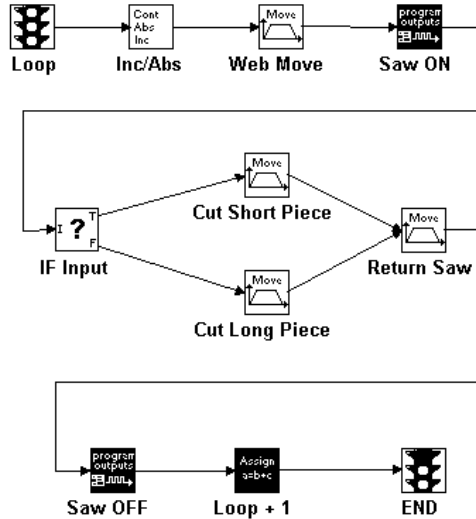


Compumotor

Motion Builder™ Start-Up Guide & Tutorial

*Iconic Programming Interface
for 6000 Series Controllers*



Compumotor Division
Parker Hannifin Corporation
p/n 88-015349-01B October 1996



Motion Builder™

The information in this document is subject to change without notice and does not represent a commitment on the part of Parker Hannifin Corporation. Motion Builder is furnished under a license agreement or nondisclosure agreement, and may be installed and used only in accordance with the terms of the agreement.

No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or information storage and retrieval systems, for any purpose other than the purchaser's personal use, without permission of Parker Hannifin Corporation.

Motion Builder is a trademark of Parker Hannifin Corporation.

Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation.

© Copyright 1996 by Parker Hannifin Corporation.
All rights reserved.
Printed in the United States of America.



WARNING



Motion Builder develops programs for controlling your system's electrical and mechanical components. Therefore, you should test your system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

Technical Assistance

Contact your local automation technology center, or ...

North America: Compumotor Division of Parker Hannifin
& Asia 5500 Business Park Drive
Rohnert Park, CA 94928
Telephone: (800) 358-9070
Fax: (707) 584-3793
E-mail: tech_help@cmotor.com
BBS: (707) 584-4059 – requires 2400 bps minimum modem

Europe: Parker Digiplan
21 Balena Close
Poole, Dorset
England BH17 7DX
Telephone: 0202-690911
Fax: 0202-600820

C O N T E N T S

Welcome

Welcome to Motion Builder.....	2
How to Give Your Feedback	2
System Requirements	2
How to Install Motion Builder	3
How to Get Help.....	3

Using Motion Builder

Motion Builder Icons.....	6
Select and Place Icons	6
Drag and Align Icons.....	6
Open and Complete Icon Dialog Boxes.....	6
Linking Icons	7
What are Projects and Programs?.....	8
Creating a Project.....	9
Creating a New Project.....	9
Creating a New Program	10
Configuring System Operating Parameters.....	10
Set Build Options for a Project.....	11
Building a Project.....	11
Downloading a Project to the Controller.....	12
Running the Main Program of a Project	12
Saving a Project	12

Configuring Your System

Participating Axes	14
Drives	15
Feedback Devices.....	16
Axis Scaling	18
Path Scaling.....	19
Programmable Inputs	20
Jog Setup.....	21
Programmable Outputs.....	22
Configuring Limit Functions.....	23
Hardware End-of-Travel Limits.....	24
Software End-of-Travel Limits.....	25
Home Limits.....	26

Configuring Joystick Inputs.....	27
Joystick Motion.....	27
Joystick Electronics.....	28
Feedrate Override.....	29
Servo Tuning	30
Assigning Specific Gain Values	31
Defining End-of-Move Settling Criteria.....	32
Zeta Damping.....	33
Variable & I/O Names	34

Icon Descriptions

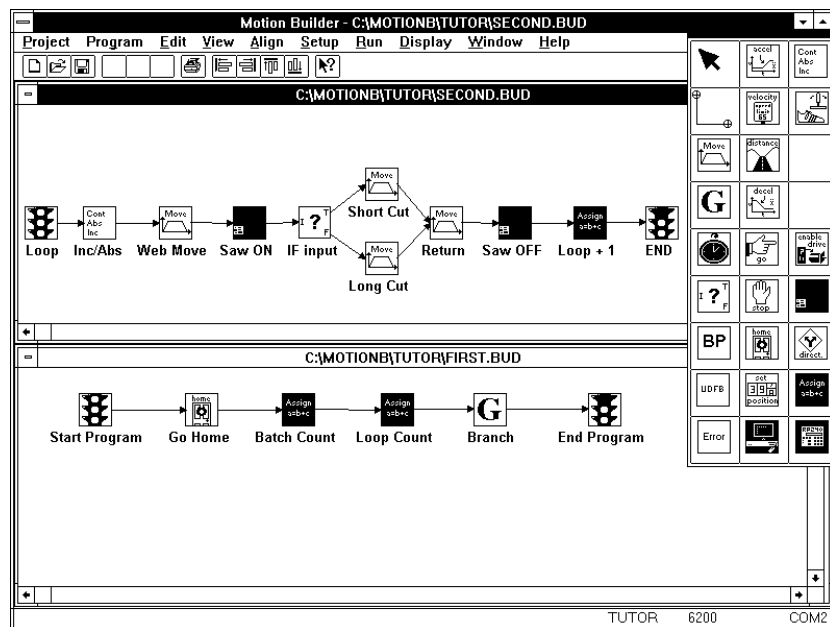
Pointer Icon.....	36
Link Icon.....	37
Move Profile Icon.....	38
Group Icon.....	39
Wait Icon	40
Conditional IF Icon.....	42
Break Point Icon.....	44
User Defined Function Block Icon	45
Error Checking Icon	46
Set Acceleration Icon.....	47
Set Velocity Icon.....	48
Set Distance Icon.....	49
Set Deceleration Icon.....	50
GO (Initiate Motion) Icon.....	51
Stop Motion Icon	52
Go Home Icon.....	53
Set Absolute Position Icon	54
Set Direction Icon.....	55
Motion Mode Icon	56
Manual Mode Icon.....	57
Set Programmable Outputs Icon.....	58
Assignment Icon	59
Enable Drive Icon	60
Select Feedback Device Icon.....	61
Select Gain Set Icon	62
RP240 Icon	63
Write to Port Icon.....	64
Begin Program Icon.....	65
End Program Icon.....	65

Tutorial

Tutorial Introduction.....	68
About the Application	68
Objectives of the Cut-to-Length Application	69
Tutorial.....	70

W E L C O M E

to Motion Builder™



Iconic Programming Interface for 6000 Controllers

Welcome to Motion Builder

Motion Builder is a Microsoft Windows™-based graphical programming tool that allows you to easily program Compumotor's 6000 Series products with visual icons. These visual icons, representing the motion function you want to perform, are simply dragged and dropped onto a program palette. Using Motion Builder with the 6000 Series products allows you to design and program your application in a flow chart methodology. This software tool decreases the learning curve, shortening your system design time, and reducing your overall system cost.

How to Give Your Feedback

We want your feedback to help guide our work on future improvements and enhancements to Motion Builder. If Motion Builder does not seem to work as you expected, or if you have an idea of how to make it work better, please let us know! (Known problems are noted in Motion Builder's readme.txt file.)

- FAX us at 707-584-2446.
- E-mail us at mbuilder@cmotor.com (use questionnaire as content guide).
- Call 800-358-0020 or 707-584-2558 and leave a voicemail message in mailbox 2606.

System Requirements

Motion Builder requires the following:

- 486 @ 66 MHz or higher
- Windows 3.1 or Windows95
- 8 MB RAM

Motion Builder can be used as is, without a controller. Of course, if you want to download and run the code that is generated, you must have a 6000 family controller. All the controllers in the 6000 family are supported (ZETA6104, APEX615n Series, AT6200 & AT6400, AT6250 & AT6450, 6200, 6201, 6250 & 6270, OEM6200, OEM6250 & OEM-AT6400).

How to Install Motion Builder

Motion Builder is equipped with an install wizard to ease installation. There is also an un-install feature so you can remove Motion Builder from your system when updated versions become available.

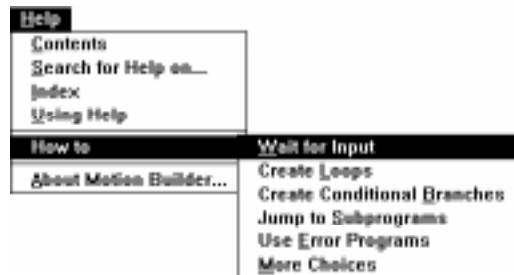
Put disk one in your floppy drive and run the “setup” program to begin installation. Follow the instructions on screen to complete the installation.

How to Get Help

Motion Builder has an integrated help system to aid in programming. The help system provides context-sensitive help and also functions as a comprehensive on-line manual. This is the predominant reference for Motion Builder.

To get context-sensitive help about specific icons, pull-down menu items and dialog boxes, select the icon (and hold down the mouse button), menu item or open the dialog box and press the **F1** key.

From the **Help** pull-down menu (see illustration below), you can access the help system table of contents (**Contents**), keyword search facility (**Search for Help on...**), and how-to information on specific programming tasks (**How to**).



If you are not familiar with Windows help system features (e.g., placing bookmarks, adding annotations, printing, copying/pasting, keeping help on top of other windows), you can find instructions by selecting **Using Help** from the **Help** menu.

If you need additional technical support:

- Phone us at 800-358-9070 or 707-584-7558
- E-mail us at tech_help@cmotor.com
- FAX us at 707-584-3793

Motion Builder Icons

The icons in Motion Builder are symbolic representations of motion and communications functions for the 6000 Series of controllers/indexers. Select the icons that correspond to the motion control activities you wish to perform. Arrange the icons on your computer screen to indicate the desired flow of motion and I/O, essentially creating a flowchart of motion and communication. Set the parameters for the chosen functions using the icon dialog boxes.

Refer to the Icon Description section of this manual for descriptions of the icons and their associated dialog boxes.

Select and Place Icons

Position the cursor over the Icon on the Icon palette and depress the left mouse button to select it. The color of the button will change to indicate that it was selected, and the cursor will change to a small square shape. Position the cursor in the desired position, and click the left mouse button to place the Icon. Once selected, an icon stays selected until another icon is selected.

Drag and Align Icons

Position the cursor over the desired icon and depress the left mouse button to grab and drag the Icon to the desired position on the program sheet. Position the icons manually, or select the icons and use the alignment commands from the toolbar or Align Menu to align the icons.

Open and Complete Icon Dialog Boxes


Position the cursor over the icon and double-click the left mouse button to open the Icon dialog box. Fill in the pertinent parameters.

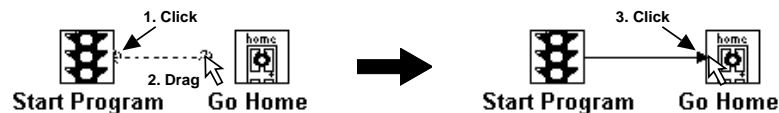
Linking Icons

Each icon has an input handle and an output handle*. The Input handle is always on the left side of the icon, and Output handle is always on the right. Connect the output and input handles of the desired two icons using the Linking function to direct the program flow from one icon to the next.

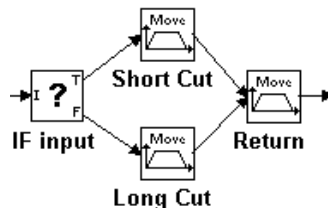
Motion Builder requires that links be made in the direction of program flow, so always connect to the Output handle first. The Link line will include an arrow to show the direction of program flow. Motion Builder will not accept links from an Input handle back to an Output handle. Motion Builder will not allow you to connect an Input handle to another Input handle, or an Output handle to an Output handle.

Once selected, the Link Icon function stays selected until you select another icon, the Pointer, or by double-clicking your left mouse button. If you start a link and wish to delete it, double-click your left mouse button

1. Select the Link tool () from the icon palette. After selecting the Link tool, when you pass the cursor over the program worksheet area, the cursor becomes a cross-hair (+).
2. Click the mouse on the right side (the output side) of the icon and then click the mouse again on the left side (the input side) of the icon you want to link. After you click on an icon's output, when you move the cursor, a dashed line trails behind. When you link successfully to the targeted icon, the line becomes solid with an arrowhead indicating the direction of program flow. The diagram below illustrates the input/output connections.



NOTE—The If Condition icon has one output for True and one for False:



***Exceptions:** Conditional IF, End Program, and Begin Program Icons.

What are Projects and Programs?

A project is a Motion Builder directory used to organize related programs with common set-up parameters. When programming with Motion Builder, you must be working within a project. Stand-alone programs are not allowed.

A program is a series of commands that are executed in the order in which they are programmed. With Motion Builder, these commands are represented by icons.

A project contains three types of files:

- *.PRJ file ASCII text file that describes:
- The 6000 series product being used
 - The configuration information for set-up
 - List of programs in the project
 - Main Program
 - Setup program
 - Error Program
 - Indication of whether the Build is debug or non-debug

The *.PRJ file has the same root name as the project.

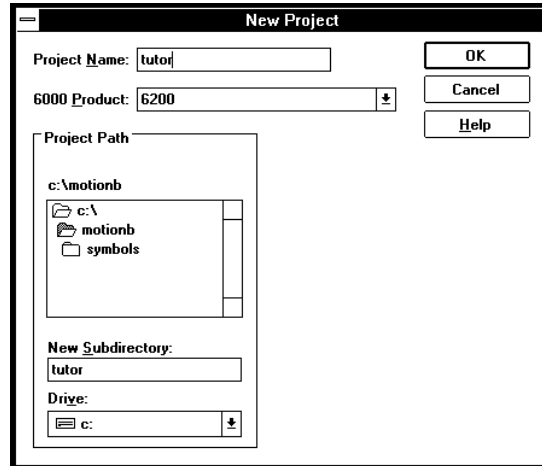
- *.BUD files Contain the symbolic representations of the programs created with icons, plus information from the icon dialog boxes.

- *.PRG files Contain the actual 6000 series commands generated by using the Build command for a project. Each *.BUD program file that is included in a project build will have a corresponding *.PRG file with the same root name.

Creating a Project

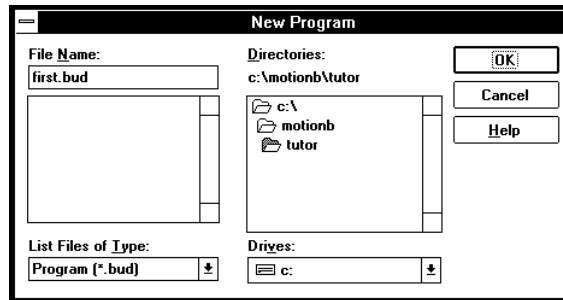
Creating a New Project

1. Choose New from the Project menu.
2. Type in the Project Name (no more than 6 characters).
3. In the 6000 Product pane, select the 6000 series product to be used.
4. Select the drive on which to store the project.
5. In the Subdirectory pane, enter or select the name of the desired subdirectory..
6. Chose the OK button to the close the New Project dialog box.



Creating a New Program

1. Choose New from the Program menu.
2. Type in Program Name (no more than 6 characters).
Program names can't begin with a number nor can they be the same as 6000 commands.
3. In the 6000 Product pane, select the 6000 series product to be used.
4. Select the drive on which to store the project.
5. In the Subdirectory pane, enter or select the name of the desired subdirectory..
6. Chose the OK button to the close the New Program dialog box.



Configuring System Operating Parameters

Before developing programs, you should verify that all your application's relevant "setup" categories, found under the Setup menu, are configured for your application.

The parameters from all setup categories are automatically saved into a "setup" program when you build your project. A check-mark appears next to the Setup menu item to let you know you've customized the setup parameters.

When you run your "main" motion program, the setup program will be automatically executed first to prepare the 6000 controller for subsequent motion control functions. The information in the setup program is based on the state of the system configuration information at the time of the project build. Every project requires a setup program.

Refer to the Configuring Your System section of this manual for descriptions of the Setup categories and their associated dialog boxes.

Set Build Options for a Project

Before building a project, you should designate the main program and error program for the build. (See below.)

1. Select the Build Options command from the Project menu.
2. Select if the Build Mode is to be Debug or Non-Debug.
3. If you wish to change the main program, select the new main program from the drop-down box. The first program created in the project is the default main program.
4. (Option) Select the error program for the project with the drop-down box.
5. Select if the main program is to be the start-up program (stand-alone controllers only).

Main Program

The Main Program in a project contains the predominant logic flow of motion and I/O for the application.

Error Program

The purpose of the error program is to provide a programmed response to certain error conditions that may occur during the operation of your system. Programmed responses typically include actions such as shutting down the drive(s), activating or de-activating outputs, etc. If an error condition occurs and the associated error-checking bit has been enabled with the Error Checking Icon, the 6000 controller will branch to the error program. See the On-line Help system for more detailed information about error programs, as well as about error conditions and their remedies.

Building a Project

1. Use the Edit command from the Project menu to select which programs in the Project directory are to be considered part of the build. All programs created while in the project are automatically stored in the Project directory, and will be included in the build unless de-selected..
2. Use the Build Options command from the Project menu to specify the main program and the error program for the project build. Also select if the main program is to be the Start-up Program (stand-alone controllers only).
3. If you wish to only build the programs (those previously selected for the build) that have changed since the last build for the project, select the Build command from the Project menu. The purpose of this is to save Build compilation time for large projects.
4. If you wish to rebuild all the programs (those previously selected for the build) regardless of when they last changed, select the Rebuild All command from the Project menu.

Downloading a Project to the Controller

Before you can execute the programs of your project, you must download them to the controller's memory.

1. Select the Communications Setup command from the Run menu.
2. For stand-alone products, select the Communications Port with the drop-down box. For bus-based products, select the device address from the drop down box.
3. Select the Connect command from the Run menu to establish the communication link with the 6000 Series controller.
4. Select the Download Project command from the Run menu. A window should appear with the contents of your programs scrolling by, followed by a message stating that the download is complete. Your programs now reside in the controller's memory.

Running the Main Program of a Project

To run the main program of your project (as well as the subprograms), select the Run Main Program from the Run menu.

Saving a Project

A project is saved by saving the elements of the project – the programs.

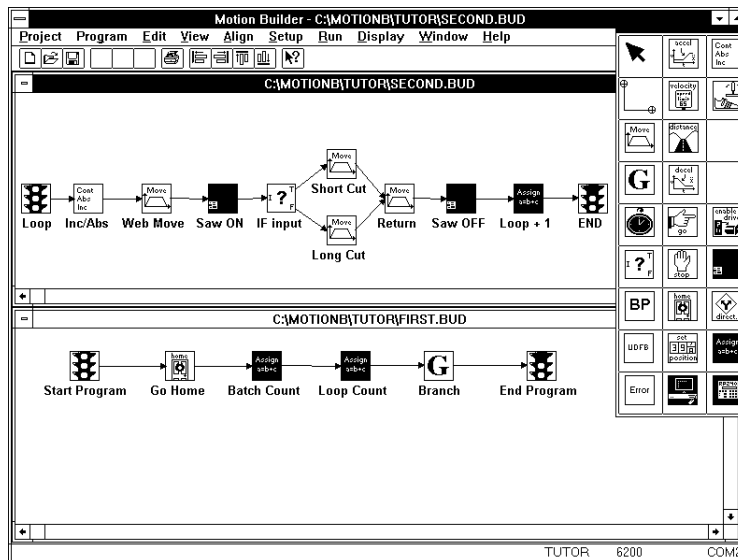
1. Choose Save from the Program menu.
2. Repeat Step 1 for each Program in the project that is open before closing the Project.

Try the Tutorial

The tutorial section of this manual demonstrates the basic process, as just described, for developing a project using Motion Builder

Configuring Your System

in Motion Builder™



Iconic Programming Interface for 6000 Controllers

Configuring System Operating Parameters

Before you begin to program your 6000 Product, you should establish basic operating (“setup”) parameters for your project. These setup parameters are compiled into a setup program which configures the 6000 Series controller at the start of the project.

Failure to configure setup parameters can lead to unexpected results. Operating systems for 6000 Series controllers contain default values for these parameters that may not be what you expect. (Refer to the Installation Guide for your 6000 Product.)

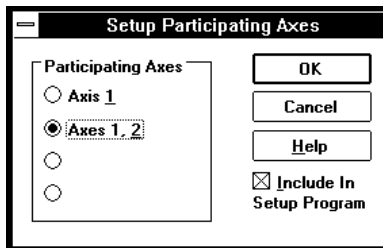
Participating Axes

If you are not going to use all the axes of your 6000 Series product, use this setup parameter to remove from service the unnecessary axes. This reduces the size of motion programs by excluding parameters for non-participating axes. For servo products, it improves performance by allowing faster servo, motion trajectory, and system update rates.

The default condition is that all axes on the product are included in programming.

To reduce the number of participating axes

1. From the Setup menu, select Participating Axes.
2. Select the maximum number of axes required for your application. Note that the axis with the highest number is excluded; axis numbers cannot be rearranged. For example, if you have a 4-axis controller and will use only 3 axes, select "Axes 1,2,3" and the controller will function as if axis #4 was deleted from its design.



Drives

Unless you are using a packaged controller/drive (e.g., APEX6154, 6201, ZETA6104, etc.), you need to configure the controller to work with the connected drive. If you are using a Compumotor or Digiplan drive, simply select it from the drive selection box and all the configuration parameters will be filled in for you.

To configure the drive(s)

1. From the Setup menu, choose Drives.
2. Select the affected axis.
3. Select the type of drive using the drop-down box.
4. Select if the Drive fault level is to be Active High or Active Low.
5. Enter the value for the Drive resolution (stepper products only)
6. Select the value for the Drive pulse width (stepper products only) with the drop-down box.
7. Select if Disable drive on Killis to be enabled (servo products only).
8. Repeat steps 2-7 for each axis.

The image shows a software dialog box titled "Setup Drives". It is used for configuring drive parameters for a specific axis. The "Axis #" is set to 1. The "Stepper Drive" is set to ZETA. The "Drive Fault Level" is set to Active High. The "Drive Resolution (steps/rev)" is set to 25000. The "Drive Pulse Width (microseconds)" is set to 0.3. The "Include In Setup Program" checkbox is checked. The dialog box has buttons for OK, Cancel, and Help.

Feedback Devices

Feedback device options depend on the product. Use the appropriate procedure below for your stepper or servo product.

To configure feedback for STEPPER PRODUCTS

1. From the Setup menu, choose Feedback.
2. Select the affected axis.
3. Set the encoder resolution.
4. Do one or both of the following (as your application requires):
 - Enable and set up Position Maintenance
 - Enable and set up Stall Detection
5. Repeat steps 2-4 for each axis.
6. Choose the OK button.

The screenshot shows a software dialog box titled "Setup Feedback". At the top left, there is a field for "Axis #". The dialog is divided into several sections:

- Encoder Operations:** Contains two checked checkboxes: "Enable Position Maintenance" and "Enable Stall Detection".
- Encoder Resolution:** Contains a text input field labeled "Encoder Resolution (post-quad counts/rev)".
- Position Maintenance(PM):** Contains three text input fields: "PM Deadband (post-quad counts)", "PM Gain", and "PM Max Velocity (rev/sec)". It also has a checked checkbox for "Enable Encoder Move Deadband".
- Stall Detection:** Contains a text input field for "Stall Backlash Deadband (motor steps)" and a checked checkbox for "Enable Kill Move on Stall".

On the right side of the dialog, there are four buttons: "OK", "Cancel", "Help", and a checked checkbox labeled "Include In Setup Program".

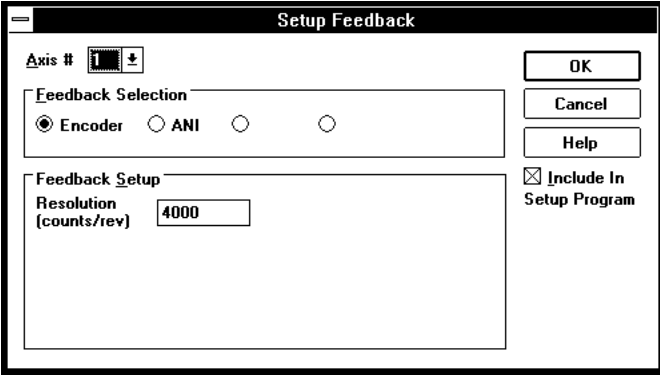
NOTE -- Steppers

If you enable position maintenance or stall detection, all the motion on the respective axis in the current program/project will be based on encoder-based positioning.

Feedback Devices (cont'd.)

To configure feedback for SERVO PRODUCTS

1. From the Setup menu, choose Feedback.
2. Select the affected axis.
3. Select the feedback source from the Feedback Selection area.
4. Fill in the Feedback Setup information for the feedback source:
 - Encoder
 - ANI (Analog Input)
 - LDT(Linear Displacement Transducer for 6270 only)
 - Resolver (internal resolver for APEX615n Series products only)
5. Repeat steps 2-4 for each axis.
6. Choose the OK button.



The screenshot shows a dialog box titled "Setup Feedback". It contains the following elements:

- Axis #**: A dropdown menu with a small icon to its right.
- Feedback Selection**: A group box containing four radio buttons. The first one, labeled "Encoder", is selected.
- Feedback Setup**: A group box containing a label "Resolution (counts/rev)" and a text input field with the value "4000".
- Buttons**: Three buttons are stacked vertically on the right: "OK", "Cancel", and "Help".
- Checkbox**: A checked checkbox labeled "Include In Setup Program" is located below the "Help" button.

NOTE -- Servos

If you change the feedback source in your motion program, the scaling and tuning parameters will automatically change to match the feedback source. Gain values may also change.

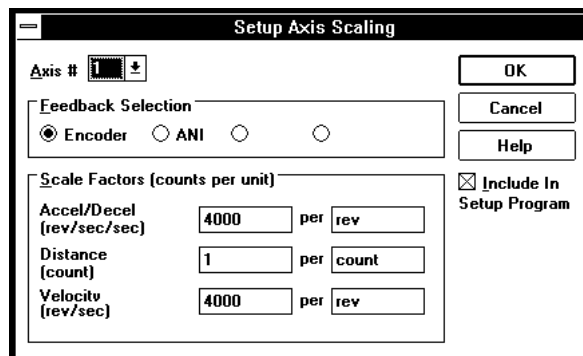
Axis Scaling

Scaling allows you to program acceleration, deceleration, velocity, and position values in units of measure that are appropriate for your application. Axis scaling pertains to general, point-to-point motion. See example scaling scenarios. The scaling parameters for servo systems are specific to the feedback source; therefore, if your application requires you to switch between feedback sources, make sure you have set up the desired scaling for each feedback source.

NOTE: To ensure that all programmed motion values are scaled for your application, be sure to include Scaling in your Setup program, and select the Main program as the Start-up program.

To Define Axis Scaling Parameters

1. From the Setup menu, select Axis Scaling.
2. Select the affected axis.
3. SERVO PRODUCTS: Select the feedback source.
4. Fill in the desired scaling value for accel/decel, including the desired units of measure for your application.
5. Fill in the desired scaling value for distance, including the desired units of measure for your application.
6. Fill in the desired scaling value for velocity, including the desired units of measure for your application.



The screenshot shows a dialog box titled "Setup Axis Scaling". It contains the following elements:

- Axis #:** A dropdown menu with a small icon to its right.
- Feedback Selection:** A group box containing three radio buttons: "Encoder" (selected), "ANI", and an unlabeled one.
- Scale Factors (counts per unit):** A group box containing three rows of input fields:
 - Accel/Decel (rev/sec/sec): 4000 per rev
 - Distance (count): 1 per count
 - Velocity (rev/sec): 4000 per rev
- Include In Setup Program:** A checked checkbox.
- Buttons:** "OK", "Cancel", and "Help" buttons are located on the right side of the dialog.

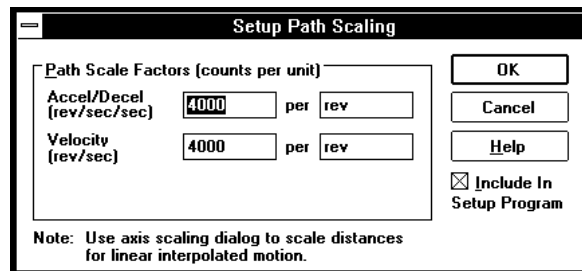
Path Scaling

Scaling allows you to program acceleration, deceleration, velocity, and position values in units of measure that are appropriate for your application. Path Scaling pertains to linear interpolated motion. See example scaling scenarios. The scaling parameters for servo systems are specific to the feedback source; therefore, if your application requires you to switch between feedback sources, make sure you have set up the desired scaling for each feedback source.

NOTE: To ensure that all programmed motion values are scaled for your application, be sure to include Scaling in your Setup program, and select the Main program as the Start-up program.

To Define Scaling Parameters

1. From the Setup menu, select Path Scaling.
2. Fill in the desired scaling value for accel/decel, including the desired units of measure for your application.
3. Fill in the desired scaling value for velocity, including the desired units of measure for your application.



Setup Path Scaling

Path Scale Factors (counts per unit)

Accel/Decel (rev/sec/sec) 4000 per rev

Velocity (rev/sec) 4000 per rev

OK

Cancel

Help

Include In Setup Program

Note: Use axis scaling dialog to scale distances for linear interpolated motion.

NOTE: If you are using Path Scaling, you must configure identical Distance Scaling using Axis Scaling.

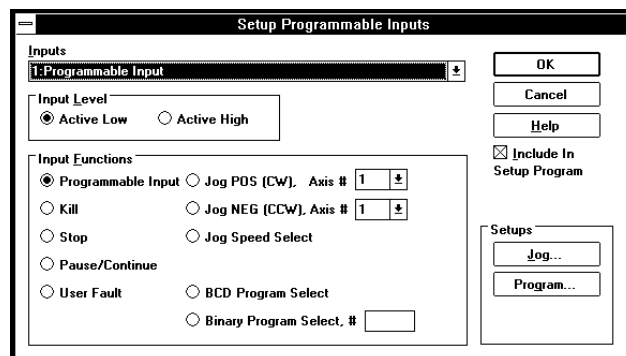
Programmable Inputs

Programmable inputs are provided to allow the controller to detect the state of switches, thumbwheels, electronic sensors, and outputs of other equipment, such as drives and PLCs. Based on the state of the inputs, and programmable outputs, the controller can make program flow decisions and assign values to binary variable for subsequent mathematical operations.

Configuration of programmable inputs, including trigger inputs, consists of assigning an Input Function for each input to be used and defining if it is to be considered active high or active low.

To configure programmable inputs

1. From the Setup menu, choose Programmable Inputs
2. Select the affected programmable input to be configured.
3. Within the Input Level area, select if the input is to be Active High or Active Low.
4. Select the desired Input Function for the selected programmable input.
 - Programmable Input
 - Kill
 - Stop
 - Pause/Continue
 - User Fault
 - Capture Position (Triggers Only)
 - Jog POS (CW), w/ Axis #
 - Jog NEG (CCW), w/ Axis #
5. Repeat steps 2-4 for each axis.
6. Select if the Setup for Programmable Inputs is to be included in the Setup Program.
7. (Optional) Complete Jog Setup
8. (Optional) Complete Program Setup.



Programmable Inputs: Jog Setup

Use to set the necessary Jog motion parameters, in conjunction with the assignment of programmable inputs for Jog POS (CW), Jog NEG (CCW), and Jog Speed Select.

To configure Jog parameters

1. From the Setup menu, choose Programmable Inputs
2. Select the affected programmable input to be configured as Jog POS (CW).
3. Within the Input Level area, select if the input is to be Active High or Active Low.
4. Repeat Steps 2 and 3 for Jog NEG (CCW) and Jog Speed Select.
5. Place the cursor over the Jog Button in the Setup area of the dialog box, and click the left mouse button to display the Setup Jog dialog box.
6. Select the affected axis.
7. Fill in the Jog acceleration value for the affected axis. Make sure that the value is within the allowed acceleration range.
8. Fill in the Jog deceleration value for the affected axis. Make sure that the value is within the allowed deceleration range.
9. Fill in the Jog Velocity High value for the affected axis. Make sure that the value is within the allowed velocity range.
10. Fill in the Jog Velocity Low value for the affected axis. Make sure that the value is within the allowed velocity range.
11. Repeat Steps 6-10 for any other affected axes.
12. Select if Jog Setup parameter are to be included in the Setup Program.

Setup Jog	
Axis #	1
Jog Parameters	
Acceleration (rev/sec/sec)	10.0000
Deceleration (rev/sec/sec)	10.0000
Velocity High (rev/sec)	10.0000
Velocity Low (rev/sec)	0.5000
<input checked="" type="checkbox"/> Include In Setup Program	
OK	
Cancel	
Help	

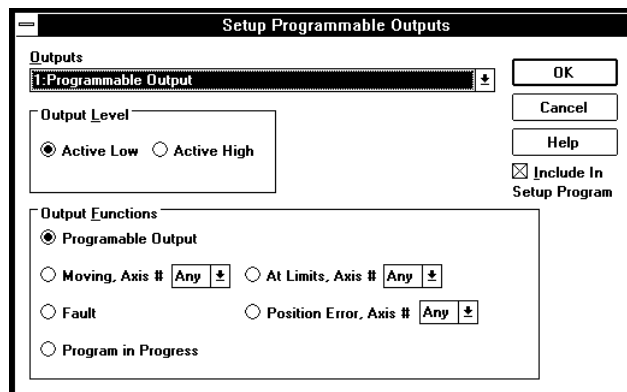
Programmable Outputs

Programmable outputs are provided to allow the controller to respond to the state of switches, thumbwheels, electronic sensors, and outputs of other equipment, in conjunction with programmable inputs.

Configuration of programmable inputs, including trigger inputs, consists of assigning an Input Function for each input to be used and defining if it is to be considered active high or active low.

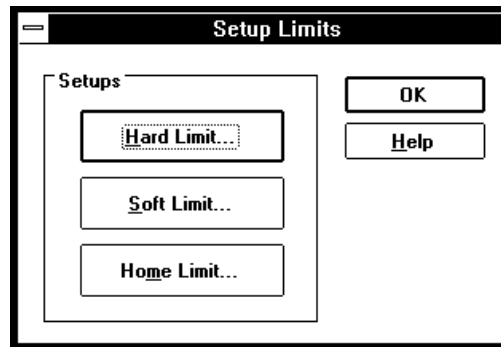
To configure programmable outputs

1. From the Setup menu, choose Programmable Outputs
2. Select the affected programmable output to be configured.
3. Within the Output Level area, select if the output is to be Active High or Active Low
4. Select the desired function for the selected programmable output.
 - Programmable Output
 - Moving
 - Fault
 - Program in Progress
 - Stall
 - At Limits
 - Position Error (Servos only)
 - Output on Position (Servos only)
5. Repeat steps 2-4 for each axis.
6. Select if the Setup for Programmable Outputs is to be included in the Setup Program.
7. (Optional) If Output on Position is assigned to any of the auxiliary outputs (**Special Output A** through **Special Output D**), fill in position parameters using the Setup Output on Position dialog box.



Configuring Limit Functions

The purpose of hardware and software end-of-travel limits is to prevent the motor's load from traveling past defined limits. Software and hardware limits are typically positioned in such a way that when the software limit is reached the motor/load will start to decelerate toward the hardware limit, thus allowing for a much smoother stop at the hardware limit. Software limits can be used regardless of incremental or absolute positioning.



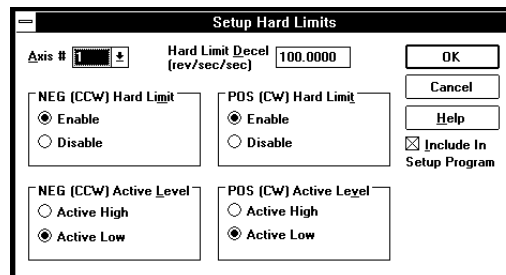
Hardware End-of-Travel Limit Inputs

6000 Series controllers are shipped from the factory with the hardware end-of-travel limit inputs enabled, but not connected. Therefore, motion will not be allowed until you do one of the following:

- Install limit switches or jumper the end-of-travel limit terminal to the GND terminal (refer to your product's Installation Guide for wiring instructions).
- Disable the limits with the Setup Hard Limits dialog box.
- Reverse the active level of the limits with the Setup Hard Limits dialog box.

To configure hardware limits

1. From the Setup menu, choose Limit Inputs
2. Place the cursor over the Hard Limit Button in the dialog box, and click the left mouse button to display the Setup Hard Limits dialog box.
3. Select the affected axis.
4. Enter the Hard Limit Deceleration value. Make sure that the value is within the allowed deceleration range.
5. Select if the NEG (CCW) Hard Limit is to be Enabled or Disabled. If disabled, motion will not be restricted when NEG (CCW) Hard Limit is reached.
6. Select if the POS (CW) Hard Limit is to be Enabled or Disabled. If disabled, motion will not be restricted when POS (CW) Hard Limit is reached.
7. Select if the NEG (CCW) Hard Limit Input is to be Active High or Active Low.
8. Select if the POS (CW) Hard Limit Input is to be Active High or Active Low.
9. Repeat steps 3-8 for each axis.
10. Select if the Setup for Hard Limits is to be included in the Setup Program.



Software End-of-Travel Limits

The software limits are referenced from a position of absolute zero. Both software limits may be defined with positive values or negative values, as long as the POS (CW) limit is greater than the NEG (CCW) limit.

Care must be taken when performing incremental moves because the software limits are always defined in absolute terms. Software limits must be large enough to accommodate the moves, or a new zero reference position must be defined using the Set Absolute Position Icon.

To configure software limits

1. From the Setup menu, choose Limit Inputs
2. Place the cursor over the Soft Limit Button in the dialog box, and click the left mouse button to display the Setup Soft Limits dialog box.
3. Select the affected axis.
4. Enter the Soft Limit Deceleration value. Make sure that the value is within the allowed deceleration range.
5. Select if the NEG (CCW) Soft Limit is to be Enabled or Disabled. If disabled, motion will not be restricted when NEG (CCW) Soft Limit is reached.
6. Select if the POS (CW) Soft Limit is to be Enabled or Disabled. If disabled, motion will not be restricted when POS (CW) Soft Limit is reached.
7. Enter the NEG (CCW) Range value in absolute steps. If scaling is enable, this is internally multiplied by the distance scaling factor.
8. Enter the POS (CW) Range value in absolute steps. If scaling is enable, this is internally multiplied by the distance scaling factor.
9. Repeat steps 3-8 for each axis.
10. Select if the Setup for Soft Limits is to be included in the Setup Program.

The image shows a dialog box titled "Setup Soft Limit". It contains the following elements:

- Axis #**: A dropdown menu.
- Soft Limit Decel [rev/sec/sec]**: A text box with the value "100.0000".
- NEG (CCW) Soft Limit**: Radio buttons for "Enable" and "Disable" (selected).
- POS (CW) Soft Limit**: Radio buttons for "Enable" and "Disable" (selected).
- NEG (CCW) Range [count]**: A text box with the value "0".
- POS (CW) Range [count]**: A text box with the value "0".
- Buttons**: "OK", "Cancel", and "Help".
- Include In Setup Program**: A checked checkbox.

Home Limits

A homing operation is a sequence of moves that position an axis using the Home Limit input and/or the Z-Channel input of an incremental encoder. The goal of the homing operation is to return the load to a repeatable initial starting location. See Homing Examples

To configure home limits

1. From the Setup menu, choose Limit Inputs.
2. Place the cursor over the Home Limit Button in the dialog box, and click the left mouse button to display Setup Home Limits dialog box.
3. Select the affected axis.
4. Within the Home Operation area, select Backup to home or No Backup to home.
5. Within the Home Reference Edge area, select whether to stop on the POS (CW) or the NEG (CCW) side of the home switch.
6. Within the Home Active Level area, select if the Home Limit input is to be Active High or Active Low.
7. (Optional) Within the Home Backup area, enter the velocity for the final approach to home position during backup to home or during homing to the Z-channel. Make sure that the value is within the allowed velocity range.
8. (Optional) Within the Home Backup area, specify POS (CW) or NEG (CCW) for the final approach direction to home position during backup to home or during homing to the Z-channel.
9. (Optional) Enable Z-channel homing.
10. Enter the Home Velocity value. Make sure that the value is within the allowed velocity range.
11. Enter the Home Acceleration value. Make sure that the value is within the allowed acceleration range.
12. Enter the Home Deceleration value. Make sure that the value is within the allowed deceleration range.
13. Repeat steps 3-12 for each axis.

The screenshot shows the 'Setup Home Limits' dialog box for Axis # 2. The dialog is organized into several sections:

- Home Operation:** Radio buttons for 'Backup' and 'No Backup'. 'No Backup' is selected.
- Home Reference Edge:** Radio buttons for 'NEG (CCW)' and 'POS (CW)'. 'POS (CW)' is selected.
- Home Active Level:** Radio buttons for 'Active High' and 'Active Low'. 'Active Low' is selected.
- Home Backup:** A text input field for 'Final Velocity (rev/sec)' with the value 0.1000. Below it, radio buttons for 'Final Direction' with 'NEG (CCW)' and 'POS (CW)'. 'POS (CW)' is selected. A checkbox for 'Enable Z-Channel Homing' is present and unchecked.
- Home Motion:** Three text input fields: 'Home Velocity (rev/sec)' with value 1.0000, 'Home Acceleration (rev/sec/sec)' with value 10.0000, and 'Home Deceleration (rev/sec/sec)' with value 10.0000.

On the right side of the dialog, there are buttons for 'OK', 'Cancel', and 'Help'. A checkbox labeled 'Include In Setup Program' is also present and checked.

Configuring Joystick Inputs

Use to configure such that the analog inputs can be used to produce motion on a specific axis. Motion will be directly proportional to the voltage on the analog inputs, which is linearly related to the joystick positioning.

Joystick Motion

To configure joystick motion parameters

1. From the Setup menu, choose Joystick.
2. Place the cursor over the Joystick Motion Button in the Setup Joysticks dialog box, and click the left mouse button to display the Setup Joystick Motion dialog box.
3. Select the affected axis.
4. Enter the Acceleration value to be used during joystick mode. Make sure that the value is within the allowed acceleration range.
5. Enter the Deceleration value to be used during joystick mode. Make sure that the value is within the allowed deceleration range.
6. Enter the Velocity High value to be used during joystick mode. Make sure that the value is within the allowed velocity range.
7. Enter the Velocity Low value to be used during joystick mode. Make sure that the value is within the allowed velocity range.
8. In the Analog Channel area, select the Analog Channel High from the drop-down box.
9. In the Analog Channel area, select the Analog Channel Low from the drop-down box.
10. Repeat steps 3-9 for each axis to be controlled by joystick.
11. Select if the Setup for Joystick Motion is to be included in the Setup Program.

Setup Joystick Motion

Axis # 1

OK
Cancel
Help

Include In Setup Program

Joystick Motion Parameters

Acceleration (rev/sec/sec) 10.0000

Deceleration (rev/sec/sec) 10.0000

Velocity High (rev/sec) 10.0000

Velocity Low (rev/sec) 0.5000

Analog Channels

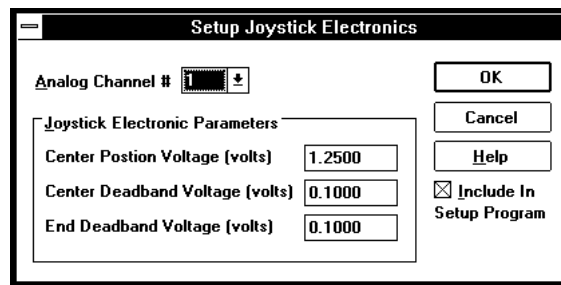
Analog Channel High 1

Analog Channel Low 1

Joystick Electronics

To configure joystick electronics parameters

1. From the Setup menu, choose Joystick.
2. Place the cursor over the Joystick Electrons Button in the Setup Joystick dialog box, and click the left mouse button to display the Setup Joystick Electronics dialog box.
3. Select the affected analog channel from the drop-down box.
4. Enter the Center Position Voltage value.
5. Enter the Center Deadband Voltage value.
6. Enter the End Deadband Voltage value.
7. Repeat steps 3-6 for each analog channel to be used.
8. Select if the Setup for Joystick Electronics is to be included in the Setup Program.



Joystick: Feedrate Override

(Steppers Only) Feedrate Override is used to synchronously scale all phases of motion on all axes (except distance) for joystick moves. The amount of scaling is expressed in terms of percentage from 0 to 100. The percentage of feedrate can be controlled by an analog voltage (Hard) or by a software command (Soft).

When feedrate override is enabled, the frequency at which the controller's motion algorithm updates the velocity output varies according to the feedrate percentage. Without feedrate override, the motion algorithm is updated every 2 milliseconds. At 100%, the velocity output is updated every 2 milliseconds. At 50%, the velocity output is updated every 4 milliseconds.

To configure feedrate override

1. From the Setup menu, choose Joystick.
2. Place the cursor over the Feedrate Override Button in the Setup Joysticks dialog box, and click the left mouse button to display the Setup Feedrate Override dialog box.
3. In the Feedrate Override Type area, select None, Hard, or Soft. If None is selected, Feedrate Override is disabled.
4. Enter the Feedrate Override Acceleration value to be used during joystick mode.
5. If Soft Feedrate Override was selected in Step 3, enter the Feedrate Override Percentage. Continue to Step 7.
6. In the Hard Feedrate Override area, use the drop-down boxes to select the Analog Channel High and the Analog Channel Low.
7. Select if the Setup for Feedrate Override is to be included in the Setup Program.

The screenshot shows a dialog box titled "Setup Feedrate Override". It contains the following elements:

- Feedrate Override Type:** Three radio buttons labeled "None", "Hard", and "Soft". The "Hard" radio button is selected.
- Feedrate Override Acceleration (percent/sec/sec):** A text input field containing the value "10".
- Include In Setup Program:** A checked checkbox.
- Hard Feedrate Override:** Two drop-down menus labeled "Analog Channel High" and "Analog Channel Low", both currently set to "None".
- Buttons:** "OK", "Cancel", and "Help" buttons are located on the right side of the dialog.

Servo Tuning

The 6000 Series servo controllers use a digital control algorithm to control and maintain the position and velocity. The digital control algorithm consists of a set of numerical equations used to periodically (once every servo sampling period) calculate the value of the control signal output. The numerical terms of the equations consist of the current commanded position value and actual position value (plus a few from the past sampling period) and a set of control parameters. Each control parameter, commonly called a gain, has a specific function. Tuning is the process of selecting and adjusting these gains to achieve optimal servo performance.

When this control algorithm is used, the whole servo system is a closed loop system. It is called closed loop because the control algorithm accounts for both the command (position, velocity, tension, etc.) and the feedback data (from the encoder); therefore, it forms a closed loop of information flow.

When all gain sets are set to zero, the digital control algorithm is essentially disabled and the system becomes an open loop system. During system setup or troubleshooting it is desirable to run the system in open loop so that you can independently test the drive and motor operation.

Positive Gains		
Proportional	<input type="text" value="0.5"/>	millivolts/step
Integral	<input type="text" value="0"/>	millivolts/step-sec
Integral Limit	<input type="text" value="200"/>	volts
Velocity	<input type="text" value="0"/>	microvolts/step/sec
Acceleration Feedforward	<input type="text" value="0"/>	microvolts/step/sec ²
Velocity Feedforward	<input type="text" value="0"/>	microvolts/step/sec

Servo Tuning: Assigning Specific Gain Values

To configure gain sets for servo tuning

1. From the Setup menu, choose Servo Tuning
2. Select the gain set to be defined or modified. If gain values for the feedback sources for each axis will remain the same throughout your project, select None.
3. (Optional) To launch Servo Tuner to help determine the optimal gain values for your project, place the cursor over the Launch Servo Tuner Button in the Gain Set area, and click the left mouse button.
4. (Optional) To import gain sets that were calculated with Servo Tuner, place the cursor over the Import Servo Tuner Gains Button in the Gain Set area, and click the left mouse button.
5. Select the affected axis for the gain values being defined.
6. Select the desired Feedback Device.
7. Enter the Maximum Position Error value.
8. Enter the positive and negative Proportional Feedback Gain values.
9. Enter the positive and negative Integral Feedback Gain values.
10. Enter the Integral Windup Limit value.
11. Enter the positive and negative Velocity Feedback Gain values.
12. Enter the positive and negative Acceleration Feedforward Gain values.
13. Enter the positive and negative Velocity Feedforward Gain values.
14. If your project requires switching between feedback sources for the same axis, repeat Steps 6-13 for each feedback source for the selected axis (only if Gain Set is None).
15. Repeat steps 5-14 for each axis.
16. Repeat steps 2-13 for each desired gain set. If None was selected in Step 2, proceed to Step 17.
17. Select if the Setup for Gain Sets is to be included in the Setup Program.

Defining End-of-Move Settling Criteria

When using the target zone settling criteria, the motor's actual position and actual velocity must be within the specified target zone and within the specified velocity band before motion can be determined complete. Use to prevent premature command execution before the actual position settles into the commanded position.

If the motor does not settle into the target zone before the specified time-out period, the servo controller detects an error. If this error occurs, you can prevent subsequent command and/or move execution by using the Enable Error Checking Icon to continually check for this error condition, and when it occurs, to branch to a programmed response defined in the Error Program.

To configure settling criteria

1. From the Setup menu, choose Settling Criteria.
2. Select the affected axis.
3. Enable the Target Zone Settling mode.
4. Enter the Target Distance Zone value.
5. Enter the Target Velocity Zone value.
6. Enter the Target Settling Timeout Period value.
7. (6270 only) Enter the Setpoint Window Distance.
8. (6270 only) Select the Setpoint Window Gain Set from the drop-down box.
9. Repeat steps 2-8 for each axis.
10. Select if the Setup for Settling Criteria is to be included in the Setup Program.

Axis: 1

OK

Cancel

Help

Target Zone

Enable Target Zone

Target Distance Zone 50 count

Target Velocity Zone 1.0000 (rev/sec)

Target Settling Timeout Period 1000 milliseconds

Include In Setup Program

ZETA Damping

To configure ZETA damping

1. From the Setup menu, choose ZETA Damping
2. Select the affected axis.
3. In the Damping Method area, select if Active Damping is to be Enabled or Disabled.
4. In the Damping Method area, select if Anti-Resonance is to be Enabled or Disabled.
5. In the Damping Method area, select if Electronic Viscosity is to be Enabled or Disabled.
6. In the Options area, select the Waveform with the drop-down box.
7. In the Options area, select if Auto Current Standby is to be Enabled or Disabled.
8. In the Active Damping area, select the type of units with the drop-down box.
9. In the Active Damping area, select the type of motor to be used
10. In the Active Damping area, select the Motor Inductance with the drop-down box.
11. In the Active Damping area, select the Motor Static Torque with the drop-down box.
12. In the Active Damping area, select the Total Inertia with the drop-down box.
13. In the Active Damping area, select the Active Damping level with the drop-down box.
14. In the Electronic Viscosity area, select the Viscosity Level with the drop-down box.
15. Repeat Steps 2-14 for other axes. (ZETA6104 has only one axis.)
16. Select if the Setup for ZETA Damping is to be included in the Setup Program.

Setup Zeta Damping

Axis #

CAUTION: Follow the procedures in the ZETA6104 Installation Guide before configuring Active Damping and Electronic Viscosity.

Damping Method

Enable Active Damping

Enable Anti-Resonance

Enable Electronic Viscosity

Options

Waveform (3rd Harmonic)

Enable Auto Current Standby

WARNING: Do not enable Auto Current Standby for vertical loads.

Include In Setup Program

Active Damping

Units

Motor Selection

Motor Inductance (mH - Large Signal)

Motor Static Torque (oz-in)

Total Inertia (oz-in²)

Active Damping Level

Electronic Viscosity

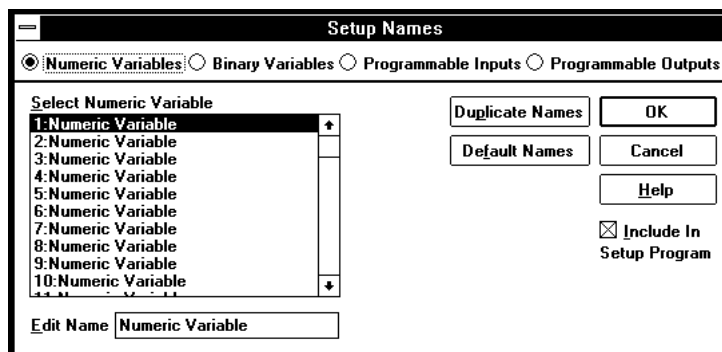
Viscosity Level

Variable & I/O Names

Use to name numeric variables, binary variables, programmable inputs, and programmable outputs.

To configure variable & I/O names

1. From the Setup Menu, choose Variable & I/O names.
2. Select Numeric Variables, Binary Variables, Programmable Inputs, or Programmable Outputs.
3. Select the desired variable, input or output to be named.
4. Type in the desired name in the Edit Name field.
5. Repeat steps 2-5, as desired.



Motion Builder™

ICONS

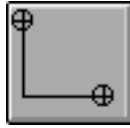




Pointer Icon

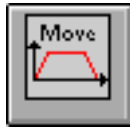
Use to un-select a previously selected Icon, thus aborting placement of that icon onto the program sheet. An arrow cursor indicates that Motion Builder is in Pointer Icon mode.

Motion Builder must be in Pointer Icon mode to delete a link.



Link Icon

The Link Icon is used to engage the Linking function of Motion Builder. When the Linking function is engaged, a cross-hatch cursor is displayed. Once selected, the Link function stays selected until you select another icon, the Pointer, or by double-clicking your left mouse button.



Move Profile Icon

Use to create a complete profile of a move segment with a single icon.

To create a move profile

1. Open the Move Profile Icon dialog box.
2. Select a move type of point-to-point or linear interpolation.
3. Select the affected axis.
4. Fill in the acceleration value for the axis or for path acceleration.
5. Fill in the velocity value for the axis or for path velocity.
6. Fill in the distance value.
7. Fill in the deceleration value for each axis or for path deceleration.
8. For a point-to-point move, repeat steps 3-7 until all affected axes of the move profile have been addressed. For a linear interpolated move, repeat steps 3 and 6 until all affected axes of the move profile have been addressed
9. (Optional) If desired, select S-Curve Profile.
10. (Optional) If desired, select Wait for move complete.
11. (Optional) Use View Motion Profile to preview the profile being created.
12. Select the axes on which to initiate motion.



Group Icon

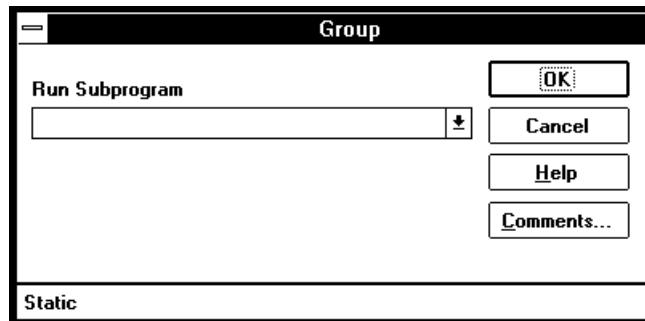
Use to branch to a subprogram. Select an existing program as the designated subprogram in the drop-down box of the Group Dialog Box. The subprogram that the Group Icon initiates will return control to the icon after the Group Icon when the subprogram completes operation.

Up to 16 levels of subprogram calls can be made without receiving an error.

To branch to a subprogram

1. Open the Group Icon dialog box.
2. Select the desired program from the drop-down box.

Note: The Group Icon is equivalent to the GOSUB command in the 6000 Series programming language.



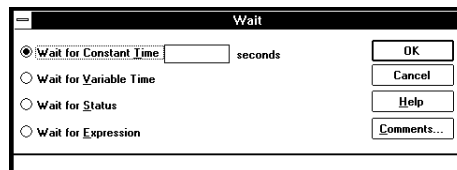


Wait Icon

Use to interrupt program flow; the program will wait for a specified time interval to elapse or a condition to become true before program flow continues. Once the specified time has elapsed or the indicated condition becomes true, program flow will continue to the Icon following the Wait Icon, and the associated commands will be executed.

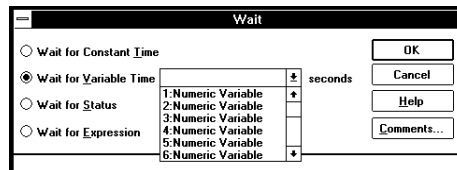
To wait for a constant time

1. Open the Wait Icon dialog box.
2. Select Wait for Constant Time.
3. Enter the desired time delay value. Make sure the delay is within the time delay range.



To wait for a variable time

1. Open the Wait Icon dialog box.
2. Select Wait for Variable Time.
3. Select the desired variable for the delay value from the drop down box. Make sure the variable value will not exceed the time delay range.

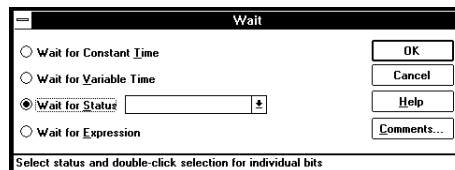




Wait Icon (cont'd)

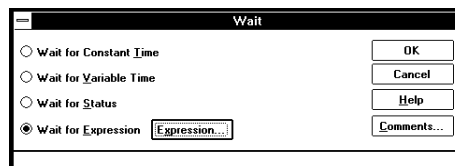
To wait for a status condition

1. Open the Wait Icon dialog box.
2. Select Wait for Status.
3. Select the desired status type from the drop down box.
4. Place the cursor over the selected status type in the drop-down box and double-click the left mouse button to display the status dialog box.
5. To set the status condition, place the cursor over the desired status bit(s) button. Click the left mouse button to toggle between the Yes, No, and Ignore states. Select Yes to wait for that bit to be active. Select No to wait for that bit to be inactive. The default state is Ignore.



To wait for a conditional expression

1. Open the Wait Icon dialog box.
2. Select Wait for Expression.
3. Place the cursor over the Expression button and click the left mouse button to display the Relational Expression dialog box.
4. Define the conditional expression to wait for using the Relational Expression dialog box.



See the Conditional IF Icon for example of Relational Expression and Status dialog box.



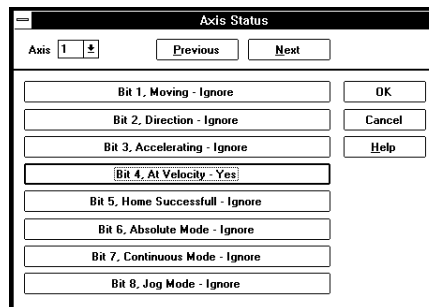
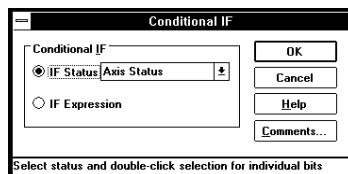
Conditional IF Icon

Use to create conditional branching within programs. If the defined expression evaluates true, then command processing continues with the first Icon command linked to the True branch. If the defined expression evaluates false, then command processing continues with the first Icon command linked to the False branch.

Up to 16 levels of Conditional IF statements can be nested without receiving an error. Use caution when nesting Conditional IF statements.

To create branching based on status condition

1. Open the Conditional IF Icon dialog box.
2. Select IF Status.
3. Select the desired status type
4. Place the cursor over the selected status type in the drop-down box and double-click the left mouse button to display the status dialog box.
5. To set the status condition, place the cursor over the desired status bit button. Click the left mouse button to toggle between the Yes, No, and Ignore states. Select Yes to wait for that bit to be active. Select No to wait for that bit to be inactive. The default state is Ignore.
6. Repeat step 5, if desired. To display the next group of eight status bits, place the cursor over the Next button and click the left mouse button. To display the a previous group of eight status bits, place the cursor over the Previous button and click the left mouse button.

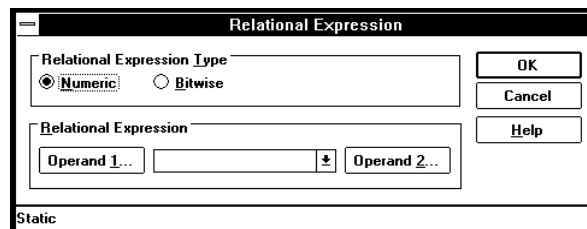
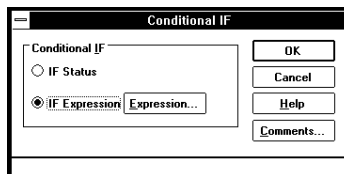




Conditional IF Icon (cont'd)

To create branching based on relational expression

1. Open the Conditional IF Icon dialog box.
2. Select IF Expression.
3. Place the cursor over the Expression Button and click the left mouse button to display the Relational Expression dialog box.
4. Define the conditional expression to branch with using the Relational Expression.



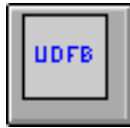


Set Breakpoint Icon

Use to set a place in the program where command processing will halt. This is primarily useful for stopping a program at specific locations in order to test status for debugging purposes.

To use the Breakpoint Icon

1. Place the Icon in the position in the program at which you wish to stop program flow.
2. Perform any debugging or other operations.
3. Resume command processing with the Continue to Next Breakpoint command or Single Step command from the Run Menu.



User Defined Function Block Icon

Use to create a user defined function block with 6000 series programming commands to handle motion programming tasks not addressed directly in Motion Builder.

To create a user defined function block

1. Open the User Defined Function Block Icon dialog box.
2. Enter in the desired 6000 series programming commands and parameters

NOTE: Refer to the 6000 Series Software Reference Guide for command, protocol, and syntax information.

A dialog box titled "User Defined Function Block". It features a text input field labeled "Enter 6000 Commands:" with a vertical cursor. To the right of the input field are four buttons: "OK", "Cancel", "Help", and "Comments...". At the bottom left of the dialog box, the word "Static" is displayed.

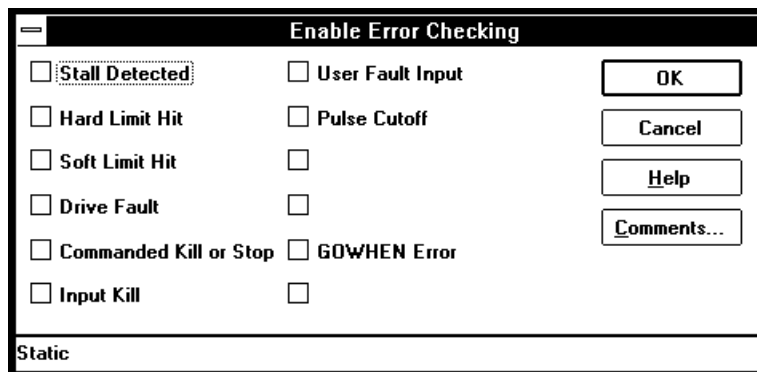


Error Checking Icon

Use to enable error checking capabilities for a variety of listed error conditions. To make use of this Icon, write an error program that responds to these error conditions, and designate it as the error program for the project. These error conditions may be used as parts of conditional expressions with the Conditional IF Icon, Wait Icon, and Assignment Icon.

To enable error checking

1. Open the Error Checking Icon dialog box.
2. Select the error conditions to be enabled from those listed by positioning the cursor in the associated box and clicking once with the left mouse button . A check mark indicates that a condition has been selected.
3. To disable error checking for an error condition, position the cursor in the associated box and click once with the left mouse button . A blank box indicates that a condition has been disabled.





Set Acceleration Icon

Use to set the rates at which the motors for the desired axes will accelerate when the next GO Iconcommand for that axis is received. The acceleration remains the same until you change it with a subsequent Set Acceleration Icon command.

To set acceleration

1. Open the Set Acceleration Icon dialog box.
2. Select a move type of point-to-point or linear interpolation.
3. Fill in the acceleration value for each axis or for path acceleration*.
Make sure that the value is within the allowed acceleration range.

***NOTE:** If the motion parameter is to be assigned to a variable, place the cursor over the data field and double-click the left mouse button. Use the resultant drop-down box to select the variable for assignment.

A screenshot of the "Set Acceleration" dialog box. The title bar says "Set Acceleration". Inside, there are two sections: "Move Type" and "Acceleration". Under "Move Type", there are two radio buttons: "Point-to-Point" (which is selected) and "Linear Interpolation". Under "Acceleration", there are four input fields. The first two are labeled "Axis 1" and "Axis 2", both with "rev/sec/sec" to their right. The last two are unlabeled. To the right of the dialog box are four buttons: "OK", "Cancel", "Help", and "Comments...". At the bottom of the dialog box, there is a note: "Double-click on edit controls for variable substitution".



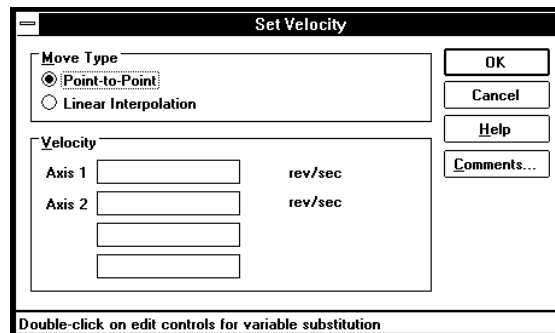
Set Velocity Icon

Use to define the speed at which the motor will run for a given axis when the next GO Icon command for that axis is received. The motor will accelerate at a pre-defined acceleration rate before reaching the velocity specified. The velocity remains the same until you change it with a subsequent Set Velocity Icon command.

To set velocity

1. Open the Set Velocity Icon dialog box.
2. Select a move type of point-to-point or linear interpolation.
3. Fill in the velocity value for each axis or for path velocity*. Make sure that the value is within the allowed velocity range.

***NOTE:** If the motion parameter is to be assigned to a variable, place the cursor over the data field and double-click the left mouse button. Use the resultant drop-down box to select the variable for assignment.





Set Distance Icon

Use to define either the number of units the motor will move or the absolute position it will seek after a GO Icon command. In the incremental mode, the distance value represents the total number of units you wish the motor to move. In the absolute mode, the distance value represents the absolute position the motor will end up at; the actual distance traveled will vary depending on the absolute position of the motor before the move is initiated. The distance remains the same until you change it with a subsequent Set Distance Icon command.

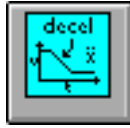
To set distance

1. Open the Set Distance Icon dialog box.
2. Fill in the distance value for each axis*. Make sure that the value is within the allowed distance range. Directionality for the move may be assigned by filling in a positive value for a move in the positive direction distance or a negative value for a move in the negative direction.

***NOTE:** If the motion parameter is to be assigned to a variable, place the cursor over the data field and double-click the left mouse button. Use the resultant drop-down box to select the variable for assignment.

Set Distance			
Axis 1	<input type="text"/>	step	<input type="button" value="OK"/>
Axis 2	<input type="text"/>	step	<input type="button" value="Cancel"/>
	<input type="text"/>		<input type="button" value="Help"/>
	<input type="text"/>		<input type="button" value="Comments..."/>

Double-click on edit controls for variable substitution



Set Deceleration Icon

Use to set the deceleration rates for the desired axes for the next GO Icon. The acceleration remains the same until you change it with a subsequent Set Deceleration Icon command.

To set acceleration

1. Open the Set Deceleration Icon dialog box.
2. Select a move type of point-to-point or linear interpolation.
3. Fill in the deceleration value for each axis or for path deceleration*.
Make sure that the value is within the allowed deceleration range.

***NOTE:** If the motion parameter is to be assigned to a variable, place the cursor over the data field and double-click the left mouse button. Use the resultant drop-down box to select the variable for assignment.

A screenshot of the "Set Deceleration" dialog box. The title bar says "Set Deceleration". Inside, there are two sections: "Move Type" and "Deceleration". Under "Move Type", there are two radio buttons: "Point-to-Point" (which is selected) and "Linear Interpolation". Under "Deceleration", there are four input fields. The first two are labeled "Axis 1" and "Axis 2", each followed by the unit "rev/sec/sec". The last two fields are empty. On the right side of the dialog, there are four buttons: "OK", "Cancel", "Help", and "Comments...". At the bottom of the dialog, there is a small text box that says "Double-click on edit controls for variable substitution".



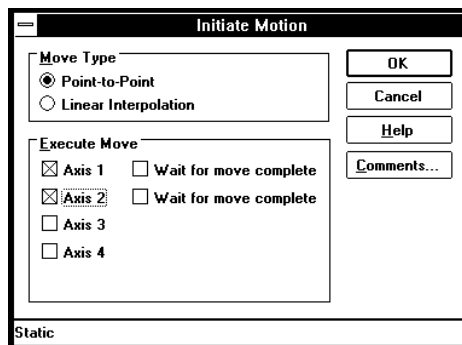
GO (Initiate Motion) Icon

Use to start motion for the indicated axes using the motion parameters that have been previously entered.

The motion parameters, such as acceleration, velocity, and distance, remain set until you specifically change them. If a motion parameter has not been changed since the previous Go (Initiate Motion) Icon command (or Move Icon command), the latest entries for the pertinent parameters will be used, even if they are from a previous program.

To initiate motion within a program

1. Open the GO (Initiate Motion) Icon dialog box.
2. Select a move type of point-to-point or linear interpolation.
3. Select the axes on which to initiate motion.
4. (Optional) If desired, select "Wait for move complete" for the selected axes.



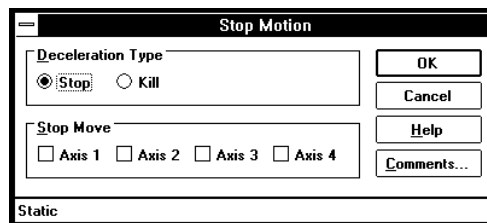


Stop Motion Icon

Use to stop motion on the specified axes. The Stop Icon command will bring the specified axes to rest using the last deceleration values entered.

To stop motion within a program

1. Open the Stop Motion Icon dialog box.
2. Select a Stop or Kill-type deceleration.
3. Select the axes on which to stop motion.





Go Home Icon

Use to instruct the controller to search for the home position in the either the positive or negative direction for the specified axes. If an end-of-travel limit is activated while searching for the home limit, the controller will reverse direction and search for home in the opposite direction. However, if a second end-of-travel limit is encountered after the change of direction, the homing operation will be aborted.

To initiate a homing move

1. Open the Go Home dialog box.
2. For each axis, select a homing direction of either Positive (CW) or Negative (CCW). If no homing is desired for a given axis, select Do Not Go Home.

A dialog box titled "Go Home" with a standard Windows-style title bar. It contains four sections for "Axis 1", "Axis 2", "Axis 3", and "Axis 4". Each section has three radio button options: "Positive (CW)", "Negative (CCW)", and "Do not home". In all four sections, the "Do not home" option is selected. To the right of the axis sections are four buttons: "OK", "Cancel", "Help", and "Comments...". At the bottom left of the dialog box, the word "Static" is displayed.

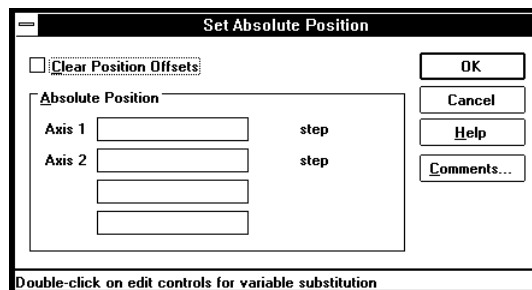


Set Absolute Position Icon

Use to offset the current absolute position to establish an absolute position reference. Also use to clear the offset. The Set Absolute Position Icon offset value (per axis) is specific only to the feedback source (per axis) selected with the last Select Feedback Icon command. If your application requires switching between feedback sources for the same axis, then you must select the feedback source with the Select Feedback Icon command and issue an absolute position value specific to that feedback source. (Each feedback source can have a separate offset.)

To establish an absolute position

1. Open the Set Absolute Position Icon dialog box.
2. Enter the absolute position values for the affected axes. Use the same range as for distance.
3. (Optional) Select Clear Position Offset.





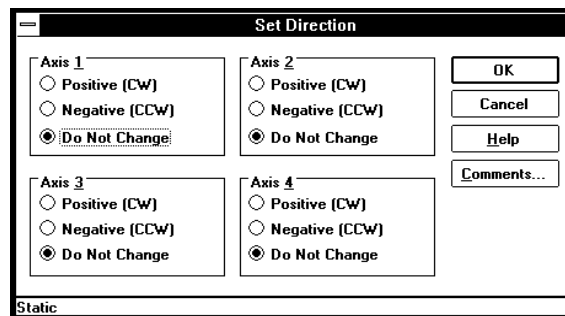
Set Direction Icon

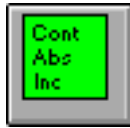
Use to set or change the direction of a move. This Icon command is useful for repeating a move in the opposite direction.

To establish an absolute position

1. Open the Set Direction Icon dialog box.
2. Select Positive (CW), Negative (CCW), Opposite Direction, or Do Not Change for each affected axis.

Direction may also be specified with the Set Distance Icon by entering a positive or negative distance value. The final directional command issued before a Go (Initiate Motion) Icon dictates the actual direction of motion. When using the Set Direction Icon, place it after the Set Direction Icon in the program flow to ensure that actual direction of motion is as desired.



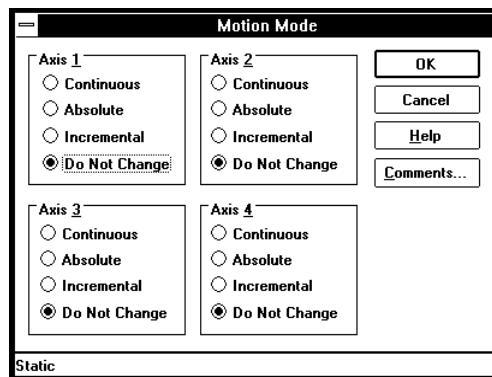


Motion Mode Icon

Use to specify whether the moves to follow are made with respect to current position (incremental), with respect to an absolute distance, or with respect to a specified velocity and direction (continuous).

To set the motion mode

1. Open the Motion Mode Icon dialog box.
2. Select the desired motion mode for each of the affected axes.



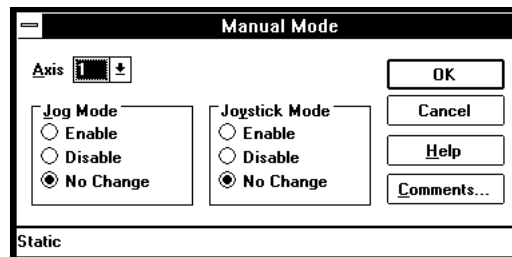


Manual Mode Icon

Use to enable or disable joystick or jogging control of motion. Jogging and joystick parameters for a project are set using the Jog Setup command (accessible from the Programmable Inputs command dialog box from the Setup Menu) and the Joystick command from the Setup Menu..

To enable or disable manual control mode

1. Open the Manual Mode Icon dialog box.
2. Select the affected axis.
3. Select either Enable, Disable, or No Change for Jog Mode.
4. Select either Enable, Disable, or No Change for Joystick Mode.
5. Repeat Steps 2-4 for all affected axes.



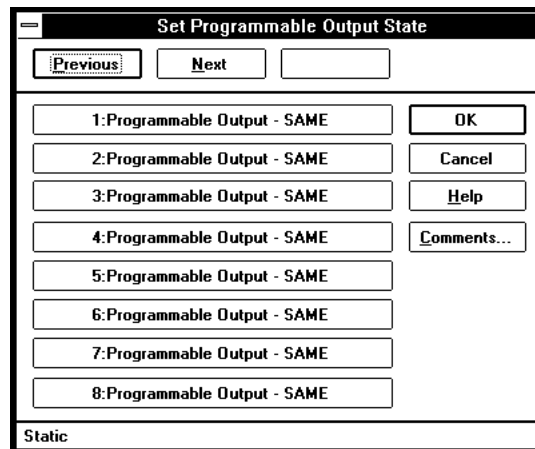


Set Programmable Output State Icon

Use to set or change the state of the programmable output bits.

To set the programmable output states

1. Open the Set Programmable Output State Icon dialog box.
2. To set the status condition, place the cursor over the desired status bit button. Click the left mouse button to toggle between the On, Off, and Same states.
3. Repeat Step 2, if desired. To display the next group of eight output bits, place the cursor over the Next button and click the left mouse button. To display the a previous group of eight output bits, place the cursor over the Previous button and click the left mouse button.





Assignment Icon

Use to assign variable or constant values to user-defined variables. Variable assignments can use constants, other variables, or conditional expressions.

To assign and compare variables

1. Open the Assignment Icon dialog box.
2. Select Numeric or Bitwise as the assignment type.
3. Select the Assignment Format.
4. Use the drop-down box on the left side of the assignment expression to select the user-defined variable to be assigned.
5. Place the cursor over the Operand 1 button and click the left mouse button to display the Operand dialog box.
6. Define the operand with the Operand dialog box. If Numeric was selected in Step 2, the Numeric Operand dialog box will be displayed. If Bitwise was selected in Step 2, the Bitwise Operand dialog box will be displayed.
7. If one of the two “assign expression” format types was chosen, place the cursor over the Operand 2 button and click the left mouse button to display the Operand dialog box. If the “assign operand” format type was chosen, proceed to Step 9.
8. Repeat Step 6.
9. Select the type of relation between Operand 1 and Operand 2 using the drop-down menu between them.
9. Repeat Steps 4-9 for all affected user-defined variables.

Assignment

Assignment Type

Numeric

Bitwise

Assignment Format

Assign operand to a variable (a=b)

Assign expression to a variable (a=b+c)

Assign expression to a variable (a=sin(b))

OK

Cancel

Help

Comments...

Assignment

Operand1...

Operand2...

Static

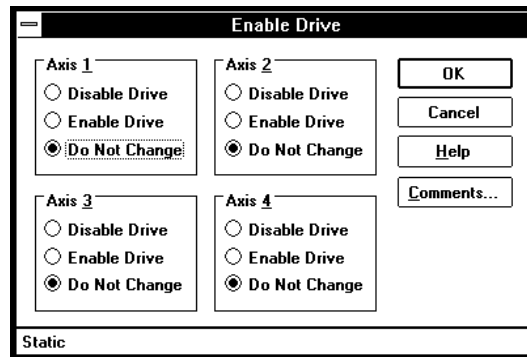


Enable Drive Icon

Use to enable or disable the drives for affected axes.

To enable or disable a drive

1. Open the Enable Drive Icon dialog box.
2. Select Enable, Disable, or Don't Change for each affected axis.



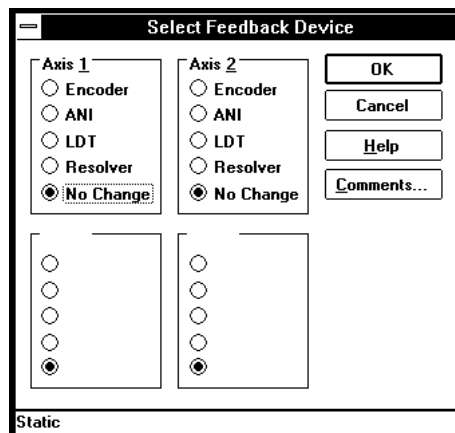


Select Feedback Device Icon

Use to select or change the designated feedback sources for servo systems. Choose from Encoder, Resolver, ANI, and LDT . Configure feedback source parameters with the Feedback command (Setup Menu).

To select a feedback device

1. Open the Select Feedback Device Icon dialog box.
2. Select the desired feedback source for each affected axis.



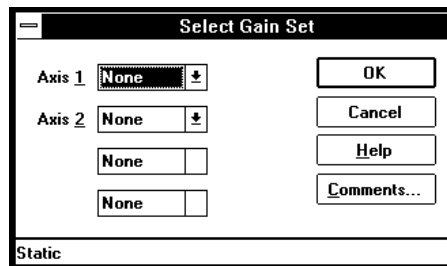


Select Gain Set

Use to select from pre-defined gain sets for servo systems. Gain sets are defined for Motion Builder with the Servo Tuning command (Setup Menu).

To select a gain set

1. Open the Select Gain Set Icon dialog box.
2. Select the desired gain set using the drop-down boxes for each affected axis.





RP240 Icon

Use to display a message or numeric variable on the RP240's LCD. Use to store numeric data entered in from the RP240's keypad or function keys into a variable. Also use to control the state of the 8 programmable LEDs on the RP240.

To display a message and/or numeric variable on an RP240

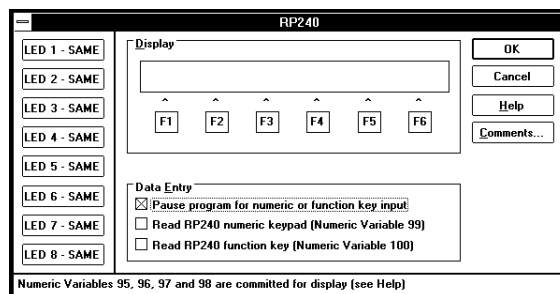
1. Open the RP240 Icon dialog box.
2. Position the cursor in the display field and click the left mouse button.
3. Type in the desired message. Be sure to follow RP240 message syntax.
4. Define the format for desired display of Variables 95-98.

To read and store numeric data entered in from RP240 keypad or function keys

1. Open the RP240 Icon dialog box.
2. Select "Read RP240 numeric keypad" if numeric data is to be entered in from the RP240 numeric keypad. See RP240 Sample Application A.
3. Select "Read RP240 function key" if data will be entered in from the RP240 function keys. The function keys store a corresponding number in Variable 100. See RP240 Sample Application B.
4. Select if program flow is to be paused to wait for input from RP240.

To control the state of LEDs on RP240

1. Open the RP240 Icon dialog box.
2. Place the cursor over the desired LED button. Click the left mouse button to toggle between the ON, OFF, and SAME states.



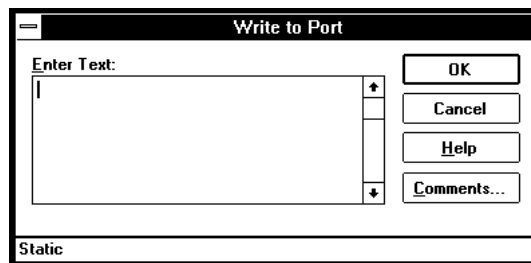


Write to Port Icon

Use to transmit message strings to the designated port (Run Menu, Communications Setup), either PC-AT bus or out the RS-232C port. These messages can then be used by the operating program.

To write a message to a port

1. Open the Write to Port Icon dialog box.
2. Enter the desired message. Make sure to follow the message syntax.



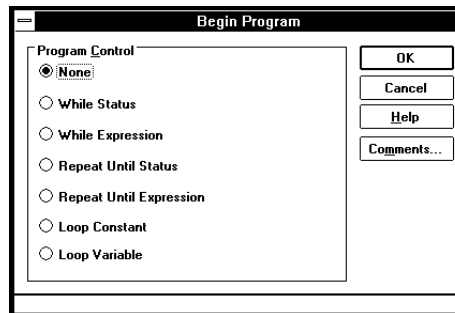


Begin Program Icon

Use to control program flow in the following ways:

- Loop: Repeat the program a specified number of times.
- Repeat: Repeat the program until a specified status or condition becomes true. Status or condition is evaluated at the end of the program.
- While: Run the program while a specified status or condition is true. Status or condition is evaluated at the beginning of the program.

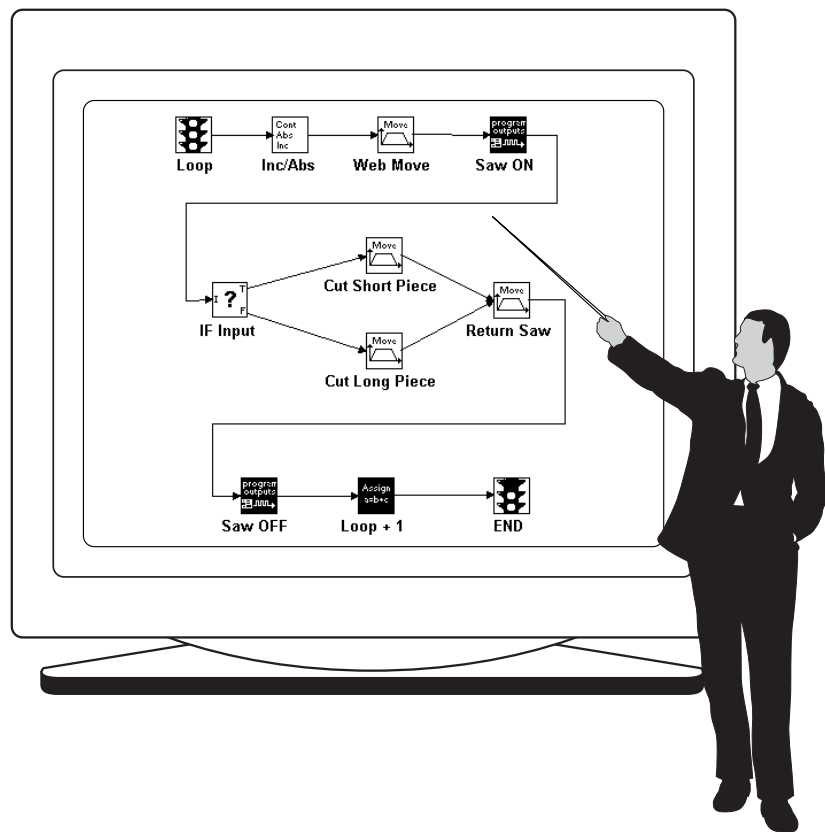
The End Program Icon defines the end of the Loop, Repeat Until, and While Statements.



End Program Icon

Use to define the end of a program. This is also used to define the end of Loop, Repeat Until, and While Statements.

Tutorial



Tutorial Introduction

Welcome to the Motion Builder Tutorial. This tutorial, based on a hypothetical application, is intended to demonstrate the basic process for developing a program using Motion Builder:

1. Create a project and open the first program file for the project.
2. Establish basic operating (“setup”) parameters for your application to
3. Develop several programs for the project. (Drop the required icons from the palette onto the worksheet, open and fill in the dialog boxes for each icon, and link the icons according to the desired program flow.)
4. Build the programs.
5. Download the programs to the 6000 controller.
6. Run the programs.

About the Application

This tutorial is based on a two-axis, cut-to-length application designed to cut two different widths of web stock. Axis 1 controls the web feed and Axis 2 controls the saw carriage to cut the stock. This application uses a 6200 controller, two OEM650 drives, and no encoder feedback (open loop is acceptable).

The application will detail programming features such as: creating programs, configuration/setup, homing, defining variables, basic motion, branching, programmable outputs, conditional statements, looping, building programs, downloading, saving and testing programs.



WARNING



The primary purpose of this tutorial is to show you the basics of programming a 6000 controller with the Motion Builder interface. Furthermore, this tutorial is based on a hypothetical application using the 6200 stepper controller. Consequently, the resulting programs may not be suitable for your machine setup.

Although the tasks of downloading and running the program files (producing actual motion) are included in this tutorial, they are not crucial to understanding the programming process.

Therefore, **If you intend to download and run the programs generated from this tutorial, use extreme caution. Make sure the motors are NOT COUPLED to the load.**

If you are using a servo system, you should do your tuning first (Servo Tuner is bundled with Motion Builder — to launch Servo Tuner, select Servo Tuning from the Setup menu and click on the “Launch Servo Tuner” button).

Objectives of the Cut-to-Length Application

This cut-to-length application will consist of two programs (called “FIRST” and “SECOND”) which will accomplish the objectives listed below.

Objectives/process of the “FIRST” program (see **NOTE** below):

1. Home both axes.
2. Initialize the batch count variable.
3. Initialize a counter variable to zero.
4. Branch to the second program.

NOTE

In this application, the FIRST program is designated as a “startup” program, which is automatically executed when the 6200 is powered up or reset (this feature is applicable only to stand-alone products). The FIRST program is also designated as the “main” program, which is the overall controlling program for the application. The first action of the main program is to execute the “setup” program. The setup program is automatically generated when you build a project; it contains the setup parameters you fill out under the **Setup** menu in Motion Builder.

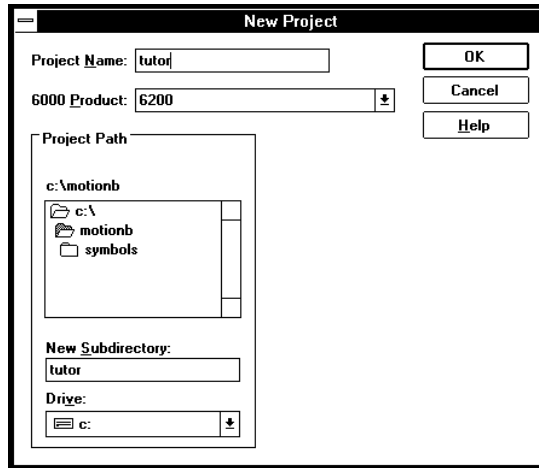
Objectives/process of the “SECOND” program:

1. Start a repeat loop (repeat this program until the counter variable equals the batch count variable).
2. Set the positioning mode of each axis.
3. Define and execute a move on axis 1 (increment the web stock).
4. Activate an output to turn on the saw blade.
5. Make axis 2 execute one of two cuts, based on the status of input #1:
 - If input #1 is on, move axis 2 to cut a small piece of stock
 - If input #1 is off, move axis 2 to cut a large piece of stock
6. Move axis 2 back to its starting position to prepare for the next cut.
7. Deactivate the saw blade output.
8. Increment the counter variable by 1.

Tutorial

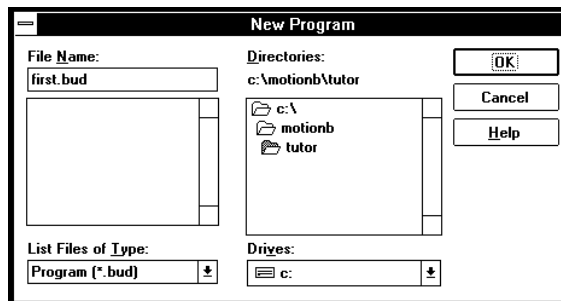
Step 1 Create a Project and Open a Program

1. To start your first programming exercise in Motion Builder, select **New** from the **Project** menu. Call the project "tutor." Select the 6200 from the 6000 Product pull-down list.

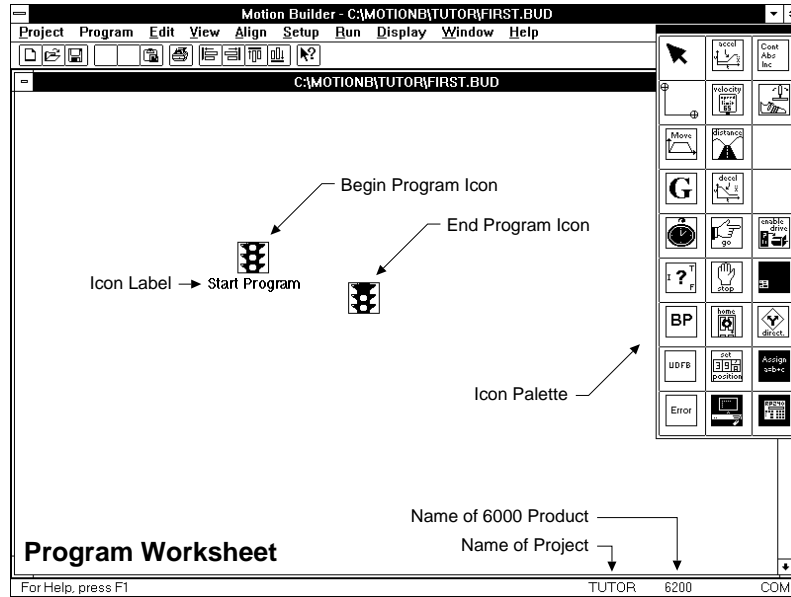


When the project name is defined, Motion Builder creates a new subdirectory under c:\mobud. For example, your project files will be stored in c:\mobud\tutor.

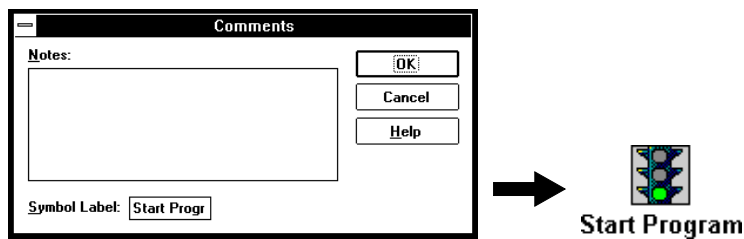
2. Click **OK**.
3. After you create a new project, a dialog box will appear asking you to declare a program name. Name the program "first.bud". Program names are limited to six characters and they are created in the specified project directory with a .bud extension. For example, the "FIRST" program is created as c:\mobud\tutor\first.bud.



- Click **OK**. Motion Builder opens a “program worksheet” for FIRST.



CUSTOMIZING THE ICON LABELS: Notice that when you place an icon onto the program worksheet it has no label under it. For example, in the diagram above, the End Program icon has no label. To add or change a label to make the icon more meaningful (e.g., we added the “Start Program” label to the Begin Program icon in the diagram above), double-click the icon, select the Comments button (**Comments...**), and type in the desired label description in the Symbol Label field (see diagram below).



The rest of this tutorial shows the icons with labels customized in this manner.

Step 2 Set Up Basic Operating Parameters

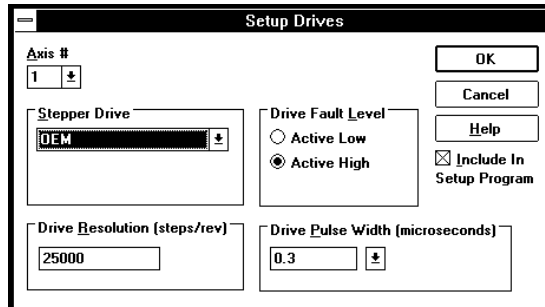
Before developing programs, you should verify that all your application's relevant “setup” categories, found under the **Setup** pull-down menu, are configured for your application. (However, for this tutorial, we will only change the **Drives**, **Axis Scaling**, and **Limit Inputs** categories—the default setup values for all other categories are acceptable.)

The parameters from all setup categories are automatically saved into a “setup” program when you build your project. A check-mark (3) appears next to the **Setup** menu item to let you know you've customized the setup parameters.

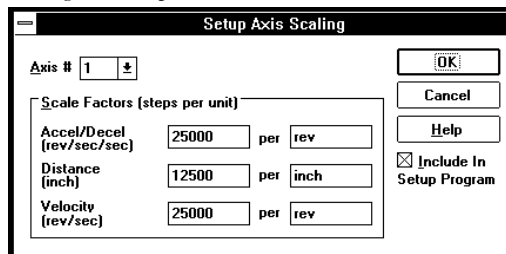


When you run your “main” motion program (later in this tutorial), the setup program will be automatically executed first, to prepare the 6000 controller for subsequent motion control functions.

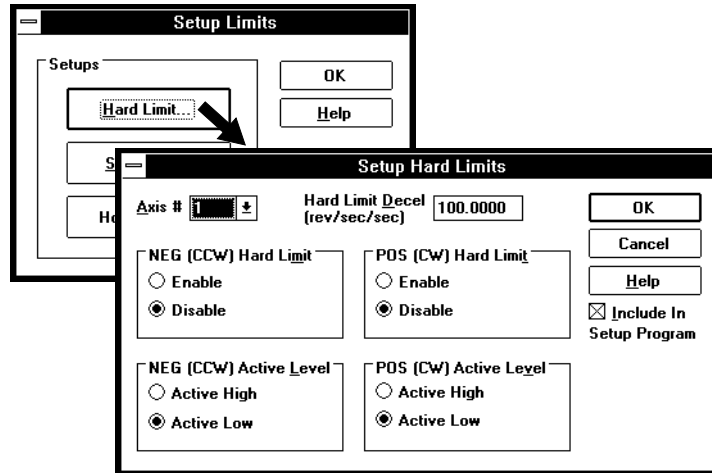
1. From the **Setup** menu, select **Drives**. From the Stepper Drive pull-down list, select OEM. Notice that the *Fault Level*, *Resolution*, and *Pulse Width* are automatically configured for the selected drive.



2. Select Axis #2 and select OEM.
3. Click **OK**.
4. From the **Setup** menu, select **Axis Scaling**. Under Scale Factors, set the Distance scaling to “12500” steps per “inch.” All subsequent dialogs will represent the distance values in inches.




5. Select Axis #2 and set the Distance scaling to “12500” steps per “inch.”
6. Click **OK**.
7. From the **Setup** menu, select **Limit Inputs**. Select the **Hard Limit** button to invoke the Hard Limits dialog box. Because this tutorial is designed for a bench-test environment (**DO NOT ATTACH THE MOTORS TO THE LOAD**), you will disable the hard limits.



8. Select **Disable** for both the NEG Hard Limit and the POS Hard Limit inputs. (see diagram above)
9. Select Axis #2 and select Disable for both limits again.
10. Click **OK** in the Setup Hard Limits dialog box, and then click **OK** in the Setup Limits dialog box.

SETUP IS COMPLETE

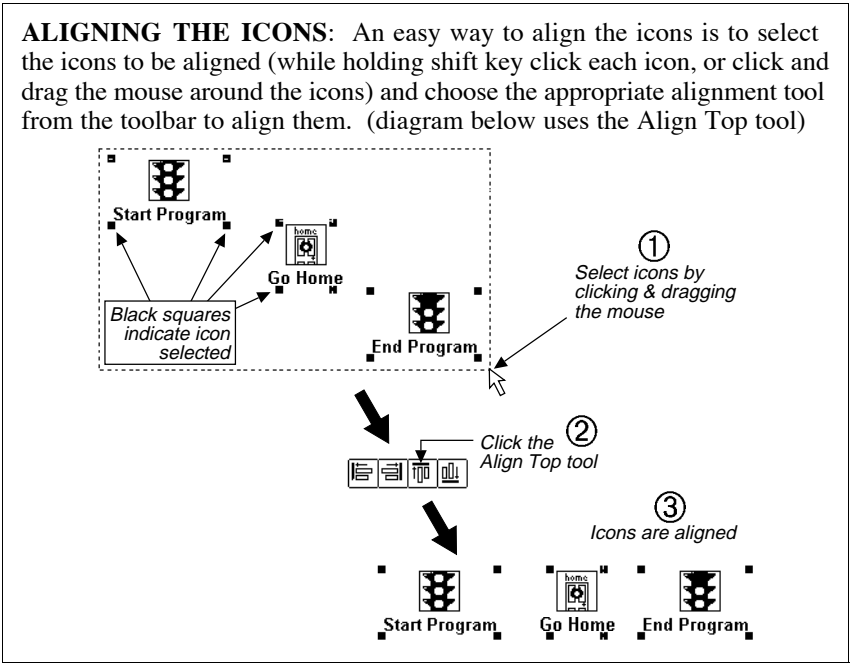
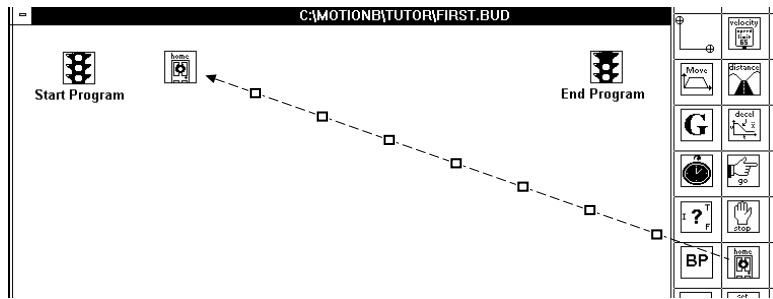
Save Your Programs Often

You should save your Motion Builder code frequently. To do this, click in the program worksheet area to make it the “active window” and choose **Save** or **Save As** under the **Program** menu (or click the Save button in the toolbar — ). Repeat this for each program you have open. (All programs in the project are saved automatically when you Build your project — see Step 16 on page 27.)

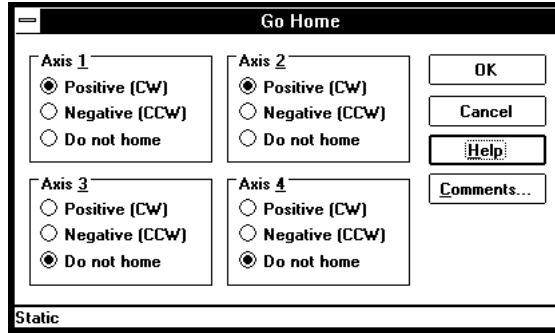
Step 3 Set Up Homing

Homing is an important functionality in many applications. It allows you to accurately position the axes of a machine for start up, and to establish zero reference positions.

1. Drag the Begin Program and End Program icons apart to create room for placing additional icons between them (see diagram below).
2. Select the Home icon from the palette (click on it). Move the mouse to the worksheet area and notice that the cursor becomes a small square. Place the Home icon (click the mouse button) on the worksheet to the right of the Begin Program icon.



- Double-click on the Home icon to open the Go Home dialog box. Set axes 1 and 2 to begin homing in the positive-count direction.



- Click **OK**.

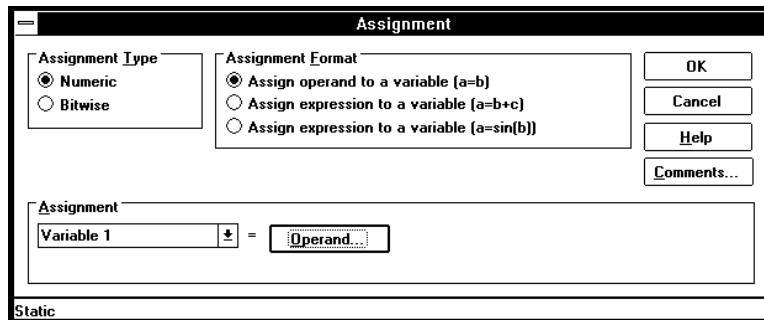
Step 4 Assign Variables


In this application, numeric variable #1 is used as a batch counter and numeric variable #2 is used as a loop counter (each cut represents one loop).

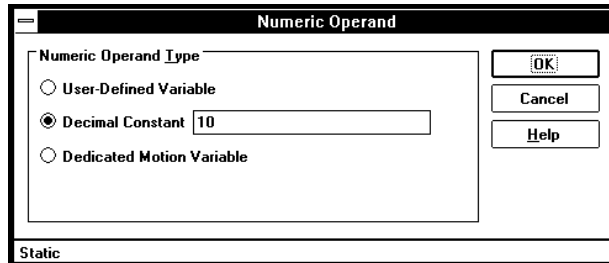
- Select the Assignment icon and place it in the workspace next to the Go Home icon.





- Double-click the Assign icon to open the Assignment dialog box. Select “Assign operand to a variable (a=b).” Select “Variable 1” from the Assignment pull-down list.



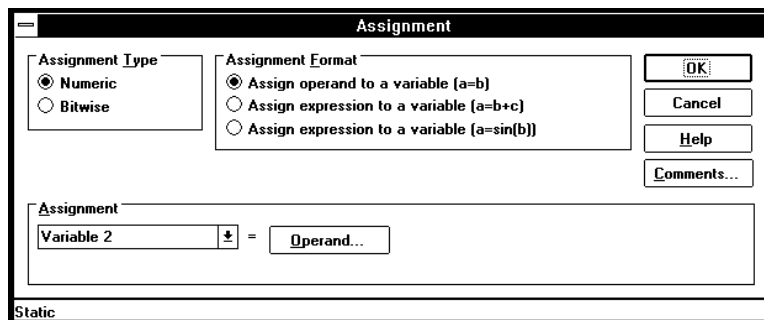
3. Click on the Operand button () to open the Numeric Operand dialog box. Select “Decimal Constant” and type in “10” in the field. This is the batch counter number.



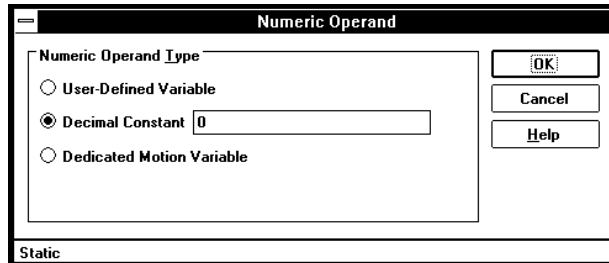
4. Click **OK** in both dialog boxes.
5. Duplicate the Batch Count icon on the worksheet. This will be used to create the Loop Count icon. To do this, follow this procedure:
 - a. Select the Batch Count icon with the mouse.
 - b. Copy the Batch Count icon to the clipboard. To do this, use the Ctrl/C keystroke or click the copy tool () on the toolbar.
 - c. Paste the icon from the clipboard to the worksheet. To do this, use the Ctrl/V keystroke or click the paste tool () on the toolbar.
6. Drag the new Assign icon over next to the Batch Count icon. (see Loop Count icon in diagram below)



7. Double-click the new Assign icon to open the Assignment dialog box. Select “Assign operand to a variable (a=b).” Select “Variable 2” from the Assignment pull-down list.



- Click on the Operand button () to open the Numeric Operand dialog box. Select “Decimal Constant” and type in “0” in the field. This initializes the loop counter to zero.

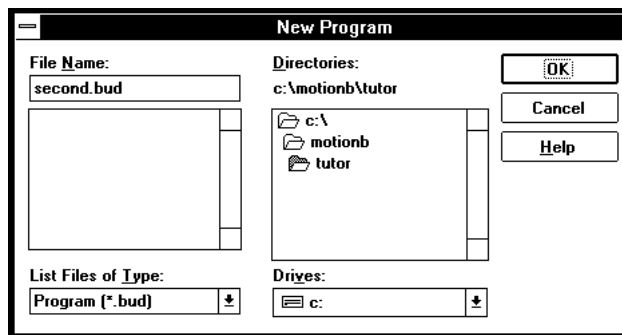


- Click **OK** in both dialog boxes.

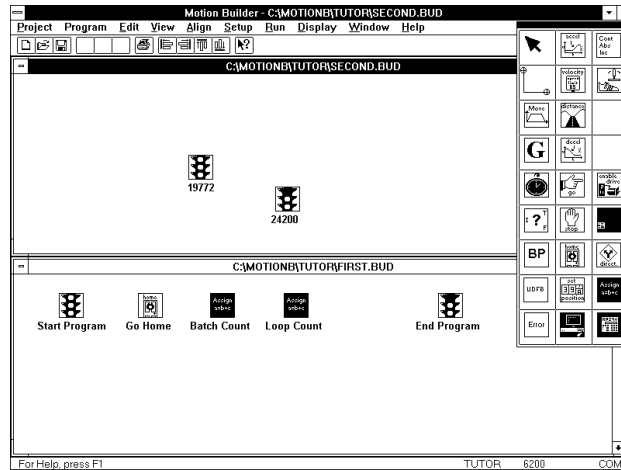
Step 5 Set Up Second Program

The motion portion of the application will be controlled by the SECOND program, functioning as a subprogram to the FIRST program.

- Select **New** from the **Program** menu to open the New Program dialog box (see diagram below). Call the new program “second.bud”. This adds the new second.bud program to the TUTOR project directory (c:\mobud\tutor\second.bud). The remainder of this tutorial refers to the second.bud program as the “SECOND” program.



- Click **OK**. Notice that the SECOND program worksheet is created in a new window and that the SECOND and FIRST worksheet windows are tile horizontally on your screen (the SECOND worksheet window is above the FIRST worksheet window).

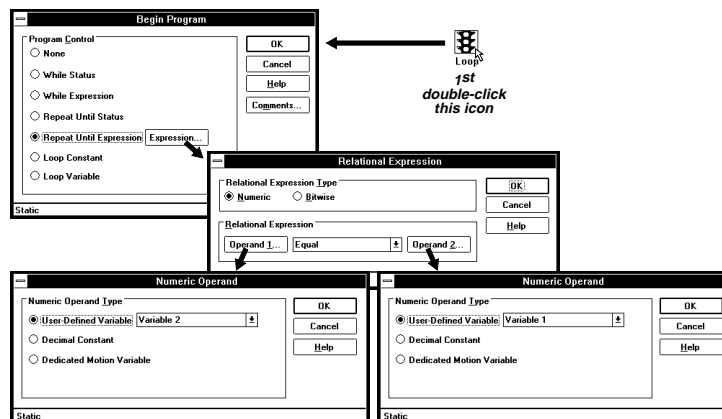


- Drag the Begin Program and End Program icons apart to make room for placing additional icons between them. (in the diagram below, the Begin Program icon is re-labeled “Loop”)



Step 6 Create a Conditional Loop — Repeat/Until

- This step is summarized in the following diagram:



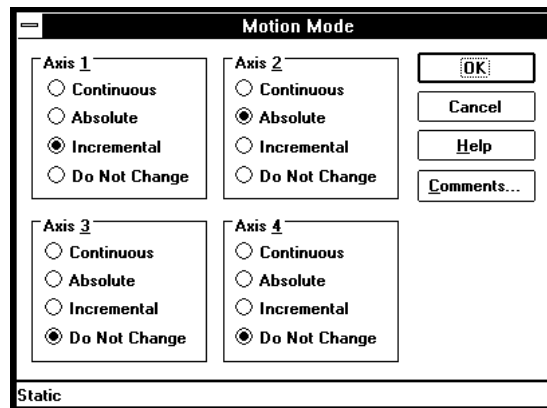
- Double-click the Begin Program icon to open the Begin Program dialog box. Select “Repeat Until Expression” and click on the Expression button to open the Relational Expression dialog box.
- Click on the Operand 1 button to open the dialog box. Select “User-Defined Variable” and select Variable 2 from the pull-down list. Variable 2 represents the loop counter. Click **OK**.
- Select “Equal” from the Relational Expression pull-down list.
- Click on the Operand 2 button to open the dialog box. Select “User-Defined Variable” and select Variable 1 from the pull-down list. Variable 1 represents the batch count. Click **OK**.
- Click **OK** in the Relational Expression and Begin Program dialogs.

Step 7 Select Positioning Modes

- Select the Cont/Abs/Inc Mode icon and place it next to the Begin Program icon (in the diagram below, the Begin Program icon is re-labeled “Loop” and the Cont/Abs/Inc Mode icon is re-labeled “Inc/Abs”).



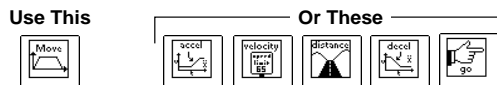
- Double-click on the Cont/Abs/Inc icon to open the dialog box. Select Incremental positioning for axis 1 and Absolute positioning for axis 2.



- Click **OK**.

Step 8 Set Up Motion – Axis 1 (Web Increment)

This step demonstrates setting up a move using the Move icon, which consolidates Accel, Velocity, Distance, Decel, and Go functions. You could achieve the same programming using the respective individual icons (see diagram below). The individual icons are usually used to conditionally change individual move elements based on other events or conditions in the application.



1. Select the Move icon and place it next to the Motion Mode icon.



2. Double-click on the Move icon to open the Move Profile dialog box. Under Move Type, select Point-to-Point. Under Execute Move, select Axis 1. Under Setup Move Profile, enter these values: Distance = 14, Accel = 50, Velocity = 4, Decel = 50. Select the “Wait for move complete” box (this ensures the move is complete before program execution continues).

The screenshot shows the 'Move Profile' dialog box. It has several sections:

- Move Type:** Radio buttons for 'Point-to-Point' (selected) and 'Linear Interpolation'.
- Execute Move:** Checkboxes for 'Axis 1' (checked), 'Axis 2', and an empty checkbox.
- Setup Move Profile:**
 - Axis: '1' with a 'Duplicate for each axis' button.
 - Distance: '14' with unit 'inch'.
 - Accel: '50' with unit 'rev/sec/sec'.
 - Velocity: '4' with unit 'rev/sec'.
 - Decel: '50' with unit 'rev/sec/sec'.
 - Checkboxes for 'Wait for move complete' (checked).
- View Motion Profile:** Radio buttons for 'Velocity' (selected), 'Position', and 'Accel'. A 'Recalculate' button is present.
- A graph showing a velocity profile for Axis 1, with velocity rising to 4, staying constant until approximately 180 units, and then decelerating to 0.
- Color selection checkboxes for 'Axis 1 (black)', 'Axis 2 (blue)', '(green)', '(cyan)', and '(red)'. 'Axis 1 (black)' is checked.

 At the bottom, it says 'Double-click on edit controls for variable substitution'.

If you wish to view the move profile, click the Recalculate button. You can view the Velocity, Position, or Accel/Decel profile.

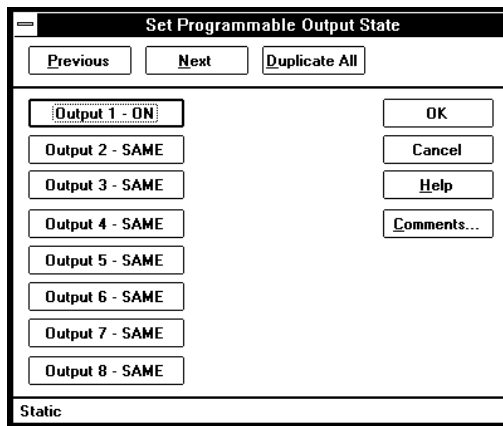
3. Click **OK**.

Step 9 Turn an Output ON

1. Select the Output icon and place it next to the Move icon (the diagram below shows that the Output icon is re-labeled as “Saw On.”)



2. Double-click the Outputs icon to open the Programmable Output dialog box. Click the button labeled “Output 1 - SAME” once to change to button label to “Output 1 - ON.”

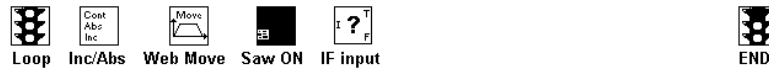


3. Click **OK**.

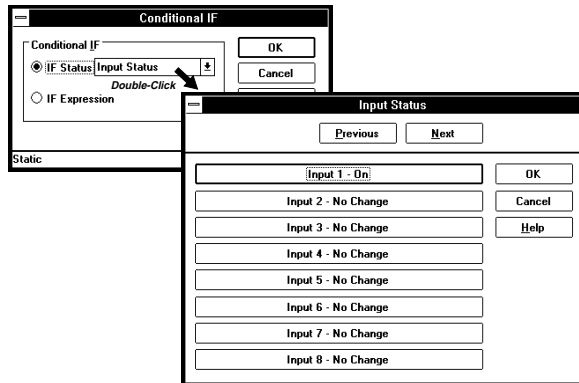
Step 10 Create a Conditional Branch – IF

Conditional branches allow the controller to make a decision based on certain conditions, such as input status, motor position, etc. In this application, the controller must make a decision based on whether or not input #1 is on. If input #1 is on, cut a short piece of stock; if input #1 is off, cut a long piece of stock.

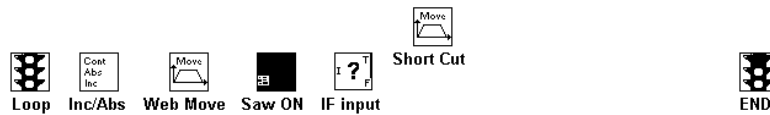
1. Select the IF Condition icon and place it next to the Output icon. (re-labeled as “IF input” in diagram below)



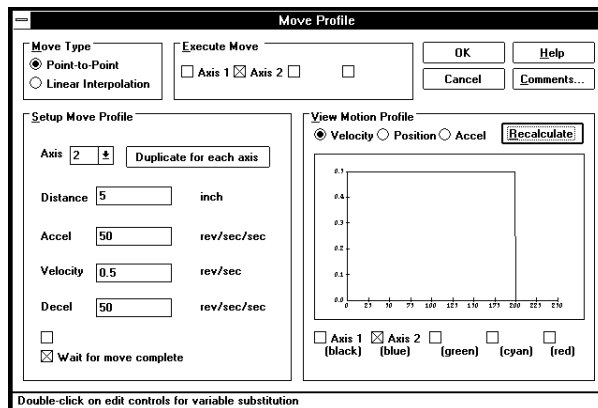
- Double-click the IF Condition icon to open the Conditional IF dialog box. From the IF Status pull-down list, select “Input Status.” Double-click the field displaying “Input Status”; this opens the Input Status dialog box. Click once on the button labeled “Input 1 - No Change” to change it to “Input 1 - On.”



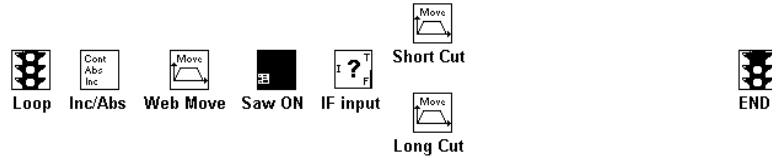
- Click **OK** in both dialog boxes.
- Select the Move icon and place it near the upper right corner of the IF Condition icon. (Move icon re-labeled as “Short Cut”)



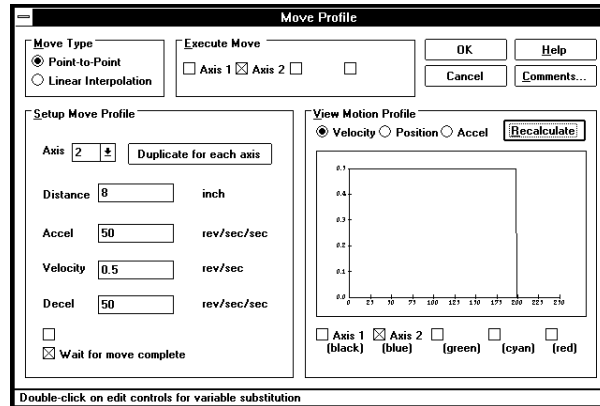
- Double-click on the Move icon to open the Move Profile dialog box. Under Move Type, select Point-to-Point. Under Execute Move, select Axis 2. Under Setup Move Profile, select axis 2 from the pull-down list and then enter these values: Distance = 5, Accel = 50, Velocity = 0.5, Decel = 50. Select “Wait for move complete” to ensure the move is complete before program execution continues.



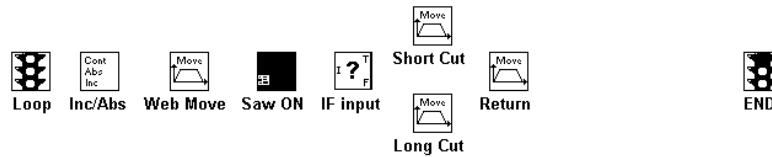
6. Click **OK**.
7. Select another Move icon and place it near the lower right corner of the IF Condition icon. (Move icon re-labeled as “Long Cut”)



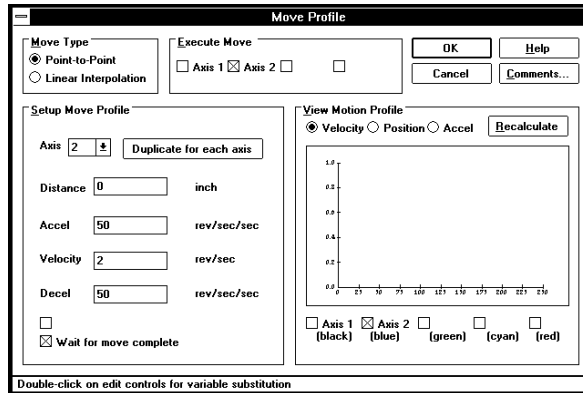
8. Double-click on the Move icon to open the Move Profile dialog box. Under Move Type, select Point-to-Point. Under Execute Move, select Axis 2. Under Setup Move Profile, select axis 2 from the pull-down list and then enter these values: Distance = 8, Accel = 50, Velocity = 0.5, Decel = 50. Select “Wait for move complete” to ensure the move is complete before program execution continues.



9. Click **OK**.
10. Select another Move icon and place it near the lower right corner of the Move icon labeled “Short Cut.” (Move icon re-labeled as “Return”)



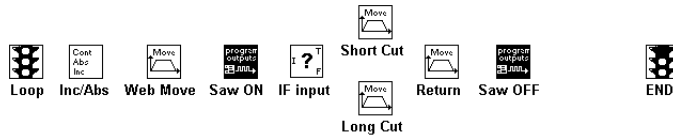
- Double-click on the Move icon to open the Move Profile dialog box. Under Move Type, select Point-to-Point. Under Execute Move, select Axis 2. Under Setup Move Profile, select axis 2 from the pull-down list and then enter these values: Distance = 0, Accel = 50, Velocity = 2, Decel = 50. Select “Wait for move complete” to ensure the move is complete before program execution continues.



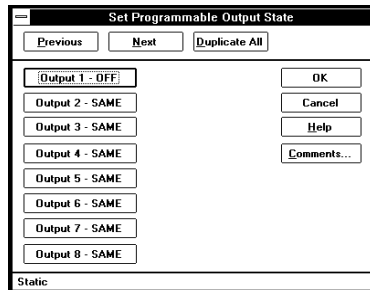
- Click **OK**.

Step 11 Turn an Output OFF

- Select the Output icon and place it next to the Move icon labeled “Return.” (Output icon is re-labeled as “Saw OFF.”)



- Double-click the Outputs icon to open the Programmable Output dialog box. Click the button labeled “Output 1 - SAME” twice to change to button label to “Output 1 - OFF.”

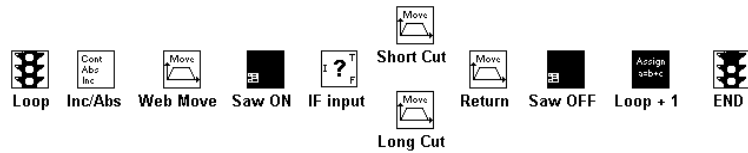


- Click **OK**.

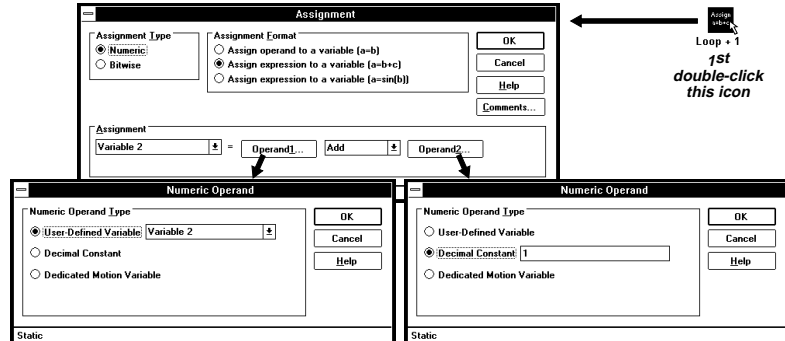
Step 12 Increment the Counter (Numeric Variable)

In this application, the SECOND program is repeated until the loop counter (variable #2) value equals 10 (the value of variable 1). The loop counter, for this application, will be incremented after the stock is cut.

1. Select the Assignment icon and place it next to the Output icon labeled “Saw OFF.” (Assignment icon is labeled as “Loop + 1”)




2. This step is summarized in the following diagram:



- a. Double-click the Assignment icon to open the Assignment dialog box. Select “Numeric” as the Assignment Type. Select “Assign expression to a variable (a=b+c).” Select “Variable 2” from the Assignment pull-down list.
- b. Click on the Operand 1 button to open the dialog box. Select “User-Defined Variable” and select Variable 2 from the pull-down list. Variable 2 represents the loop counter. Click **OK**.
- c. Select “Add” from the pull-down list between the Operand 1 button and the Operand 2 button.
- d. Click on the Operand 2 button to open the dialog box. Select “Decimal Constant” and type the number 1 in the field. Click **OK**.
- e. Click **OK** in the Assignment dialog.

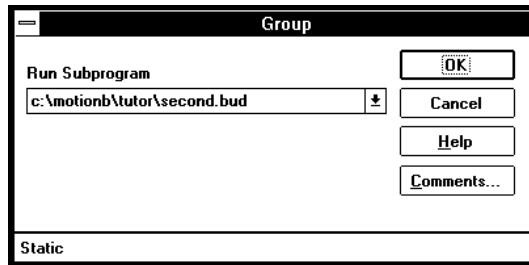
Step 13 Create a Branch to a Subprogram

The Group icon allows you to branch to other programs (subprograms) in the project. This is an important programming tool because it allows you to create modular code.

1. In the FIRST program worksheet, select the Group icon () and place it between the “Loop Count” and the “End Program” icons. (the Group icon in the diagram below is re-labeled as “Branch”)



2. Double-click the Group icon to open the Group dialog box. From the Run Subprogram pull-down list, choose c:\motionb\tutor\second.bud.

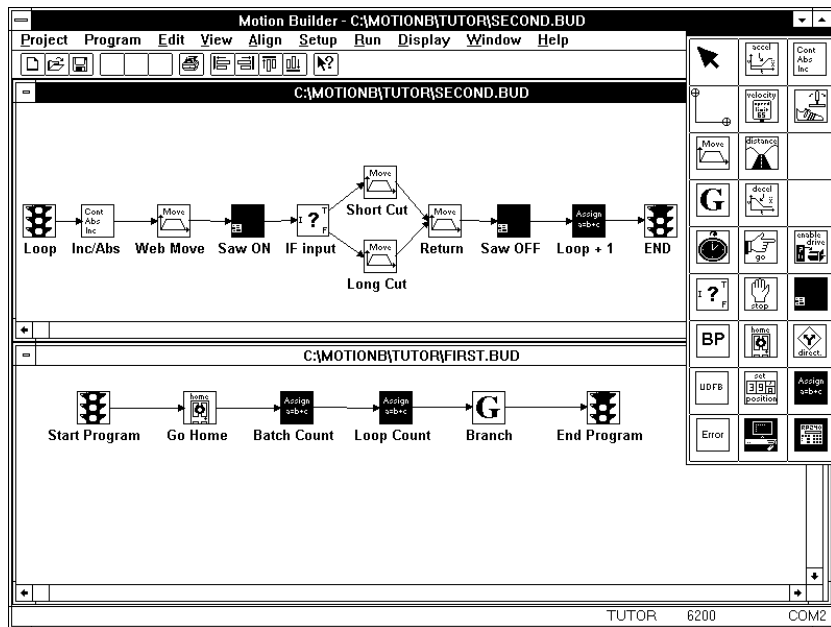



3. Click **OK**.

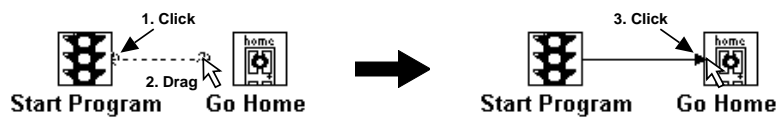
Step 14 Link the Program Icons

Before a Motion Builder program can be built into 6000 code, the icons to be included in the program must be linked together. (It is possible to leave some icons on the worksheet not connected so that you can test different portions of code in separate builds.)

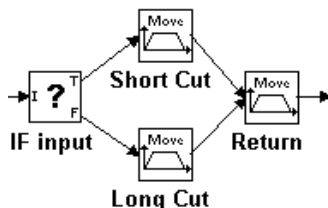
Use the following procedure as a guide to linking the icons. After all the icons are linked, the programs should look like the ones in the diagram below.



1. Select the Link tool () from the icon palette. After selecting the Link tool, when you pass the cursor over the program worksheet area, the cursor becomes a cross-hair (+).
2. Click the mouse on the right side (the output side) of the icon and then click the mouse again on the left side (the input side) of the icon you want to link. After you click on an icon's output, when you move the cursor, a dashed line trails behind. When you link successfully to the targeted icon, the line becomes solid with an arrowhead indicating the direction of program flow. The diagram below illustrates the input/output connections.

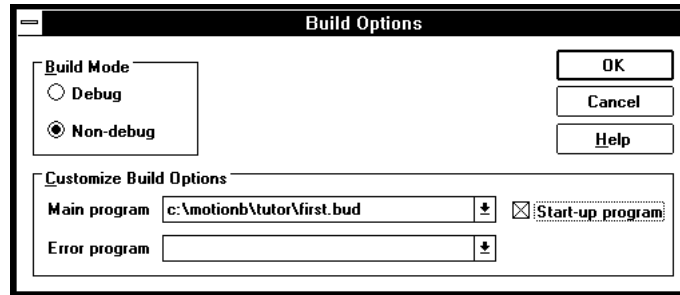


NOTE—The If Condition icon has one output for True and one for False:



Step 15 Set Build Options

1. From the **Project** menu, select **Build Options** (dialog box appears).



2. For the purposes of this tutorial, select Non-Debug as the Build Mode.
3. Under Customize Build Options, select “c:\motionb\tutor\first.bud” as the Main Program. The purpose of the Main Program as to function is the main controlling program for the application. Other programs in the project (in this case, the second.bud program) are subprograms to the Main program.

The first action that the Main program performs is to execute an embedded “setup program.” The setup program is automatically generated when you build a project (setup.prg file appears in the tutor directory); it contains the code for the setup categories found under the **Setup** menu.

4. With “c:\motionb\tutor\first.bud” showing in the Main Program field, click the Start-up Program box to assign the main program as the “start-up program.” The Start-up program, available only to stand-alone controllers, is automatically executed every time the 6000 controller is powered up or reset.

NOTE: In this tutorial, an error program is not defined; therefore, you should leave the Error program field blank.

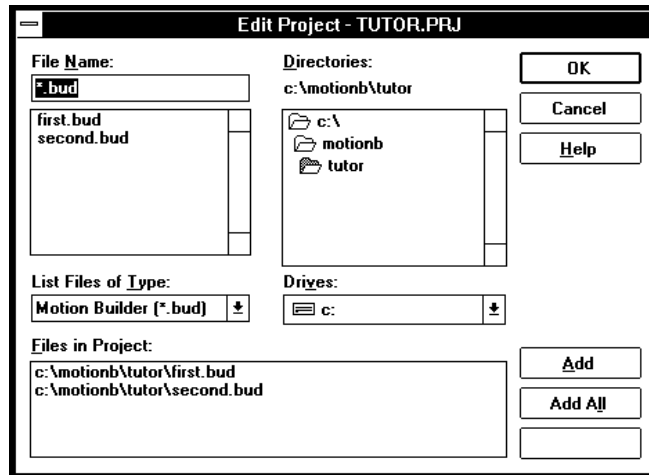
5. Click **OK**.

Step 16 Build Your Programs

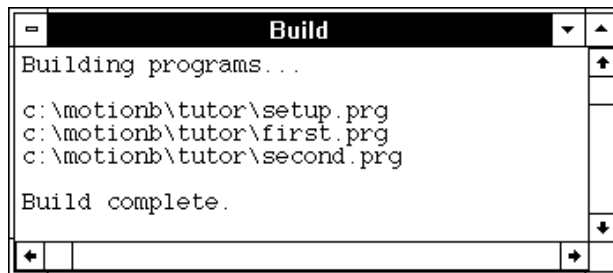
CAUTION

Before building, select **Edit** from the **Project** menu and check that there are no unwanted programs assigned to your project (see "Files in Project" list). For this tutorial, the only files listed should be "c:\motionb\tutor\first.bud" and "c:\motionb\tutor\second.bud" (see diagram below)

The reason for this check is this: If, while working in project A, you open a program file from project B, project A automatically adds the program file from project B to the "Files in Project" list for project A.



1. Under the **Project** menu choose **Rebuild All** to build all programs in the TUTOR project at one time. The following Build window will appear on your screen to show the progress of the build, and the files resulting from the build.

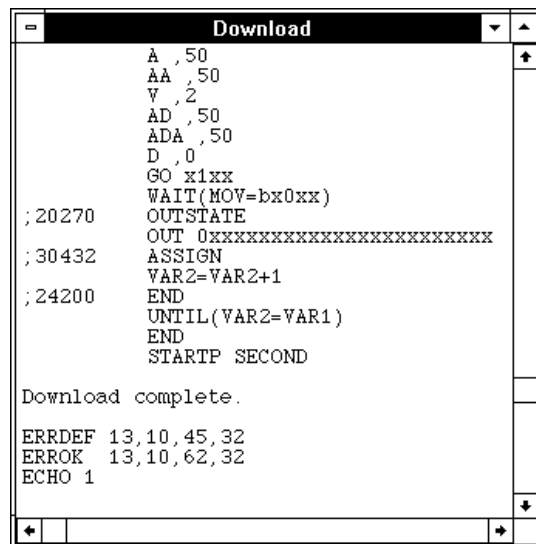


Step 17 Download Your Programs to the Controller

BEFORE YOU PROCEED

The purpose of this tutorial is to show you the basics of programming a 6000 controller with the Motion Builder interface. The previous portions of this tutorial have achieved this. Although the tasks of downloading and running the program files (producing actual motion) are included in the remainder of this tutorial, they are not crucial to understanding the programming process and may be attempted at your discretion.

1. Before you can execute your programs, you must download them to the controller's memory. From the **Run** menu choose **Communications Setup** and select the correct serial port (default is COM 2). If you were using a bus-based product (e.g., AT6400), instead of selecting a serial port you would download the controller's operating system.
2. From the **Run** menu, select **Connect**. This establishes the communication link with the 6000 controller.
3. From the **Run** menu, select **Download Project**. A window like the one displayed below should appear with the contents of your programs scrolling by, followed by a message stating the download is complete.



```
Download
A , 50
AA , 50
V , 2
AD , 50
ADA , 50
D , 0
GO x1xx
WAIT(MOV=bx0xx)
;20270 OUTSTATE
OUT 0xxxxxxxxxxxxxxxxxxxxxxxxxxxx
;30432 ASSIGN
VAR2=VAR2+1
;24200 END
UNTIL(VAR2=VAR1)
END
STARTP SECOND

Download complete.

ERRDEF 13,10,45,32
ERROK 13,10,62,32
ECHO 1
```

(The ERRDEF, ERROK and ECHO commands in the last three lines are simply communication setup commands generated by Motion Builder.)

Your programs now reside in the controller.

Step 18 Run the Main Program

To run your main program (and subprograms), select **Run Main Program** from the **Run** menu.




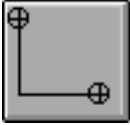

























The program for this tutorial starts by commanding both motors to seek a home switch. To allow the rest of the program to continue, you must ground the home limit switch (connect the HOM terminal to GND). You will notice the loops progress: each axis should move, in alternating sequence with the other axis, a total of ten times and then stop.

If motion does not occur:

- Make sure the P-CUT or ENBL input is connected to ground (GND).
- If you are using a servo controller, make sure your feedback device is connected properly and that your system is tuned.
- REFER ALSO TO THE TROUBLESHOOTING SECTION IN THE ON-LINE HELP OR IN YOUR CONTROLLER'S MANUAL.

TUTORIAL COMPLETE

Motion Builder Icons

	Pointer Tool		Acceleration		Positioning Mode (Continuous, Absolute, or Incremental)
	Link Tool		Velocity		Manual Mode (Joystick or Jogging)
	Move (Motion Profile)		Distance		Select Feedback Source (Servos Only)
	Group (Branch to Subprogram)		Deceleration		Variable Assignment
	Wait (Conditional Statement)		Go (Initiate Motion)		Enable or Disable Drive
	IF (Conditional Statement)		Stop		Select Feedback Source (Servos Only)
	Break Point		Go Home		Select Tuning Gain Sets (Servos Only)
	User-Defined Function Block		Set Absolute Position		RP240
	Error Checking		Set Direction		Write to Port
			Begin Program		End Program