40.

6.2.11. Clearing Faults

This screen not only permits the user to view the active faults and masks that affect the U31's response to those faults, but also provides the ability to clear the active faults. Activating the **CLEAR-F12** Push-Button or the [F12] Function Key initiates an attempt to clear all faults currently present in the system. Cleared fault conditions will be updated on the screen..

Related Parameter(s): FAULT (Refer to section 5.3.36.)

Related Function(s): DMRSetFault()

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6.3. Axis Processor Firmware Status Display

This screen allows the user to determine the general state of the axis processor card. It also provides controls that permit the user to reset the axis card and reinitialize the system. Refer to Figure 6-6.

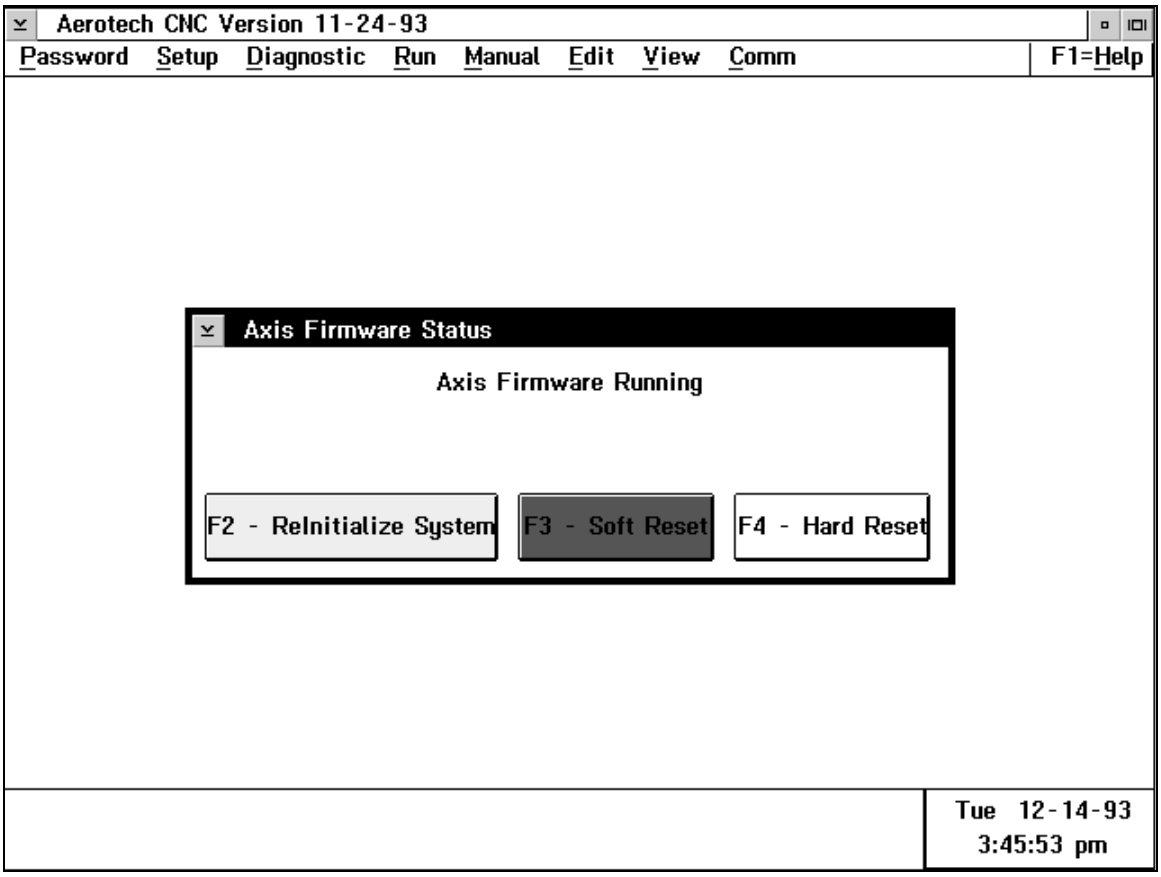


Figure 6-6. Axis Firmware Status Dialog Box

If an abnormal condition exists within the axis processor, the "Axis Firmware Running" message, seen in the illustration above, changes into a message that describes the nature of the abnormality detected.

Push-button controls located within this dialog box permit the user to correct many of the problems that may be encountered. The **F2-Reinitialize System** Push-Button causes "MAINMENU" to re-configure the axis processor as specified in the initialization files. The current user is then logged off (if passwords are active), and the application re-enters its initial state (see Chapter 3).

The **F3-Soft Reset** Push-Button functions similar to the F2-Reinitialize System control. However, the Soft Reset function first requests that the axis processor execute its power-up initialization sequence. Upon completion of this, the system re-loads the firmware, and the axis processor is configured as specified in the initialization files. Once again, the

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system logs off the current user (if passwords are active), and "MAINMENU" re-enters its initial state (see Chapter 3).

In the event that the axis processor does not respond to the soft reset, the system has lost communication between the axis processor and the CPU board. The System Failure Information Dialog Box appears to notify the user of the error (see Figure 6-7).

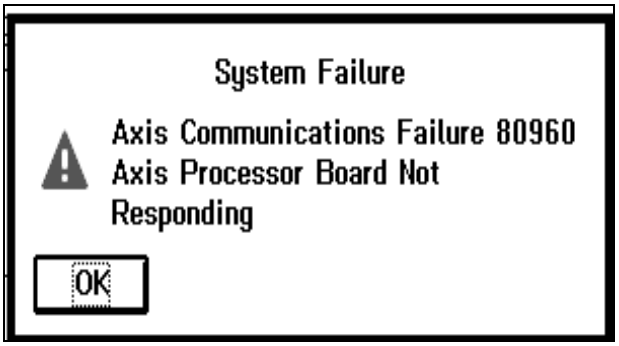


Figure 6-7. System Failure Information Dialog Box

After loosing communications between the axis processor and the front end, it is necessary to reset the axis processor. There are two ways to do this. First, the user may physically press the reset button located on the front of the axis processor card, and re-initialize the system with either the **F2-Reinitialize System** or the **F3-Soft Reset** controls.

Future revisions of "MAINMENU" are to support another way of resetting the axis processor card. The **F4-Hard Reset** Push-Button causes the system to assert RESET* on the VME bus. Therefore, the system resets all of its VME based cards. After clearing the reset, the system performs the actions described while processing the soft reset request.

6.4. Axis Processor Programming Error Status Display

Another diagnostic option available. It is the 80960 Axis Processor Board Programming Error Status Display. This utility permits the user to request status information pertaining to command execution from the axis processor. It also provides controls that permit the user to clear the errors.

The list box located in the upper portion of the screen displays the errors currently active in the system. This list box contains one entry for each axis. The user may view all axes by using the vertical scroll bar on the right side of the list box.

Each axis specific entry contains, at a minimum, the axis number, the axis name, and a text string to notify the user of active programming errors. If none are active, the following phrase appears for that axis.

"No Error"

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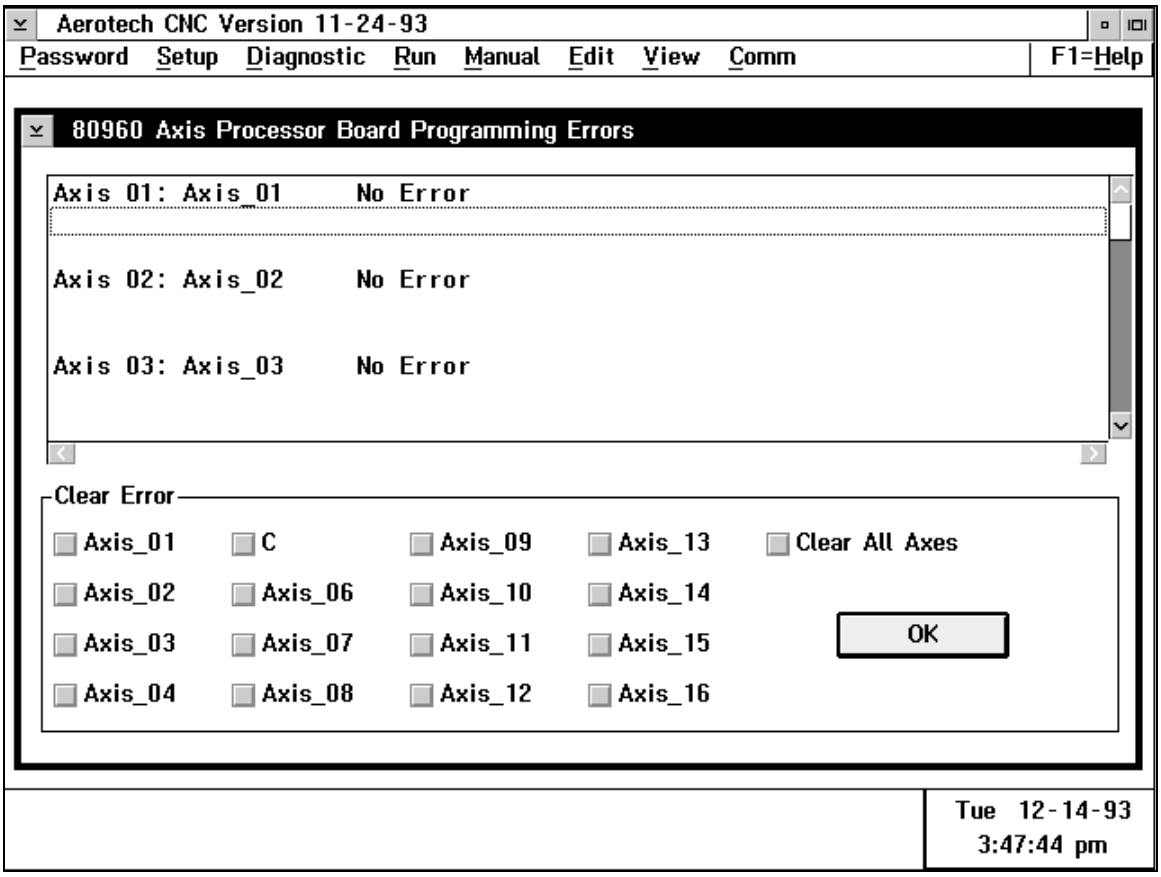


Figure 6-8. Programming Error Status Screen- No Errors Present

However, with a programming error present, the next line will display debug information to help the user determine the cause of the error. This debug information includes the error code number and a copy of the command packet that caused the error. The error code number typically corresponds with the text description of the error type. The erroneous command packet appears on the display in hexadecimal format, with the least significant byte of each word first.

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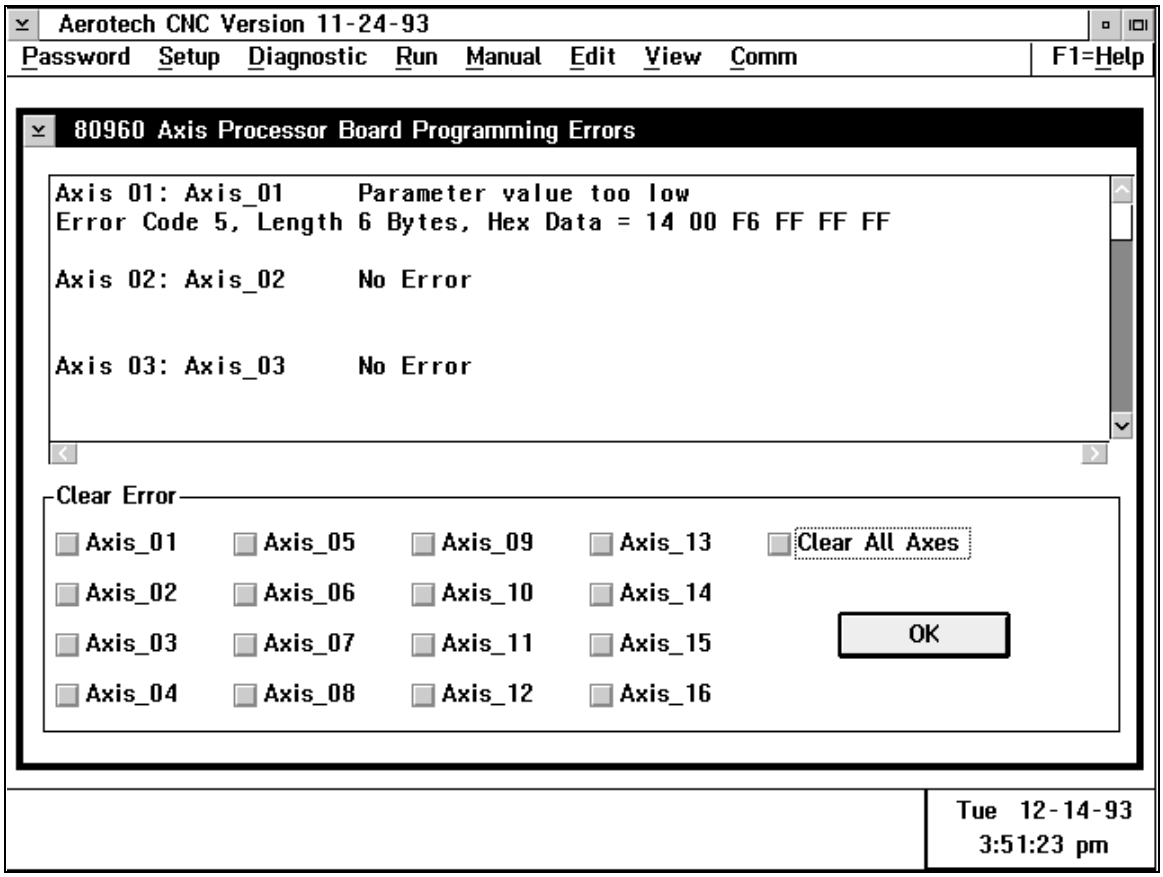


Figure 6-9. Programming Error Status Screen- Errors Present

The Clear Error Group Box contains controls that permit the user to clear the programming errors from the memory of the axis processor. To clear an error on specific axes, it is necessary to activate the check boxes associated with those axes. Use the **OK** Push-Button to clear the programming error on the selected axes. Activating the "Clear All Axes" check box and pressing the **OK** Push-Button clears all active programming errors from the system.



If multiple programming errors occur on a specific axis, this screen indicates to the user the one that occurred most recently. The system does not remember previous errors.

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6.5. Drive Enable Control

Selecting the "Drive Enable Control" option from the Diagnostic Menu causes the Drive Enable Control Group Box to appear on the display. This group box contains fields that indicate the state of the Drive Enable signal for each axis, as well as check boxes to change their state. Refer to Figure 6-10.

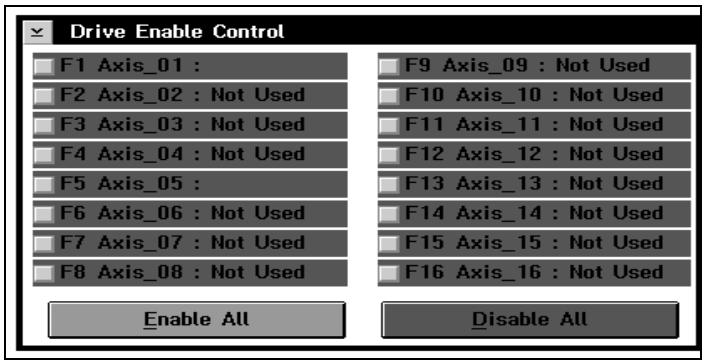


Figure 6-10. Drive Enable Control Group Box

Enabled axes appear on the screen in green and have a check mark in the check box associated with that axis. Disabled axes appear on the display in red, but its associated check box is empty.

The **Enable All** and **Disable All** push-buttons force all axes to a specific state.

Users operating "MAINMENU" without a mouse may use the **<TAB>** key to alternate between the check boxes and the push-buttons. The arrow keys permit movement within each group.

If the emergency stop circuitry detects an active ESTOP, the system may not enable the drives. "MAINMENU" enforces this rule by displaying all axes selections in halftone (see Figure 6-11 below).

6.6. Emergency Stop Control

Selecting the "Emergency Stop Control" option from the Diagnostic Menu causes "MAINMENU" to determine the current state of the emergency stop monitor from the axis processor. It then displays an Emergency Stop Control Dialog Box to notify the user of this state (see Figure 6-11).

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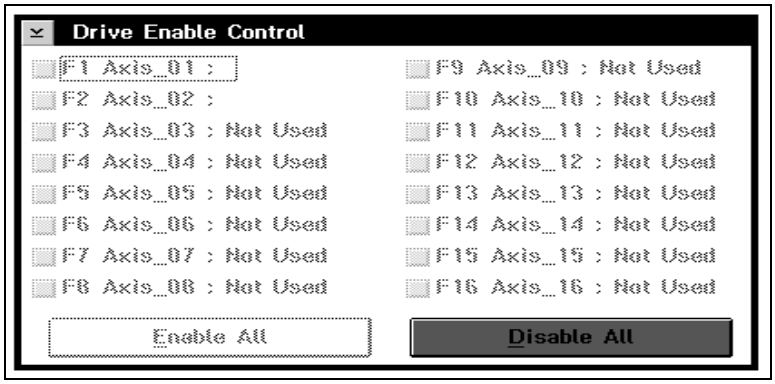


Figure 6-11. Drive Enable Control Group Box with E-Stop Active

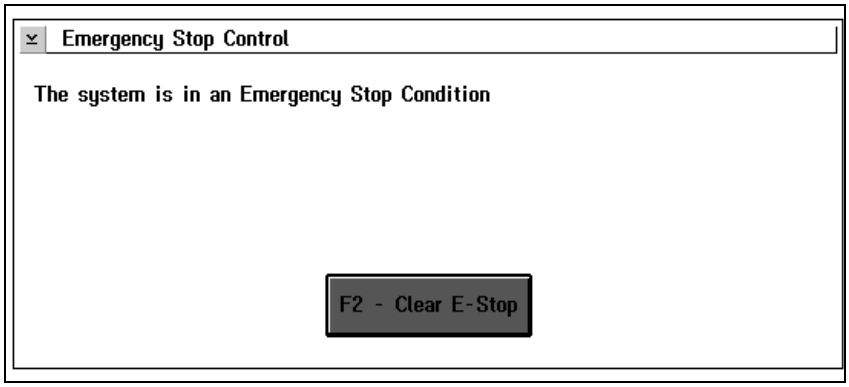


Figure 6-12. Emergency Stop Control Dialog Box



The **F2-Clear E-Stop** Push-Button is red when the E-Stop is active, otherwise it is green.

The **F2-Clear E-Stop** Push-Button or the [F2] Function Key clears the emergency stop condition. Pressing this button sets the appropriate outputs that reset the emergency stop monitor. However, if the emergency stop circuitry remains active, "MAINMENU" notifies the user that it is not possible to release E-Stop with the Failure to Clear Emergency Stop Dialog Box depicted in Figure 6-13, below.

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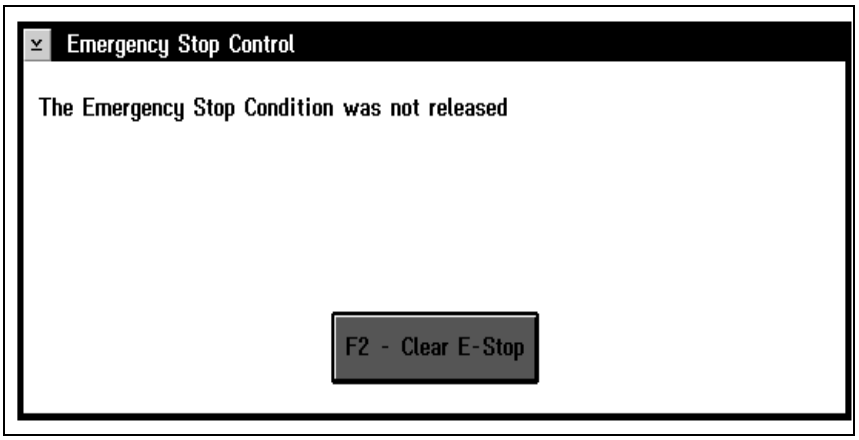


Figure 6-13. Failure to Clear Emergency Stop Dialog Box

If the user was able to clear the emergency stop condition, the dialog box shown in Figure 6-14 appears on the display.

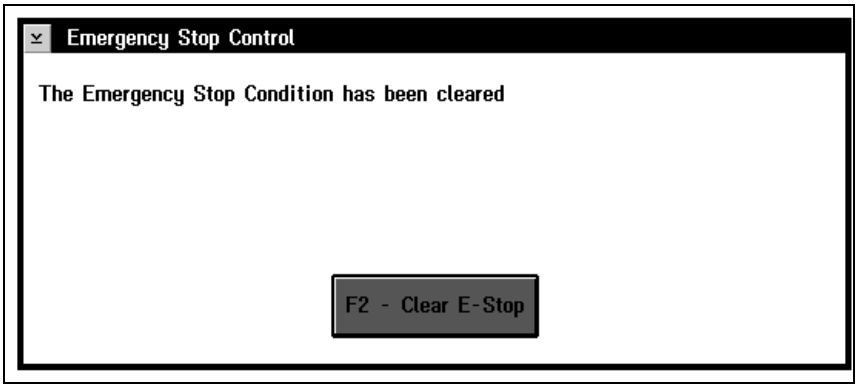


Figure 6-14. Emergency Stop Cleared Dialog Box

6.7. Digital Input/Output Status

Selecting the "Xycom Digital I/O" option from within the Diagnostic Menu causes "MAINMENU" to display the Xycom Digital Input/Output Status Dialog Box (see Figure 6-15). As can be seen, this dialog box shows the user the state of each digital input and digital output channel. A check mark appears in the check box associated with a given I/O channel if that I/O channel is active.

This dialog box is only valid when a single Xycom I/O board is used. Otherwise, the PLC Diagnostic window should be used.

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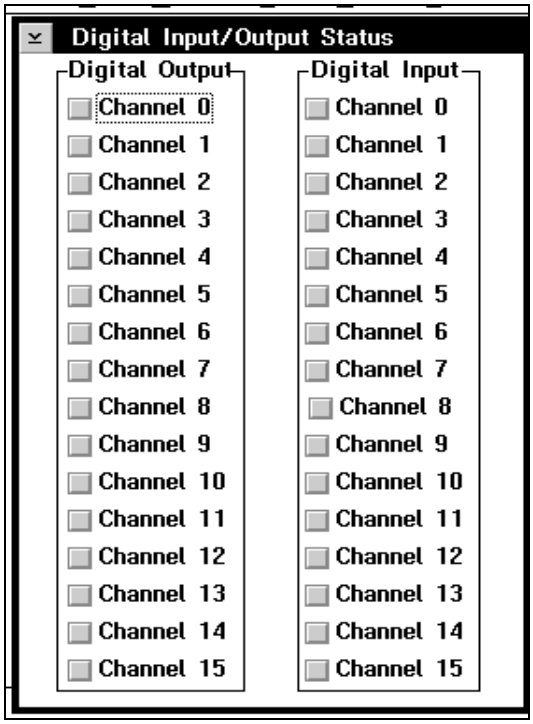


Figure 6-15. Xycom Digital Input/Output Status Dialog Box

6.8. Matrix Option Analog Input Status

This option found within the Diagnostic Menu causes the Analog Input Status Dialog Box to appear on the display (see Figure 6-16). This box displays the voltage present on each of the matrix analog input channels.



Currently, this application displays eight channels of information. However, future revisions will support the use of additional channels.

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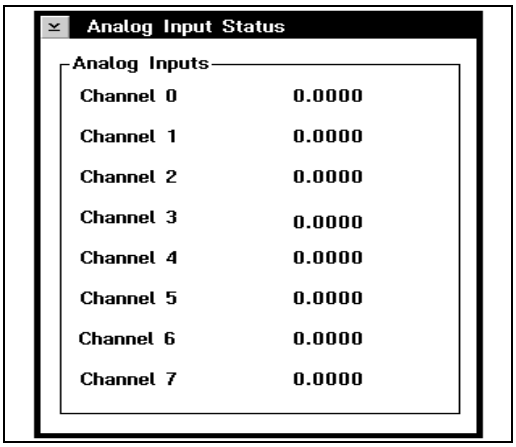


Figure 6-16. Analog Input Status Dialog Box

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6.9. PLC Analog Input/Output Control

This option screen, from the Diagnostic Menu, shown below in figure 6-17 displays the current voltage level present on each of the inputs and outputs specified in the ANALOG.INI initialization file.

This screen contains two group boxes; one for inputs and one for outputs. Each of these group boxes contains a list box and two push-buttons. The list box contains the name of each I/O point, as well as its current value. The push-buttons permit the user to scroll through the undisplayed items in the list box.

The ANALOG.INI initialization file is an ASCII text file that the user can edit. The format for this file appears below.

<Name>, <Type> <Source> <Scalar>

where:

<Name> – text displayed on the screen when referring to this input or output.

<Type> – may be any of the following:

RI - Register Input

RO - Register Output

BI - Binary Input

BO - Binary Output

PLCx - 4xxxx Register of Modicon PLC

<Source> – is for all <Type>'s except PLCx. This field specifies the channel associated with the input or output. For <Type> PLCx, this field specifies the particular 4xxxx register associated with this I/O point.

<Scalar> – This field converts the voltage present on the I/O point into real world units. The value entered should be the number to be displayed when the maximum voltage is present on the I/O point. Note that this value has no effect on the operation of the I/O points, only on the values displayed within the PLC Analog I/O Dialog Box.

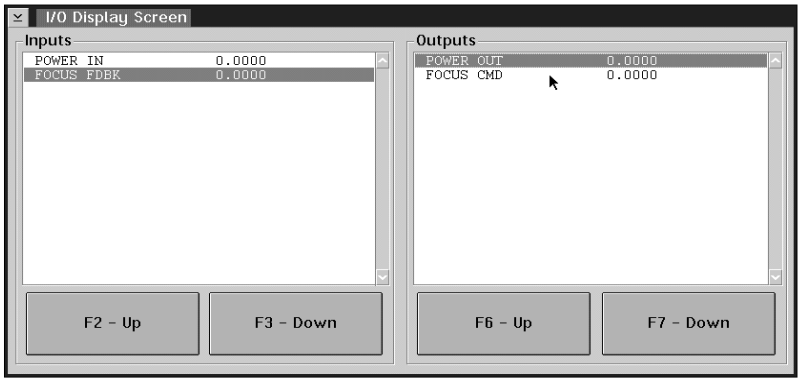


Figure 6-17. PLC Analog Input Output

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Upon invocation of "MAINMENU", the system associates the PLC analog inputs to I/O channels. Therefore, if it is necessary to modify this file while executing "MAINMENU", the user must re-initialize the system to enable these changes.

The user may delimit any of the fields in the line described above using any number of spaces, tabs, commas, or periods.

To change the state of a particular output, mouse users may simply click the check box located just to the left of the output name. "MAINMENU" responds by toggling the state of the specified output, as well as updating the display to reflect the current state. Active states appear in green on the display with a check mark in the associated check box. Inactive states appear on the screen with the normal background color and do not have a check in the check box.

"MAINMENU" users without a mouse may use the **<TAB>** key to position the cursor on the desired output. Then, using the space bar, he may toggle the current state of the output.

Currently, this application displays sixteen channels of inputs and sixteen channels of outputs. However, future revisions will support the use of additional channels.

6.10. Virtual I/O Utility (PLC Window menu)

The PLC window shown in figure 6-18, may be used to display the state of the virtual I/O within the system or the state of the 4xxxx registers within the Modbus PLC. Refer to the PLC Manual for more information on the Modbus PLC registers. This screen has seven keys and one entry box for specifying and controlling the display format. The displayed format can be changed at any time by selecting the **F6-Decimal** or the **F7-Hex** buttons. A single virtual I/O point may be displayed on the screen by entering an I or an O (to specify a virtual input or output) followed by the desired virtual I/O point number into the entry box. Then, by clicking on any display location with the mouse, select **F2-Get Reference** button. This will read the current value of the specified virtual I/O point and display it's value in the current format in the specified location on the screen. Likewise, a single virtual I/O point and it's value may be cleared from the screen using **F4-Clear Reference** button. A block of contiguous virtual I/O points may b e cleared or displayed in the same way using the **F3-Get Column** and **F5-Clear Column** buttons. The only difference is that an entire column will be filled with the values of virtual I/O points begining with the value specified.

The value of the PLC registers may also be displayed by entering the 4xxxx register number into the entry box and selecting the **F8-Select PLC** button. This will activate a pop up window prompting the user for a PLC number. Where the user may use the **Get** (F2 or F3) or **Clear** (F4 or F5) value buttons to display the register values.

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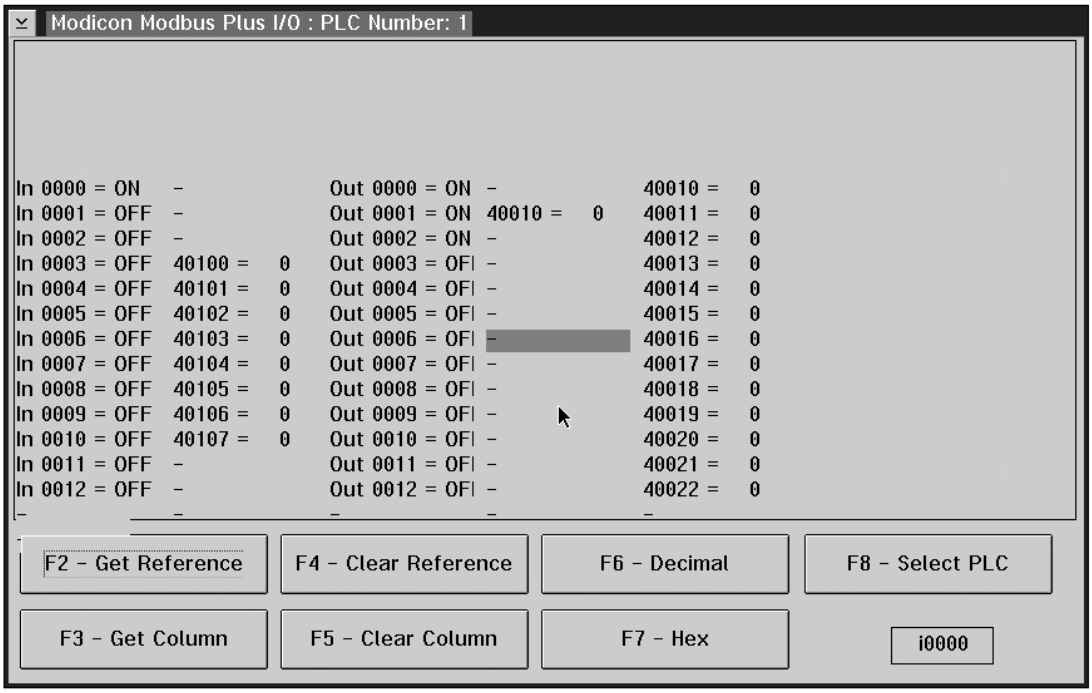


Figure 6-18. PLC Window

6.11. The FAULTMSG.INI File

The FAULTMSG.INI file allows text to be associated with an error condition for any of the virtual I/O points. This text will be displayed in the fault window when the designated I/O error occurs, refer to figure 6-19. Using the mouse and clicking on the message in the error window will open a help window displaying more information about the error.

The general format of the FAULTMSG.INI is as follows:

SYNTAX: *I/O_TYPE# BIT# FAULT_LEVEL ERROR_TEXT [,FILENAME]*

Where:

I/O_TYPE specifies the type of I/O and register number (if applicable). *I/O_TYPE* may be:

- PLC# (# is 1-7)
- RI 4xxxx (4xxxx is a valid PLC register number)
- RO 4xxxx (4xxxx is a valid PLC register number)
- BI (no parameter)
- BO (no parameter)
- GLOBAL# (# is 1-32).

BIT# is a valid bit number (1-16) with the least significant bit being bit 1.

FAULT_LEVEL is the error state, either logic 0 or 1.

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ERROR_TEXT is the error message to be displayed in the window.

FILENAME is an optional filename that will provide more information if the error message in the error window is clicked on with the mouse. The specified file is an ascii text file containing information on the error message. Each I/O error must have a separate help file.

EXAMPLES:

IO_TYPE#	*BIT#*	*FAULT_LEVEL*	*ERROR_TEXT*	*[,FILENAME]*
PLC 2	1	0	plc2 error on bit 1	,c:\u31\ini\plc.hlp
RI 40100	3	1	reg. 40100 in bit 3 error	,c:\u31\register.hlp
RO 40110	5	0	reg. 40110 out bit 5 error	
BI	7	0	binary in bit 7 error	,c:\u31\program\binary.hlp
BO	9	1	binary output 9 failed	
GLOBAL 3	11	1	global 3 bit 11 error	

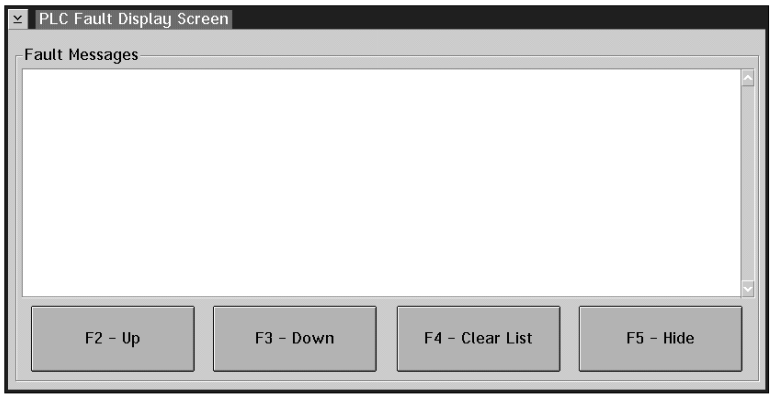


Figure 6-19. Fault Display Screen

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6.12. Plot Data Utility

This function performs real-time data acquisition based on certain parameters selected in the Data Acquisition Parameter Editor (discussed earlier). This utility is useful for acquiring data from several axes at once. Analog input data can also be collected and displayed as well.

PlotData is a data acquisition application which is very similar to the plot utility discussed earlier (see Section 5.14.1). The PlotData "MAINMENU" Dialog Box is shown in Figure 6-20.

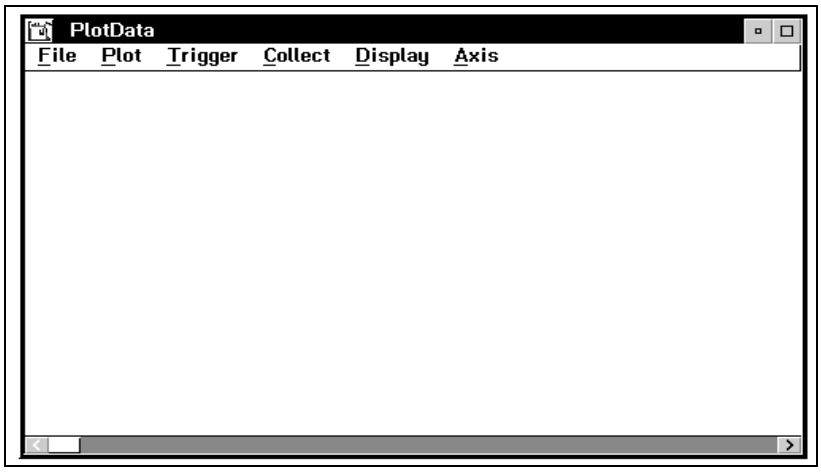


Figure 6-20. Plot Data MAINMENU Dialog Box

The following sections cover all the available choices from within the PlotData "MAINMENU" Dialog Box.

6.12.1. File

Under this menu the user may load previously saved files, save the current data to a specific file, and inquire about the version of PlotData currently running. These options are identical to the corresponding plot options (see Section 5.14.1.1). Data files saved from Plot and PlotData are not interchangeable. Data saved from PlotData can only be loaded by PlotData.

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6.12.2. Plot

This menu toggles (on or off) between displays of channels of servo information. To determine the available choices that exist, refer to Figure 6-21. These channels include all the available choices under the "Plot" option except "Spare". Also available are "Raw Position", "Master Pos", "Acceleration", and analog channels one (1) through eight (8). Selecting one of these channels causes the requested information to appear on the display. The data from channels not selected remains in memory and therefore the user can select it for viewing anytime data collection has taken place. Each time the user saves a file, the system saves all information - not just the selected channels.

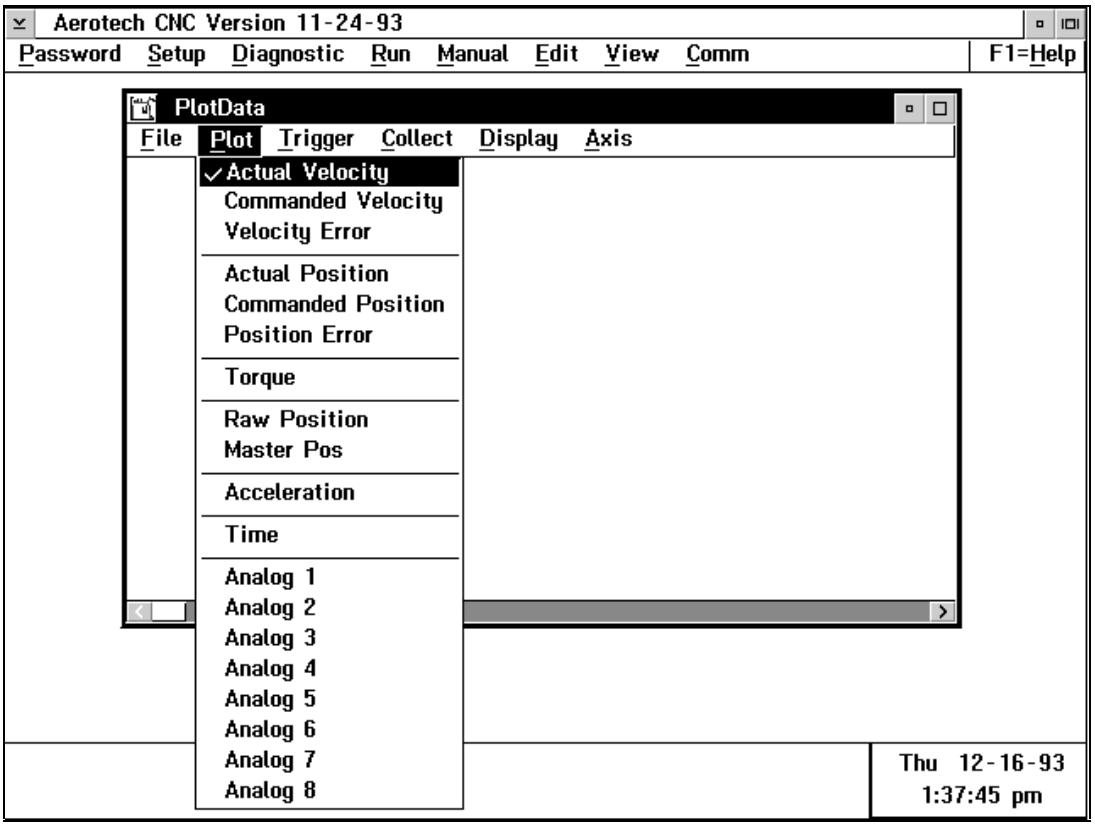


Figure 6-21. Plot Menu

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6.12.3. Trigger

There are five choices offered through this menu. For a list of these choices, refer to Figure 6-22. This menu behaves similar to the trigger control on an oscilloscope. The "Acquire 1 Set of Data" option performs the same function as the single sweep control on a scope. Using this control allows only one acquisition of data. The "Acquire Data Continuously" option collects data on a continuous basis and is the equivalent of putting an oscilloscope in the auto or freerun modes. The "Stop Data Acquisition" feature halts the data collection at the end of the current sample period. The "Abort Data Acquisition" feature aborts the data acquisition immediately.

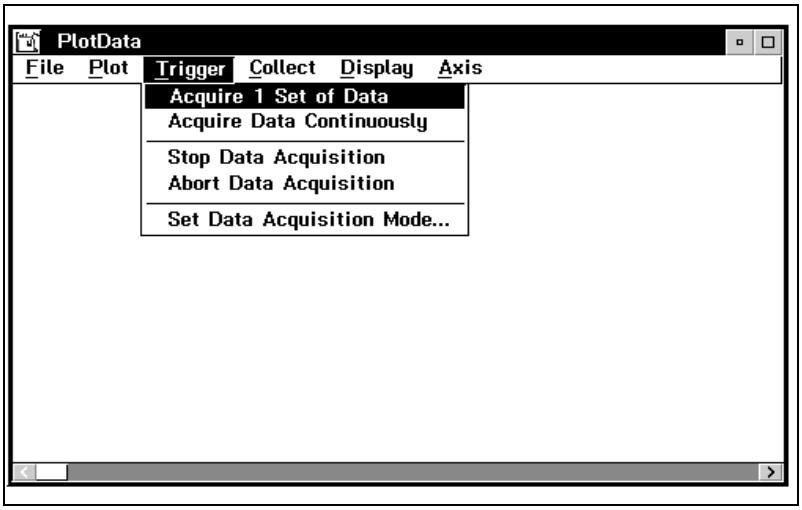


Figure 6-22. Trigger Menu

The final choice under the Trigger Menu is the "Set Data Acquisition Mode". This option is identical to same the "Plot" utility option. Refer to Section 5.13. of this manual for information concerning the data acquisition modes.

6.12.4. Collect

Through this menu the user can set the number of samples desired. This menu is identical to the Plot Utility Collect Menu (see Section 5.14.1.4. of this manual).

6.12.5. Display

This menu allows the user to choose the resolution for the displayed data. This menu is identical to the Plot Utility Display Menu (see Section 5.14.1.5. of this manual).

Selecting the "Cursor" option from the Display Menu causes a Cursor Measurement Tool Dialog Box to appear in the lower right corner of the screen (see Figure 6-23). Unlike the plot utility cursor, this dialog box only displays the time information associated with cursors A and B. This is due to the large number of channels and axes which can be plotted at any given time.

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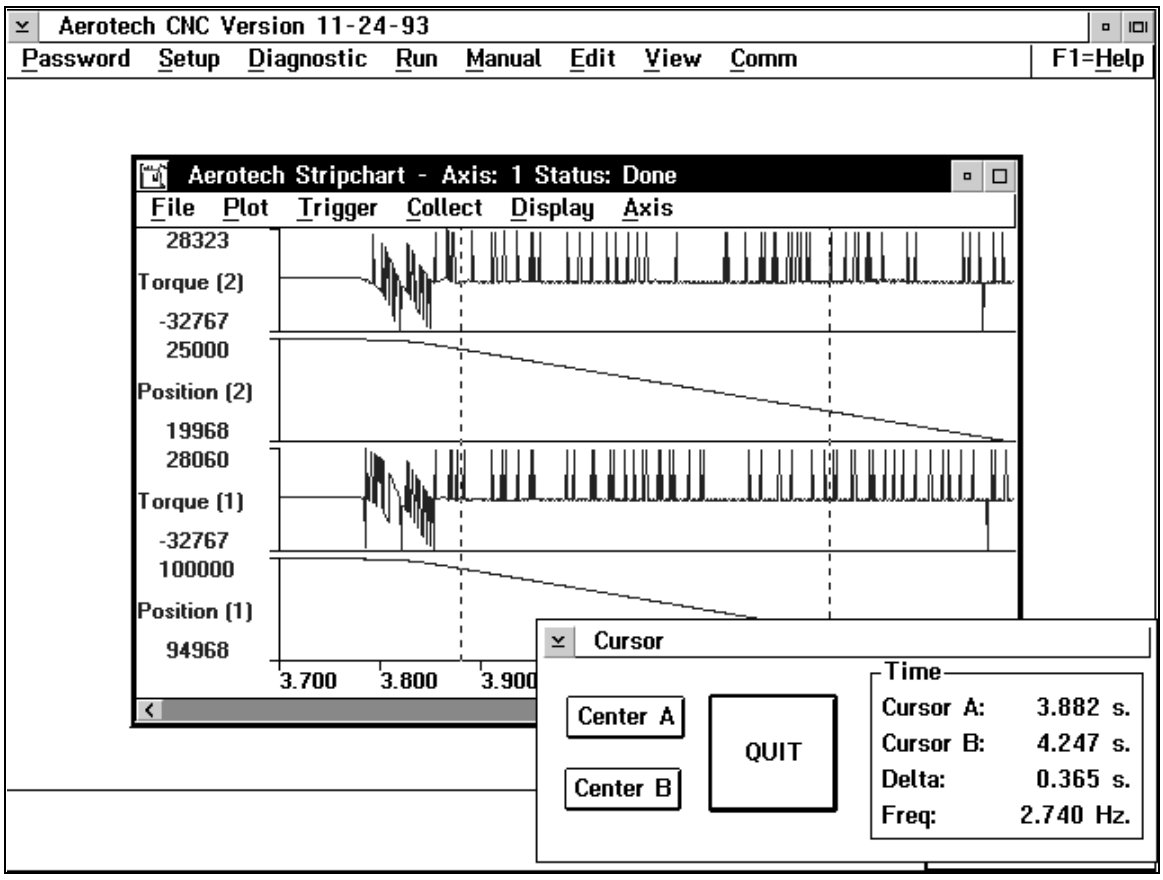


Figure 6-23. Cursor Measurement Tool Dialog Box

6.12.6. Axis

Selecting the "Select Axis" option under the Axis Menu permits the user to select or change the available axes (see Figure 6-24). Unlike the "Plot" utility, the " PlotData" option allows multiple axes to be displayed at any given time.

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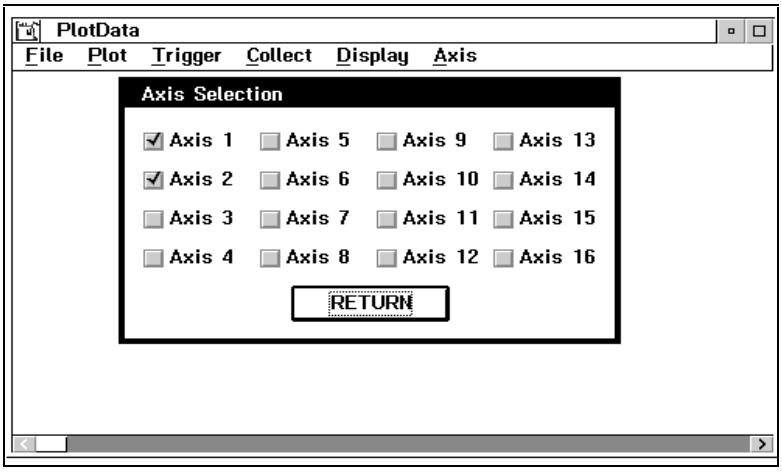


Figure 6-24. PlotData Axis Selection Dialog Box

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6.13. Plot XY Utility

Selecting the "Plot XY" option from the Diagnostic Menu invokes a utility that allows the user to plot the position of any two axes while executing a Parts Program in the simulation mode. While operating in this mode, the axis processor executes the Parts Program for data acquisition purposes only. That is, all calculations are normal, but instead of sending the position command to the servo, the axis processor uses it as feedback for the axis. However, the system maintains torque on the motor.

Since this utility can run concurrently with other screens, it is very useful for debugging of Parts Programs. It permits the user to execute the Parts Program, and to look at a graphical representation of the part they want to produce. Therefore, the user need not worry about safety issues that relate to incorrect programming. See Figure 6-25 below.

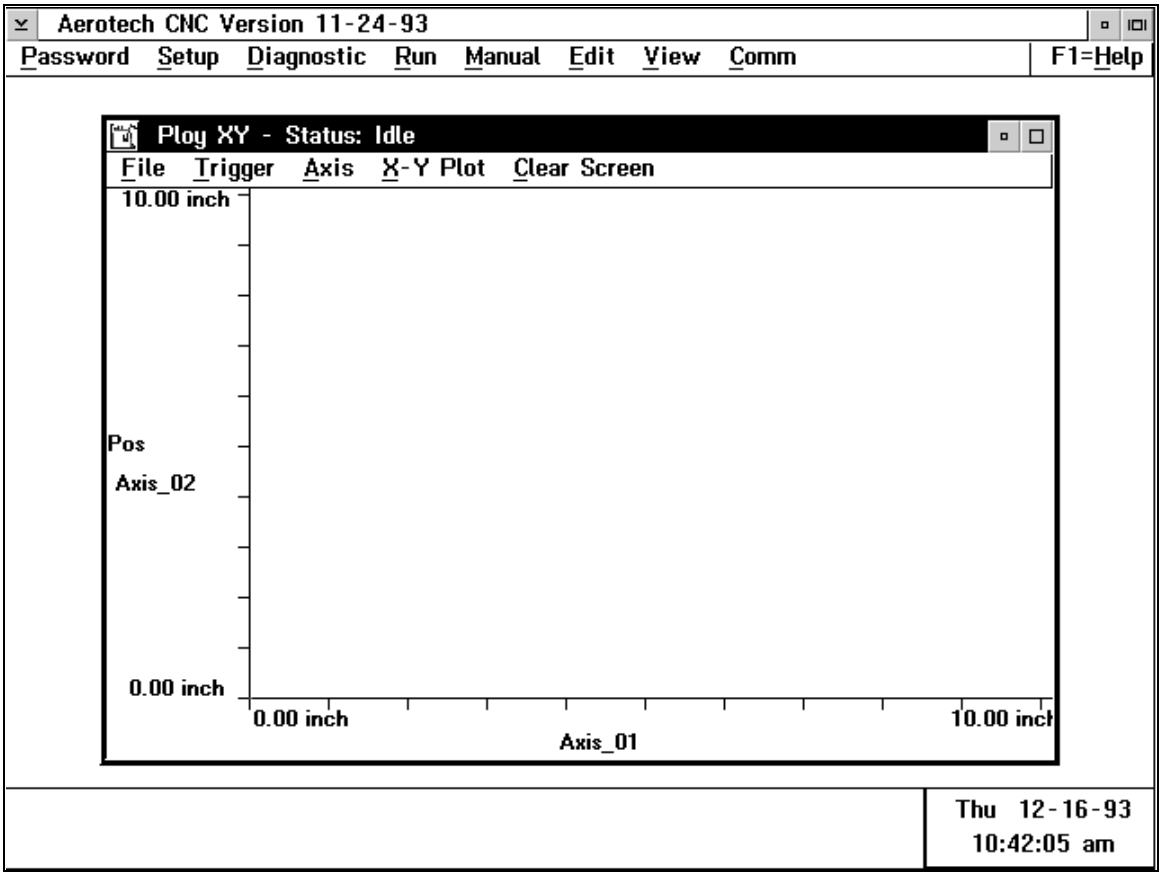


Figure 6-25. Plot XY Status Dialog Box

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6.13.1. Configuration File

The configuration of the "Plot XY" utility can be saved by selecting the "Save Configuration" option under the File Menu (refer to Figure 6-26). The configuration data includes the selected axes, coordinate limits, and display units. To load the saved configuration select the "Load Configuration" option.

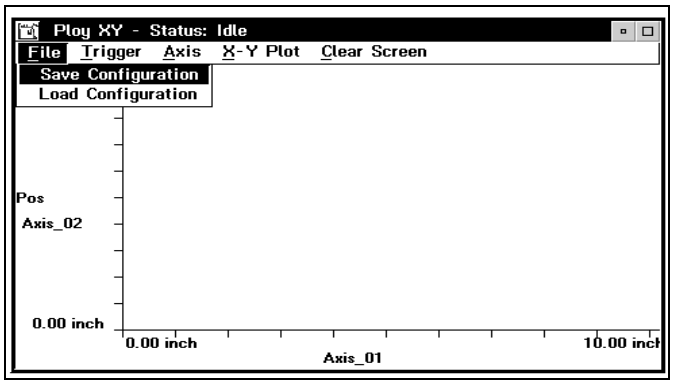


Figure 6-26. Plot XY File Menu

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6.13.2. Trigger

Looking below at Figure 6-27, the options found under the Trigger Menu permit the user to begin and end data acquisition.

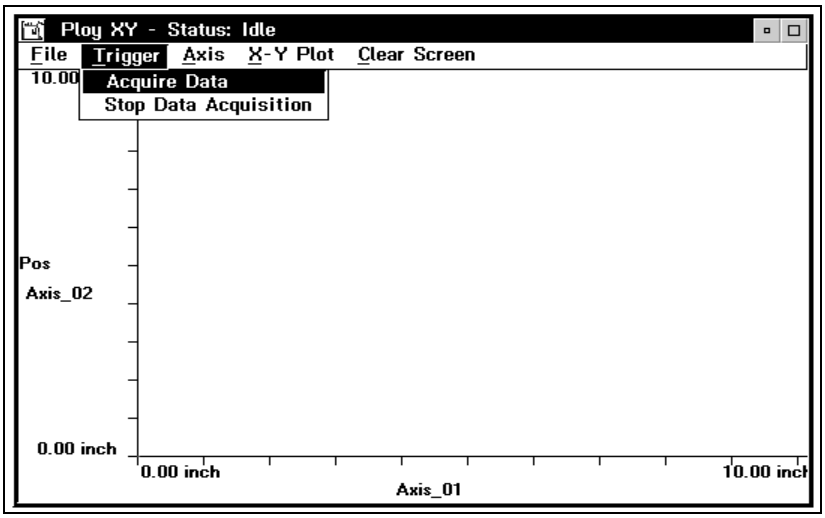


Figure 6-27. Plot XY Trigger Menu

With data acquisition enabled, the acquired data appears graphically on the screen (see Figure 6-28). The title bar of the window indicates triggered acquisition.

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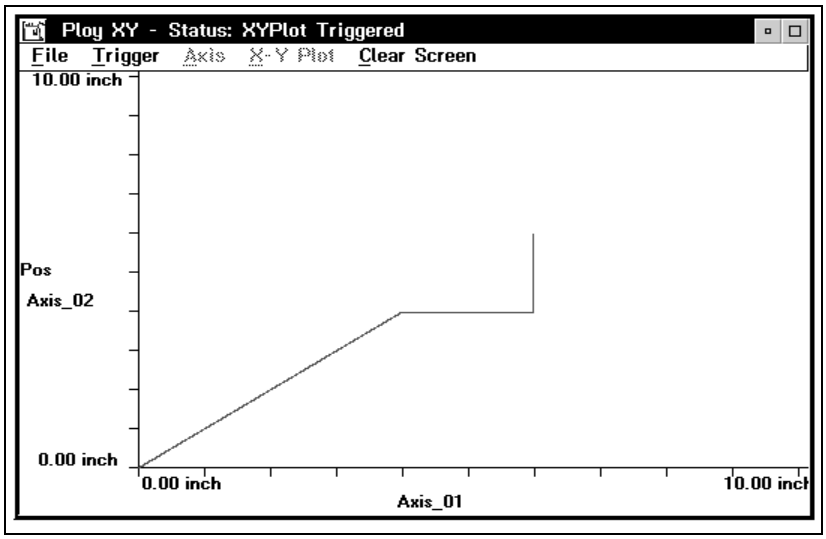


Figure 6-28. Plot XY Data Acquisition in Progress Dialog Box

Selecting the "Stop Data Acquisition" option from within the Trigger menu (see Figure 6-29) places the "Plot XY" utility back into its idle mode. Therefore, any changes in position do not affect the data displayed on the screen. A change in the status of the axis appears in the title bar indicating that the utility is idle.

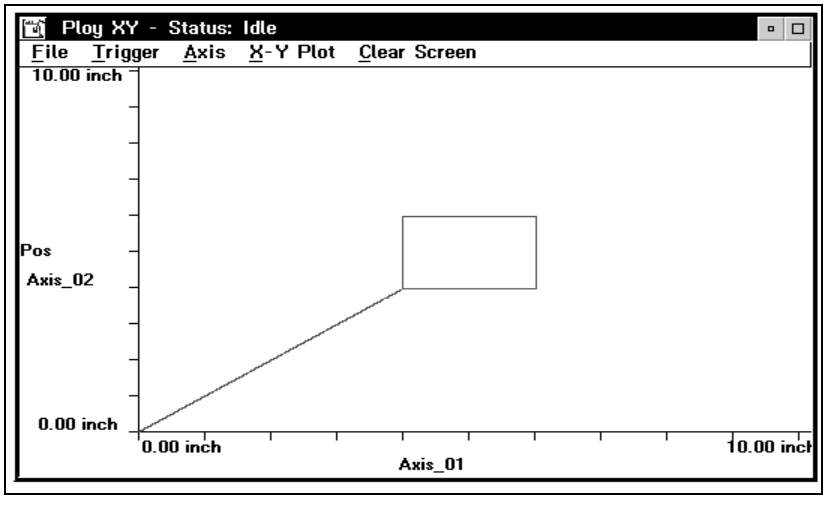


Figure 6-29. Plot XY Data Acquisition Complete Dialog Box

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6.13.3. Axis

The Axis Menu permits the user to select which two axes to plot within the window. Select the desired axes under the appropriate "Mask" option (see Figure 6-30). A check mark appears next to the currently displayed axes.

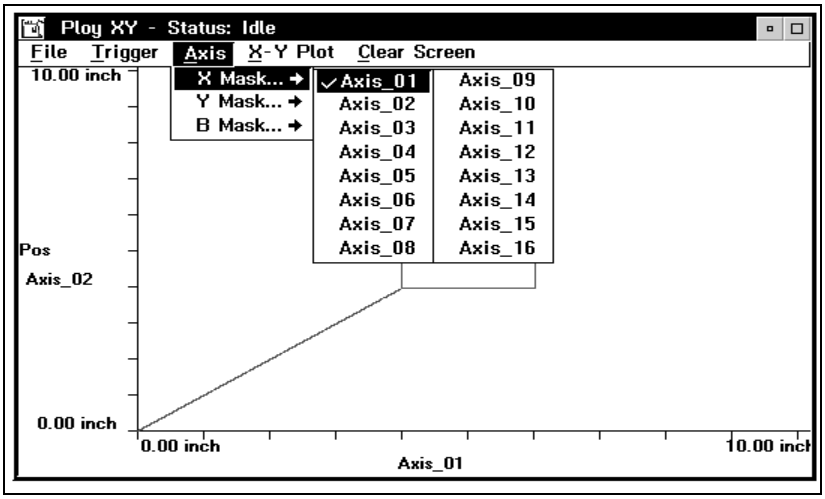


Figure 6-30. Plot XY Axes Menu

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6.13.4. X-Y Plot

The options found under the X-Y Plot Menu specify what type of information to display, as well as the format for displaying the information. Notice from Figure 6-31, below, that the grouping of each option depends on the function.

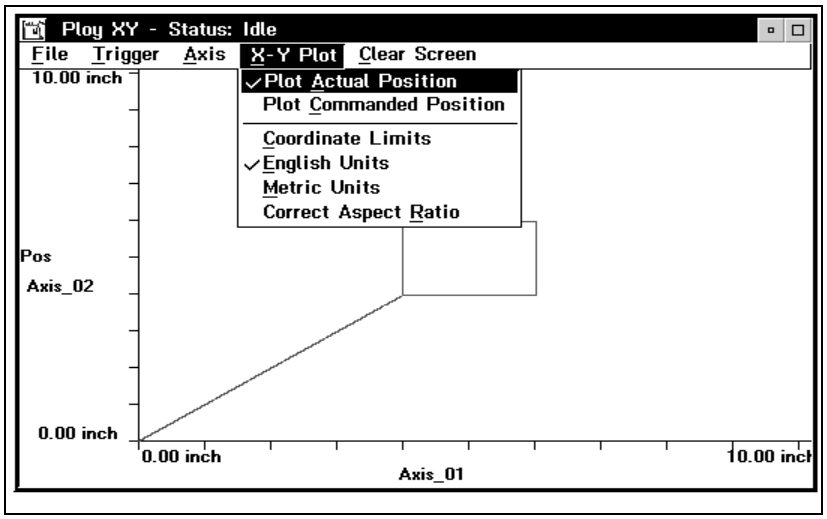


Figure 6-31. X-Y Plot Menu

6.13.4.1. Actual/Commanded Position

The first group of options available on this sub-menu permit the user to choose the type of position to plot. These choices include commanded position and actual position. Commanded position is the position command used in the Servo Loop. Actual position is the position feedback received from the transducer associated with the axis. For axes configured to use a null feedback type, the actual and command positions are equivalent. This option applies to both axes display (i.e., both will either be commanded position or both are actual position).

6.13.4.2. Coordinate Limits

Selecting this option, from the X-Y Plot Menu, permits the user to specify the scale of the horizontal and vertical axes in the graph drawn. Upon selecting this option, "MAINMENU" responds by displaying a Plot XY Coordinate Limits Dialog Box (see).

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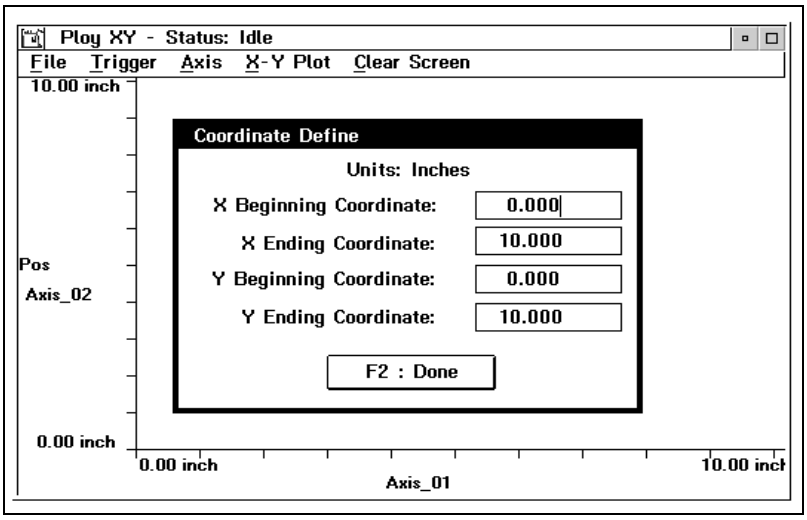


Figure 6-32. Plot XY Coordinate Limits Dialog Box

The dialog box in Figure 6-32 indicates the currently active units that are in effect (inches/millimeters), as well as an entry field that displays the leftmost and rightmost points on each axis. The X axis in this dialog box refers to the horizontal axis while the Y axis is the vertical axis. The value displayed on the leftmost (lowest) portion of the axis is the beginning coordinate and the value in the rightmost (topmost) portion of the axis is the ending coordinate.

The **<F2:Done>** Push-Button or the [F2] Function Key signifies that entry is complete. The new scale factors become active upon starting the next data acquisition.

This option is not available for triggered utilities. "MAINMENU" indicates this by displaying the option with a half-tone attribute.



6.13.4.3. Units of Measure

The last two options available on the X-Y Plot Menu permit the user to select the units of measure to use when interpreting the position information received from the axis processor. Selecting English causes the unit of measure to be inches. Conversely, selecting metric causes the display to be in millimeters.

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6.13.4.4. Correct Aspect Ratio

This menu option under the X-Y Plot Menu corrects the window size to display the axes in a 1 to 1 ratio. The X-Y Plot window is always decreased in size to achieve the correct aspect ratio. A check mark appears on the menu when the correct aspect ratio is enabled. When enabled, the X-Y Plot window can not be resized manually. To manually change the window size the correct aspect ratio must first be disabled.

6.13.5. Clear Screen

This menu option does not have a menu associated with it. It simply removes all old graphs from the window currently being displayed.

6.14. Hexadecimal Calculator

The last option available on the Diagnostic Menu is the "Hex Calculator" option. This utility is for convenience only. This calculator permits the user to do rudimentary arithmetic and logical functions in either a base 10 (decimal) or base 16 (hexadecimal) format (see Figure 6-33).

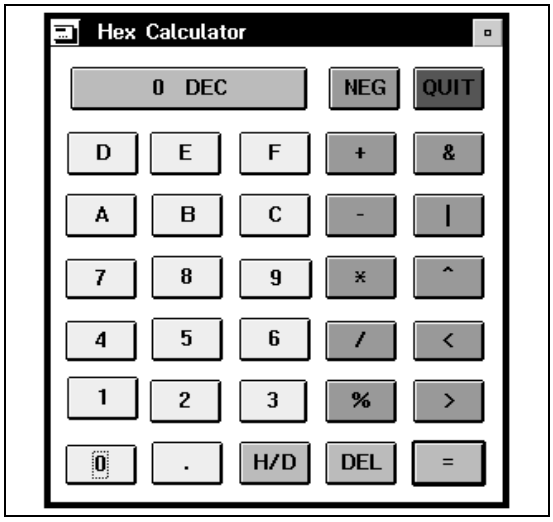


Figure 6-33. Hexadecimal Calculator Dialog Box

The calculator that appears in the dialog box shown in Figure 6-33 resembles a normal calculator with each key color coded according to its functionality.

The current value entry, as well as the result of the operations, appears on the display in a large blue rectangular field located in the upper left portion of the dialog box. The keys that directly affect that field also appear on the display in blue. These keys include:

H/D	Hexadecimal/Decimal Base
DEL	Undo the last key entered
=	Display result of last operation.

Use the yellow keys below the "display" field when entering the values to be operated upon. These include the digits 0-9, the letters A-F, and a decimal point. The digits 0-9 are valid in any mode of operation. Letters A-F are only valid when operating in the

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Hexadecimal Mode. The decimal point is only valid while operating in the decimal Mode.

The green keys permit the user to specify mathematical operations. Selecting one of the following buttons permit the user to perform the arithmetic operation associated with it. Refer to Table 6-1.

Table 6-1. Mathematical Operations on the Hexadecimal Calculator

Key	Function
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulus (Remainder)
NEG	Negation

However, the user may only perform logical functions while operating in the Hexadecimal Mode. These functions are listed in Table 6-2.

Table 6-2. Logical Operations on the Hexadecimal Calculator

Key	Function
&	AND
|	OR
^	Exclusive OR
<	Shift Left
>	Shift Right

The red **QUIT** Push-Button located in the upper right corner of the Hexadecimal Calculator Dialog Box permits the user to exit the screen. Upon exiting the screen, control returns to the previous "MAINMENU" screen.

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CHAPTER 7: RUN CNC PARTS PROGRAM

In This Section:

- Selecting the Parts Program 7-1
- CNC Parts Program Decoding 7-2
- CNC Run Mode 7-2
- Position Display 7-6
- Program Controls 7-10
- Status Window 7-13
- Begin Program Execution from an Arbitrary Point 7-13
- Feedhold Jogging 7-14
- Debug and Debug Feedrate 7-16
- Variables Menu 7-17
- Reset Option 7-19

7.1. Selecting the Parts Program

The first step in running a CNC parts program is to select the program for execution. The "MAINMENU" program provides a File Open Dialog Box to aid the user in this task. Figure 7-1 depicts this dialog box.

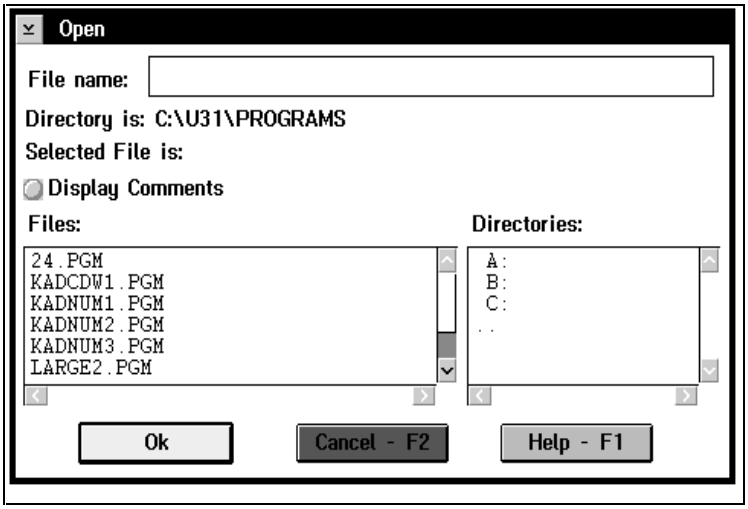


Figure 7-1. File Open Dialog Box

By default, "MAINMENU" expects all CNC parts programs to use the *.PGM extension and reside in the \U31\PROGRAMS directory of the drive on which OS/2 boots. However, the user is permitted to select parts programs files which have any extension and reside in any directory.

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The File Open Dialog Box, used to select the parts program for execution, is identical to the one used when selecting an axis correction table. For more details on the operation of this dialog box, refer to Selecting the axis correction table in Chapter 5.

In the event that the user does not select a valid CNC parts program file, an Open File Error Dialog Box appears to notify the user of the error (see Figure 7-2).



Figure 7-2. File Selection Error Dialog Box

7.2. CNC Parts Program Decoding

After selecting a valid CNC parts program, the system decodes each line within the program and translates it into a format accepted by the axis processor. If a program contains erroneous statements, the Program Translation Error Dialog Box appears to notify the user of the translation error. The Program Translation Error Dialog Box contains information that specifies the line number on which the system encountered the error, as well as the type of error that occurred (see Figure 7-3). The user may not execute this program.

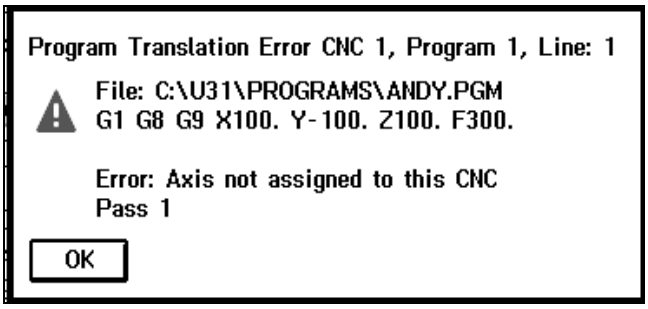


Figure 7-3. Program Translation Error Dialog Box

7.3. CNC Run Mode

After downloading the entire parts program, to the axis processor, "MAINMENU" enters the CNC Run Mode Dialog Box (see Figure 7-4). This screen displays information such as the current position of each axis and the G-Codes currently active. It also displays the parts program being executed, and provides controls that allow the user to manipulate the characteristics of its execution.

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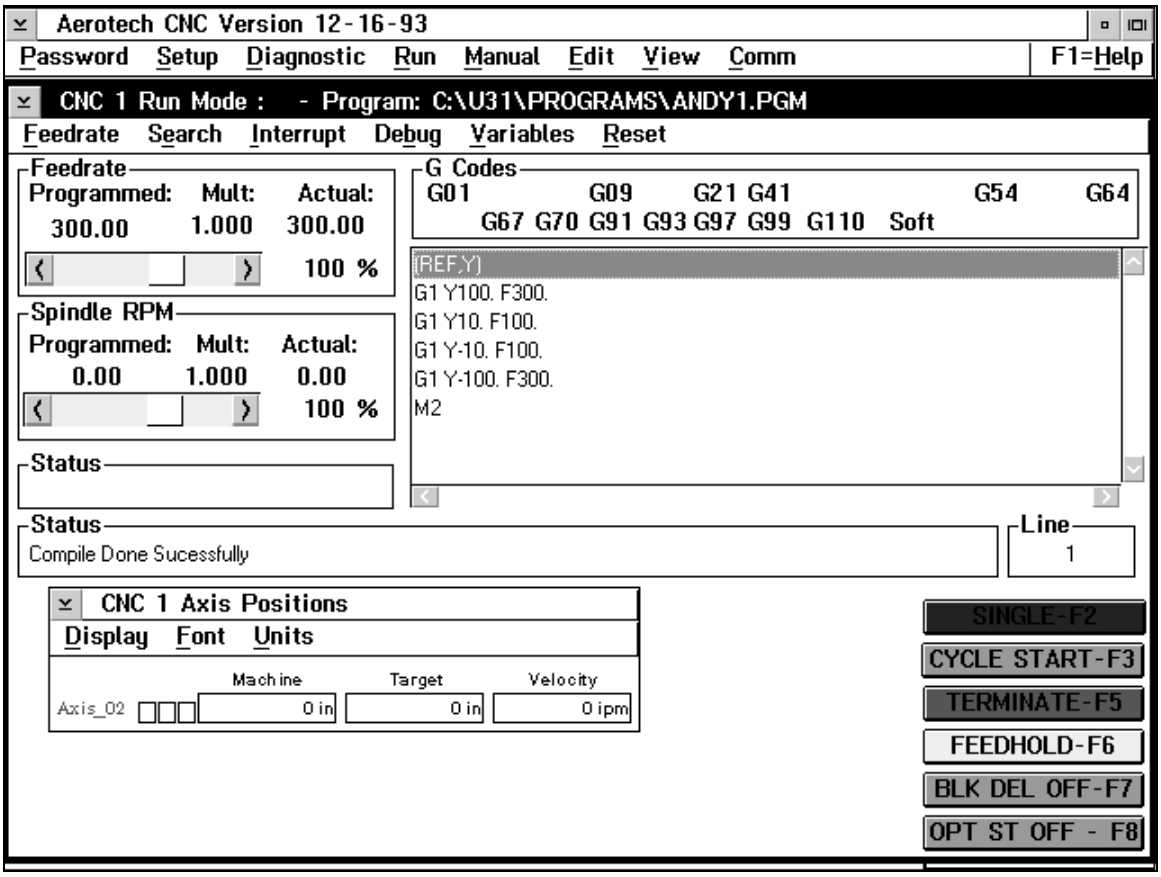


Figure 7-4. CNC Run Mode Dialog Box

7.3.1. Parts Program Display

Looking at Figure 7-4, note that the parts program being executed appears in a large list box in the upper right portion of the screen. Each program block represents an element within that list.

A line within a program that is ready for execution always appears, on the display, in reverse video. The highlighted part of the program changes after execution of the block.

The user may alter program execution using the program flow controls described in Section 7.5.



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7.3.2. G-Code Display

As mentioned earlier, the U31/U600 CNC has several distinct modes of operation. These modes remain active until explicitly commanding the CNC to enter another mode. The G-Codes Group Box indicates the current operating mode of the CNC while executing the parts program. This dialog box is updated each time the parts program changes any of these modes.

The following sections discuss these modes and the choices available to each one.

7.3.2.1. 1st Axes Plane Move Type

There are eight available options when using this mode. These include:

G00 - Rapid Traverse
G01 - Linear Programming
G02 - Clockwise Circular Programming
G03 - Counter-Clockwise Circular Programming
G30 - Cubic Spline Programming

7.3.2.2. 2nd Axes Plane Move Type

There are five available options when using this mode. These include:

G10 - Rapid Traverse
G11 - Linear Programming
G12 - Clockwise Circular Programming
G13 - Counter-Clockwise Circular Programming
G30 - Cubic Spline Programming

7.3.2.3. Axes Plane Designation First Set

There are three available options when using this mode. These include:

G17 - 1st Axes Plane X/Y
G18 - 1st Axes Plane X/Z
G19 - 1st Axes Plane Y/Z

7.3.2.4. Axes Plane Designation Second Set

There are three available options when using this mode. These include:

G27 - 1st Axes Plane V/W
G28 - 1st Axes Plane W/A
G29 - 1st Axes Plane A/V

7.3.2.5. Cutter Compensation Mode

There are three available options when using this mode. These include:

G40 - Cutter Compensation Disabled
G41 - Cutter Compensation Enabled to Left
G42 - Cutter Compensation Enabled to Right

7.3.2.6. Touch Probe Cycle Active

This is the G51 mode and does not contain any options.

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7.3.2.7. Fixture Offset Active

There are three available options when using this mode. These include:

G53 - Fixture Offset Disabled
G54 - Fixture Offset #1 Enabled
G55 - Fixture Offset #2 Enabled

7.3.2.8. Accel/Decel Mode

There are two available options when using this mode. These include:

G63 - Sinusoidal (1-cosine) Ramping Enabled
G64 - Linear Ramping Enabled

7.3.2.9. Units Of Measure

There are two available options when using this mode. These include:

G70 - English Programming (inches)
G71 - Metric Programming (millimeters)

7.3.2.10. Absolute/Incremental Positions

There are two available options when using this mode. These include:

G90 - Absolute Programming
G91 - Incremental Programming

7.3.2.11. Feedrate Mode

There are two available options when using this mode. These include:

G93 - Inverse Feedrate Mode
G94 - Normal Feedrate Mode

7.3.2.12. Programming Mode

There are two available options when using this mode. These include:

G98 - Axes Moves Dominated by Rotary Feedrate, if simultaneous linear/rotary moves
G99 - Axes Moves Dominated by Linear Feedrate, if simultaneous linear/rotary moves

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7.4. Position Display

For each axis associated with the CNC, the CNC Run Mode Dialog Box (see Figure 7-4) contains a group box to convey position information to the user. Appearing within the border of the group box is an axis name. This name corresponds with the axis position displayed on the screen.

This position display box is also used in the Manual Mode Screens (see Section 8). The following is a description of how to manipulate the position display boxes (see Figure 7-5).

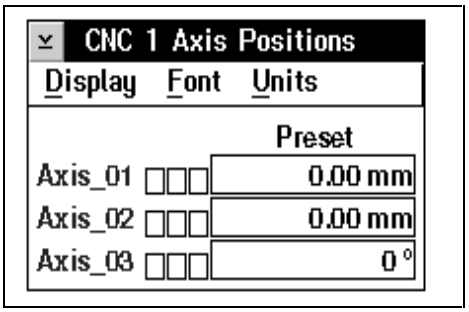


Figure 7-5. Initial Axis Position Display Dialog Box

7.4.1. Moving the Dialog Box

The attributes associated with this dialog box permit the user to move it anywhere on the screen. Mouse users can do this by dragging the box (by its title bar) to the new location. Keyboard users may use the **<Alt-F7>** key to enable moving the box, and the arrow keys to place the box in the desired location.

7.4.2. Sizing the Dialog Box

Although the dialog box is not directly sizable by the user, options available on the menu bar will affect the size and shape of this box. The user may change the size of this box by changing the size of the font. This will resize the dialog box accordingly.

Through the Axis Position Display menu, in Figure 7-6, the user can display several types of information that pertains to each axis.

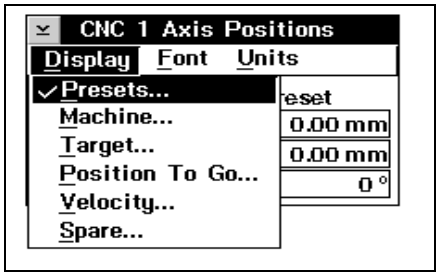


Figure 7-6. Axis Position Display Menu

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For every new option added to the display, the system adds a new column of information. Refer to Figure 7-7.

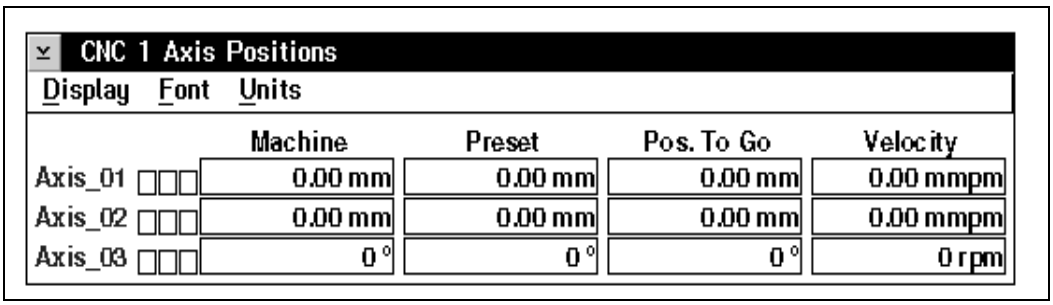


Figure 7-7. Displaying Multiple Positioning Items Dialog Box

The following sections describe the different types of information that is available to the user.

7.4.2.1. Presets

This value represents the position of the motor as an absolute distance from the current software home (G92). The system continuously updates this value as long as it receives feedback from the transducer.

7.4.2.2. Machine

This value represents the motor position as an absolute distance from the hardware home. The system continuously updates this value so long as it receives feedback from the transducer.

7.4.2.3. Target

The value displayed in this field shows the commanded position at the completion of the motion command currently being executed. The system updates this value upon starting each axis movement. When the machine position equals the target position, the move is complete.

7.4.2.4. Position To Go

This value shows the remaining distance of the currently executing motion command. It is equivalent to the target position minus the preset position. Each time the value of these two fields changes, this value also changes.

7.4.2.5. Velocity

This value corresponds with the current motor speed. The system computes this value by differentiating the position over a period of time. The period of time used depends on the setting of the AVGVELTIME parameter (see Chapter 5 for more information).

7.4.2.6. Spare

This value is used by Aerotech debugging utilities to represent the various features being debugged. During normal operation, the user need not concern themselves with this value since it has no significance to them.

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7.4.2.7. Fonts

Another way of changing the size of the dialog box below is to change the size of the font used to display the information. The Axis Position Display Font Options menu provides the user with a variety of font sizes to choose from (see Figure 7-8).

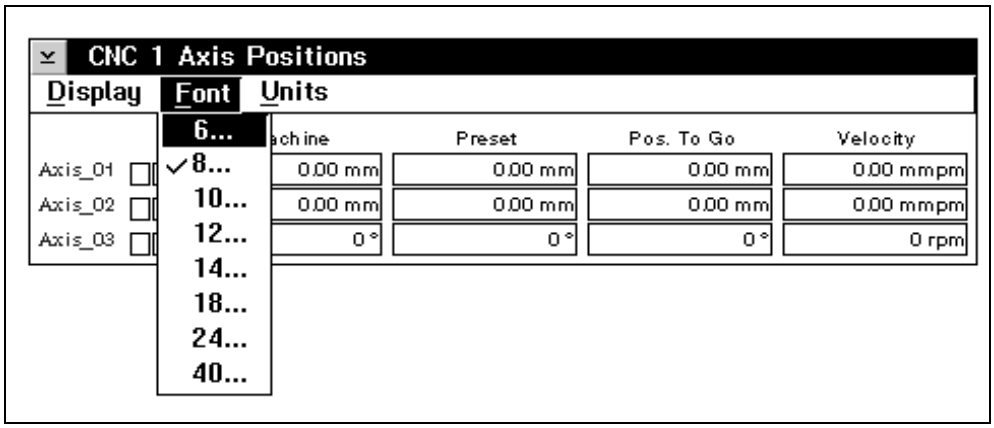


Figure 7-8. Axis Position Display Font Menu

The applicable size depends upon the number of fields being displayed, as well as the distance from which the user needs to view the display.

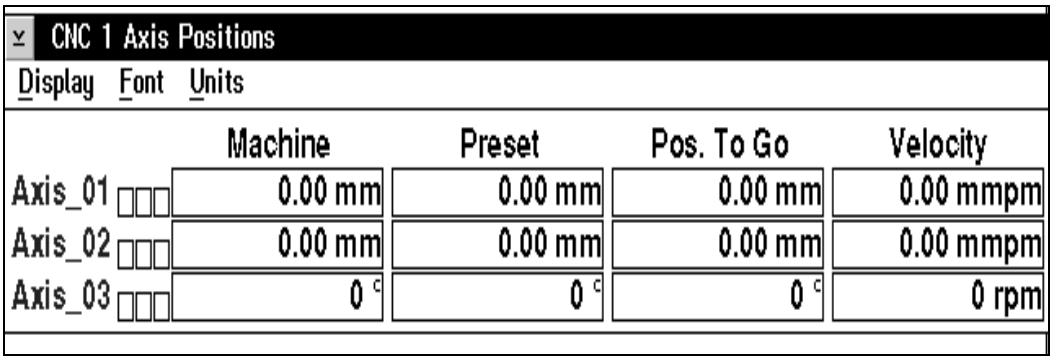


Figure 7-9. Axis Position Display - Font 12 Dialog Box

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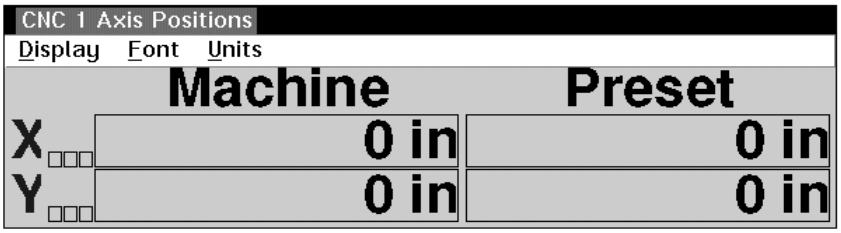


Figure 7-10. Axis Position Display - Font 40 Dialog Box

7.4.3. Units

As can be seen from Figure 7-11, the Units Available in Axis Position Display Menu permit the user to configure the display in one of two modes: English (inches) or metric (millimeters). This setting applies to all linear axes being displayed. Rotary axes always appear on the display in degrees.

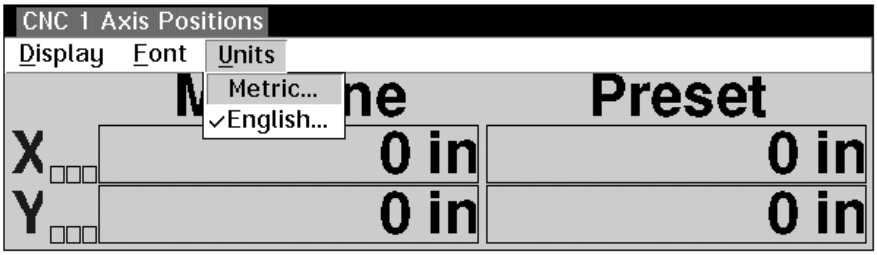


Figure 7-11. Units Available in Units Menu

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7.5. Program Controls

This screen (see Figure 7-4) permits the user to control the execution of the parts program. The following sections discuss each of these features in detail.

7.5.1. Execution Mode Selection

The U31 CNC can execute a parts program in one of two ways: single-step mode or auto mode. The blue **SINGLE-F2** button displays the current execution mode and toggles between the two available execution modes.

Upon invocation, the mode of operation for the CNC Processor is the single-step mode. To change the execution mode, the user must press the blue **SINGLE-F2** button or press the [F2] function key. In response to this action, the CNC changes into the auto mode of execution, and the blue **SINGLE-F2** button changes into an **AUTO-F2** button.

Since this push-button acts as a toggle between the single-step mode and the auto mode of execution, pressing it again places the CNC Processor back into the single-step mode. Doing this while executing the parts program causes execution to halt upon completion of the current program block.

7.5.2. Program Execution

The **CYCLE START-F3** button initiates execution of the parts program. Pressing this push-button or the associated [F3] function key, causes the CNC Processor to execute one block of the parts program. Upon completion of this block, the system determines the current execution mode. If the enabled mode is the auto-step mode, the system proceeds by executing the next program block. This process repeats until the system encounters the programs end.

While operating in the single-step mode the system only executes one program block in response to this push-button. The system ignores all cycle starts encountered during the execution of that program block.



It is not always necessary to begin program execution with the first line of the parts program. See Section 7.6 for further information.

7.5.3. Suspending Axes Motion

The **FEEDHOLD-F6** button or the associated [F6] function key temporarily halts the axes motion. This is accomplished by decelerating all axes to zero velocity in the amount of time specified by the CNC Decel Time parameter (see Chapter 5 for more information). Then, the **FEEDHOLD-F6** button begins to flash.

Upon releasing the feedhold, the CNC continues the suspended move. The processor recalculates all the move parameters as though it received a move command. The new move uses the accel and decel times specified by the appropriate CNC parameters (see Chapter 5 for more information)

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While the axes are in a feedhold state, the options found within the JOG Menu are valid. Refer to Section 7.7 for more details.



Activation of feedhold may affect the operation of some data acquisition utilities. Refer to Chapter 5 for more details.

7.5.4. Block Delete Operation

The UNIDEX 31 CNC programming language includes a "Block Delete Operator" (/). This operator permits the user to select certain program blocks that may be skipped during a program run. During program editing, the user may insert a "/" at the beginning of programming blocks to designate them as optional blocks.

If the block delete function is active during program execution, the system treats the optional blocks as comments. When block delete is inactive, the system ignores the block delete operator and executes the program block as normal.

The green **BLK_DEL_OFF-F7** button displays the current state of the block delete operation, as well as activate and deactivate this function. Pressing the **BLK_DEL_OFF-F7** button or the associated [F7] function key allows the system to treat optional program blocks as comments. Then, the push-button name changes to **BLK_DEL_ON-F7** so as to notify the user that the block delete option is active.

To deactivate this function, the user must, again, press the **BLK_DEL_ON-F7** button or the associated [F7] function key. This then disables the block delete option, and returns the push-button label to its initial state.

7.5.5. Optional Stop Operation

UNIDEX 31's CNC programming language supports the use of an optional (planned) stop command (M01 - see the *UNIDEX 31 Programming Manual*). With the optional stop activated, the program execution stops. To restart program execution, use the **CYCLE START-F3** button or the associated [F3] function key. Failure to activate the optional stop causes the system to ignore the M01 command.

The green **OPT ST ON-F8** button displays the current state of the optional stop operation, as well as activate and deactivate it. To enable this feature, the user must press the **OPT ST OFF-F8** button or press the associated [F8] function key. Then, the push-button name changes to **OPT ST ON-F8** to notify the user that the optional stop operation is active.

To deactivate this feature, the user must, again, press the **OPT ST ON-F8** button or the associated [F8] function key. The system then disables optional stop and returns the push-button to its initial state.

7.5.6. Terminating Program Execution

The red **TERMINATE-F5** button terminates program execution immediately. This causes all axes currently in motion to decelerate to zero velocity based on the time specified in the decel time parameter (see Chapter 5 for more information). Once terminated, the user may not restart the program unless they exit this screen and enter it again.

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7.5.7. Feedrate Control

The group boxes labeled Feedrate and Spindle RPM permit the user to vary the speed at which the axes are commanded to move from within a parts program. Refer to Figure 7-12. These controls limit this variance from 0 percent to 200 percent of the feedrate specified by the parts program. The feedrate control is often referred to as the manual feedrate override control or MFO.

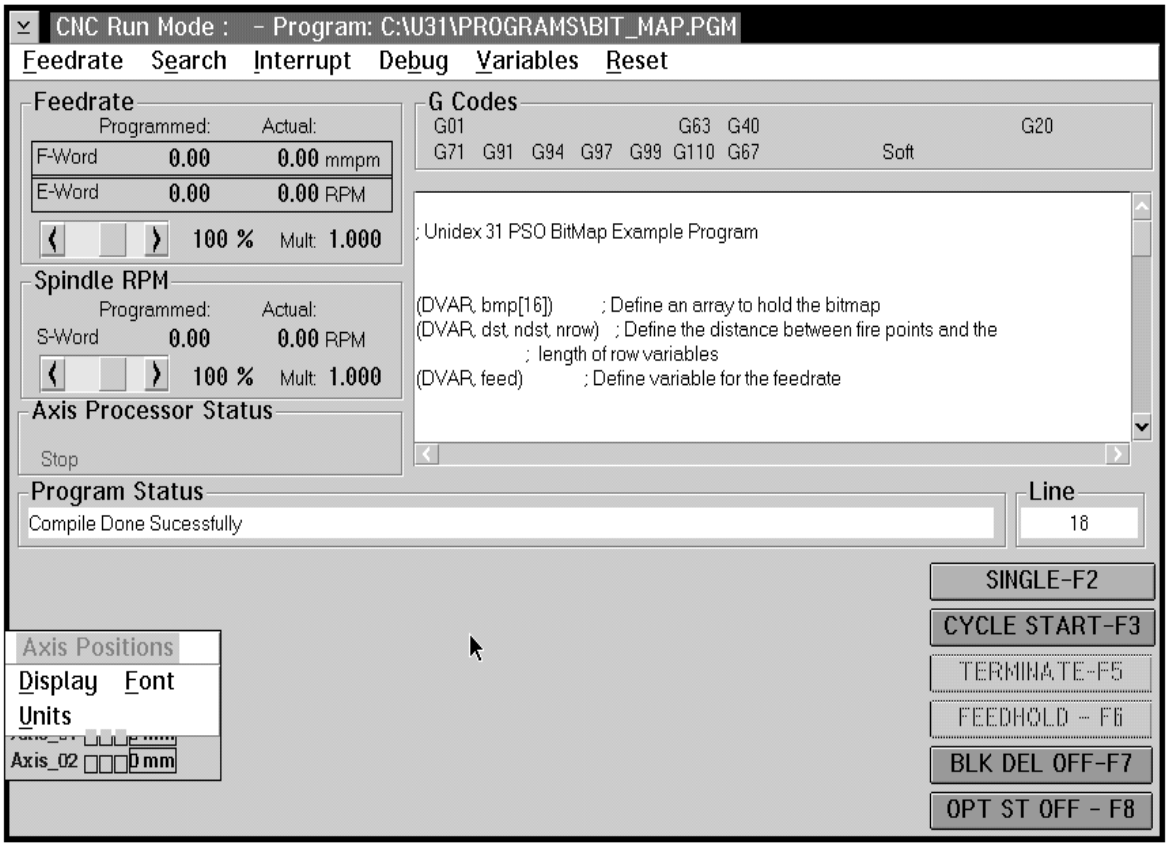


Figure 7-12. Feedrate Control Sections of the CNC Run Screen

Both boxes contain the same controls and operate in the same manner. However, they operate on different axes. The Spindle RPM Group Box varies the speed of the Spindle Axis (the axis selected in the CNC Parameter Screen). For additional information about the Spindle Axis see Chapter 5. The feedrate control affects all other axes (linear or rotary) associated with the CNC.

Each of these boxes contain three information fields and a horizontal scroll bar. The scroll bar changes the MFO percentage currently being applied to the programmed feedrate. The scroll buttons increment or decrement the current percentage by one percent. Mouse users may also click on an area of the scroll box to the right of the scroll bar to increment the percentage by ten percent. Conversely, clicking on an area of the scroll box to the left of the scroll bar causes the percentage to decrement by ten percent.

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Dragging the scroll bar with the mouse also permits the user to obtain the desired percentage.

The information fields found within these boxes display the feedrate commanded by the parts program, the current MFO percentage, and the feedrate after scaling by the MFO. Each of these fields has a label to easily identify it ("Programmed:", "Multi", and "Actual:"), respectively.

7.6. Status Window

This window displays information concerning the execution of the parts program. Refer to this window to observe the present state of the CNC or to determine whether a command has executed.

7.7. Begin Program Execution from an Arbitrary Point

By default, program execution begins with the first line of the selected parts program. However, "MAINMENU" also supports beginning execution from any valid program block.

The user may select the point at which they want execution to begin in one of two ways. If the starting point required for an application appears within the parts program window, the user may manually place the cursor at that point. The user may use the vertical scroll bar associated with that window to view any undisplayed portion of the program. Execution begins from the location pointed to by the cursor.

The Search menu allows the user to scan the parts program for the next occurrence of a given text string. Selecting the "Find" option from this menu causes a Find Dialog Box (see Figure 7-13) to appear on the display.

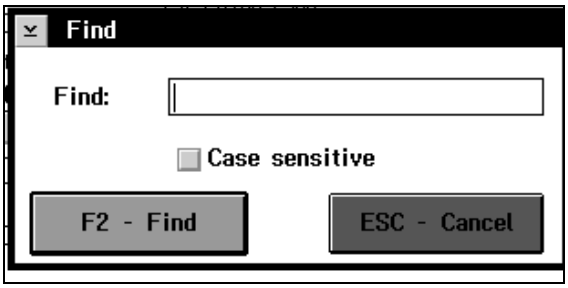


Figure 7-13. Find Dialog Box

The "Find:" entry field specifies the text string to search for. The user may specify any valid text string up to 255 characters in length. Pressing **<Enter>** or the **Find** button causes "MAINMENU" to search the active parts program for the first occurrence of the specified string. Upon locating the string, the cursor appears on that program block. To search for other occurrences of the string, repeatedly press the **<Enter>** or the **Find** button.

This dialog box also contains controls that permit the user to specify some characteristics of the search. The "Case sensitive" check box specifies that upper and lower case characters are distinct; therefore, do not treat them as equivalents. By default, this case is ignored.

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In the event that the system never locates the specified string, the Find Notification Dialog Box appears on the display (see Figure 7-14). After acknowledging this notification, the user may specify to search for a new string.

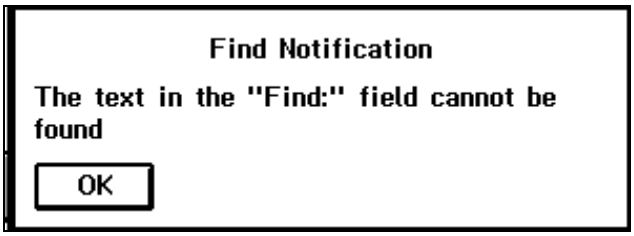


Figure 7-14. Find Notification Dialog Box

Upon locating the desired text string, the **Cancel** button deactivates the Find function. The cursor remains at the location of the text found.



The user can only change the current program location before program execution begins. After pressing the **CYCLE START-F3** button, the system ignores all changes in the cursor position.

7.8. Feedhold Jogging

During normal operation of the CNC, the options found under the Jog Menu appear on the display in a half-tone attribute. The half-tone signifies that presently the user can not access these options. However, by placing the axes into a feedhold state, the user may jog the axes to a new location. Program execution may continue from the new axis position, or return to the position at which the system encountered the feedhold.

7.8.1. Jog & Return

The most common use for the "Jog & Return" option of the Interrupt Menu is to move the axes to a position in which the system can inspect the cutting tool. Selecting this option deactivates the **CYCLE START-F3** and **FEEDHOLD-F6** Push-Buttons, as well as activate the Jog & Return Dialog Box (see Figure 7-15).

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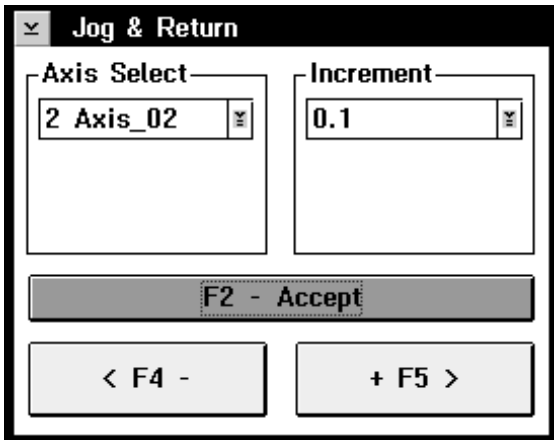


Figure 7-15. Jog & Return Dialog Box

The controls found within this dialog box permit the user to move any axis a fixed distance in either direction. The Axis Select Group Box specifies which axis is to move. The drop-down list box permits the operator to select any axis associated with the CNC, with the exception of the optional Spindle Axis.

The Increment Group Box specifies the distance that the axis is to move each time the user presses the **Jog** button. The drop-down menu permits the selection of various distances. The choices available depend upon the current operational mode. If the current CNC mode is G70 (English units), the available jog increments are 0.1, 0.01, 0.001, 0.0001, and 0.00005 inches. The jog increments for G71 (metric units) options include 1.0 and 0.1 millimeters.

The **< F4> -** button or the [F4] function key moves the selected axis in the negative direction. Each time the user presses the key, the axis position changes by the amount specified in the Increment Group Box. It is necessary to do multiple key presses when moving the axis multiple increments. The **< F5 >** button (and the [F5] function key) perform an identical function, except that the axis moves in the positive direction.

The **F2 - Cancel** button exits the Jog & Return Dialog Box. Pressing this button causes the **CYCLE START-F3** and **FEEDHOLD-F6** Push-Buttons to re-activate. After releasing the feedhold condition, all jogged axes return to their position prior to activating the "Jog & Return" function. The axes that were jogged have their positions restored before all axes resume motion.

When jogging axes multiple increments, the user may depress and hold in the associated function key. This causes the auto-repeat feature of OS/2 to simulate multiple key presses until the user releases the key.

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7.8.2. Jog & Offset Tool Path

Changing the cutting tools is a common use of the "Jog & Offset Tool Path" option of the Jog Menu. The user may move the axes away from the part and the tool being changed. Then, the user may position the tool appropriately and continue with program execution.

Figure 7-16 shows that the controls within the Jog & Offset Tool Path Dialog Box are similar to those found in the Jog & Return Dialog Box. With the exception of the **F2 - Cancel** button, these controls function identically to those described above in Section 7.8.1.

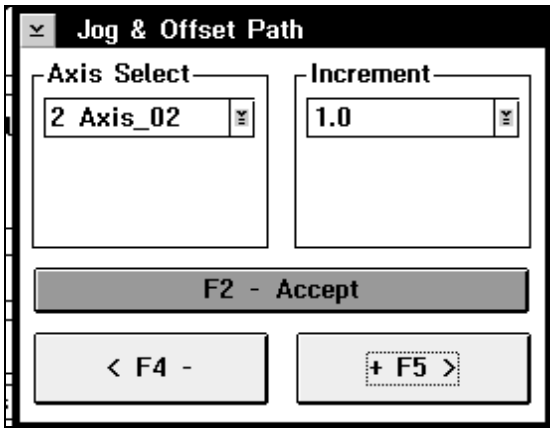


Figure 7-16. Jog & Offset Tool Path Dialog Box

As mentioned, the functionality of the **F2 - Cancel** button found within this dialog box differs from the one found in the Jog & Return Dialog Box. However, the user may perform the new function using the **F3 - Abort Offset** control.

The **F2 - Cancel** button found within this dialog box returns to the CNC Run Mode Dialog Box. However, after releasing the feedhold condition, the jogged axes do not return to their position prior to activating the Jog & Offset Path Dialog Box. The new axis location is the point at which the program execution continues. The position display for those axes reflect the offset of jogged axes. That is, after completion of the current program block, the parts program commanded position display, and the actual axis position display will differ by the amount of this offset.

7.9. Debug and Debug Feedrate

To facilitate easy debugging of parts programs, the user may place a set of axes into "Debug" mode. While in this mode, the CNC Processor treats these axes as virtual axes. That is, Trajectory Generation occurs normally, but velocity commands are not sent to the motor. Instead, the system uses these commands as feedback for those axes. In effect, a zero following error system is simulated.

Although no CNC motion occurs on an axis operating in the Debug Mode, the system continues to maintain torque on the motor. All other features function normally. Therefore, it is possible to use all data acquisition utilities to predict axis response to the parts program being executed.

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Selecting Debug Mode Active from the Debug menu will activate this mode, placing a check mark beside it in the menu. Activation also cause the word Debug to begin flashing in the axis processor status area of the run screen. In addition, the Debug menu allows a debug feedrate to be specified. This is the feedrate that is used during debug mode.

For additional information on debug, refer to the SIMULATION axis parameter in Section 5.1.1.27.

7.10. Variables Menu

The variables menu allows you to view and edit global, local and user-defined variables. There are five menu selections in this menu:

Edit Local Variables Display
Display Local Variables
Display Static Variables
Display Global Variables
Edit Global Variables.

Each of these menu items is discussed in the following sections.

7.10.1. The Edit Local Variables Display Option

The Edit Local Variables Display option displays a dialog box with the user-defined variables. From this display, you can highlight a variable and then select or deselect it for display in the Display Local Variables display. Once a variable is highlighted, it can be selected for the Display Local Variables display (F2 key) or deselcted for the Display Local Variables display (F3 key). When you are finished, press the ESC key. As an alternative to using keyboard keys, these functions can be performed using the mouse and the software buttons on the screen. A sample dialog box is illustrated in Figure 7-17.

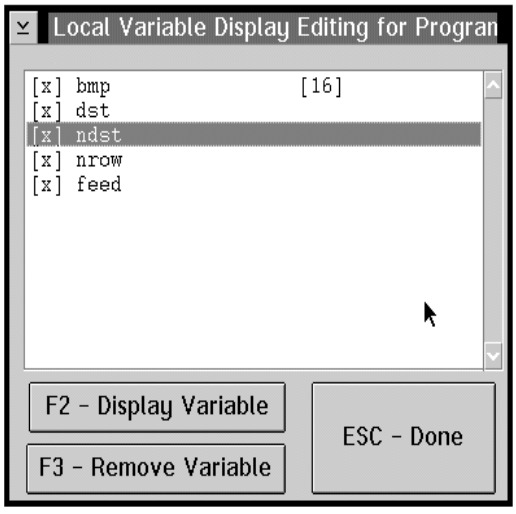


Figure 7-17. Sample "Edit Local Variables Display" Dialog Box

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7.10.2. The Display Local Variables Option

The Display Local Variables option displays a dialog box containing the values of the variables selected in the Edit Local Variables Display option. Press the ESC key (or use the mouse) when you are finished viewing these values. See Figure 7-18.

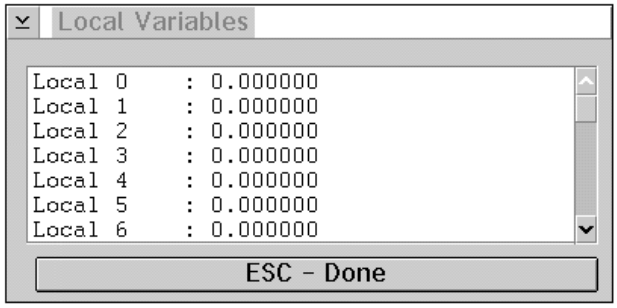


Figure 7-18. Sample "Display Local Variables" Dialog Box

7.10.3. The Display Static Variables Option

The Display Static Variables option displays all of the local variables and their current values. As before, press the ESC key (or use the mouse) when you are finished viewing these variables' values. The display is the same as in Figure 7-18.

7.10.4. The Display Global Variables Option

The Display Global Variables option is used to display all of the global variables and their current values. As before, press the ESC key (or use the mouse) when you are finished viewing these variables' values.

This dialog box also has a single submenu (the Display submenu) that contains two options: display global variables by alias and display global variables by variable number. You select your preference of one of these two display methods using the choices in the Display submenu. Refer to Figure 7-19.

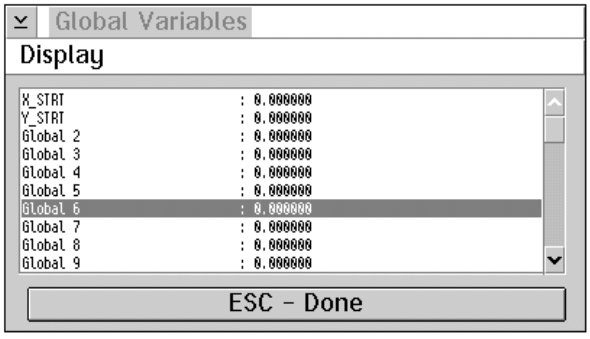


Figure 7-19. Sample "Display Global Variables" Dialog Box

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7.10.5. The Edit Global Variables Option

The Edit Global Variables option is used to display all of the global variables (by alias name and display text name) and their current values. In addition, this menu allows you to edit values. The names of the global variables displayed in this screen come from the GLBALIAS.INI file.

Selecting a variable and pressing the enter key displays a dialog box used to change the value of the variable. Press the enter key (or use the mouse) to go back to the previous screen. Press ESC when you are done to go back to the Run Screen. Refer to Figure 7-20.

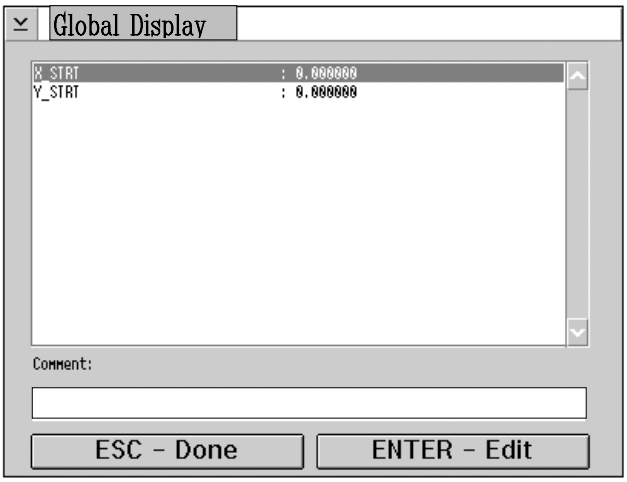


Figure 7-20. Sample "Edit Global Variables" Dialog Box

7.11. Reset Option

To reset the parts program select the "Reset Menu" option. The parts program will be reinitialized to the starting location. This reset process is necessary after the termination of a program.

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CHAPTER 8: MANUAL OPERATION

In This Section:

- Introduction 8-1
- Jog & Home Axes 8-1
- CNC Manual Entry Mode 8-8
- Manual I/O 8-11
- Ethernet 8-14

8.1. Introduction

The options found within the Manual menu permit the user to manually interact with the CNC. This menu permits functions such as jogging, homing, RS-274 command entry, and controlling general purpose inputs and outputs. Figure 8-1 shows the available options.

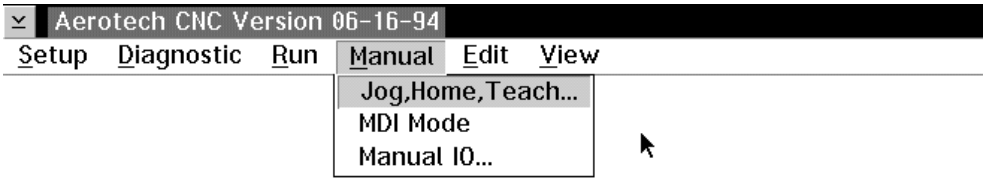


Figure 8-1. Manual Menu

8.2. Jog & Home Axes

The Axes Jog, Home, Teach dialog box permits the user to manually move the axes to a new location, and/or request that an axis return to its home position. In Figure 8-2, each of the axes has an identical group of controls associated with it. The lower portion of the screen contains a position display for the associated axes. Several global controls also appear within this screen.

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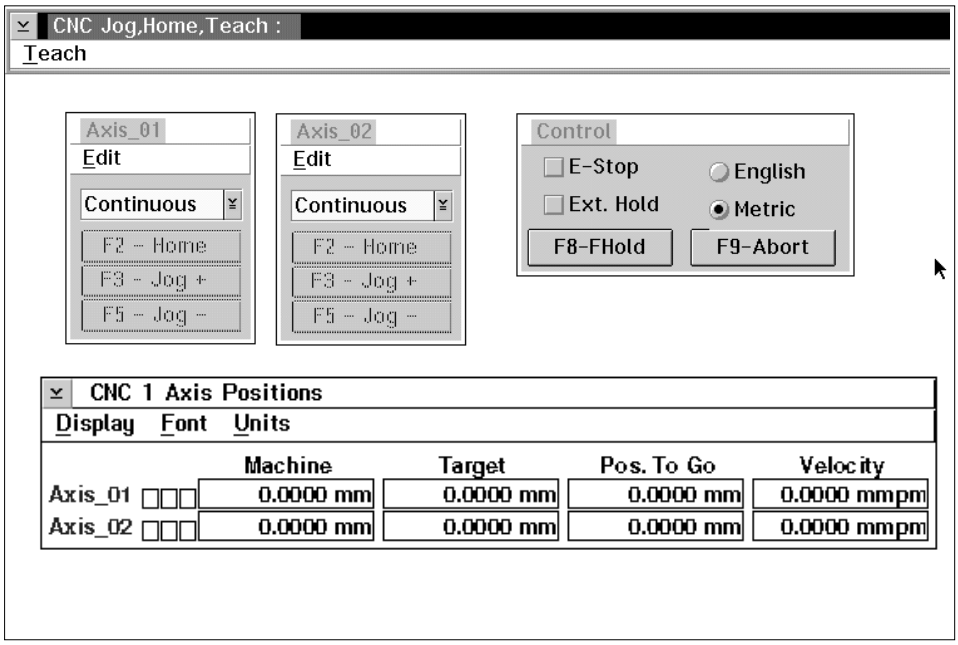


Figure 8-2. Axes, Jog, Home, Teach Dialog Box

8.2.1. Per Axis Controls

As already mentioned, this screen contains a separate group box for each axis in the system. With the exception of the axis name (displayed within the border), these boxes are identical. Each dialog box contains an information field that displays the incremental jog move value, as well as several controls that permit the user to jog the axis in either direction and home the axis.

8.2.1.1. Axis Homing

The **F2-Home** button sends the axis to its home reference position. When homing, the axis begins moving in the direction specified in the home direction parameter (see Chapter 5 for more information). Detection of the home limit switch causes motion to stop on the first encountered resolver null (or encoder marker pulse). Then, the position register is zeroed. However, if the axis encounters an end of travel limit switch, it reverses direction and continues to seek the home limit switch. Once the axis locates the home limit switch, it continuous to move in the current direction until the switch becomes inactive. Then, it reverses direction and approaches the limit from the specified direction. Motion stops as soon as the axis encounters the resolver (or null position for the encoder's marker pulse) and thus resets the position to zero. Detecting a second end of travel limit before finding the home limit causes a homing fault to occur.

8.2.1.2. Jogging

The **F3-Jog+** button and the **F5-Jog-** button controls, found within this group box, permit the user to move the axis a fixed distance in either direction. The drop-down list box specifies the distance that the axis is to move each time the user presses the jog key. The choices available depend upon the position units being used.

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The **Jog** push-buttons jog the axis in the negative and positive direction, respectively. Each time the user presses one of these keys, the axis position changes by the amount specified in the drop-down list box. Multiple key presses are necessary when moving the axis multiple increments.

The Edit menu allows the user to edit the available jog values displayed in the drop-down list box. Figure 8-3 displays the Edit Jog Increments dialog box. The **F2-Add** button adds the value located in the edit box to the right into the list. There may be a maximum of seven values. Adding another value will overwrite one of the previous values. The **F3-Delete** button deletes the highlighted increment from the list. Pressing the **ESC-Done** button returns to the Axes Jog, Home, Teach dialog box.

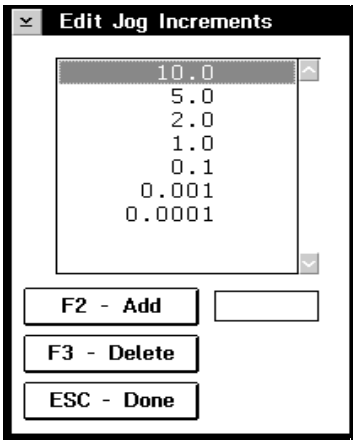


Figure 8-3. Edit Jog Increments Dialog Box

8.2.2. Common Controls

The Axes Jog, Home, Teach dialog box also contains controls that pertain to all axes. These controls permit the user to select the position units being used, as well as temporarily suspend the axis motion.

The English and Metric radio buttons, located in the upper portion of the screen, designate the position units. Selecting one of these options causes MAINMENU to update the position displays so that they correspond with the desired units. The system resets all jog increments to their default values.

Another control that affects all axes is the **F8-FHold** button or the associated [F8] function key. Upon pressing this key, the CNC decelerates all axes to zero velocity in the amount of time specified by the CNC decel time parameter (see Chapter 5). This then results in a flashing **F8-FHold** button.

Upon releasing the feedhold, the Axis Processor resumes execution of the motion in progress. Acceleration and deceleration occurs in the amount of time specified in the accel time and decel time CNC parameters (see Chapter 5 for more information).

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Activating a feedhold may affect the operation of some data acquisition utilities.

The last control that affects all axes is the **F9-Abort** button or the associated [F9] function key. Upon pressing this key, the CNC aborts all axes moves.

8.2.3. CNC Axis Position

As mentioned, the lower portion of the screen contains the Axis Position group box. Refer to Position Display in Section 7.4.

8.2.4. Teach Mode

The Teach Mode dialog box, shown in Figure 8-4, is displayed by selecting the "Teach Menu" option in the Axes, Jog, Home, Teach dialog box.

The "Teach Menu" option is used for recording position information. This information can be saved to a file, edited, and used as a normal parts program. This allows the user to manually jog the axes to the desired locations and store the moves. The stored moves can then be loaded and run automatically.

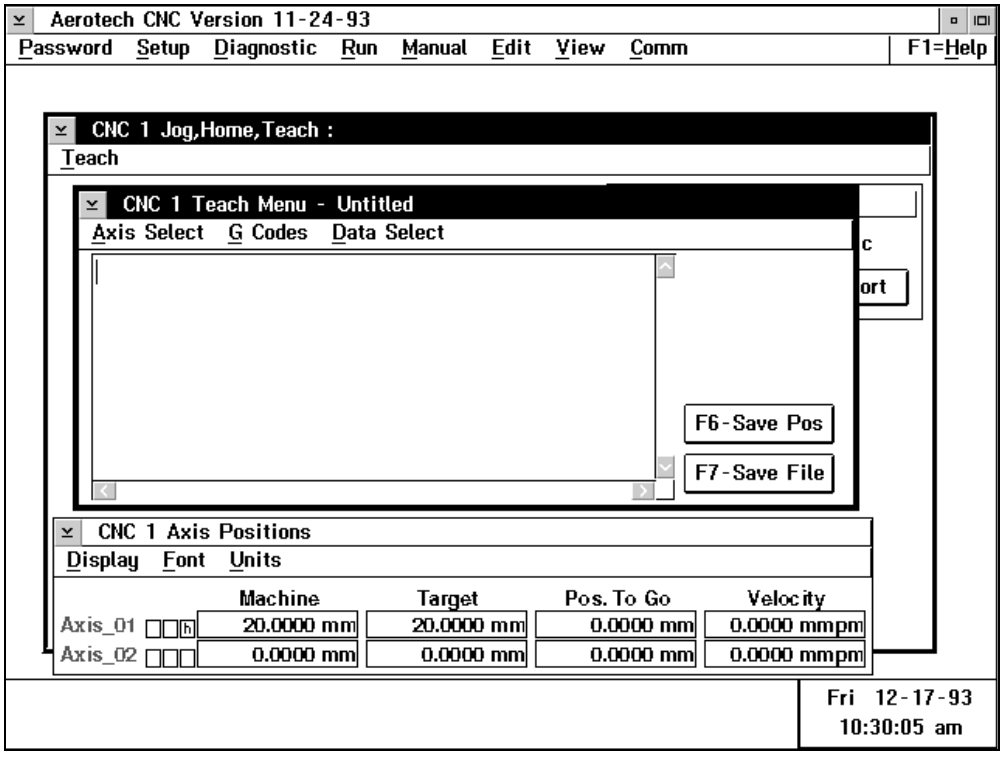


Figure 8-4. Teach Mode Dialog Box

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8.2.4.1. Stored Axes

Only certain axis positions are stored. These axes are selected under the Axis Selection Menu option. A check mark appears by the axes whose positions will be stored (refer to Figure 8-5).

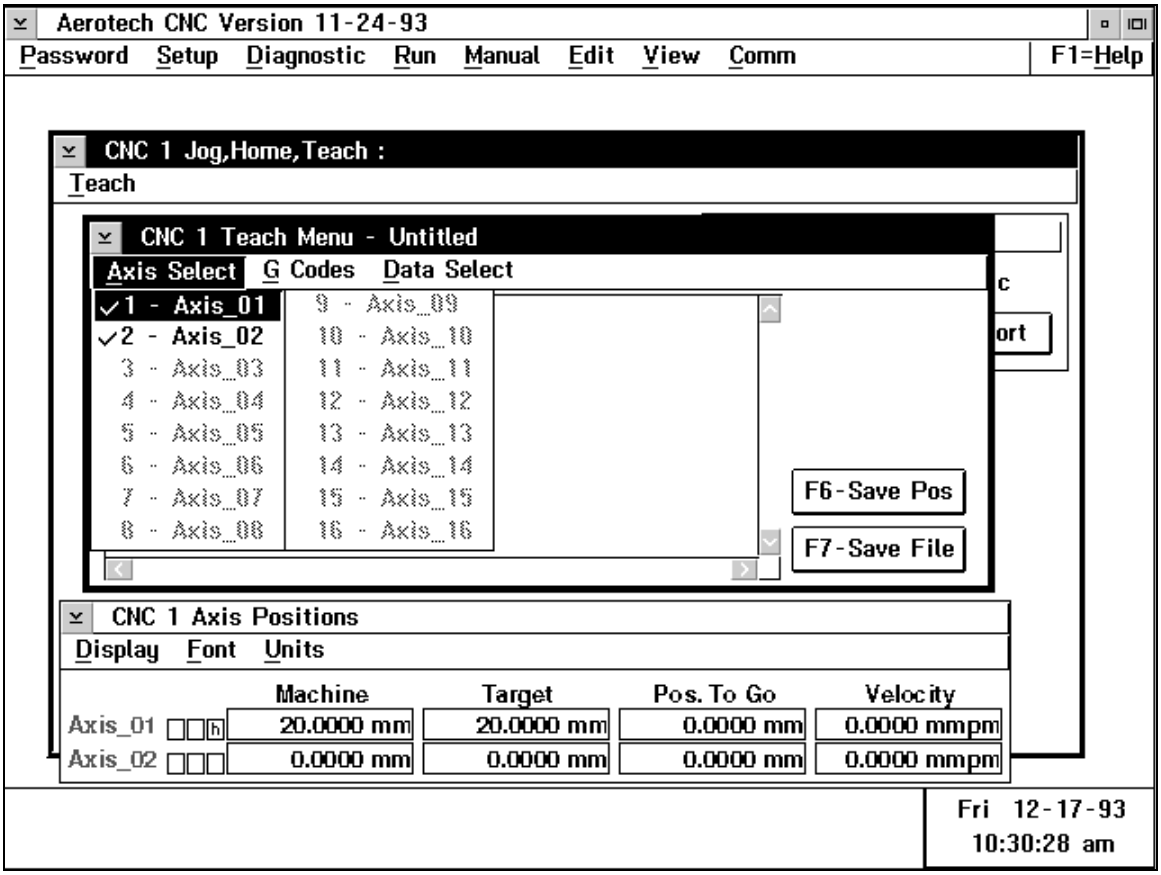


Figure 8-5. Teach Mode Axis Select Menu

8.2.4.2. Stored G-Codes

The G-Codes Menu option allows the user to select the G-Codes to use for storing the position data (refer to Figure 8-6). These G-Codes do not affect the actual motion being performed in the teach mode. They determine how the move is taught, or recorded. For example, selecting G90 (absolute positioning) causes the teach mode to store all moves as absolute - whether or not the actual command was absolute.

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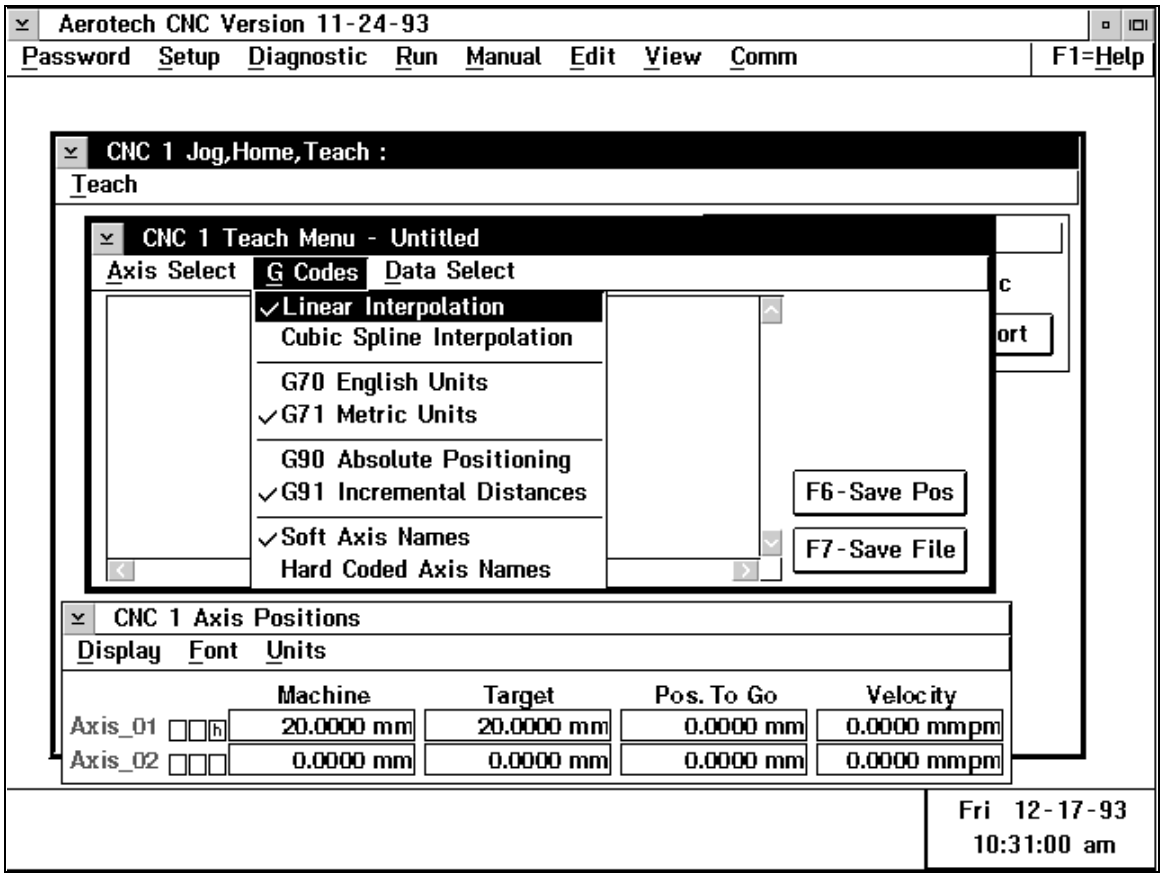


Figure 8-6. Teach Mode G Codes menu

8.2.4.3. Stored Data

The Data Select Menu option allows the user to select which type of position data to store (refer to Figure 8-7). The user may select either Machine, Preset, or Target Data. Refer to Chapter 7 for information concerning these data types.

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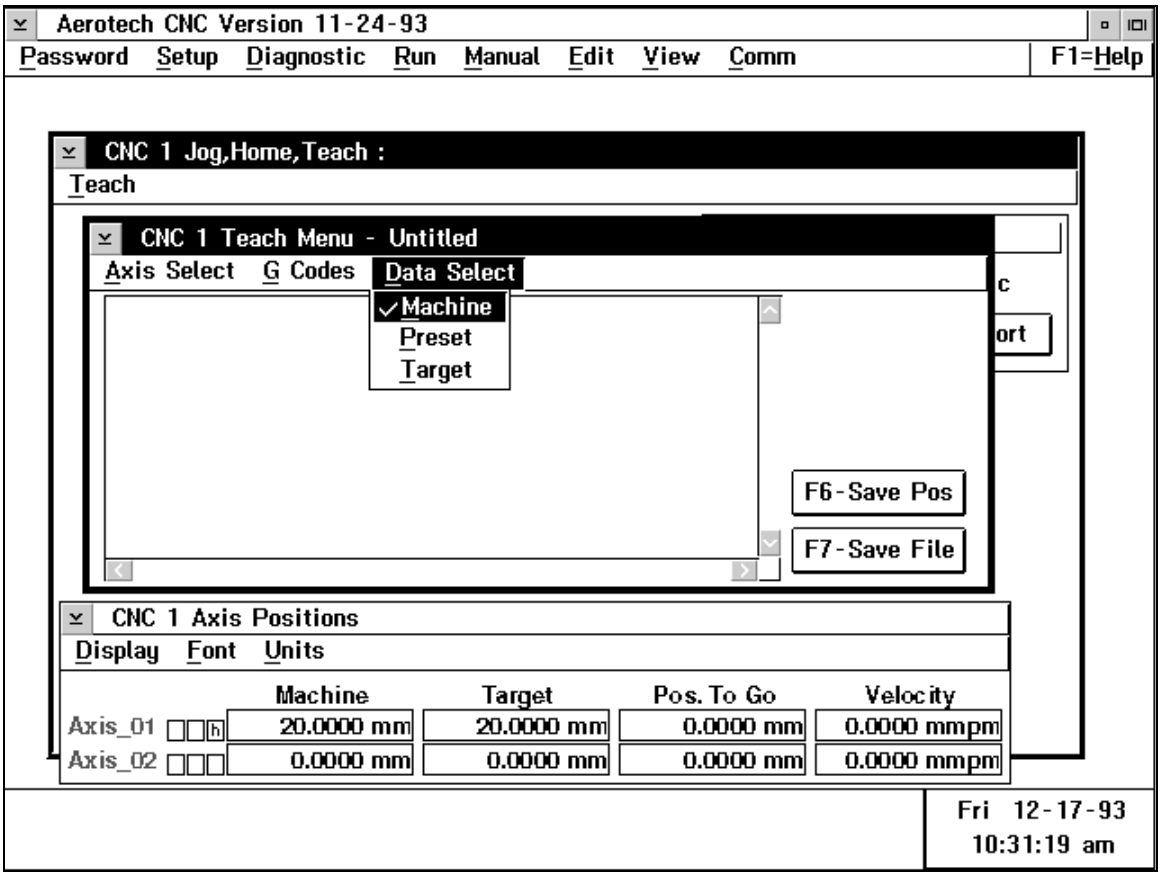


Figure 8-7. Teach Mode Data Select Menu

8.2.4.4. Storing Position

To record the current position press the **F6-Save Pos** button. This position is then recorded. The format and type of position stored is based upon the selected G-Codes and the data type.

8.2.4.5. Saving Teach Positions To a File

To save the information displayed in the Teach Mode Data Collection menu to a file press the **F7 Save File** button. A Save Teach File dialog box is illustrated in Figure 8-8. Enter the file name and press the **F2-Accept** button. To abort the save press the **F3-Abandon** button.

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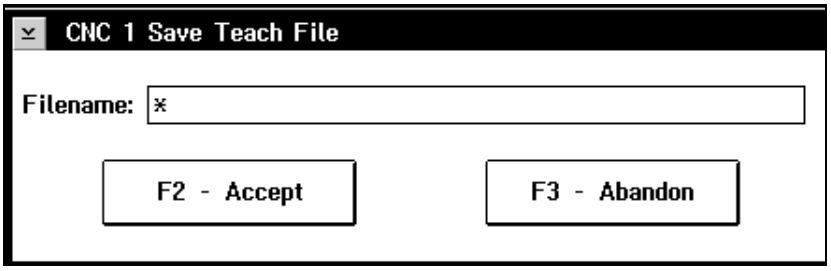


Figure 8-8. Save Teach File Dialog Box

8.2.4.6. Editing Teach Positions

The information shown in the Save Teach File dialog box can be edited in two ways. The user can edit the information in the Teach Menu itself by placing the cursor in the display box. The normal edit keys can be used to change the information. It can then be saved as stated previously.

The second option is to save the file first and then use the Parts Program Editor discussed in Chapter 9. This editor provides many more editing features than does the Teach Menu. It is suggested that the Teach menu be used only for saving the position information and the Parts Program Editor for making any necessary modification.

8.3. CNC Manual Entry Mode

Selecting the "CNC Manual Entry" option, from within the Manual menu, invokes the CNC Manual Mode dialog box. This screen allows the user to manually command the CNC. As can be from Figure 8-9, this screen is very similar to the CNC Run Mode dialog box (see the illustration in Chapter 7).

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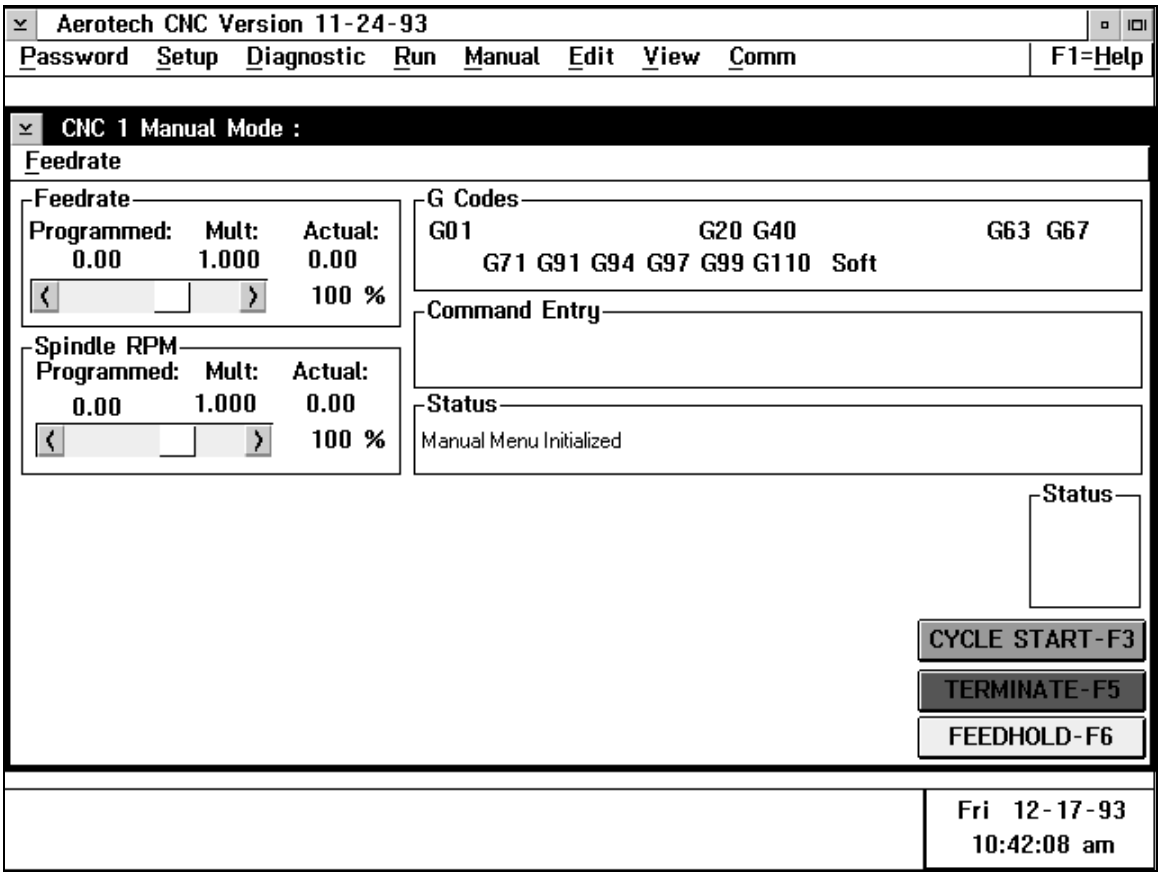


Figure 8-9. CNC Manual Mode dialog box

8.3.1. Similarities with CNC Run Mode

Many of the controls found on this screen function identically to those found on the CNC Run Mode Screen. These features include the following: G-Code Display group box, Feedrate Controls, and Status Window. Refer to these sections in Chapter 7 for more information on the operation of these controls.

8.3.2. Manual Command Entry

As mentioned, this screen allows the operator to directly command the CNC. The CNC immediately executes the individual commands.

To command the CNC, the user must place the cursor within the "Command" entry field and type in a valid CNC command block. After entering the data, the **CYCLE START-F3** button or the associated [F3] function key causes the command to execute. The operator is then free to begin entering the next command for execution.

If the user wishes to execute the command more than once, he must wait until the first execution process is complete. Then, the user must again activate the **CYCLE START-F3** button. The system ignores all cycle starts encountered during the execution of a command block.

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In the event that the user enters an invalid command in the "Command" entry field, the Program Translation Error dialog box appears on the display as notification of the error (see Figure 8-10). The dialog box in Figure 8-10 also contains information that specifies the type of error encountered.

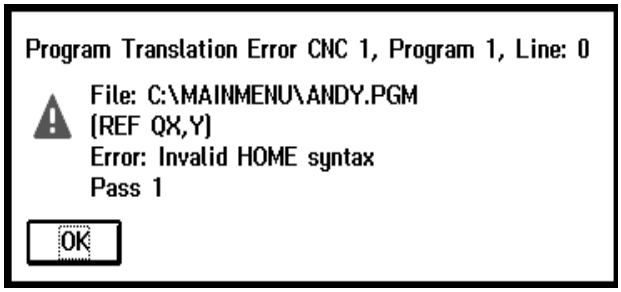


Figure 8-10. Program Translation Error Dialog Box

8.3.3. Suspending Motion Command Execution

The **FEEDHOLD-F6** button or the associated [F6] function key performs a function similar to that performed on the CNC Run Mode dialog box. In fact, the only significant difference is that the operator can not jog with the presence of an active feedhold.

In review, this function immediately decelerates all moving axes to zero velocity based on the amount of time specified in the CNC deceleration time parameter (see Chapter 5). While feedhold is active, the label associated with the **FEEDHOLD-F6** button flashes.

Upon releasing the feedhold, the CNC continues the suspended move. The system recalculates all move parameters as though it received a move command. The new move uses the accel/decel times specified by the appropriate CNC parameters. (See Chapter 5 for more information).



Activating a feedhold may affect the operation of some data acquisition utilities.

8.3.4. Terminating Motion Commands

The **TERMINATE-F5** button or the associated [F5] function key, also performs a function similar to that on the CNC Run Mode dialog box. After pressing this key, the CNC decelerates all moving axes to zero velocity based on the amount of time specified in the decel time CNC parameter (see Chapter 5 for more information). Once terminated, it is no longer able to resume the last command block.

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8.4. Manual I/O

The manual I/O page (screen), see Figure 8-11, is selected from the Manual Menu. There is a manual I/O page associated with each CNC. There are 20 keys on each I/O page. The first key is the [F1] help key which is not implemented at this time. The [F20] key allows the user to advance to the next page, while the [F19] key allows the user to go back to previous pages. There are four I/O pages per CNC, allowing up to 68 I/O devices to be manually controlled by the operator. This screen allows the user to program on-screen function keys used for controlling the I/O devices present in the system. This is done through the use of the OCC.INI file. This file allows an M-code to be executed when an on-screen button is pressed. Optionally, two different M-codes may be executed dependant upon the state of the device as indicated by a specified feedback M-code. Each manual I/O button may be limited to a particular mode (manual or auto) of operation.

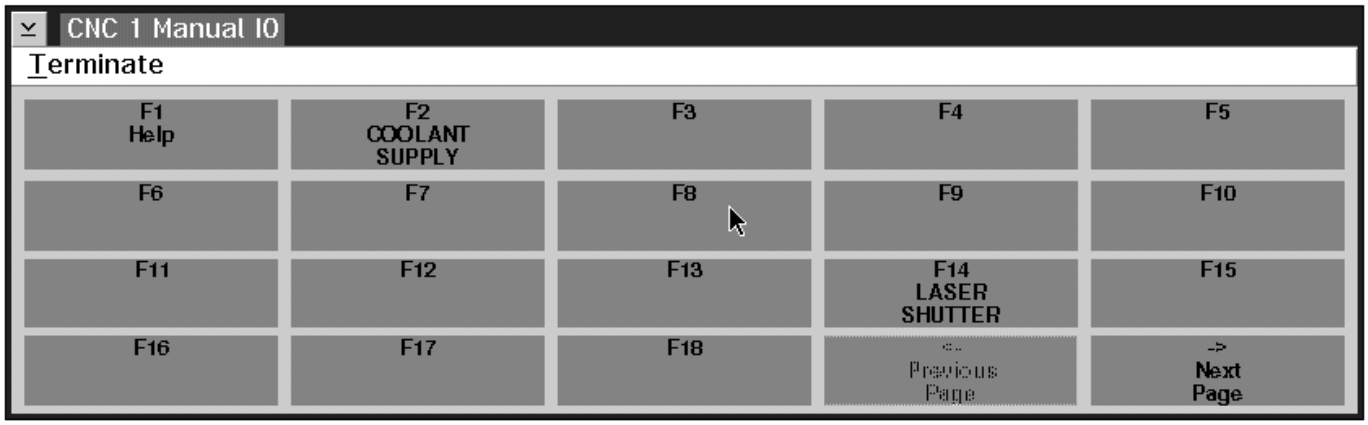


Figure 8-11. Manual I/O Screen

8.4.1. OCCx.INI File

There must be an OCCx.INI description file for each CNC that needs a manual I/O page (screen). All parameters within the syntax must be separated by commas, as shown below.

SYNTAX: *page#, key#, text_line1 [, text_line2] , on_mcode# [, off_mcode# on_feedback1] [, off_feedback2] [, man/auto]*

The "*page#*" parameter must be a range of 0 through 3, representing pages 1 through 4.

The "*key#*" parameter must be a range of 1 through 17 which selects keys 2 through 18 (the help key is [F1] and is not implemented, [F19] and [F20] are used to toggle between pages).

The "*text_line1*" parameter is a text string that must be filled by the operator to display the designated function of the key selected under that key (see [F2] in Figure 8-11).

"*text_line2*" parameter is an optional text string that appears under the first text string.

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There must be at least one "*on_mcode#"* parameter defining key operation. If there is only one M-code associated with the key, then that M-code is executed every time the key is pressed.

The "*off_mcode#"* parameter is an optional M-code which defines a second operation of a key. If this M-code is defined, there must be at least one feedback to define the on and off state of the key.



The "*on_mcode#"* and "*off_mcode"* are specified as numbers (#) only without the M designation.

The "*on_feedback1"* parameter designation may be a SPINDLE, PLC I/O point, or Virtual IO point with an optional level specified.

SPINDLE

The feedback is defined by "SPINDLE" type. where type can be one of the following:

- CW - meaning the spindle is moving CW for this feedback to be in the on state
- CCW - meaning the spindle is moving CCW for this feedback to be in the on state
- ACTIVE - meaning the spindle is executing a M3 or M4 for this feedback to be in the on state
- POS - meaning the spindle is not executing a M3 or M4 for this feedback to be in the on state.

PLC IO Point

The feedback may be a Modicon IO point in one of the following forms:

- PLC n GLOBAL m
- PLC n 0xxxx
- PLC n 1xxxx
- PLC n 4xxxx.

where n is the PLC number in the range 1 thru 7, m is a GLOBAL IO point in the range 1 thru 32, and xxxx is a valid PLC register number.

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Virtual IO Point

The feedback may be a virtual IO point in onE of the following forms:

- BO n
- BI n
- RO m B x
- RI m B x.

where n is the binary IO number in the range 0 to 511, m is the register number in the range 0 to 127, and x is the bit number in the range 1 to 16.

The "*L#"* level designation is an optional parameter that specifies the on state of the IO feedback. Where "#" is in the range of 0 to 1. If the level is not specified, the on state is assumed to be high.

The "*off_feedback2"* parameter is an optional designation that takes the same form as the "*on_feedback1"*. If it is present, it specifies the off state of the key, while the "*on_feedback1"* specifies the on state of the key.

The "*manual"* or "*auto"* keywords are optional and specify what mode the key will be allowed to operate. If the keyword is omitted, the key may operate anytime. If the keyword is present, it signifies the end of the line. Anything after the keyword on the line is ignored.

Figure 8-12 is an example of an OCCx.INI file and concurs with what is displayed on the Manual I/O Screen in Figure 8-11.

```
1, 2, Coolant, Supply, 1000, 1001, AUTO
1, 14, Laser, Shutter, 1010, 1011, AUTO
```

Figure 8-12. Manual I/O OCCx.INI File

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8.5. Ethernet

Ethernet is a factory installed option that provides DNC (Direct Numerical Control) capability for the U31. Figure 8-13, shows that this option is available from the CNC Manual Mode screen. MDI type command strings (non-looping, non-jumping commands) may be sent to the U31 via an Ethernet link. CR LF (Carriage Return Line Feeds) are used to terminate all command strings. Configuration of the Ethernet parameters are accomplished through the CNC General Parameters screen. Refer to section 5.6.1. CNC General Parameters Menu Selection and Figure 5-7. CNC Initialization Screen.

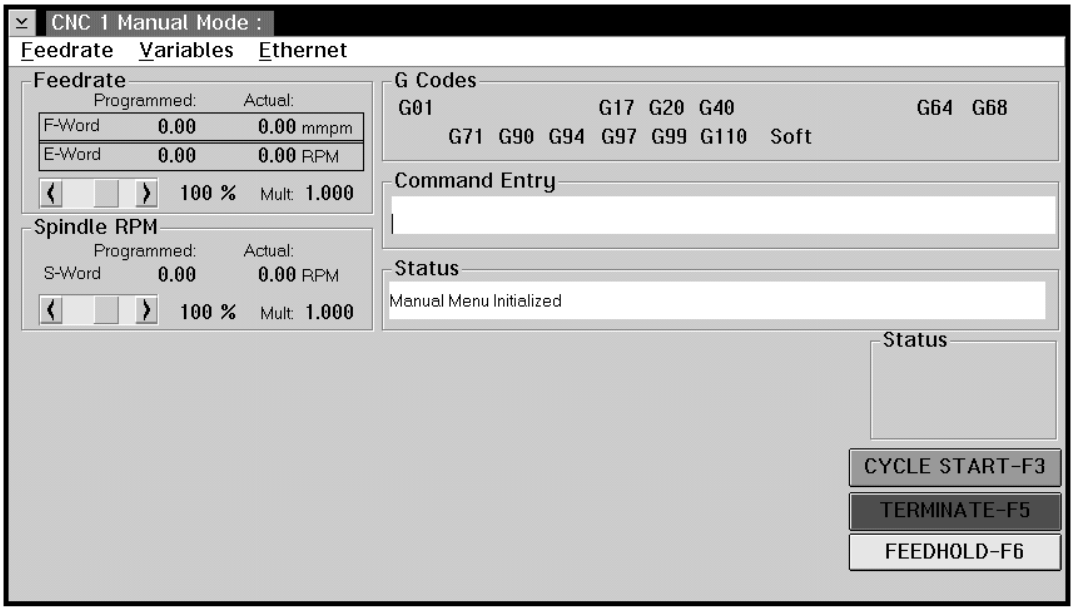


Figure 8-13. Ethernet Option

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CHAPTER 9: TEACH PENDANT

In This Section:

- Introduction 9-1
- Accessories 9-2
- Operation and Setup.....9-3

9.1. Introduction

The U31/U600 teach pendant provides the user with 4-axis jog/teach capability through a two-axis joystick for a single CNC. Active in the jog, manual, and run modes, the teach pendant allows the operator to manually input axis commands and positions to the U31/U600 from remote locations other than the main keyboard. The unit is comprised of:

- a 4-line LCD display window
- a lighted tactile 20-key keypad
- 16 LED indicator lights
- a joystick
- a feedhold button
- an E-stop pushbutton
- and a 18 pin connector.

Also provided is a 200 foot cable that allows communication between the U31/U600 and the teach pendant through the RS-422 communication port. As described the teach pendant is RS-422, the U31/U600 has only RS-232 ports. If a complete U31/U600 system is purchased from Aerotech, an integral RS-232/RS-422 converter will be supplied.

Figure 9-1, is an illustration of the teach pendant.

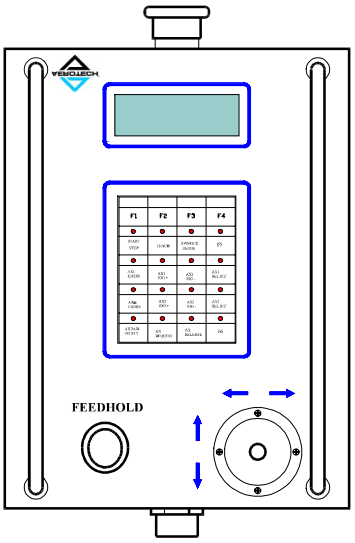
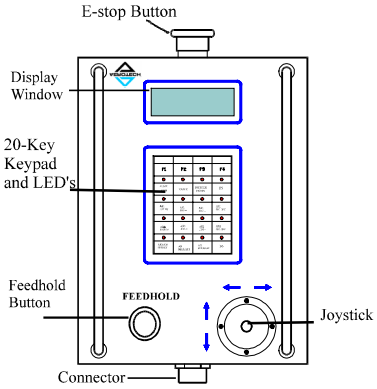


Figure 9-1. Teach Pendant

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9.2. Accessories

The following sections give a brief description of each accessory on the teach pendant. The picture in the margin (see left) illustrates where these accessories are on the pendant.

9.2.1. Display Window

The display window, located at the top of the teach pendant is a 4-line LCD display used to show axis positions, operational mode, status, and key function menu information. The first line of the display window shows the active CNC number followed by one of the three possible active modes. The second line of the display shows the the first axis name followed by its axis absolute position. The third line displays the same information for the second axis assigned to the pendant. The last line of the display is the menu line that is activated by the keys directly below it.

9.2.2. E-stop Button

The E-stop button, located on the top of the teach pendant is an emergency pushbutton that shuts down all axis motion when activated by the operator.

9.2.3. Feedhold Button

Located in the left lower corner of the teach pendant is the feedhold button. This button temporarily halts the axis motion by decelerating all axes to zero velocity in the amount of time specified by the CNC Decel Time parameter (see chapter 5 for more information). Upon releasing the feedhold button, the CNC continues the suspended move.



While the axes are in the feedhold state, the options found within the JOG Menu are valid.

Activation of feedhold may affect the operation of some data acquisition utilities.

9.2.4. Joystick

Located in the right lower corner of the teach pendant is the joystick. The joystick permits the operator to manually move the axis that the joystick is assigned to, where the velocity of the axis is proportional to the deflection and direction of the joystick.

9.2.5. Connector

The 18 pin connector, located on the bottom of the teach pendant provides the capability to connect the teach pendant to the U31/U600 via a cable. Allowing the user to communicate with the U31/U600 using the teach pendant from remote locations up to 200 feet away.

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9.2.6. LED Indicators

There are 16 LED indicators located on the keypad, one above each key except for the top row of keys. Each indicator works in conjunction with the key directly below it. When a key is toggled on, the indicator above it illuminates, when toggled off, the indicator extinguishes, where applicable. Refer to Table 9-1 for information on which LED's illuminate when a button is toggled.

9.2.7. Keypad

The 20-key keypad, located in the middle of the teach pendant is utilized by the operator for manual inputs to the U31/U600. The operator can activate the joystick, start and stop a parts program, save axis position information, engage one or both axes and manually move the axes' up or down incrementally.

9.3. Operation and Setup

The operator must configure the teach pendant from within the Setup Menu (Refer to Figure 9-2). Once configured and connected to the U31/U600, it becomes another command input device (keyboard) that operates in parallel with the main keyboard.

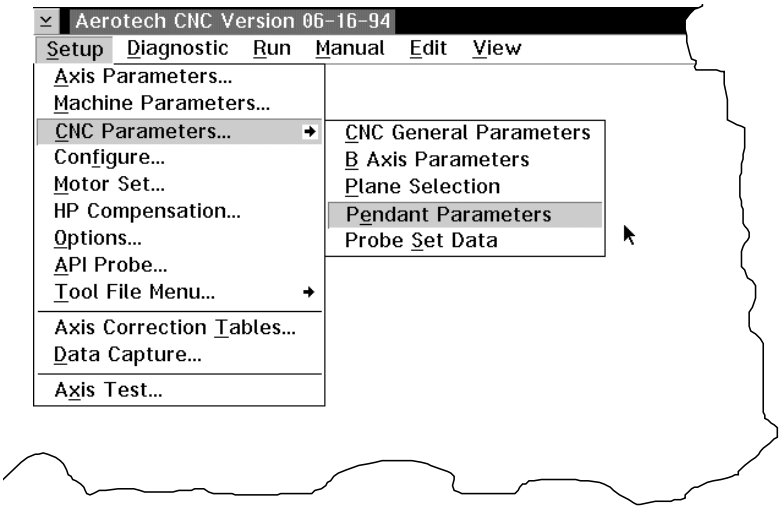


Figure 9-2. CNC Parameters Menu Options

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9.3.1. Setup

To setup the teach pendant for operation with the U31/U600, the user must first connect one end of the cable to the teach pendant. The other end of the cable connects to the RS-232 communication port on the U31/U600 with the use of a RS-232/RS-422 converter.(*Refer to The U31/U600 Hardware Manual*). Second, the user must configure the teach pendant from the Setup Menu. A submenu appears to the right of the Setup Menu. From this submenu the operator must toggle down and select Pendant Parameters as shown in Figure 9-2. The Pendant Initialization dialog box appears (Refer to Figure 9-3). From this screen the operator must associate a pendant to a particular CNC. To select a CNC process, click on the radio button beside the desired CNC process.

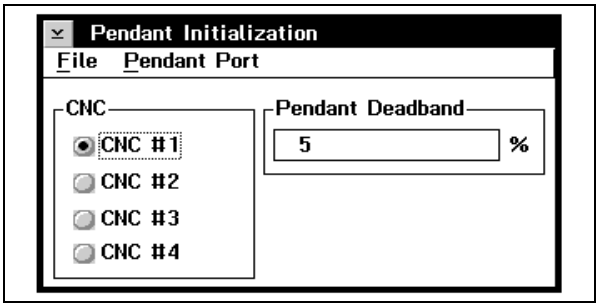


Figure 9-3. Pendant Initialization Dialog Box

The operator must select the correct communication port from the Pendant Port menu, shown in Figure 9-4 when connecting the teach pendant to the Axis Processor. Select None if no pendant is being used.

The "Pendant Deadband" entry field allows the user to specifiy the stationary deadband range. This percentage creates a deadband region around the joystick center point. This is useful in eliminating unwanted motion caused by slight movements in the joystick.



Every time the teach pendant is disconnected from the U31/U600, the deadband returns to zero (0). The operator must leave the current active screen and then return to reset the deadband.



IMPORTANT

The following is a factory set procedure and is not required to be performed by the user unless troubleshooting a problem with the teach pendant.

Temporarily set the deadband to 0%, in the "Pendant Deadband" entry field enter a 0% deadband. Set the desired port number from the Pendant Port menu. Select File, Save, then Load. Reinitialize the system through the Diagnostics pull down menu. Select Axis Firmware Status..., then from that screen, press F2. Select the Manual pull down menu.

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Then select "Jog, Home, Teach..." to display the Teach screen. This will initialize the teach pendant to the new deadband value just entered.

Open an OS/2 window and start Debug960.exe (or Zsid960.exe). If it starts without an AXIS 01> prompt, press X, then enter. Enter ReadPendantAnalog #, where # is the axis processor port number (0-3, i.e., 1-4). Disassemble the teach pendant by removing the screws from the rear of the box. The A1 - A4 values indicated by the ReadPendantAnalog command signify the state of the joysticks.

If there is only one joystick A1 and A2 represent the values of the Y and X pots on the joystick. If there are two joysticks, the right most joy axis will be indicated as A3 and A4 , joy2-Y and joy2-X respectively.



Adjust the mechanical center position of each joystick axis to within 65 counts of zero by turning the two (blue) potentiometers on the side of each joystick. Reassemble the teach pendant.

Reset the deadband back to 5% and reinitialize the system.



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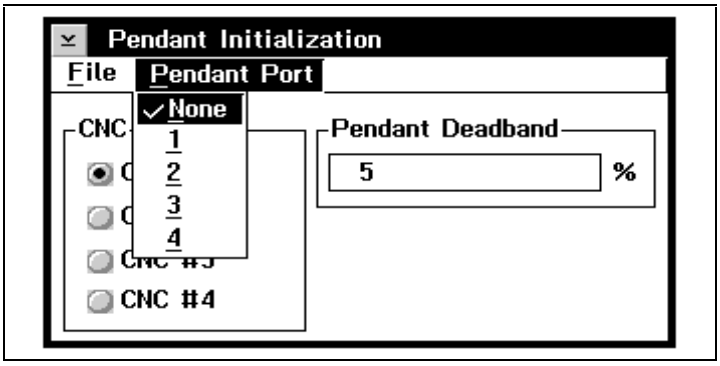
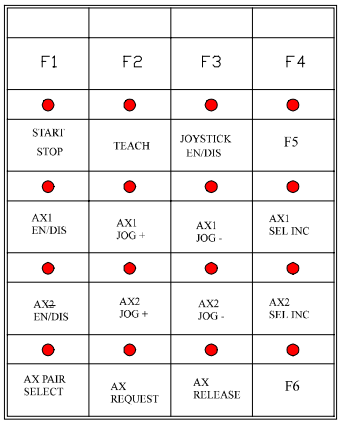


Figure 9-4. Pendant Port Menu



9.3.2. Operation

Once the teach pendant is connected and configured to the U31/U600, it is now another command device for the operator to use from remote locations. The CNC number selected by the operator and one of the three possible modes (jog, manual, and run) is displayed on the first line of the display window. The first axis assigned to the teach pendant is displayed on the second line followed by its axis absolute position. The same information is displayed on the third line for the second axis assigned to the teach pendant. The fourth line of the display window is the menu line whose selections may be activated by the keys directly below it (the top row of the keypad). This menu line will show F1 - MACHine, F2 - IN or MM, and F4 - NEXT. For operation of the keys and their function, Refer to Table 9-1. The picture in the margin (see right) illustrates where these keys are on the keypad.

Table 9-1. Keypad Operation and Function

Key	Mode Active	Function/Operation
Start/Stop	Run	Toggling the button once allows the operator to start a parts program. The LED indicator above the button will illuminate. Toggle the button again and the parts program is terminated and the LED indicator extinguishes.
Teach	Jog	The teach button is active when the teach sub-menu is open. When toggled, axis position information is recorded and saved to a file that can be used as a normal parts program. The LED indicator is inoperable when this button is toggled. Toggle the button again and the operation is stopped. This operation is the same as pressing [F6] on the U31/U600's main keyboard.

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Table 9-1. Keypad Operation and Function Con't

Key	Mode Active	Function/Operation
Joystick En/Dis	Manual/Jog and Run (when JOGOFFSET and JOGRET are active)	When this is toggled the joystick on the pendant is enabled and the operator can manually move the axis assigned to it. The LED indicator above the button is lit. Toggle the button again and the joystick is disabled and the indicator extinguishes.
Ax1 Sel Inc	Jog, Run (if JOGOFFSET and JOGRET are active)	When toggled, the current jog increment, which is selected from the JOG menu is displayed on line 2 of the pendant display. The LED indicator above the button is inoperative. The menu line (line 4) will show F1 - NEXT, F2 - PREV, F3 - NONE, and F4 - DONE. These menu selections work the same as using the mouse in the "Edit Jog Increments Dialog Box" (refer to section 8.2.1.2. and figure 8-3). F1-NEXT will toggle down to the next jog increment, F2-PREV will toggle up to the previous jog increment. F4-DONE will return to the regular menu line. Toggle it again and the current jog increment disappears.
Ax1 En/Dis	Manual/Jog Run	When toggled, axis 1 is enabled and the information pertinent to this axis is displayed on line 2 of the display window. The LED indicator above the button will illuminate. Toggle the button again and axis 1 will be disabled and the information on line 2 disappears. The LED indicator will extinguish.
Ax1 Jog +	Manual/Jog	Each time this button is toggled it will jog the axis a preset increment that was selected from the JOG menu. The LED indicator is inoperative.
Ax1 Jog -	Manual/Jog	Each time this button is toggled it will jog the axis a preset increment that was selected from the JOG menu. The LED indicator is inoperative.
Ax2 Sel Inc	Jog, Run (if JOGOFFSET and JOGRET are active)	When toggled, the current jog increment, which is selected from the JOG menu is displayed on line 3 of the pendant display. The LED indicator above the button is inoperative. The menu line (line 4) will show F1 - NEXT, F2 - PREV, F3 - NONE, and F4 - DONE. These menu selections work the same as using the mouse in the "Edit Jog Increments Dialog Box" (refer to section 8.2.1.2. and figure 8-3). F1-NEXT will toggle down to the next jog increment, F2-PREV will toggle up to the previous jog increment. F4-DONE will return to the regular menu line. Toggle it again and the current jog increment disappears.

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Table 9-1. Keypad Operation and Function Con't

Key	Mode Active	Function/Operation
Ax2 En/Dis	Manual/Jog Run	When toggled, axis 2 is enabled and the information pertinent to this axis is displayed on line 3 of the display window. The LED indicator above the button is lit. Toggle the button again and axis 2 will be disabled and the information on line 3 disappears. The LED indicator will extinguish.
Ax2 Jog +	Manual/Jog	Each time this button is toggled it will jog the axis a preset increment that was selected from the JOG menu. LED indicator is inoperative.
Ax2 Jog -	Manual/Jog	Each time this button is toggled it will jog the axis a preset increment that was selected from the JOG menu. LED indicator is inoperative.
Ax Pair Select	Manual/Jog	When toggled, this button allows the two axes' assigned to the teach pendant to be toggled by the menu keys (the keys on the top row of the keypad). F1 will toggle axis 1 and F2 will toggle axis 2. These will update the pertinent line on the display indicating the current axis assigned to the joystick.
F1	Jog/Manual/Run	In the initial start up state of the teach pendant (when it is plugged into the U31/U600) F1 will toggle through MACHine, Preset, Target, Pos. To Go (position to go), and Vel. This operation is the same as described in section 7.4.2., using the Axis Postion Display menu. In the "Jog" mode, F1 will have the designation of "NEXT" displayed on the menu line (refer to the operation of AX1 or AX2 SEL INC). In the "RUN" mode F1 will toggle from "JOG" to "OFFSET". This operation is the same as described in section 7.8.2. of this manual.
F2	Jog/Run	In the initial start up state of the teach pendant (when it is plugged into the U31/U600) F2 will toggle between "IN" (inches) and "MM" (millimeters). One of these will be displayed on the menu line. This operation is the same as described in section 7.4.3. which permits the user to configure the display in one of two modes. In the "RUN" mode F2 will toggle between "JOG" and RETurn". This operation is the same as described in section 7.8.1. of this manual.
F4	Jog/Run	F4 permits the user to toggle between one of two menu lines. Initially F4 will have the designation "NEXT" displayed on the menu line. In the "RUN" mode pressing F4 will cause the regular menu line to change from F1 - MACHine, F2 - IN or MM, and F4 - NEXT to F1 - JOG or OFFSET, F2 - JOG or RETurn, and F4 - NEXT (allowing the user to toggle back to the regular menu line)



The AX REQUEST, AX RELEASE, F3 (will display "NONE" on the menu line), F5, and F6 keys have no function at this time.

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CHAPTER 10: PARTS PROGRAM EDITOR

In This Section:

- Introduction 10-1
- Selecting the Parts Program..... 10-2
- Editing the Program..... 10-2
- Saving the Modified Parts Program..... 10-6
- Auto-Save Feature 10-8
- Exiting the Editor 10-9
- Editor Options 10-9

10.1. Introduction

The options found under the Edit menu permit the user to create and modify parts programs. Selecting this option invokes the parts program Editor. Figure 10-1 illustrates the initial state of this editor.

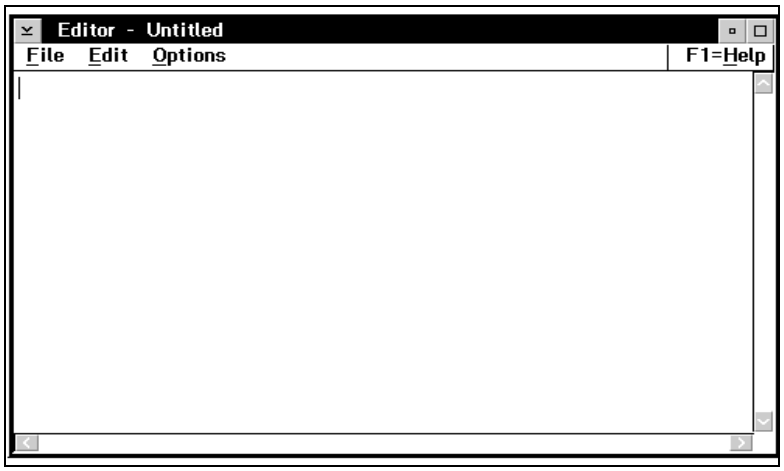


Figure 10-1. Parts Program Editor Dialog Box

After invoking the editor, "MAINMENU" assumes that the user is attempting to create a new parts program. In this case, the user is free to begin editing. The user must specify a filename at the time they choose to save the program. The following sections explain how to perform these functions.

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10.2. Selecting the Parts Program

"MAINMENU" provides a dialog box to aid in the selection of the parts program file that they wish to edit. Using the "Open" option, from within the File menu, permits the user to activate the File Open dialog box. An illustration of this box appears in Figure 10-2, below.

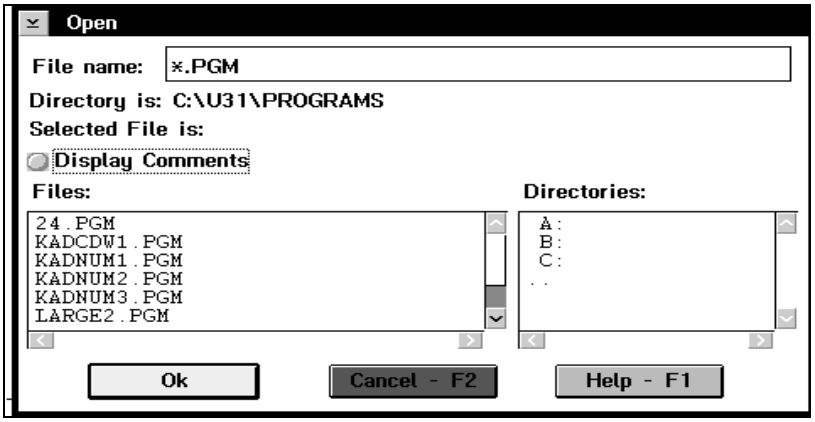


Figure 10-2. File Open Dialog Box

By default, "MAINMENU" expects all parts programs to use the *.PGM extension and reside in the \U31\PROGRAMS directory of the drive on which OS/2 boots. However, the user can select parts program files with any other extension regardless of the directory they reside in.

The File Open dialog box, shown in Figure 10-2, selects the parts program for execution and is identical to the one used when selecting an axis correction table. For more details on the operation of this dialog box, refer to Selecting the Axis Correction Table in Chapter 5.

10.3. Editing the Program

The parts program Editor provides all functions normally associated with a text editor (i.e., Cut/Paste, Search/Replace, etc.,). Most of the controls for these features appear within the options displayed in the menu bar at the top of the window. However, some features, such as the selection of text, do not have explicit controls associated with them. These features function according to the specifications found within the *OS/2 Common User Access Guide to User Interface Design*.

Two commonly used features implemented in this way are cursor placement and text selection.

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10.3.1. Cursor Placement

The user can accomplish cursor placement within the parts program Editor in one of two ways: through keyboard control or through mouse control. Mouse users may simply place the mouse pointer to the desired location and press the mouse button once. Horizontal and vertical scroll bars permit the user to edit undisplayed portions of the program.

Controlling the cursor from the keyboard is a bit more difficult than using the mouse. The UNIDEX 31/U600 supports all normal editing keys. That is, all arrows, the page up, page down, home, and end keys all function as one would expect. The UNIDEX 31/U600 offers additional functions for many of these keys used in conjunction with the **CONTROL** key. The following list describes these features.

Control	**Response**
Right Arrow	Move One Word to the Right
Left Arrow	Move One Word to the Left
Home/Page Up	Move to the Program Start
End/Page Down	Move to the Program End

10.3.2. Text Selection

Another commonly used feature involves the selection of text. Many of the editing controls treat the selected text as a single entity.

To select an area of text, mouse users need to position the mouse pointer at the start of the text area, press and hold the mouse button, and move to the end of the area they wish to select. Upon releasing the mouse button, the highlighted area of text remains selected. To extend the currently selected area, mouse users need to position the mouse pointer at the end of the extended area, press and hold the **SHIFT** key, and press the mouse button. This causes the highlighted area to extend to its new position.

Keyboard users may also select text areas. To do this, hold down the **SHIFT** key while positioning the cursor as described above. The highlighted area follows the cursor movements. After releasing the **SHIFT** key, the text area remains highlighted until the cursor gets moved.

The user may select the entire parts program with the "Select All" option located within the Edit menu.



10.3.3. Operations on Selected Area

The parts program Editor contains several controls that operate on the currently selected area of text. Most of these appear within the Edit menu. Refer to Figure 10-3 for an illustration of this menu.

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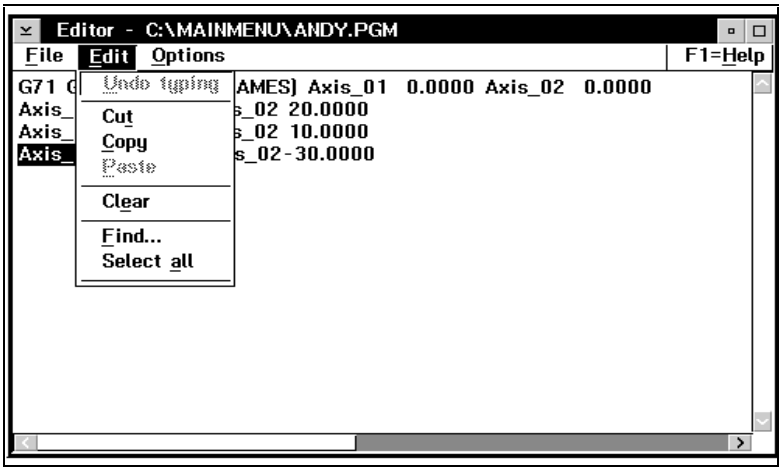


Figure 10-3. Edit Menu

The "Cut" and "Copy" options, located in the Edit menu, perform similar operations on the currently selected area of text. All currently highlighted text gets copied into a paste buffer. The user can later insert this buffer into another program using the "Paste" option from the Edit menu. The following text discusses details of this operation.

The difference between these two options is that the "Cut" option removes the selected text from the parts program, while the "Copy" option does not.

Another function that uses the selected area of text is the "Clear" option, also located in this menu. The "Clear" option deletes the highlighted area of text from the parts program without copying it into the paste buffer.

Another way to perform a clear function is through the Delete and the Backspace keys. With an area of text currently selected, insert a character into a file, delete the highlighted text, and watch the system replace the deleted text with the new character. The cursor repositions itself adjacent to the new character.

10.3.4. Undo Typing

The "Undo typing" option, located within the Edit menu, reverses the last action performed by the user. The only exception to this is cursor movement operations. Therefore, with this option, the user may remove newly inserted text or restore text just deleted. The undo function can only undo one operation.

10.3.5. Searching for a Text String

Selecting the "Find" option, from within the Edit menu, causes a Find dialog box, shown in Figure 10-4, to appear on the display.

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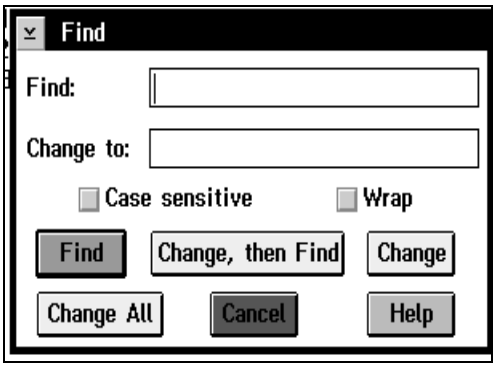


Figure 10-4. Find Dialog Box

The Find dialog box, in the above figure, provides several controls that permit the user to control the search process. Initially, the user places the cursor within the "Find:" entry field. This field specifies the text string that the user wishes to locate within the parts program. The user may enter up to 255 characters within this field. Activating the function associated with the **Find** button then causes the editor to locate that string within the parts program. In the event that the system does not find the text string, the dialog box in Figure 10-5 appears on the display as notification.

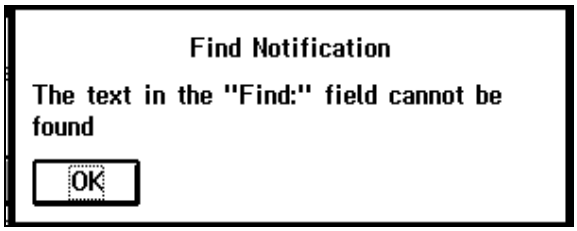


Figure 10-5. String Not Found Dialog Box

In a successful find function, the located string appears highlighted on the screen providing the user with several options. The first option uses the **Cancel** button to conclude the search process. The second option permits the user to press the **Find** button to search for the next occurrence of the string. As an option, the user may use one of the change options.

Before the user can use any of the change options, he must fill in the "Change to:" entry field of the Find dialog box. To accomplish this, place the cursor within the field and type the new value. This field accommodates up to 255 characters. Invoking any of the change operations causes the specified string, from the "Find" entry field, to be replaced by the located text in the "Change to:" entry field.

Although all the change options perform the same basic function, there are slight differences in each option. The **Change** button only performs text replacement. The user may then terminate the search process with the **Cancel** button, or look for the next occurrence of the string with the **Find** button. Pressing the **Change, then Find** button first performs the text replacement, and then searches for the next occurrence of the string. This is identical to using the **Change** button followed by using the **Find** button. The **Change All** button automates the change and then finds the function. It

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automatically searches for all the occurrences of the "Find" string and replaces it with the "Change to:" string. This would be identical to repeatedly pressing the **Change, then Find** button until the search is complete (all searched text has been found).

The two check boxes, labeled "Case Sensitive" and "Wrap" control the search process. If a check mark appears on the display in the "Case Sensitive" box, then the upper and lower case letters are distinct. Otherwise, the system ignores the case of the letters.

The "Wrap" check box specifies where the search is to terminate. If this box does not contain a check mark, the **Find** button causes the editor to search for the specified string from the current cursor location to the end of the file. Enabling the wrap function causes the search to continue from the beginning of the program after it encounters the end of the file. Note that this type of search is not limited to only one iteration of the file.

10.4. Saving the Modified Parts Program

The File menu performs all disk related activities, as well as exiting the parts program Editor. Figure 10-6 shows the options available from within this menu.

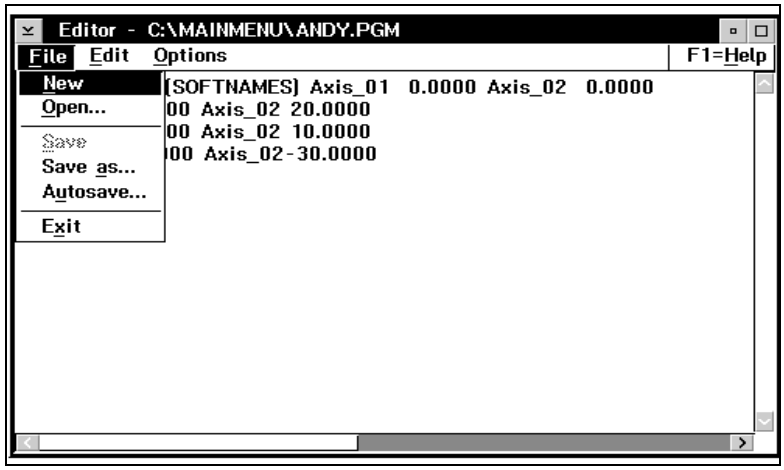


Figure 10-6. File Menu

The "Save" and "Save As" options found within the File menu save the changes made to the parts program. For new programs that do not have a filename associated with it, selecting either of these options results in the Save As dialog box shown in Figure 10-7.

The operation of this dialog box is very similar to the operation of the File Open dialog box. The "File name:" entry field specifies what name to save the parts program as. The user may enter all valid OS/2 filenames. That is, the user may directly specify drive and path specifications. Valid path specifications can be either absolute or relative.

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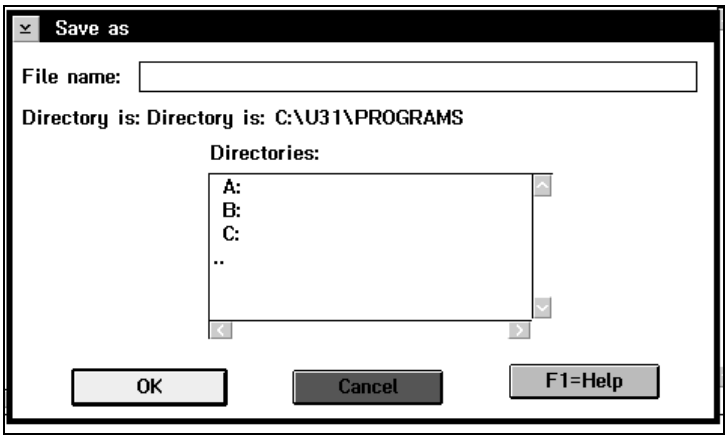


Figure 10-7. Save As Dialog Box

In the event that the user does not wish to explicitly specify the drive and path designations, he may use the Directories list box to change the default. The "Directory is:" information field displays the current defaults.

The options displayed in this list box correspond with all the disk drives found on the system, as well as with all sub-directories of the current directory. The ".." option permits the user to move up one level in the directory tree. Selecting one of these options causes the selected drive/directory to become the current drive/directory.

Pressing the **OK** button signifies entry of a valid filename, and causes the parts program Editor to attempt to write the file to a disk. In the event that the user explicitly specifies an invalid drive or directory, an Invalid Directory dialog box appears on the display to notify the user of the error. Refer to Figure 10-8.

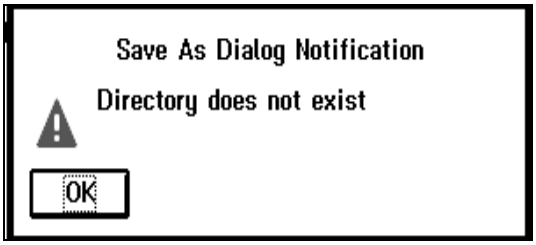


Figure 10-8. Invalid Directory Dialog Box

The **Cancel** button aborts saving the file and returns control back to the edit window.

After assigning a filename to a program, the save feature automatically updates that file without prompting the user to enter a new name.

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10.5. Auto-Save Feature

This feature provides the ability to have the system automatically save the changes made to the file. Selecting this option from within the File menu causes an Auto-Save Configuration dialog box to appear. Refer to Figure 10-9.

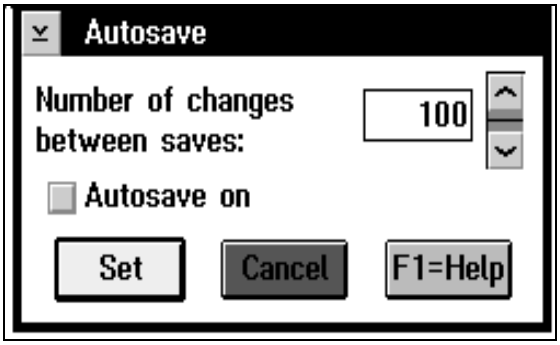


Figure 10-9. Auto-Save Configuration Dialog Box

The number of changes made to a file determines how often the system activates the "Auto-Save" option. The "Number of changes between saves:" entry field specifies how frequently the system is to activate the "Auto-Save" option. There are two ways to edit the value displayed in this field. The first method uses the vertical scroll buttons on the right side of the field and increments or decrements the current value by one. The second method allows the user to clearly state the value by: 1. placing the cursor inside the field, and 2. manually entering the new value.

The "Autosave on" check box permits the user to enable the automatic save feature. Placing a check mark within this box enables this feature.

The **Set** button completes the automatic save configuration. The configuration for this feature depends on the parameter values established through the Auto-Save Configuration dialog box. The **Cancel** button may also restore all auto-save parameters to their initial value (that is the value prior to making the Auto-Save selection from within the File menu).

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10.6. Exiting the Editor

Selecting the "Exit" option from within the File menu causes the parts program Editor to terminate and thus return the program control back to the main screen of "MAINMENU".

Failure to save a modified parts program results in the appearance of a File Not Saved dialog box (see Figure 10-10).

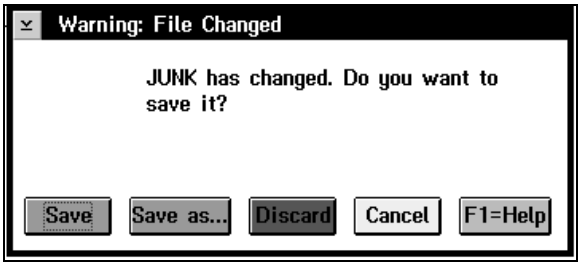


Figure 10-10. File Not Saved Dialog Box

In reviewing Figure 10-10, note that the user has several options available to them. Selecting the **Save** button or the **Save As** button activates the same function as if the corresponding selection came from the File menu. Details on these options appear earlier in this chapter.

The **Discard** button exits the parts program Editor without updating the file associated with that program. The system looses all changes made during this edit. Activating the **Cancel** button aborts the exit function and returns control to the edit window.

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10.7. Editor Options

The Options menu configures several features of the editor. Looking below at Figure 10-11, the first of these options permits the user to specify the color scheme used within the editor.

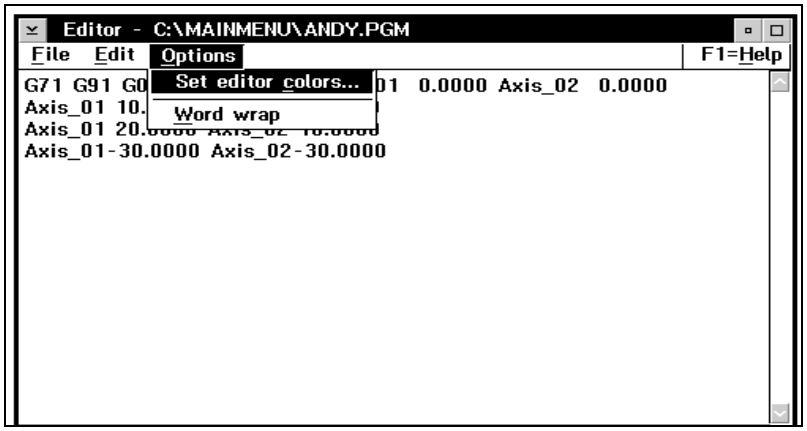


Figure 10-11. Options Menu

Selecting the "Set editor colors" option from the Options menu causes the Set Editor dialog box to appear on the display. See Figure 10-12.

In Figure 10-12, notice that there is a list box to permit the user to specify both the background and foreground colors. The user may view a sample of the selections through the Color Sample group box. The text within this box shows an example of both normal text and selected text.

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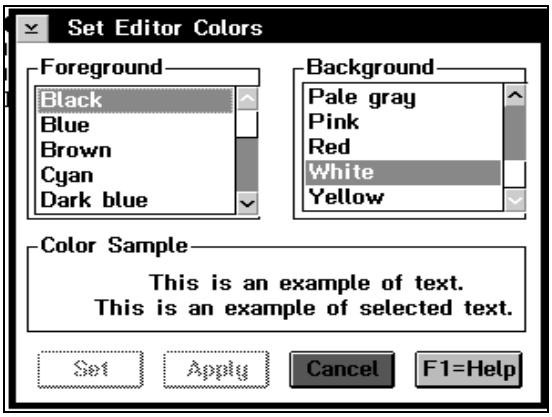


Figure 10-12. Set Editor Colors Dialog Box

Both the Background Colors list box and the Foreground Colors list box function identically. The user may scroll through the available choices. The system updates the Color Sample group box each time the user highlights a new choice.

The **Set** button and the **Apply** button cause the new color choices to take effect on the edit window. The difference between these two features is in the fact that the **Set** button closes the Set Editor Colors dialog box, whereas the **Apply** button just permits the user to view the new colors.

The **Cancel** button closes the Set Editor Colors dialog box. The editor colors remain on the display the same way they appeared at the time the user selected the "Set Editor Colors" option. That is, after selecting and applying a new color scheme, using the **Set** button, causes the new colors to remain in effect. Failure to apply a newly selected color scheme, using the **Apply** button, causes the editor colors to remain as they were before the user selected the "Set Editor Colors" option from within the Options menu.

The other configurable feature of the editor pertains to the displaying of program lines that are too long to fit within the edit window. The "Word wrap" option from the Options menu configures this feature. Placing a check mark next to this option enables the feature.

Selecting to disable word wrap results in an edit window that displays as much of the program block that can fit into the window. Resizing the window permits the user to display more text. If the user chooses to view/edit the undisplayed portions of the program block he may do so by using the cursor placement techniques described in the previous section.

Enabling the "Word wrap" option, causes the program blocks that exceed the window size to appear on the display as multiple lines. Whenever possible, the system divides the lines on a word boundary.

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CHAPTER 11: VIEW MENU OPTIONS

In This Section:

- Introduction 11-1
- The Clock/Calendar Option..... 11-2
- The Error Log Option..... 11-2

11.1. Introduction

The options found under the View menu permit the user to modify the appearance of the "MAINMENU". Looking at the options, from within the View menu, notice that the operator may choose to display a Clock Calendar, and/or an Error Log (see Figure 11-1).

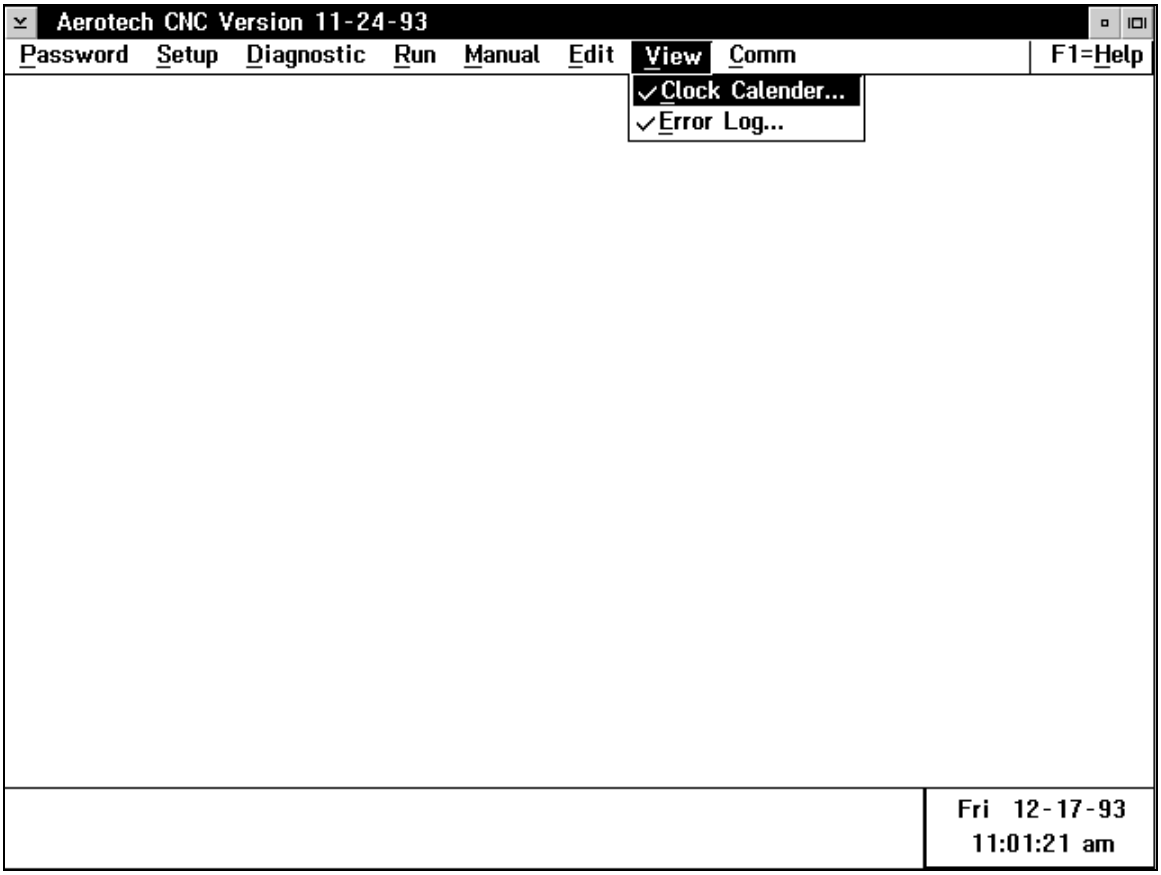


Figure 11-1. View Menu

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11.2. The Clock/Calendar Option

The "Clock/Calendar" option displays the current date and time within a group box located on the lower right-hand portion of the screen. The date and time displayed here corresponds to the operating system settings. Figure 11-2 depicts the location of this group box.

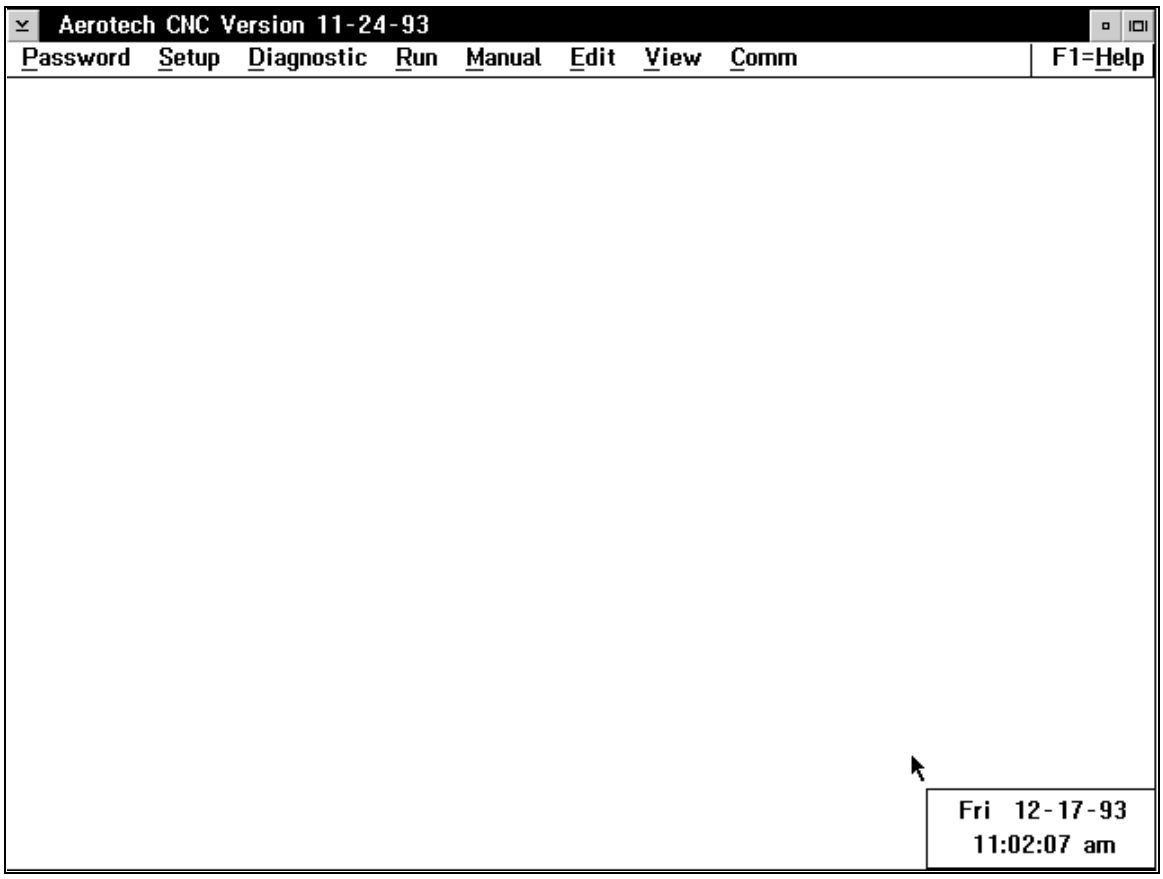


Figure 11-2. Clock/Calendar Group Box

11.3. The Error Log Option

The "Error Log" option also causes a group box to appear on the display in the lower left portion of the screen. A text description of all errors encountered by the CNC appears on the display within this group box. Refer to Figure 11-3 on the following page.

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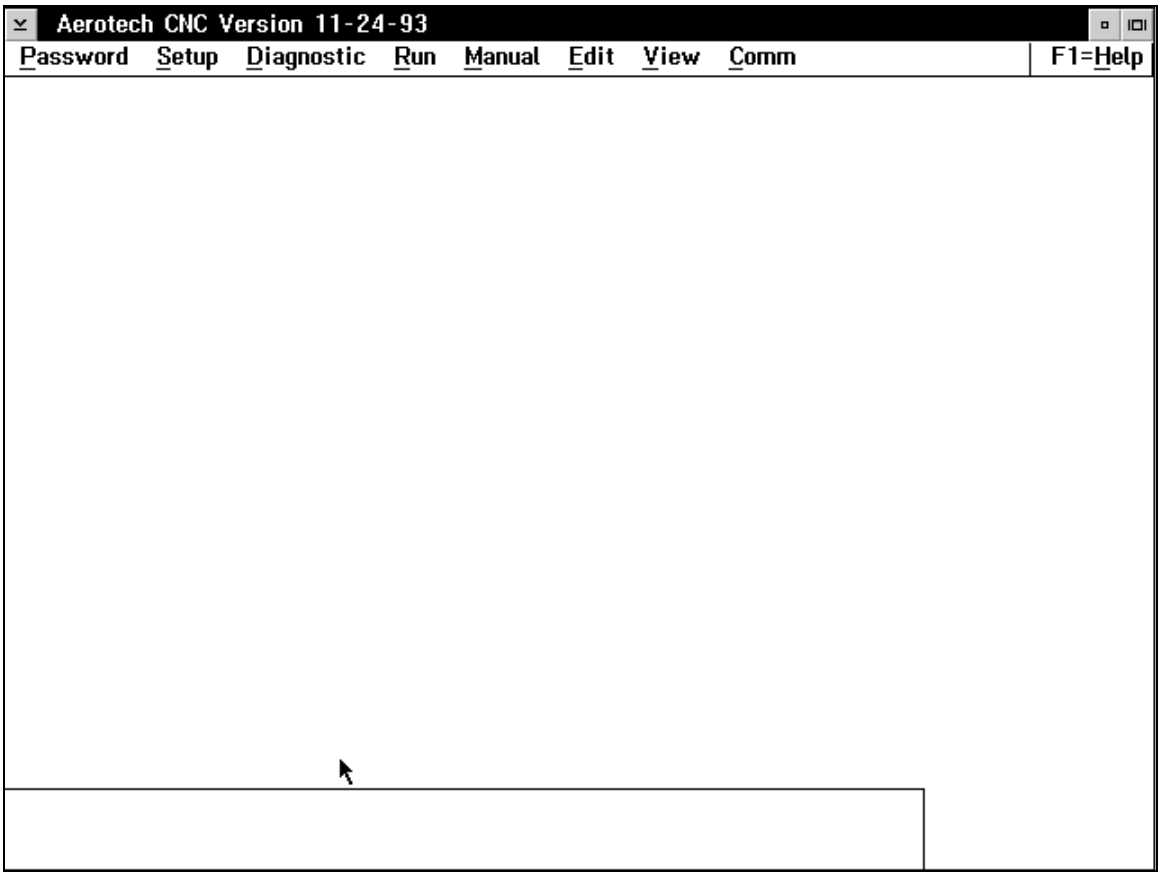


Figure 11-3. Error Log Group Box

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CHAPTER 12: COMMUNICATIONS

In This Section:

- Introduction 12-1
- RS-232 File Transfer 12-2
- Ethernet File Transfer 12-2

12.1. Introduction

The COMM menu provides the ability for the user to transfer files to remote systems. In looking at Figure 12-1, note that this transfer may occur via an RS-232 port or via Ethernet.

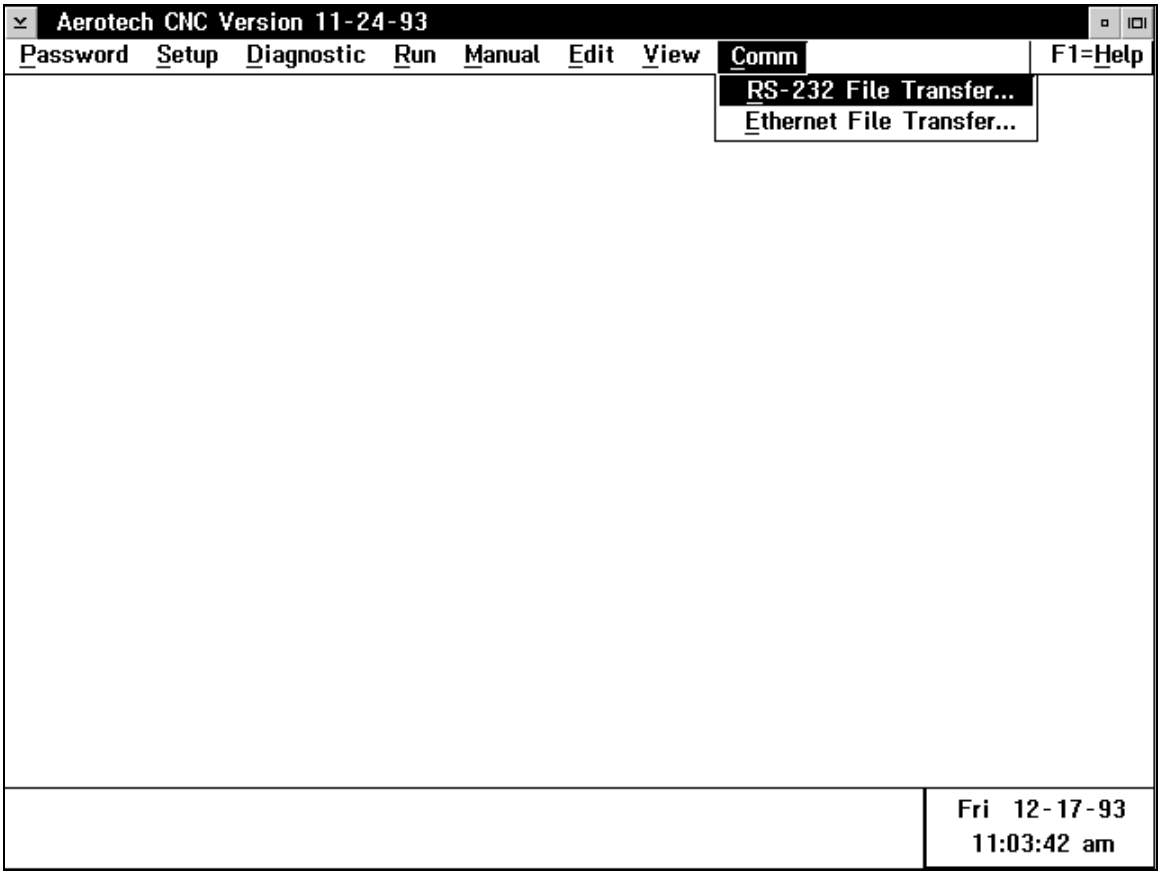


Figure 12-1. COMM Dialog Box

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12.2. RS-232 File Transfer

Selecting the "RS-232 File Transfer" option, from within the Communications menu, invokes the OS/2 utility SOFTTERM (see Figure 12-2, below). Please refer to the documentation on this utility (provided by IBM) for further details.



Figure 12-2. OS/2 SOFTTERM Utility

12.3. Ethernet File Transfer

The "Ethernet File Transfer" option has not been implemented at this time. The Ethernet File Transfer Dialog Box, shown in Figure 12-3, appears on the display to notify the user of this fact.

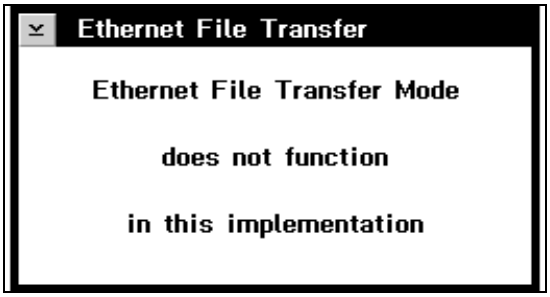


Figure 12-3. Ethernet File Transfer Dialog Box

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APPENDIX A: WARRANTY AND FIELD SERVICE

In This Section:

- Laser Products A-1
- Return Procedure A-1
- Returned Product Warranty Determination A-1
- Returned Product Non-warranty Determination A-2
- Rush Service A-2
- On-site Warranty Repair A-2
- On-site Non-warranty Repair A-2

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, where or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability or 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 Products

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 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.

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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 any 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.

Company Address

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2897
USA

Phone: (412) 963-7470
Fax: (412) 963-7459

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APPENDIX B: Optional Options

Appendix B

In This Section:

- Optional Options on the System Options Screen

The following section provides information concerning two options now available on the System Options screen, the "automatic-object-file" and "infinite-download" option checkboxes.

B.1. Automatic-object-file Option

The "automatic-object-file" option writes object files to the hard disk drive during the compile process. This slows down the compile process the first time, but speeds up future compiles. If no changes are made to the file (or any included file) since the last object file formation, the compiler reads the object file instead of performing a compile. However, if the program changes, the file is automatically recompiled. Use of the object files results in approximately 3/2 longer compile time when forming the object file the first time, but uses only 1/3 the compile time on successive compiles.

The object file is actually a combination of two file types (.OGM and .SGM) with the same file name. The .OGM file contains the actual program binary text sent directly to the 80960 (the motion processor). The .SGM file contains the program text, the variable definitions, and other items needed by the 486 (frontend processor) in order to track program execution properly.

If the user attempts to compile one of the file types (.OGM and .SGM) directly, then the compiler assumes that the file is an object file and tries to read it that way.



This creates a new restriction that program files cannot be .OGM or .SGM file types. This is true regardless of whether the "automatic-object-file" or "infinite-download" options are on or off.

Forming an object file requires approximately 25 times as much disk space as the size of the uncompiled file.



The compiler will inform the user whether it is reading a source or object file by observing the text in the title bar on the Runbox (the smaller box within the run window that shows the program lines). If the title is the same as source file (the same as the one on the larger run window), then a source file is being compiled. If the run box lists a title of a file type (.SGM or .OGM), then its reading in an object file.

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The compiler will always process the .SGM file first, then the .OGM file. The title bar will change the name printed as the compiler moves from one part of the compile to the next.

B.2. Infinite-download Option

When the user checks this box, the size of the program is virtually unlimited. This feature has been tested with 70,000 line programs and it is believed that it can compile much larger programs. The only known theoretical limit is 2.2 billion lines.

The lines are downloaded into a circular queue until that queue is filled up. The remaining lines are held in the compiler until room is made for them. As the program finishes executing a line it discards that line making room for another one. The compiler constantly watches the queue, downloading another line once space becomes available. In order for this mode to be successful, the compiler must be able to download lines as fast or faster than they are executed. The size of the circular buffer is critical to maintain this.

The user specifies the size of the circular buffer from the CNC Parameters screen under the Setup menu item. The buffer size appears at the bottom right of this screen. If the buffer is too large, the 960 will not be able to allocate that many lines or it may not be able to perform other activities requiring memory. If it is too small, the CNC will run out of lines before MAINMENU can download them and the program will trigger a CNC fault number 99 (queue buffer is empty). If this happens, increase the queue size.

Available on the Mode Status screen is a display that shows the number of lines left before the queue runs empty. It is directly beneath the "HARD" or "SOFT" designation and only appears when the "infinite-download" mode is active. The queue size should be increased so that this number never nears zero. A sugested starting point (for a 1.5 meg board) is 200 lines. For an 8 meg board start with 1000 lines.

There are a number of restrictions and important considerations in the infinite-download mode; they are listed below in decreasing order of importance.

1. Any statement that can potentially jump to a line other than the line immediately after it, is disallowed. Statements such as JUMP, WHILE, REPEAT, IF, and ONERROR are all disallowed. CLS statements are also disallowed. In some cases the INCLUDE statement can be used as an alternative to the CLS statement.
2. Normally, the user can specify a line to begin execution at other then the first line of the program by clicking on the line in the display before hitting "cycle start". This is not allowed in "infinite-download" mode, the program will always start at the beginning regardless of line clicked on by the user.
3. In the "infinite-download" mode, the user might notice a line of semicolons (;;;;;;;;;;) inserted as the first line in the program. This is required due to an error in the Microsoft fwrite() routine in OS/2 C600. This line is interpreted as a comment and has no effect on program execution and is only required for program display.

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4. A problem that is related to item 3, the text for the lines falling on the 64K character boundaries will not show properly on the program display. Instead, a blank line will be displayed for these lines. For example, if the average line has 10 characters, this will happen every 6,400 lines. This has no effect on program execution of these lines and only effects the display of the program.
5. The compiler will take significantly longer in this mode if object files are not being used or if it is the first time compiling. In these cases, the compiler will appear to repeat itself, listing passes 1 and 2 several times; this is normal.
6. If the user resets a file (red button in the middle of the program display box) in "infinite-download" mode, the compiler must recompile the program before resetting. The reason for this is, many of the lines being executed have been discarded to make room for new lines and must be reloaded.
7. A bug still remains in the CNC where the user cannot recompile a program that has completed execution without exiting and re-entering the Run screen.
8. The "infinite-download" mode requires writing object files (even if automatic-use of object files is turned off). The size of this object file can be ten to twenty times the size of the source code file.
9. The editor within MAINMENU cannot edit files larger than 32,000 characters. Therefore, if there is a compile error in a file larger than 32,000 bytes, the user cannot fix that error by clicking on the error message.
10. While the program executes, the CNC will continue to show the current line number and display the current line in the program display box. However, the user will not be able to see the entire program at once in the listbox. The listbox will only show the current block of 32,000 lines that the program is currently executing. For example, if the user proceeds to the bottom of a 70,000 line program using the scrollbar on the side of the program display, the user will not be able to see lines past 32,000. These lines become accessible only after the program has actually begun executing line 31,900, where the user will not be able to view the lines less than 32,000.
11. Normally, after finishing a compile, the program display will highlight the first executable line in the program (skipping any DVAR or other declaration statements). However, in the "infinite-download" mode, the display will always show the first line. This has no effect on line execution and only effects the display. After the first executable line is executed, the display behaves normally.

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