
MODSIM III[®]

The Language for Object-Oriented Programming

User's Manual

Title: (CACI Logo, eps)
Creator: Adobe Illustrator 88(TM) 1.0.3
CreationDate: (10/8/90) (9:11 AM)

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December 1996

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Preface

This Document

This document provides documentation of MODSIM III as of December 1996 for all implementations. The *MODSIM III Reference Manual* was revised and republished at the same time as this revision.

MODSIM III Documentation

There are four documents pertaining to MODSIM III:

- ***MODSIM III Reference Manual*** - The language reference. Contains information about the syntax and structure of MODSIM III as a programming language. Also covers object-oriented programming, simulation, graphics and I/O.
- ***MODSIM III Tutorial*** - Provides a broad overview of the language features of MODSIM and then concentrates on the object-oriented programming and simulation capabilities in MODSIM.
- ***MODSIM III User's Manual*** - This document. Contains information about: **mscomp**, the compilation manager; **MODBENCH**, the development environment under Windows; MODSIM compiler options; and debugging MODSIM.
- ***SIMGRAPHICS II User's Manual*** - This manual contains information about **SIMGRAPHICS II**, the integrated graphics development and animation environment for MODSIM III.

This manual is organized to discuss the following topics:

- **mscomp:** The MODSIM III development environment under UNIX. How to configure and use it to simplify the compiling and linking of MODSIM executables.
- **MODBENCH:** The MODSIM III development environment under Windows.
- **Debugger:** The MODSIM III debugger under Windows and Unix.
- **Command Line Interface to MODSIM III Compiler:** How to use the command line interface.
- **Standard Modules:** A listing of MODSIM III's standard modules.

Early MODSIM users will note that some material which previously appeared in this document has been moved to the *Reference Manual*.

Free Trial & Training

MODSIM III is available exclusively from CACI Products Company. MODSIM III can be sent to your organization for a free trial. We provide everything needed for a complete evaluation on your computer: software, documentation, sample models, and immediate support when you need it.

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1. MSCOMP — A Modular Compilation Manager Under UNIX

1.1 Background

mscomp is a program which manages the MODSIM compile process on UNIX operating systems. This chapter describes how to use **mscomp**. If you are working under Microsoft Windows, use the MODBENCH development environment instead of **mscomp**. See the next chapter for more information on MODBENCH.

mscomp manages separate compilation of MODSIM programs consisting of multiple modules by determining which modules have been edited since the last compilation and recompiling only those modules and any other modules which depend on them. This process is accomplished automatically using information in the MODSIM program and the machine's file system without need for “make” or project files to describe the process.

A MODSIM executable program is produced in several distinct steps. In the simple case of a single main module, the following must be done:

- The MODSIM source code file, **Mxx.mod**, is given to the MODSIM compiler which produces the following files:

Mxx.cpp	C++ code
Mxx.err	error file { <i>optional</i> }

Here **xx** is the name of the MAIN module. Naming conventions will be covered more fully shortly.

- The generated C++ code is compiled using the system's C++ compiler. This results in a file **Mxx.o**.
- The object file produced by the C++ compiler is linked with the MODSIM III library producing an executable file. This is named **xx**.

If the program is composed of a number of modules, the process is more complex. Because of the many steps involved in the C++ compile and link process and the need to perform the C++ compile and link with particular options on each machine type, the **mscomp** compilation manager has been provided to automate these steps.

The current version of the MODSIM III environment has been designed to allow you to keep each project in a separate subdirectory with its own **mscomp.cfg** configuration file, if desired. Of course, you can also keep several projects in one subdirectory. **mscomp** will not have any problems keeping track of projects. All MODSIM system files reside in their own directories.

Note: File and subdirectory names **are** case sensitive on UNIX systems.

1.2 MSCOMP's Configuration File

A configuration file called **mscomp.cfg** must exist in any directory in which **mscomp** will be used to perform compiles. If such a file does not exist, **mscomp** will offer to write a default file into the directory.

The **mscomp.cfg** file contains configuration lines which determine where **mscomp** will look for files needed to compile a project and which compile options will be in effect. Each line starts with a keyword followed by a ">" and a space. This is followed by the information for that line. After a further space and a "'" you can place any comments. Lines which contain path information for directories follow these conventions:

- A single period "." indicates the current directory.
- Two periods ".." indicate the directory above the current one.
- Multiple paths can be indicated for libraries only. They are separated by a "+". No spaces are allowed.
- The paths can end with or without a terminating forward or backward slash.

You should attempt to keep the path names short by using relative paths or by using short directory names where possible. The paths mentioned in the configuration file are used to build command lines for system utilities such as compilers and linkers.

Here is how the default version **mscomp.cfg** file looks on a Unix system:

```
x.x.x '- Version of 'mscomp' and MODSIM III Compiler
MSEXEC> /modsimx.x.x/bin '- MODSIM III system directory
MSLIB> /modsimx.x.x/lib/modsim '- MODSIM III library/import
directory(s)
DEF> . '- Definition source module directory
IMP> . '- Implementation source module directory
OBJ> . '- Object file directory
VIEW> project '- database filename for debug

SR> ON '- Subrange and subscript checking
PTR> ON '- Pointer checking
REF> ON '- Reference variable checking
TB> OFF '- Runtime error traceback
DEBUG> OFF '- Generate debugger code
GRA> ON '- Link with graphics library
3D> OFF '- Link with 3D graphics library
SO> OFF '- Link with SimObject library
LIS> OFF '- Generate compilation listing
ERR> OFF '- Keep .err files, if any
BEEP> ON '- Audible prompts
```

The first line is the version number of the current release. This information is used by the system to ensure that the configuration file is compatible with the current release.

The **MSEXEC** line contains the full path of the MODSIM system directory. The **MSLIB** line contains the full path of the MODSIM library directory. This is the directory which contains the header, definition and library archive files for the MODSIM system. This can optionally be followed by zero or more additional directories containing other project's libraries from which you are importing. These additional directories are separated by the plus character '+'. No spaces should appear between (or within) directories.

The **DEF** and **IMP** lines are the directories which contain, respectively, the project's definition module source code and the implementation source code. These two directories (which usually will be the same directory) may be thought of as the "current working directory". The **OBJ** line is the directory in which to place the object files generated from the compilation. Each of these must be a single directory path. Only the library line allows the '+' notation.

When **mscomp** generates the default **mscomp.cfg** file, it attempts to insert correct information about the current installation in the **MSEXEC** and **MSLIB** lines. It does this by searching the system's path looking for the MODSIM system files.

Following the path information in the **mscomp.cfg** file are a number of lines which describe system options. Note that the choices here are **ON** or **OFF**.

The **SR** option specifies whether the system will enable runtime checking to ensure that subscripts and subranges are never assigned any value which would be out of bounds for that type.

The **PTR** option is not used in MODSIM III.

The **REF** option specifies whether the system will check object and record reference values when they are dereferenced (e.g. as ASK statement).

The **TB** option specifies whether the compiler generates code to print a traceback of the current calling sequence when a runtime error occurs.

The **DEBUG** option specifies whether the compiler generates code to allow debugging.

The **GRA** option specifies whether the generated code will be linked with the SMIGRAPHICS II libraries.

The **3-D** option specifies whether the generated code will be linked to a Open GL compatible library.

The **SO** option specifies whether the generated code will be linked to a set of library routines specifically designed for simulation programming referred to as SimObject.

The **LIS** option is not used in MODSIM III.

The **ERR** option specifies whether the compiler will keep **.err** files, if any. These are files which, for each module compiled, list the line number, column number and error message for each compile time error encountered. These files can be used with configurable text editors to place the cursor directly on indicated errors to be edited.

The **BEEP** option specifies whether **mscomp** will be silent or will emit warning beeps.

You may edit the entries in the file **mscomp.cfg**, as required, using any text editor, or use **mscomp** to set the configuration options.

1.3 Files

The following naming conventions are used by the MODSIM compilation manager. Note that on other than PCs, file names are case sensitive. On all machines, module names are case sensitive:

Module Name	File Name
MAIN MODULE Alpha	MAlpha.mod
DEFINITION MODULE Beta	DBeta.mod
IMPLEMENTATION MODULE Beta	IBeta.mod
C++ code to support Beta	Beta.cpp

It is important that the above conventions are followed since they are used by the compilation manager to perform compiles and links.

1.4 Using MSCOMP

mscomp's **Main Menu** offers the most frequently used options:

```

MAIN MENU
(M)ake project
(E)valuate status
(O)ther compile/link options
(C)onfiguration
(H)elp
(Q)uit

```

- (M) This selection will prompt for the name of the main module of the project to be compiled. The name must be provided without the preceding “**M**” and without the succeeding “**.mod**” file extension. The program may include simply a main module or it may have a main module, definition and implementation modules

(MODSIM and/or C++). The compilation manager will determine which files are required to build this project (based upon imports into **MAIN** and then their imports and so on). The manager determines which modules are required by observing certain naming conventions. If any module imports from a **DEFINITION** module, then the manager will see if an **IMPLEMENTATION** module and a C++ file of the same name exist. If so, it will assume they are required for the project.

```

MAIN MODULE abc;
...
FROM foo IMPORT bar, .... ;
...

```

Upon examining main module **abc**, the manager knows that this project requires definition module **foo** (assuming that **foo** is not a system library definition module - see below for explanation). The manager will see if **Dfoo.mod** exists, and then it will check for the existence of **Ifoo.mod** and **foo.cpp**. If either or both of these do exist, it assumes they are required for the project.

Once the required modules are identified, the compilation manager ascertains whether any of these modules require compilation. A source code module will require compilation if:

- Its date is later than the corresponding object file.
 - Any module on which it depends has a later object file date than the module's corresponding object file.
 - Any module on which it depends is going to be scheduled for recompilation this time. Once all modules which require recompilation have successfully compiled, the manager will schedule a link of all modules required for the project. This final step produces an executable program.
- (**E**) This selection will perform a project evaluation starting from a **MAIN** module. It works exactly like the first option except that it merely reports to you which modules need to be compiled. It does not actually schedule any compiles.
- (**O**) Selecting “**O**” from the main menu will take you to the “**OTHER OPTIONS MENU**”. The menu provides many compilation and linking variations that are useful in managing large and small projects. These are explained below.
- (**C**) Item “**C**” displays the “**CONFIGURATION MENU**” which allows you to view and change the current configuration settings as specified in the configuration file.

The following describes the subsidiary menus of **mscomp**. Each menu page has a (**H**)**e1p** selection which briefly explains the options on that particular menu.

1.4.1 Other Options Menu

- (C) This selection will identify the modules required for a project from the **MAIN** module you specify. A full description is given under **MAIN MENU** option “M”. Once all such modules are identified they will all be scheduled for compilation. No date checking will be performed. This option forces compilation of all modules whether or not they are out of date. This comes in handy if you have previously compiled all or some of the modules with certain options switches set, but now want to have them turned off to speed up code and reduce executable size. No link will be performed.

- (S) This item will compile an individual **MAIN**, **DEFINITION**, **IMPLEMENTATION** or C++ module. You will be required to specify which type of module is to be compiled (“M”, “D”, “I”, “C”, respectively) and then provide the name of the module **without** the preceding qualifier or the succeeding file extension. This option can be used to compile one particular module with a different set of compile options than the rest, or to simply check the module for syntax errors.

- (P) This selection will force the compilation of all modules specified in a project file. This option functions much like item “C” except that the compilation manager will not automatically determine which files are to be compiled. Instead, this information is taken from the modules listed in the project file whose name you specify. The project file name should be entered **without** the succeeding file extension (all such files must have a “.prj” file extension). The format for project files will be explained below.

- (L) This selection will force a link of all modules required for a project. The list of modules required will be determined as described in **MAIN MENU** option “M”.

- (K) The “K” option will also force a link of all project modules. These modules are specified in a project file rather than being determined from a main module as in “L” above.

- (M) Option “M” performs like **MAIN MENU** option “M” except that the modules are specified in a project file rather than being determined from a main module. Dependency checking and date checking are also performed to ensure that all required modules are re-compiled.

- (A) The “A” selection uses both a **MAIN** module and a project file. The compilation manager will determine from the main module which modules are required for the project and whether any of these modules require recompilation. All of these modules will be scheduled for linking into the executable. In addition to these modules any modules specified in the project file by the “O” or “L” modifier will also be linked into the final project executable. This allows specification of ob-

ject and/or library files for use in projects. Items in the project file preceded with “D”, “I”, “M” or “C” will not be scheduled for compilation and/or link.

1.4.2 Configuration Menu

- (V) Option “V” displays the current configuration for this invocation of the compilation manager. Initially the configuration comes from the **mscomp.cfg** file in the current directory. The various settings and directories may be temporarily changed for an individual run or permanently edited by using options “C” and “M” described below.
- (C) Option “C” allows you to change switch settings for compiler options such as reference checking, range checking, traceback, etc. These changes will persist only for this invocation of the compilation manager unless you specify that they be saved. If any options are changed, you are asked if the changes should be permanent (i.e., overwrite the configuration file in the current directory). If so, the current settings will be saved. You may change these options as many times as necessary during any particular session.
- (M) The “M” selection allows you to modify the directory specifications for the compilation manager. These changes persist only for the current run of the manager unless you indicate that they be saved in the configuration file. If modifications are not saved, these directories will revert to those specified in the configuration file upon subsequent runs.

1.5 Command Line Operation

Most of **mscomp**'s compile/link/evaluate menu options may be invoked from the command line. If you will not need to use the menu options at all or will want to run the compiler in batch mode, a flag may be given to **mscomp** to indicate this. In batch mode, compilation will not stop upon errors or wait for keyboard input. Output will continue to go to the screen unless redirected to a file or printer. The command line switches parallel the menu selection keys as much as possible. In command line mode, **mscomp** uses the settings specified in the **mscomp.cfg** file unless they are explicitly overridden by one of the command line options.

To use **mscomp** from the command line, invoke it followed by one or more of the following options on the command line: **mscomp**

<main> **mscomp** followed by the name of a main module (**without** the preceding “M” or the succeeding “.mod”) will determine the modules required to build an executable from this named main module, determine which, if any, need to be recompiled, schedule their compilation and finally perform a link, producing an executable program. This is identical to selecting option “M” from the **MAIN MENU**.

- v Performs an evaluation of which modules for a particular main module will need recompilation and reports the result. Same as “E” from **MAIN MENU**.

- c <main> Compile all modules required for the project specified by main module <main>. Same as selecting “C” from **OTHER OPTIONS MENU**.

- s{m|d|i|c} <module name>
 This switch (a “-s” followed by one of “m,” “d,” “i” or “c”) will perform a single module compilation of <module name>. Same as “S” item on **OTHER OPTIONS MENU**.

- p <project> The “-p” switch followed by the name of a project file **without** the “.prj” suffix will force compilation of all modules listed in <project>. Same as “P” item on **OTHER OPTIONS MENU**.

- l <main> “-l” switch forces a link of all modules required for the project specified by <main> module. Same as “L” on **OTHER OPTIONS MENU**.

- k <project> This switch forces a link of all modules specified in the file <project>.prj. Same as “K” on **OTHER OPTIONS MENU**.

- m <project> This switch causes an evaluation of the dependencies of the modules specified in the <project>.prj file. Any modules which require compilation will be scheduled and then a link on all modules will be performed. Same as “M” option of **OTHER OPTIONS MENU**.

- a <main> <project>
 This switch will evaluate all modules required from <main> module, schedule any modules requiring compilation and perform a link of all such modules plus any “O” or “L” modules specified in the <project>.prj file. Same as “A” on **OTHER OPTIONS MENU**.

- u <project> This switch will assess the modules listed in project file <project>.prj and report which modules require compilation. Same as “U” on **OTHER OPTIONS MENU**.

- e Specifies that the system will check for **NILOBJ** reference values being passed in formal parameter lists.

- l Specifies that the compiler will emit a listing of compiled code.

- b Specifies that **mscomp** will be run in batch mode. After performing the indicated actions it will not return to the main menu. Instead it will terminate.

1.6 Project Files

A number of options are designed to be used with project or script files which contain a script in the following format:

```
' This is project file Alpha.prj
' last edited 6/14/95
  I Beta
  C Delta
  M Alpha
  O other
  L libstuff.a                               Unix
```

The project file must be in the following format. It does not allow a “free” format. The first character on each line specifies the type of module to be compiled. The choices are **M** for main, **I** for implementation, **C** for C++ source files, **O** for object files and **L** for libraries. The letter must be in uppercase and must be followed by a space. Comments may be included if an apostrophe is the first character on a line.

Where the first character is **M**, **I**, or **C**, the second entry is the **full** module name, not the truncated file name. The module name is case sensitive.

Where the first character is **O**, the second entry is the full path for an object file (without the file extension) which is to be linked into this executable. Unix systems assume an “.o” extension.

Where the first character is **L**, **mscomp** expects the full path and extension for a library file. The extension information is required since some systems will have several versions of system libraries whose names differ only in the extension.

mscomp expects project file names to end with the extension “.prj”.

1.7 Checking Out the Installation

Program “**MErrors.mod**” demonstrates how errors are handled by the compilation process. Program “**Mhello.mod**” can be used to verify proper operation of the compile process. It should produce an executable called **hello** which prints out a brief message.

See the sample programs in the **demoss** directory of the distribution disk for more examples of MODSIM code. The file **README**, in that directory, explains what each one does.

2. MODSIM III Development under Microsoft Windows

The chapter covers the following topics:

- Overview of MODSIM III for Windows
- Hardware and Software Requirements
- Use of MODSIM III Workbench to Manage MODSIM III projects.

2.1 Overview

As in the previous release, full MODSIM III functionality is provided in the context of Microsoft Windows for PC computers. MODSIM uses the virtual memory manager of Microsoft Windows to run large models. When used with a fast PC, its performance for both compilation and simulation runs is comparable with many Unix workstations. MODSIM III system libraries have been compiled to take advantage of 32 bit memory access.

2.2 Hardware and Software Requirements

MODSIM III can be run on a large number of PCs because it does not make special hardware demands beyond those of typical “high end” Windows systems.

- 80486 processor or greater
- 16 MB of system memory minimum. 32 MB recommended
- 27 MB of available hard disk space minimum
- Microsoft Windows 95 or Windows NT 3.51 (or greater)
- Microsoft Visual C++ 4.x
- On all systems, a larger monitor is preferred. It should be 17" or greater and have a display card capable of operation at 1,024 x 768 resolution with 256 colors.

2.3 Using MODSIM III Workbench to Manage Your Projects

MODSIM III Workbench is an integrated program environment for conveniently organizing, creating, compiling, running and debugging your MODSIM III programs.

This overview follows the Workbench's menu choices. Where menu choices open dialog boxes, these dialog boxes are described separately at the end of the walk through of the main menu choices.

2.4 Organizing Your Program with a Project

The **project** is the basic organizing unit of MODSIM III Workbench. A project records all of the relevant information about the program you are creating: its name, its location, what files are used to build it, current compilation options, etc.

Typically, opening a project is the first step in using MODSIM III Workbench. Only one project can be open at a time; this is the **current project**. MODSIM III Workbench automatically saves any changes you make to the current project. This occurs when you leave MODBENCH, when you explicitly close the project or when you open another project.

The **Project** menu supports a number of operations on the current project, such as **building** the project and **running** or **debugging** the program.

2.5 Creating a Program

The easiest way to create a program is to use the **Project New** menu choice. It offers you the option of creating a new subdirectory for your project and of creating a new MAIN Module.

Once this has been done, you can use the MODSIM III Workbench editor to edit, create, or view program files.

The **File** menu offers commands to open an existing file for editing, to save changes to a file, to create a new editing window, etc.

If you want to use the editor of your choice, you can use the **Options** menu **Tools** option to install your own editor. The editor can then be launched from the **Tools** option.

2.6 Compiling a Program

MODBENCH allows you to compile a single module, but usually it is easier to select **Project Build** instead of **Project Compile Module**. **Build** will compile all modules which need to be compiled and will then link to build an executable program.

2.7 Running a Program

After your program compiles successfully, you can execute your program from MODSIM III Workbench by choosing **Execute** from the **Project** menu.

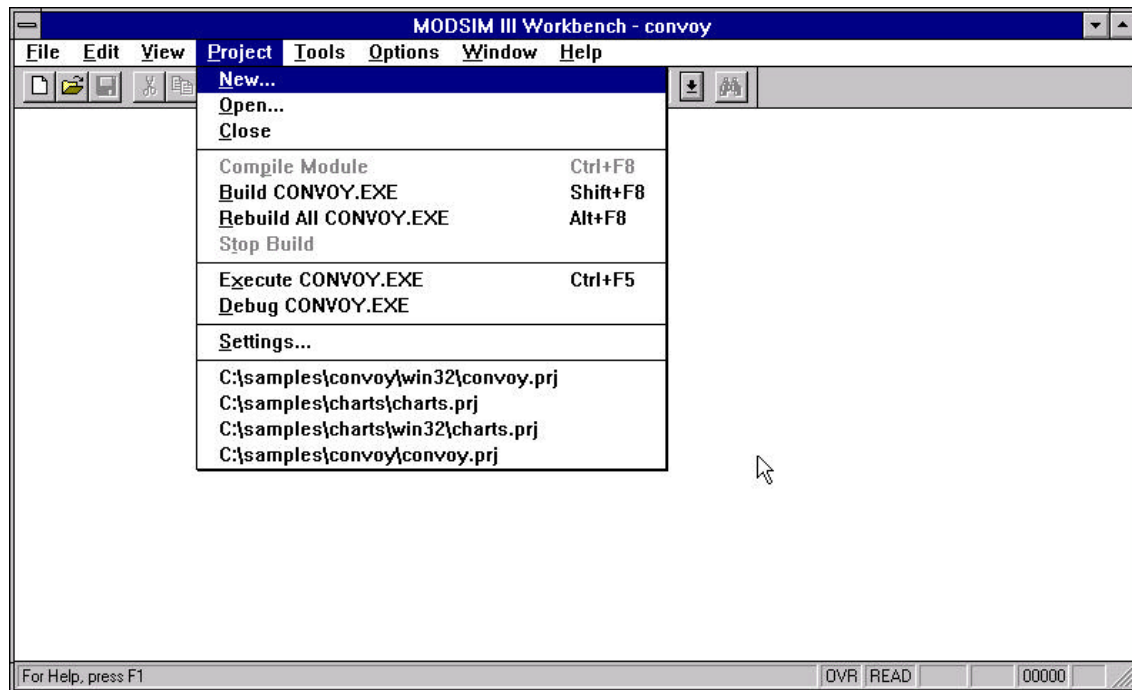
2.8 Text Input/Output

MODSIM has several statements that input and output text: **INPUT**, **OUTPUT**, **PRINT**. MODSIM also prints messages in response to runtime errors.

In the Windows version of MODSIM, these statements are output to a **console window** that is created automatically. You can use the scrollbar in Windows NT to review previous output.

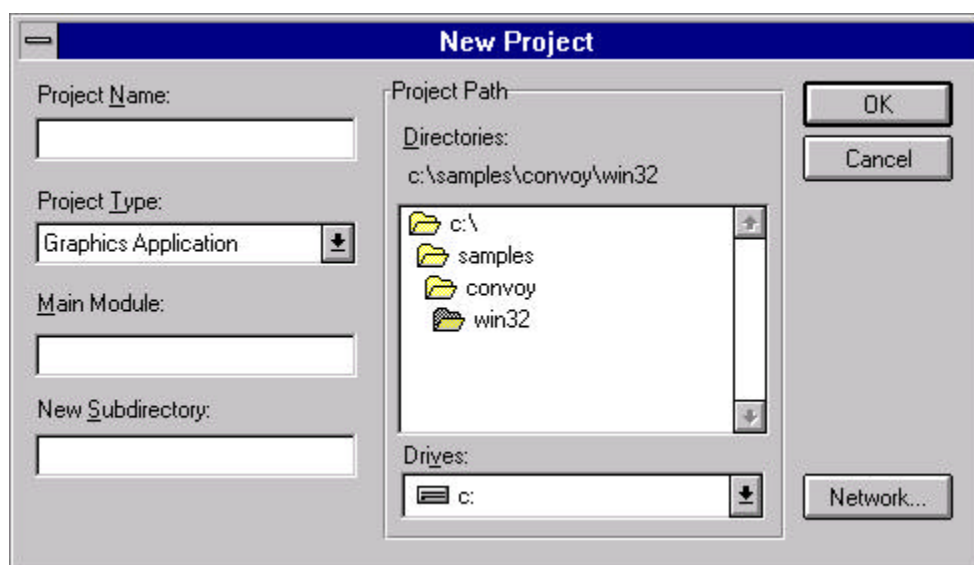
2.9 Project Menu

The **Project** menu offers commands for manipulating the current project.



2.9.1 Project / New

Presents the **New Project** dialog, which lets you create a new project. After specifying the new project and pressing **OK**, the new project becomes the current project. The project which is currently open is automatically saved and closed.



Note: This dialog is derived from the standard Windows file browsing dialog box. Its use and operation should be familiar to the Windows users.

2.9.1.1 Project Name

All project information is stored in a file specified by the project **Project Name** field, which is given the extension **.prj** by the user or by the system if the user omits it. The executable file generated by MODSIM III Workbench for this project will have the same name, with the extension **.exe**. For example, if the project name was **sample.prj**, the executable will be called **sample.exe** and the MAIN module will be named **sample**.

The project file and all of the related source files will be created in the directory specified in the browsing window of this dialog box. To create a new directory for your project:

1. Browse to the location in which you want the directory to be created.
2. Enter the name of the new directory in the **New Subdirectory** field.

The new directory is created and you are placed in the new directory.

Every MODSIM III application has one main module. The **Main Module** field specifies the name of the main module. The main module name can contain only letters and numbers, and must start with a letter. Capitalization is important.

For example, if the **Project Name** which was entered was **VegetableSoup**, the main module which is created would have this first line:

```
MAIN MODULE VegetableSoup;
```

The project file would be **VegetableSoup.PRJ** and the main module would be in the file **MVegetableSoup.MOD**.

Note: MODSIM requires a strict relationship between a module name and the name of the file containing the module.

2.9.1.2 MODSIM III Module and File Naming Conventions

MODSIM III's compiler and utilities expect that a certain naming convention will be used for files which contain modules. MODSIM source files are expected to have the extension **.mod**.

The file name is composed by preceding the module name with an **M** for a **MAIN** module, **D** for a **DEFINITION** module, and **I** for an **IMPLEMENTATION** module. The file name must match the module name exactly, and is case sensitive. The **.mod** extension is then added. The following examples illustrate the process.

```
MAIN MODULE Alpha      ⇨      MAlpha.mod
MAIN MODULE AlphaNumeric  ⇨      MAlphaNumeric.mod
IMPLEMENTATION MODULE BackRack  ⇨      IBackRack.mod
DEFINITION MODULE Beta      ⇨      DBeta.mod
```

2.9.1.3 Project Type

There are four project types to choose from:

- **Graphics Application**
- **Text Application**
- **Graphics Only Application**
- **Static Library**

Choose **Graphics Application** if you want to use MODSIM's graphics capability (i.e. SIMGRAPHICS II) and need to use **OUTPUT/INPUT** statements. Choose **Text Application** for text only applications which do not use graphics. This will make your executable smaller. Choose **Graphics Only Application** if you want to use graphics and do not want to use **OUTPUT/INPUT** statements.

2.9.2 Project / Open

Presents a **File Open** dialog that lets you select the project to open; this becomes the current project. Projects are stored in files with the **.prj** extension. The project which is currently open is automatically saved and closed.

2.9.3 Project / Close

Closes the current project, saving its current state.

2.9.4 Project / Compile Module

Compiles the module displayed in the topmost editor window of MODBENCH's editor.

2.9.5 Project / Build ...

Ensures that all modules used in the current project are compiled, and creates the executable. MODSIM III Workbench only recompiles a module if necessary. **Build** and **Rebuild** will build an application in **Debug** or **Release** mode depending on the option currently selected in the **Project Options** dialog. A project may be built of a mixture of modules which were compiled with and without debugging.

If errors are found during the compilation phase of the build process, the errors will be noted in the output window and the system will continue to compile the remaining modules which require building. The link will be canceled since at least one module had errors. You can press the **F4** key to review each error. See **View Next Error**.

2.9.6 Project / Rebuild All ...

MODSIM III Workbench uses a sophisticated algorithm to detect when it can avoid recompiling a module. However, there are times when it is desirable to force a compile of all modules. This might occur after program development and debugging when all mod-

ules are compiled with error checking off. The **Rebuild All** command forces MODSIM III Workbench to recompile all modules.

2.9.7 Project / Stop Build

Select this command to terminate a build in progress. The build process will stop at the end of the current step, so there may be a delay between the time this option is selected and the termination of the build process. An acknowledgment will be displayed in the output window when the build process terminates.

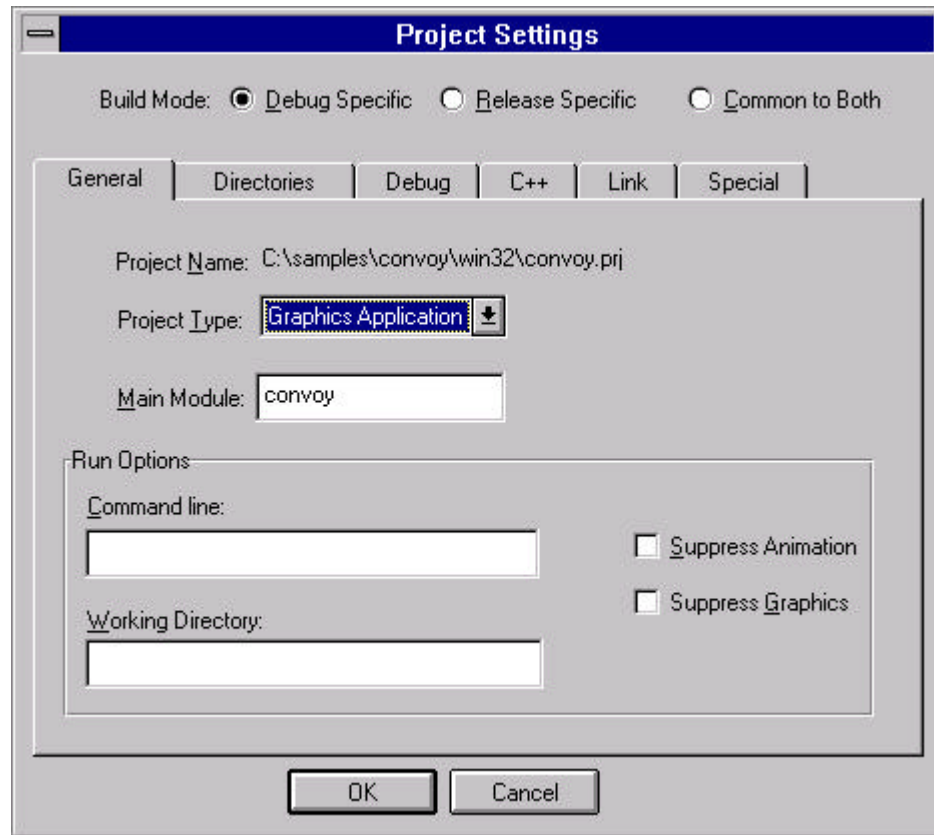
2.9.8 Project / Execute ...

The **Execute** command runs the program, if it exists. If the program does not yet exist, you will be asked if you would like to build the application.

2.9.9 Project / Debug ...

The **Debug** command runs the program in interactive debugging mode. The main module and any module which you would like to debug must have been compiled with debugging support enabled. The program will stop at the first executable line. From there, you can examine variables and types, set breakpoints, execute the program line by line, or examine the execution stack. For further information, see **Introduction to Debugging with MODSIM III**, use the **Help** option for debugging, or press the **Help** button once you are in debugging mode.

2.10 Project / Settings ...

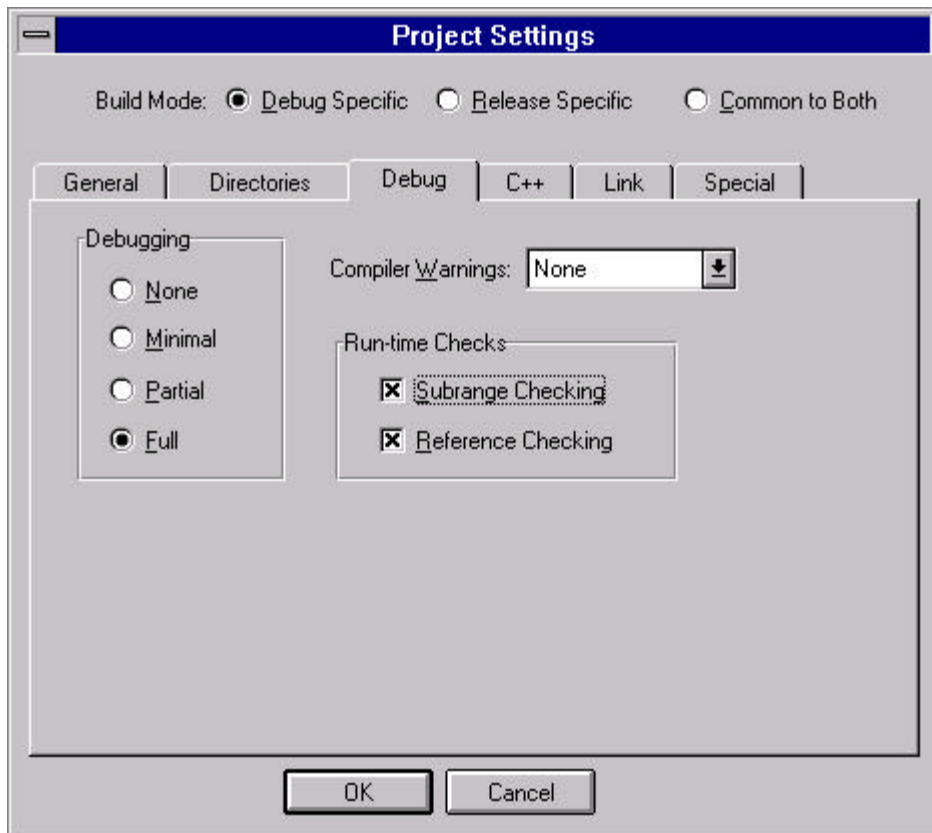


Often, you want to use different settings while debugging than for the final release. For example, during debugging you may want all checking turned on, to catch errors. For the final release, you may want checking turned off, for speed.

There are a number of settings for controlling the compilation process. If **Debug Specific** is selected, any change will apply to the debugging set of options; if **Release Specific** is selected, any change will apply to the release set of options; if **Common to Both** is selected, any change applies to both the debugging and release sets.

Debug Specific:

When checked, MODSIM III enables interactive debugging of a running application.



No Debugging:

When an error occurs, MODSIM III displays no debugging information.

Minimal Debugging:

When an error occurs, MODSIM III displays the only a trace of the calling routine that resulted in the error.

Partial Debugging:

When an error occurs, MODSIM III displays the trace of the calling routines that resulted in the error, and allows examination of the data local to that routine. This is useful when you wish to allow the use of an inherited method, but not source level access.

Full Debugging:

When an error occurs, MODSIM III displays the sequence of calls that resulted in the error. In addition, breakpoints can be set and stepping through source code is available.

Warning Messages:

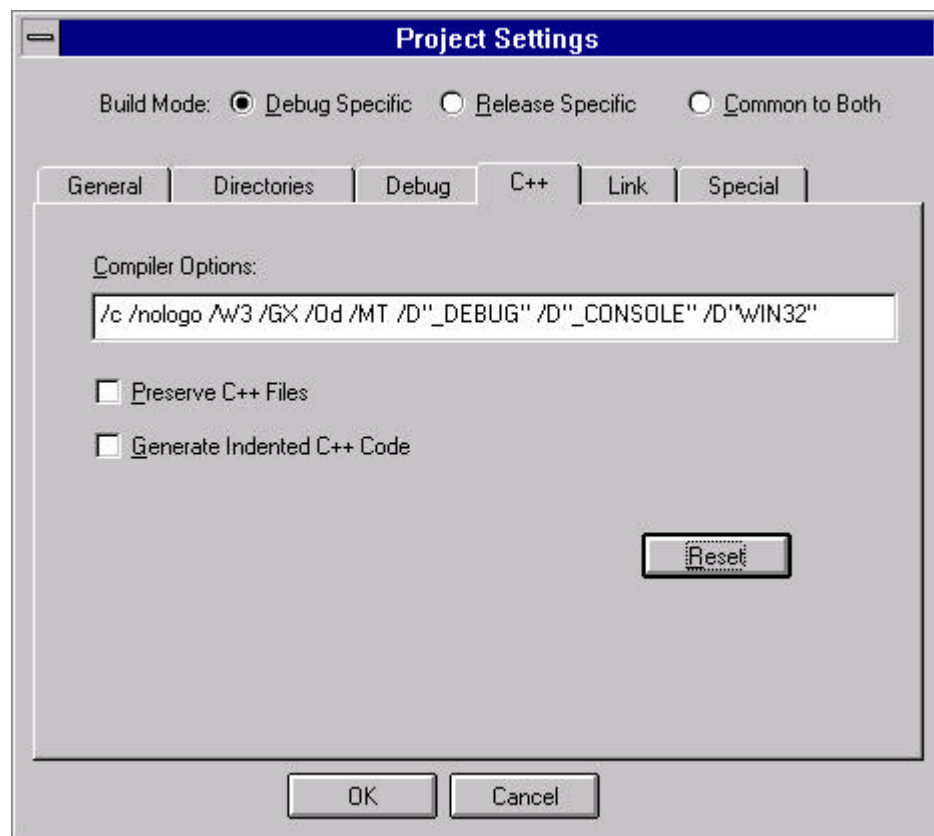
Warning messages and their levels are not implemented at this time; the program defaults to none.

Subrange Checking:

When checked, MODSIM verifies all array references at runtime, reporting an error if it detects an out-of-bounds index. This option also controls bounds checking of enumerated types and subrange types.

Reference Checking:

When checked, MODSIM verifies at runtime all references to objects to ensure that the object is valid. An error is reported if a problem is detected.

2.10.1 C++ Tab**Compiler Options:**

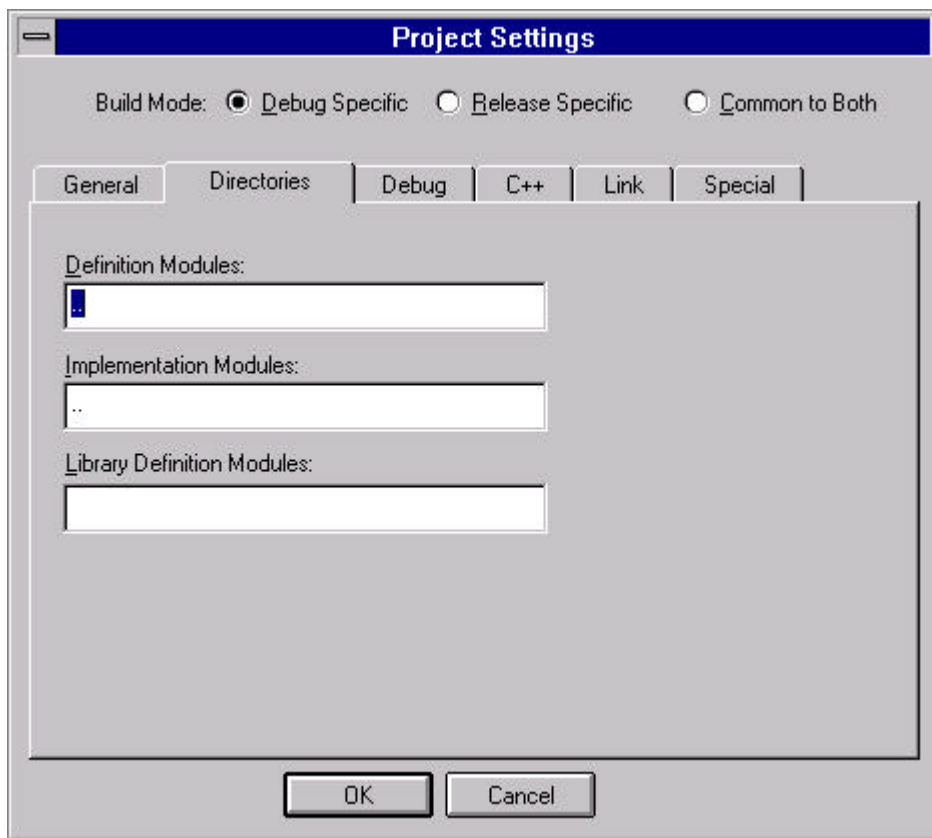
In ordinary use, you will not need to change the C++ **Compiler Options**. In fact they should normally not be changed since MODSIM III's libraries expect that certain of the options are selected. Consult your C++ compiler documentation for more information on these switches.

Preserve C ++ Files:

MODSIM III works by compiling a MODSIM program into C++, and then compiling the C ++ code into object code. Ordinarily, the intermediate C++ files are deleted after compilation, but if this option is checked the intermediate C++ files are retained.

Generate Indented C++ Code:

When checked, MODSIM produces a C++ code which is indented.

2.10.2 Directories Tab**Project Definition Module Directory:**

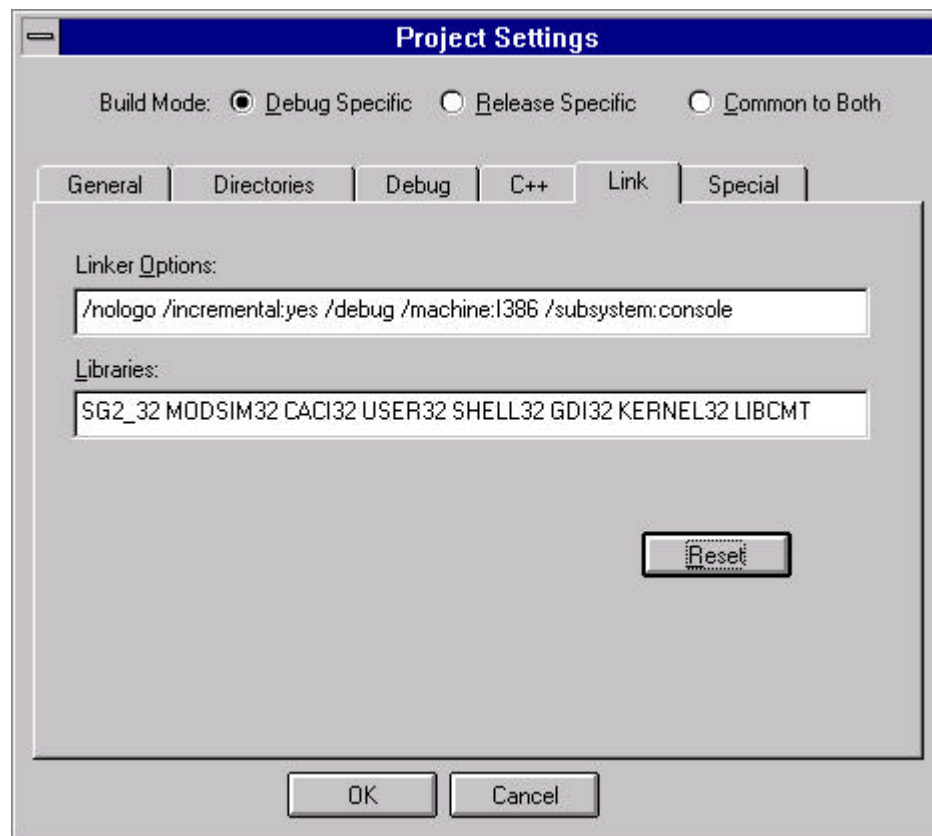
This field specifies one (and only one) directory in which the MODSIM Definition modules for the current project can be found. The “.” specifies the current directory, while “..” specifies the parent directory.

Project Implementation Module Directory:

This field specifies one (and only one) directory in which the MODSIM IMPLEMENTATION modules for the current project can be found. The “.” specifies the current directory, while “..” specifies the parent directory.

Project Library Definition Directory:

This field specifies one or more directories to search to find additional MODSIM DEFINITION modules. Each directory path is separated with a semicolon ‘;’. This field would typically be used to specify a collection of frequently used definition files similar to the MODSIM III system and graphics files found in MODSIM’s definition directory, but provided by the user. Typically, the implementation code for these files has been compiled and consolidated in a **.LIB** file which is specified in the link options.

2.10.3 Link Tab**Linker**

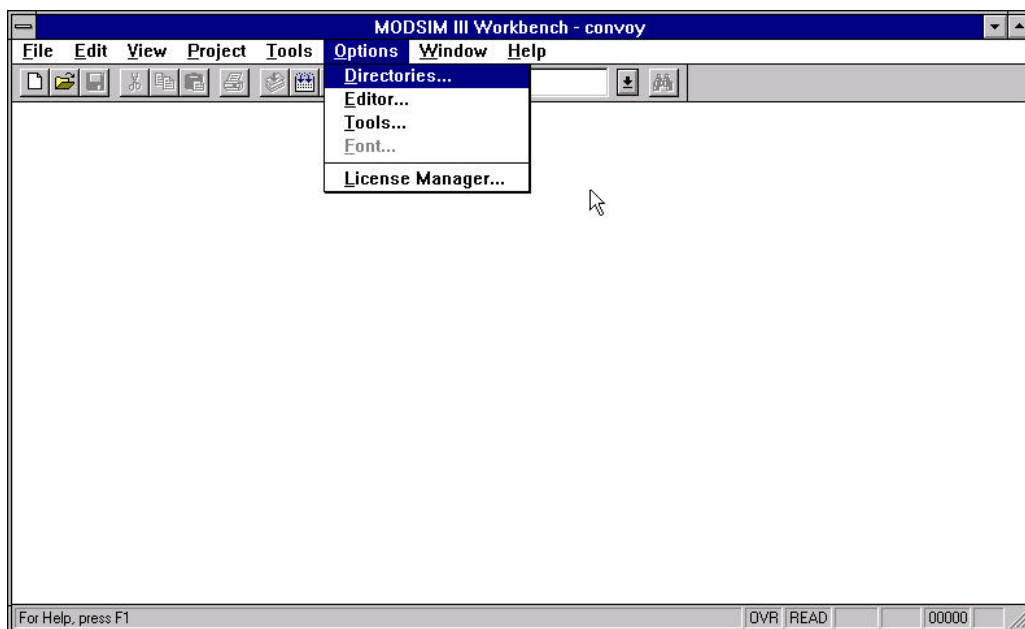
The **Linker Options** field lets you specify the options passed to the linker when linking the various modules into a MODSIM application.

The **Libraries** field lets you specify the libraries that will be included during the link. If there are multiple libraries, separate them by spaces.

Reset will return you to the supplied default values for both the linker and libraries.

2.11 Options Menu

The **Options** Menu commands let you change options that affect the MODSIM III Workbench in general, and the current project in particular. For example, you can change



where MODSIM III Workbench looks for executables, and you can change whether or not the current project should be compiled with or without run time debugging checks.

The **Options** menu allows adjustment of the MODSIM III Workbench environment.

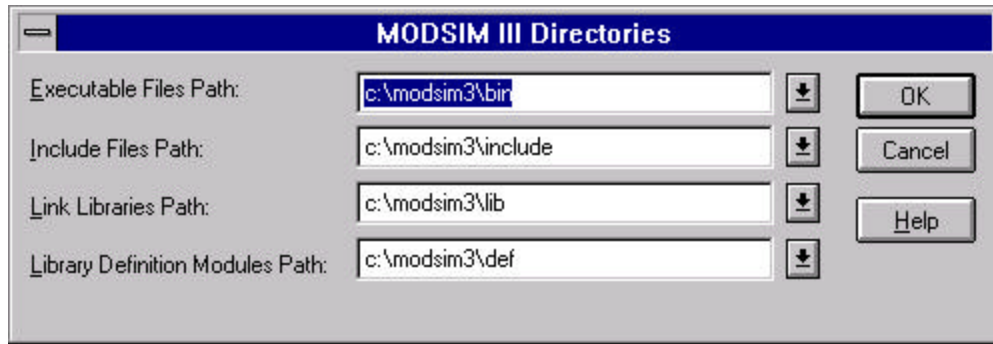
2.11.1 Options / Directories...

The directories listed here tell MODSIM III Workbench where to look for various MODSIM files. The **Executables** directory gives the location of **modsim3.exe**, and other MODSIM executables and dynamic link libraries.

The **Include** directory gives the location of the MODSIM header files.

The **Link** directory gives the location of the MODSIM runtime libraries (**.lib** files). Multiple directories may be specified separated with a semicolon ';'.

The **Library Definition** directory gives the location of the system definition modules (**D*.mod** files) for MODSIM's runtime and SIMGRAPHIC II libraries.



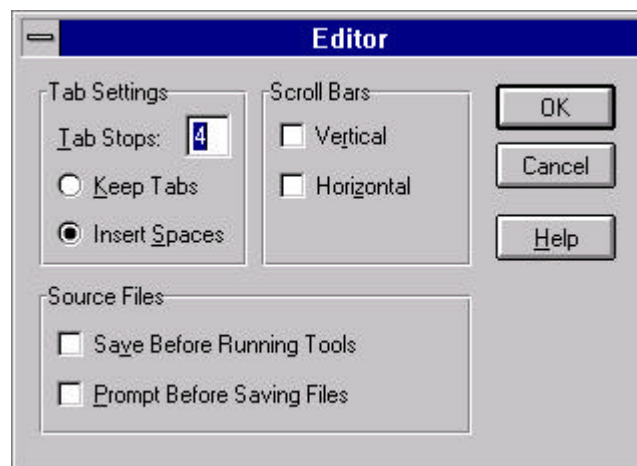
2.11.2 Options / Editor...

MODSIM III Workbench provides a simple editor that you can use to create, view, and update modules. Use this command to customize editor behavior. Use the **Options/Editor** dialog to customize the editor's settings.

The **Tab Stops** field sets the number of positions between tab stops. It is not yet implemented. If **Keep Tabs** is selected, then when you type a tab it remains a tab. If **Insert Spaces** is selected, a tab is converted into an equivalent number of spaces.

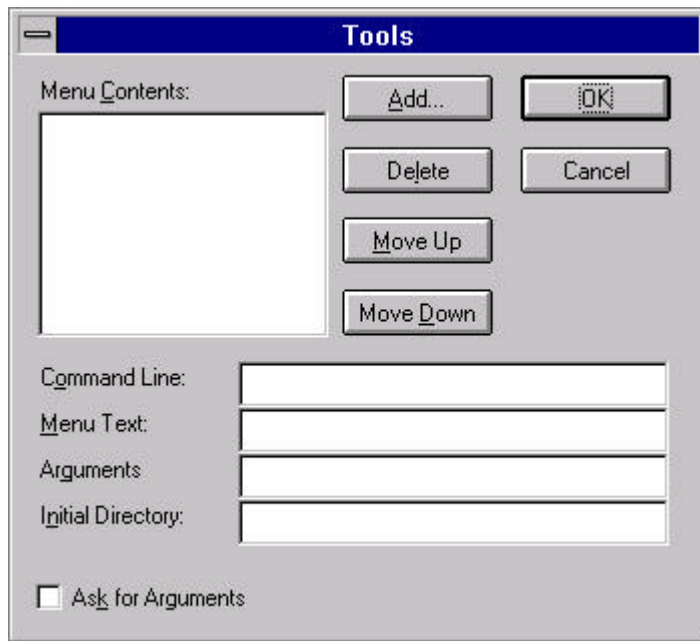
If you want scroll bars to help you move around a file, check the **Vertical** and **Horizontal Scroll Bars** option. Otherwise, you must use the **Page-Up**, **Page-Dn**, and arrow keys to view portions of the file that are off-screen.

The **Save Before Running Tools** option will ensure that your source files which have been edited will be saved before any compile, build or program execution. If you want MODSIM III Workbench to prompt you before saving, check the **Prompt Before Saving Files** option.



2.11.3 Options / Tools...

This command allows you to install your own tools in the **Tools** menu.

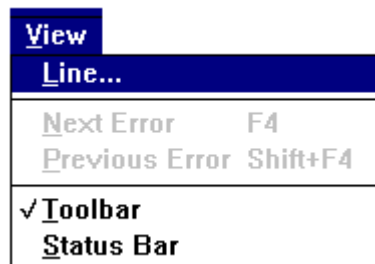


2.11.4 Options / Font...

The **Font** option lets you choose the font face, style, and size to use in the editor windows.

2.12 View Menu

Select **Line** to view a specific line in the topmost editing window.



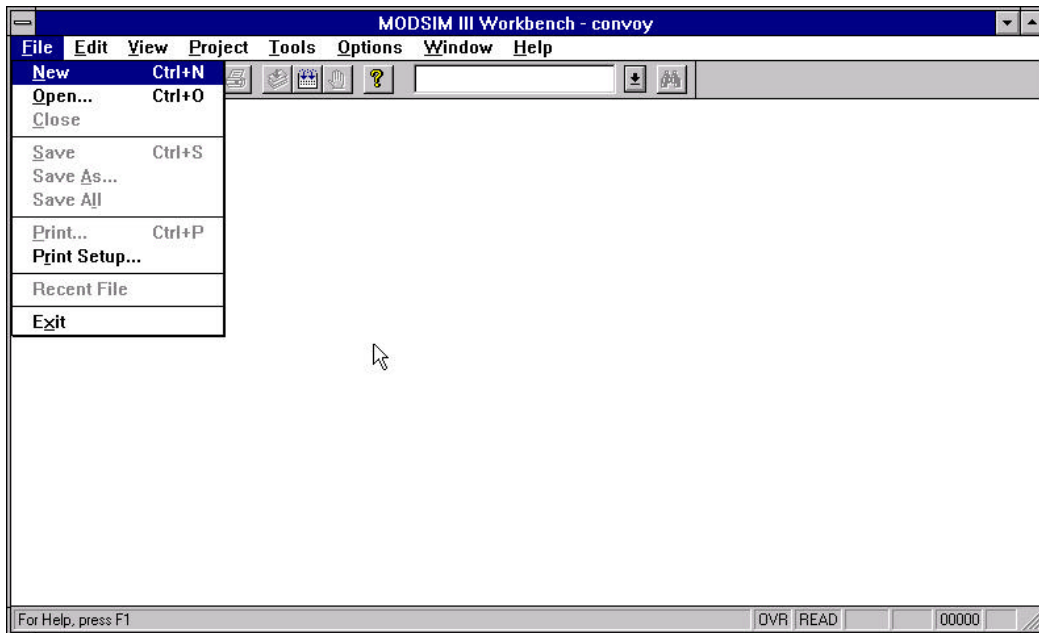
Select **Next Error** to view the next error, after a MODSIM compile.

Select **Previous Error** to view the previous error, after a MODSIM compile.

Select **Toolbar** to toggle the display of the Toolbar.

Select **Status Bar** to toggle the display of the Status Bar.

2.13 File Menu



2.13.1 File / New

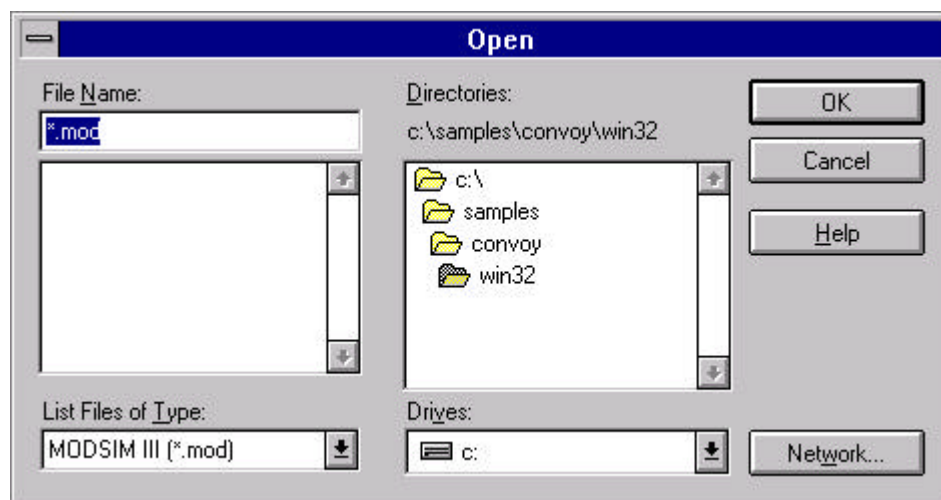


Creates a new editing window that you can use to enter text.

2.13.2 File / Open...



Presents the **File Open** dialog, which you use to select a file to edit. The file does not have to be related to the current project.



The following options allow you to specify which file to open:

File Name

Type or select the filename you want to open. This box lists files with the extension you select in the **List Files of Type** box.

List Files of Type

Select the type of file you want listed in the Files list:

- modsim files (***.mod**)
- c files (***.c**)
- project files (***.prj**)
- any other files

Drives

Select the drive containing the file that you want to open.

2.13.3 File / Close

Closes the topmost editing window.

2.13.4 File / Save

Saves the topmost editing window in the same file it was initially loaded from. If the topmost editing window was created by **New**, then it prompts for a filename to save to.

2.13.5 File / Save As...

Prompts for a filename to save to, using the **File Save As** dialog, and then saves the topmost editing window in that file.

The following options allow you to specify the name and location of the file you are about to save:

File Name

Type a new filename to save a document with a different name. A filename can contain up to eight characters and an extension of up to three characters. MODSIM III Workbench adds the extension you specify in the **Save File As Type** box.

Drives

Select the drive in which you want to store the document.

Directories

Select the directory in which you want to store the document.

2.13.6 File / Print...



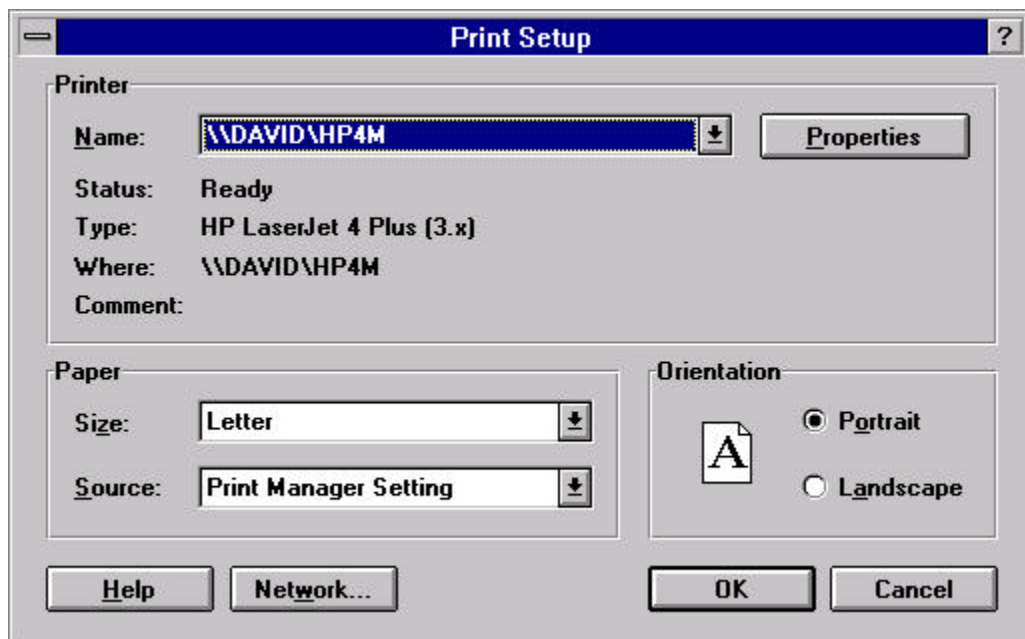
The **Print...** dialog lets you specify how you want to print the document in the topmost editing window.

2.13.7 File / Print Preview

The **Print Preview** command shows how the document in the topmost editing window will appear when printed.

2.13.8 File / Print Setup...

The **Print Setup** dialog lets you change the current printer, and how the current printer behaves.



The following options allow you to select the destination printer and its connection.

Printer

Select the printer you want to use. Choose the **Default Printer**; or choose the **Specific Printer** option and select one of the current installed printers shown in the box. You install printers and configure ports using the Windows **Control Panel**.

Orientation

Choose **Portrait** (normal) or **Landscape** (sideways).

Paper Size

Select the size of paper that the document is to be printed on.

Paper Source

Some printers offer multiple trays for different paper sources. Specify the tray here.

Options

Displays a dialog box where you can make additional choices about printing, specific to the type of printer you have selected.

Network...

Choose this button to connect to a network location, assigning it a new drive letter.

2.13.9 File / 1. Z:\modsim\....

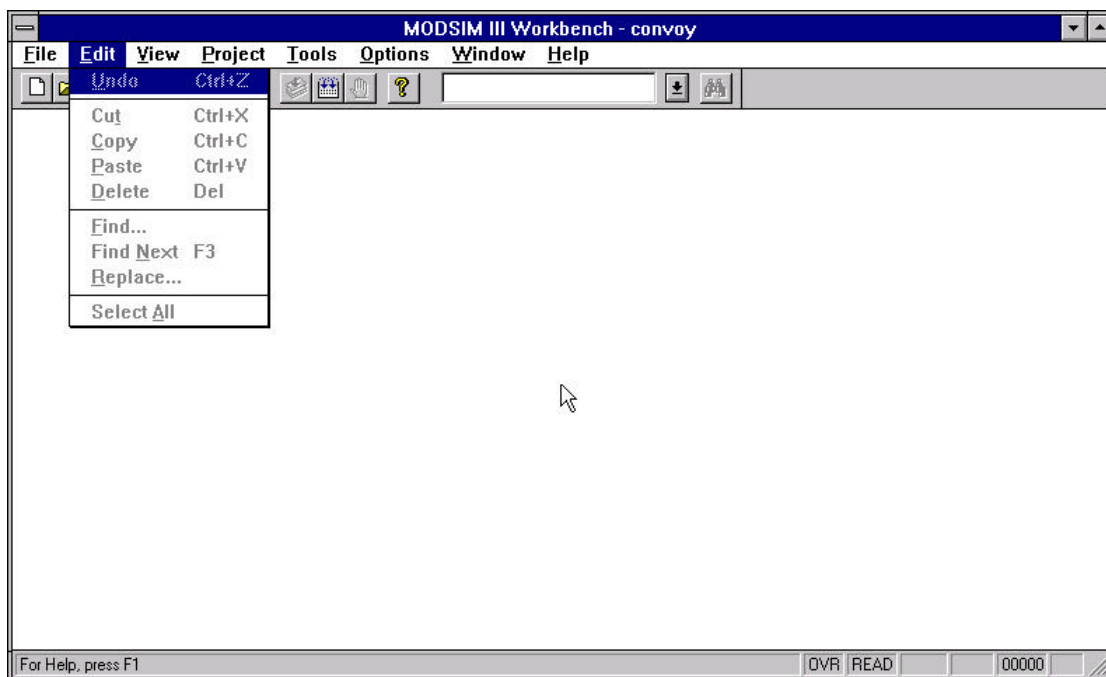
MODSIM III Workbench remembers the last four files you edited, and lists them in the **File** menu. You can instantly **Open** one of these files by selecting the corresponding menu item.

2.13.10 File / Exit

Exit saves any work in progress, and quits MODSIM III Workbench.

2.14 Edit Menu

The **Edit** menu provides the functionality available to all Windows programs.



2.14.1 Edit / Undo

If the last editing command is reversible, selecting **Undo** will reverse it.

2.14.2 Edit / Cut



If text is currently selected in the topmost editing window, this command deletes it and puts it into the clipboard.

2.14.3 Edit / Copy



If text is currently selected in the topmost editing window, this command copies it and puts it into the clipboard.

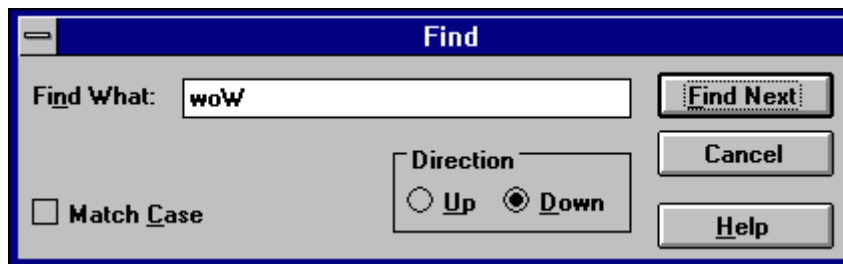
2.14.4 Edit / Paste



Paste the text on the clipboard into the topmost editing window at the current cursor position.

2.14.5 Edit / Find...

Use this option to find the first occurrence of a string, after the cursor position. Use the **Find** dialog to locate a specific string.



Check **Match Case** if the capitalization of the characters in the search string should be considered when looking for a match. Otherwise, characters will match even if one is uppercase and the other lowercase.

Select **Up** to search backwards from the current cursor position. Select **Down** to search down from the current cursor position.

Type the string to match in the **Find What** field.

Press **Find Next** to begin the search. MODSIM III Workbench will beep if no matching string is found.

2.14.6 Edit / Find Next:

Finds the next occurrence of the string most recently specified through the **Find** command.

2.14.7 Edit / Replace...

Use this option to replace all occurrences of one string by another. The topmost editing window is scanned, from the current cursor location to the end, to find text to replace.

Type the text to search for in the **Find What** field. Check **Match Case** if you want capitalization to be considered when searching.

Type the text to replace with in the **Replace With** field.

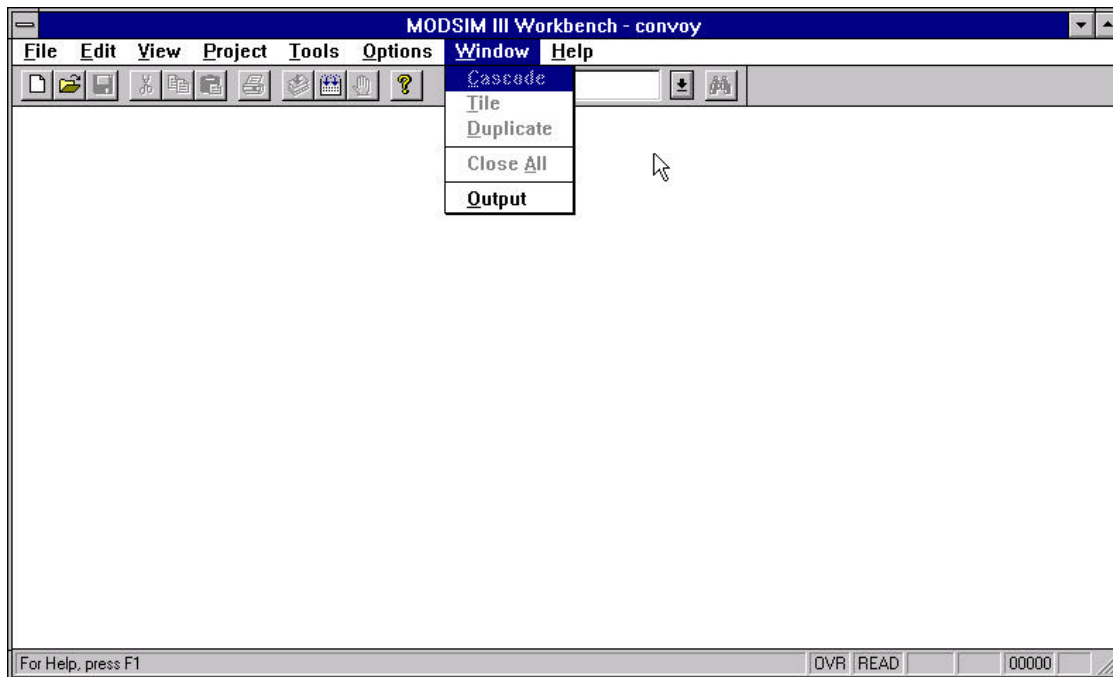
Find Next will select the first text after the current cursor position which matches the search text.

If **Text Matching the Search Text** is selected, then pressing **Replace** will replace the selection with the replacement text. Pressing **Replace All** will replace the selection, and all further matches, with the replacement text.

2.14.8 Edit / Select All

Selects all the text in the topmost editing window.

2.15 Window Menu



The **Window** menu offers the following commands, which enable you to arrange multiple views of multiple documents in the application window:

2.15.1 Window / Cascade

Arranges the windows in an overlapping fashion, so that any window can be selected.

2.15.2 Window / Tile

Arranges the windows so that each is visible, but none overlap.

2.15.3 Window / Duplicate

Makes a new editing window onto the same file as the topmost window.

2.15.4 Window / Close All

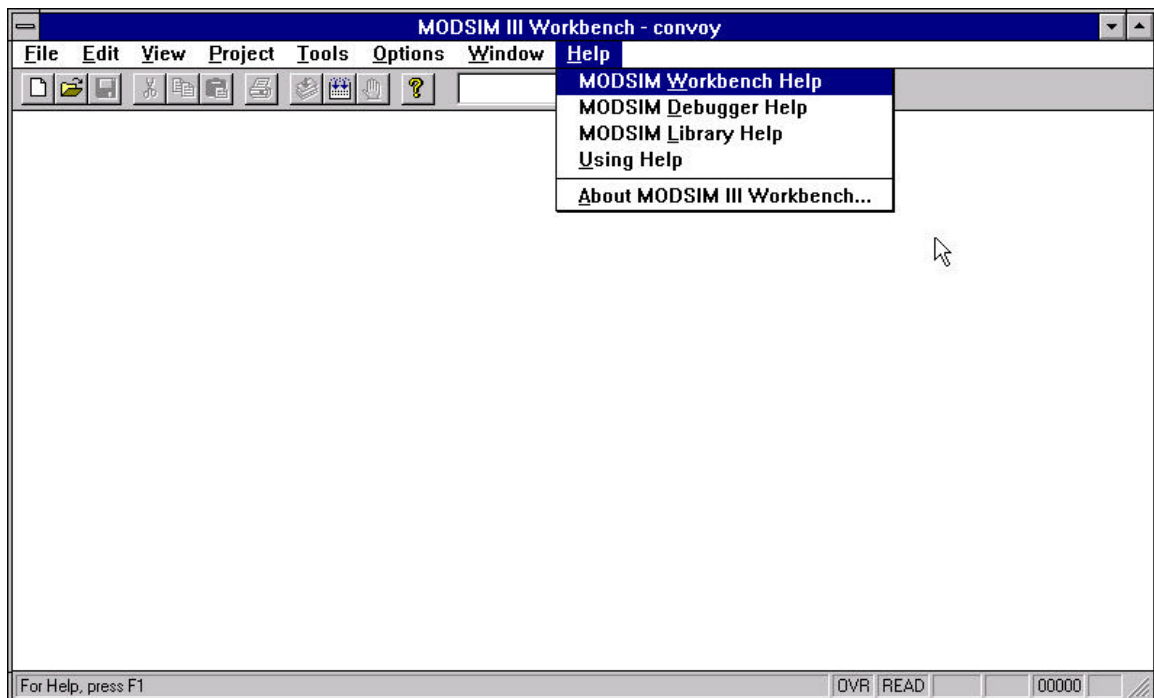
Closes all open windows.

2.15.5 Window / Output

Displays the **Output** window, which captures the output of the MODSIM compiler, linker, etc.

2.16 Help Menu

The **Help** menu offers the following commands, which provide help with MODSIM III Workbench questions.



2.16.1 Help / MODSIM Workbench Help

Displays the table of contents to the MODSIM III Workbench Help.

2.16.2 Help / Debugger Help

Displays the table of contents to the Debugging Help.

2.16.3 Help/MODSIM Library Help

Displays help on the MODSIM runtime and SIMGRAPHICS II libraries.

2.16.4 Help / Using Help

Gives instructions on using Windows Help.

2.16.5 Help / About ModBench








Choosing **About ModBench** from the **Help** menu, or selecting it from the toolbar, brings up a dialog box that gives the version and copyright of MODSIM III Workbench.

2.17 The Workbench Toolbar

The toolbar is displayed across the top of the application window, below the menu bar. The toolbar provides quick mouse access to many tools used in MODSIM III Workbench.



To hide or display the Toolbar, choose **Toolbar** from the View menu.

Click	To
	Open a new document. A shortcut for File/New .
	Open an existing document. A shortcut for File/Open .
	Save the active document or template with its current name. A shortcut for File/Save .
	Remove selected data from the document and store it on the clipboard. A shortcut for Edit/Cut .
	Copy the selection to the clipboard. A shortcut for Edit/Copy .
	Insert the contents of the clipboard at the insertion point. A shortcut for Edit/Paste .
	Build the project.



Re-build all modules in the project.



Stop Build at next opportunity.



Print the active document. A shortcut for **File/Print**.



Displays the **About** box.



Initiates Context Sensitive Help.

2.18 The Workbench Status Bar

The status bar is displayed at the bottom of the MODSIM III Workbench window. To display or hide the status bar, use the **Status Bar** command in the **View** menu.



The left area of the status bar describes actions of menu items as you use the arrow keys to navigate through menus. This area similarly shows messages that describe the actions of toolbar buttons as you depress them, before releasing them. If after viewing the description of the toolbar button command, you wish not to execute the command, release the mouse button while the pointer is off the toolbar button.

The right areas of the status bar indicate which of the following keys are latched down:

Indicator	Description
CAPS	The Caps Lock key is latched down.
NUM	The Num Lock key is latched down.

The rightmost windows indicate the line and column number of the active edit window.

Context Help Command



Use the Context Help button to obtain help on some portion of MODSIM III Workbench. When you choose the Toolbar's Context Help button, the mouse pointer will change to an arrow and question mark. Then click somewhere in the MODSIM III Workbench window, such as on another Toolbar button. The Help topic will be shown for the item you clicked. Shortcut: Keys: **SHIFT+F1**

Title Bar

The title bar is located along the top of a window. It contains the name of the application and document.

To move the window, drag the title bar.

Note: You can also move dialog boxes by dragging their title bars. A title bar may contain the following elements:

- Application Control-menu button
- Document Control-menu button
- Maximize button
- Minimize button
- Name of the application
- Name of the document
- Restore button

Scroll Bars

Displayed at the right and bottom edges of the document window. The scroll boxes inside the scroll bars indicate your vertical and horizontal location in the document. You can use the mouse to scroll to other parts of the document.

Size Command (System Menu)



Use this command to display a four-headed arrow so you can size the active window with the arrow keys. After the pointer changes to the four-headed arrow:

1. Press one of the DIRECTION keys (left-, right-, up-, or down-arrow key) to move the pointer to the border you want to move.
2. Press a DIRECTION key to move the border.
3. Press **Enter** when the window is the size you want.

Note: This command is unavailable if you maximize the window.

Shortcut: Mouse: Drag the size bars at the corners or edges of the window.

Move Command (System Menu)




Use this command to display a four-headed arrow so you can move the active window or dialog box with the arrow keys.

Note: This command is unavailable if you maximize the window.

Shortcut: Keys: **CTRL+F7**


Minimize Command (System Menu)

Use this command to reduce the MODSIM III Workbench window to an icon.

Shortcut: Mouse: Click the minimize icon  on the title bar.
Keys: **ALT+F9**

Maximize Command (System Menu)

Use this command to enlarge the active window to fill the available space.

Shortcut: Mouse: Click the maximize icon  on the title bar; or double-click the title bar.
 Keys: **CTRL+F10** enlarges a document window.

Next Window Command (Document System Menu)

Use this command to switch to the next open document window. MODSIM III Workbench determines which window is next according to the order in which you opened the windows.

Shortcut: Keys: **CTRL+F6**

Previous Window Command (Document System Menu)

Use this command to switch to the previous open document window. MODSIM III Workbench determines which window is previous according to the order in which you opened the windows.

Shortcut: Keys: **SHIFT+CTRL+F6**



Close Command (System Menu)

Use this command to close the active window or dialog box. Double-clicking a System-menu box is the same as choosing the **Close** command.

Shortcuts: Keys: **CTRL+F4** closes a document window.
ALT+F4 closes the window or dialog box.

Restore Command (System Menu)

Use this command to return the active window to its size and position before you chose the Maximize or Minimize command.

Switch to Command (Application System Menu)

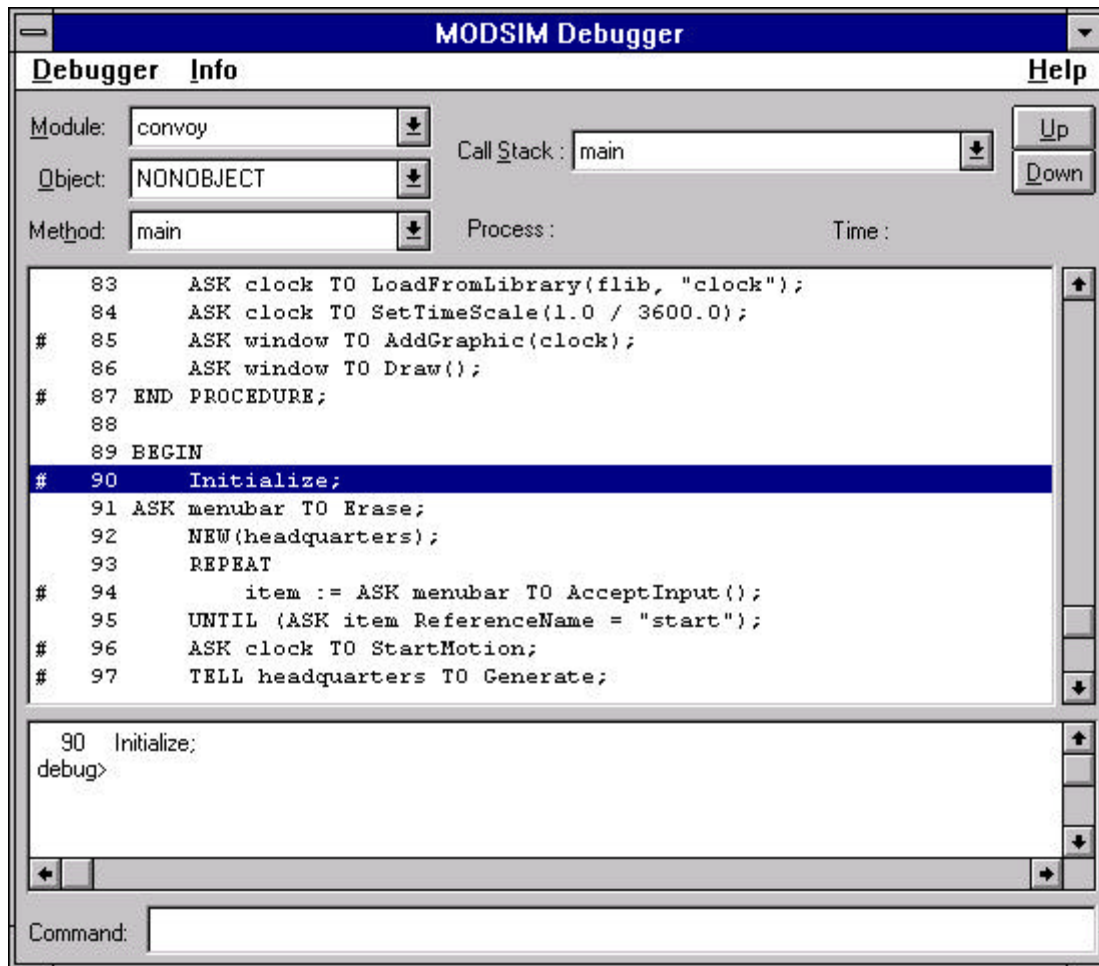
Use this command to display a list of all open applications. Use this "Task List" to switch to or close an application on the list. Shortcut: Keys: **CTRL+ESC**

3. The MODSIM III Debugger

MODSIM III provides built-in debugging capabilities to your application. You can either start up your application in debugging mode or execute it normally, allowing MODSIM to drop you into debugging mode if a runtime error occurs. Unlike conventional debuggers, it is not necessary to restart your application under control of a debugger to determine the cause of an error. Once your application has entered debugging mode, you can examine variables, browse up and down the execution stack, print simulation statistics, memory usage, etc. If you enter into debugging mode before a fatal error occurs, you can have full control of what points in the code you wish to stop at for more detailed examination or can set up automatic watching of chosen variables.

Enabling debugging support in your MODSIM III program has minimal impact to either compile-time or runtime performance. It is convenient to leave debugging enabled throughout the development phase of writing an application. Then when you are convinced that the program is correct, you can recompile the entire application without debugging support.

There are some differences between debugging on Microsoft Windows systems and on Unix systems. On MS Windows systems you can enter debugging commands through the graphical user interface. On Unix systems, you enter debugging commands at the command line. These commands also work on MS Windows systems, and are entered via a command line window at the bottom of the debugging window (see figure below). In what follows, we distinguish between what applies to MS Windows systems only (labelled *MS Windows*) and what applies everywhere (labelled *Unix*).



3.1 Basics

To debug your program:

1. Compile your main module and any other modules you desire with debugging support enabled. This procedure is described in detail in paragraph 3.3 below.
2. On systems running Microsoft Windows 95 or NT, select **Debug** from the **Project** menu of MODSIM III Workbench. On other systems, you debug a program by giving it the argument "**-msdebug**" when you start it up. A DOS window may be opened and the program name entered with **-msdebug** as a parameter; a **Return** will then cause the program to execute with the debugger active. If your program also has arguments, you can place the "**-msdebug**" flag before, after, or in the middle of the other arguments to your program. The flag will be stripped away before your program sees it.

Your program will stop at the first executable statement in your code including the mod inits (these may be stepped over with the "**continue**" command or stepped into using the "**step in**" command, displaying the debugger graphical interface. You can either use the command line interface or, in Windows, use the **Tool** palette and dialogs to control the debugger.

Essential commands for the command line interface are:

- **step** : continue to next executable line, stepping into procedures
- **next** : continue to next executable line, stepping over procedures
- **continue** : continue to the next breakpoint
- **break** : set a breakpoint at the current line, at a function entry, or at a specified line number
- **traceback** : show the calling chain that led to the current method or procedure
- **print <variable name>** : print the value of a variable
- **locals** : show all of the local variables
- **fields** : show all of the fields of the object that is currently executing.

Most Microsoft Windows users will opt to use the **Tool** palette to control execution and to set and clear breakpoints with the click of a mouse.

3.2 Interfacing with the Debugger

You can control the execution of your program and examine its state either through the graphical interface (on MS Windows systems) or a command line interface (available on all systems).

Unix

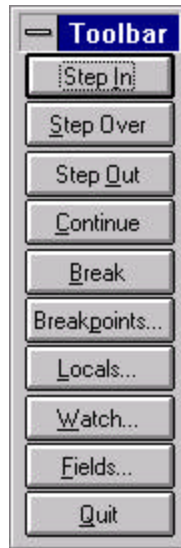
Most commands entered into the command line interface can be shortened or abbreviated. The command reference provides details for each individual command. For instance, **disable breakpoint** can be abbreviated as **d** or **show modules** can be shortened to **sh m**.

All command line interface commands are terminated by a carriage return. A carriage return by itself has a special significance. Its general meaning is to do the next logical thing. For instance, a carriage return entered by itself after a **list** command will cause additional source code to be displayed from the source code line where the previous listing ended. Typically, a carriage return by itself will repeat the previous command. For instance, after entering a **step** command, additional **step** commands can be generated by pressing carriage returns.

MS Windows

The main dialog has one primary window and a movable **Toolbar** palette of debugger commands. The MODSIM **Debugger** window (shown above) displays the code which is currently executing, the currently selected stack frame, or code which you are navigating through. A command line interface window appears at the bottom of the primary window and allows entering commands directly. A trace log of all issued debugger commands and their results is copied to the file **msdebug.tra** . This provides a log of the entire debugging session.

The buttons **Step In**, **Step Over**, **Step Out** and **Continue** on the **Toolbar** palette (shown below) perform identically to entering the corresponding commands **step**, **next**, **step-out** and **continue** from the command line interface.



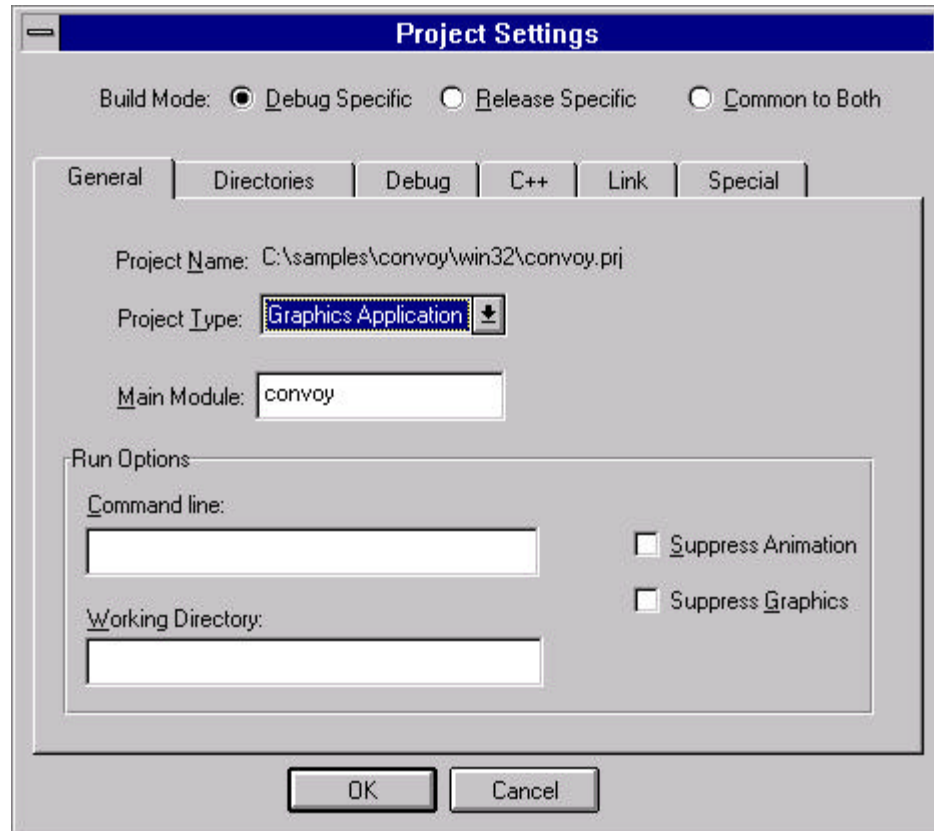
3.3 Compiling for Debugging

MS Windows

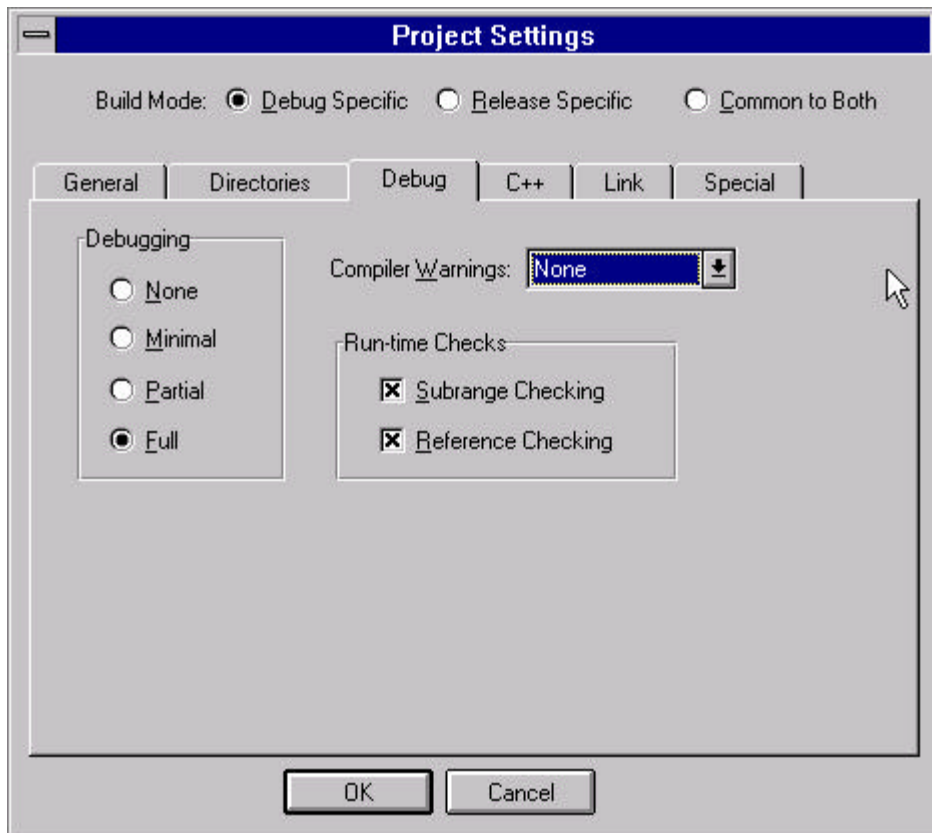
From the MODSIM Workbench Menu select **Project** and then **Settings ...**



A tabbed window will appear which contains a number of compilation, linking and debugging settings. These settings will be used by the various tools in the creation of an executable module. Note that the three radio buttons on the top indicate whether the code will be compiled and linked with debugging on or for release (debugging suppressed).



When the **Debug Specific** tab is selected, even more granularity regarding the code being compiled can be selected. This includes the level of error messages and range checking. These selections control the amount of code placed in the executable as debugger runtime libraries and may affect execution performance.



Unix

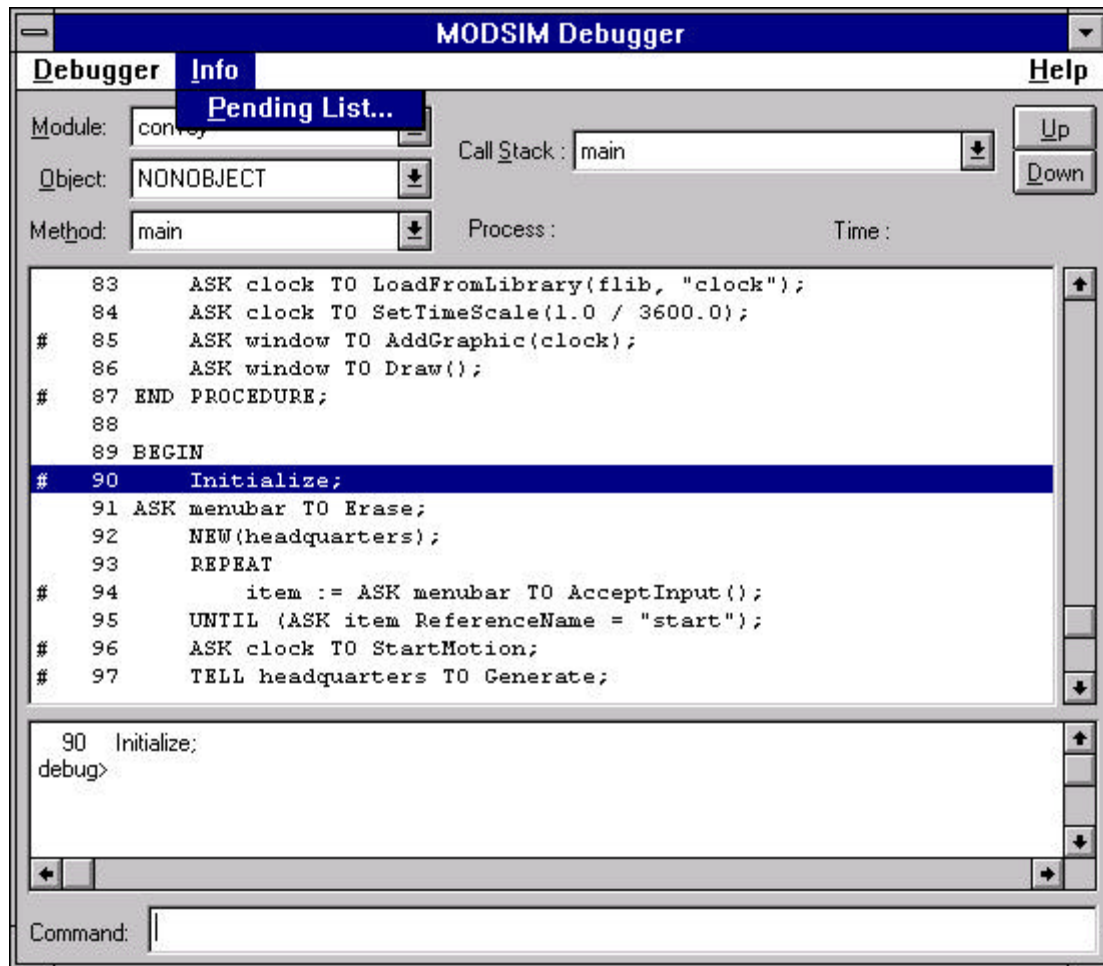
On other systems, enable debugging support with **mscomp** or edit the **mscomp.cfg** file to turn debugging support on in **mscomp**.

To terminate your program use the **quit** command.

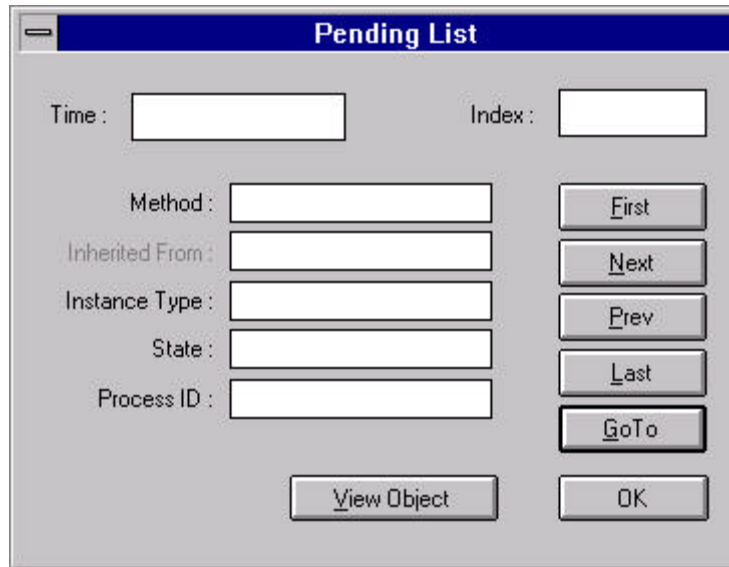
3.4 Examining Memory and Simulation Statistics

MS Windows

To browse the pending list of scheduled activities, select **Info** and then **Pending List** from the main menu in the MODSIM III **Debugger** window.



By selecting **First**, **Next**, **Last**, and **GoTo**, you can browse up and down the pending list. To examine all of the fields of the object whose activity is being viewed, select **View Object**.



Unix

Simulation time can be printed by using the command line interface command **simtime**. The **pendinglist** command prints the entire list of pending activities. An aid to debugging memory leaks is the **memstats** command. It displays a list of all the objects, records, and strings which have been allocated. A copy of the list is also written to the file "msdebug.mem".

3.5 Running

MS Windows

If you start your application in debugging mode, you can control its execution either from the **Toolbar** palette or from the command line interface. The **Toolbar** palette has the buttons **Step In**, **Step Out**, **Step Over**, and **Continue**. The corresponding command line interface commands are **step**, **stepout**, **next**, and **continue**.

Unix

Use **step** if you just wish to execute the next executable line. If the next executable line is a procedure or method call, then the **step** command will cause the program to stop at the first line of that procedure or method. However, if you do not wish to stop in a called procedure or method, then use the **next** command. Both **step** and **next** will take an integer argument which specifies how many lines to execute. For instance, you can stop at the fifth line from the current location by using **next 5**.

The **continue** command will cause your program to stop at the next breakpoint. Breakpoints can be added with the **break** command, clicking on a line in the source window, or by using the **Breakpoints** dialog box.

To terminate your program use the **quit** command.

3.6 Setting Breakpoints

MS Windows

Setting a breakpoint can be accomplished by clicking on a line in the source window, by using the **Breakpoints** dialog box, or by using the **break** command .

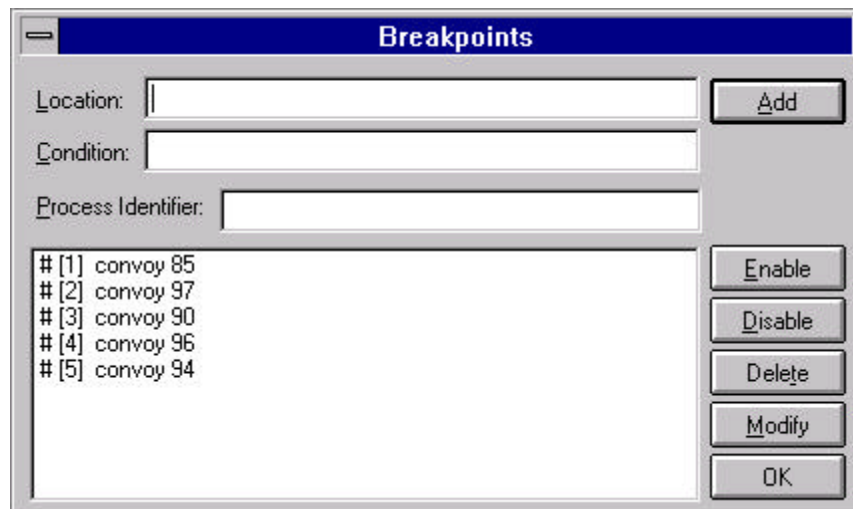
Unix

At the command line, you can create a breakpoint by specifying a line number or the entry point of a procedure or method. Assuming there is a method named **foo** in an object type **myObjectType** which has been defined in the module name **myModule**, you can explicitly set the breakpoint at the first executable line of **foo** by entering the command :

break myModule.myObjectType.foo.

If an explicit description of the breakpoint location is not given, then the current context is used to fill in the missing details. For instance, if you enter **break foo**, then a breakpoint will be set at the method **foo**, if the currently executing object has such a method. If it does not, then it will try to set a breakpoint at a procedure named **foo**.

At any time you can view the breakpoints which are currently in effect by using the **Breakpoints** dialog box. If you want to delete an existing breakpoint, select the breakpoint and press the **Delete** button. If you want to disable or enable an existing breakpoint, simply double click on it.



3.7 Examining Source Code

MS Windows

Every time your program stops, the currently executing code is displayed in the source window. You can browse other source code by selecting the desired module, object type, and method in the source code selector. Otherwise, you can use the cursor bar to scan through the source code in the currently displayed module.

If the source window is empty except for line numbers, it is probably because the debugger is not able to find the source code. In this case, use the `option` (or the `dir`) command to specify the source code directory.

Unix

Every time your program stops, the debugging window will display the next MODSIM statement that will be executed. In order to display the surrounding source code or to display source code in another module or procedure, use the `list` command. If the `list` command cannot find the source file, then the directory to find source files must be added to the source file search path using the `option` command.

3.8 Examining Variables

MS Windows

There are various facilities available for examining the values of variables. If you want to see all of the local variables, use the **Locals** button in the **Toolbar** palette or use the `locals` command. To see all of the fields of the currently executing object, use the **Fields** button in the **Toolbar** palette.

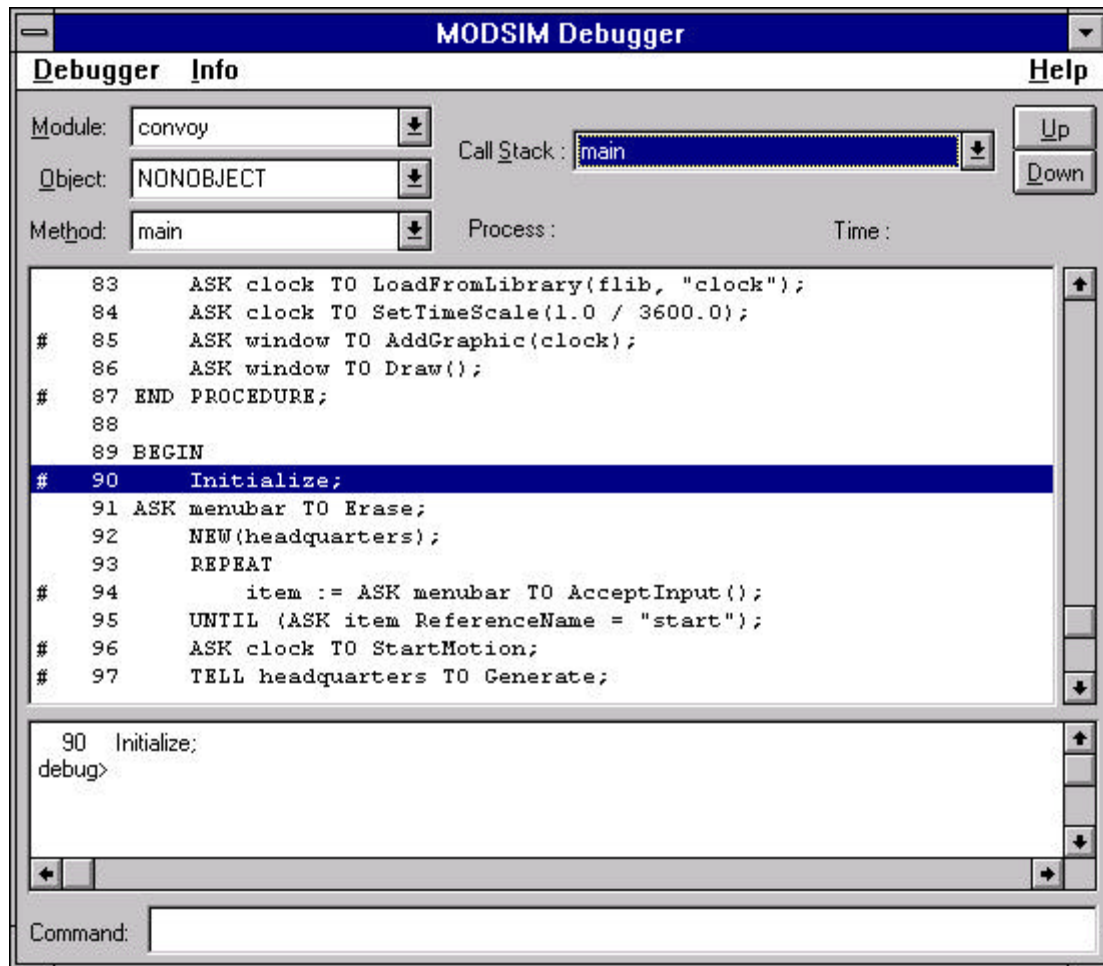
Note: Double clicking on an object or a dynamic record in any of the variable inspector dialog boxes will cause that object or record to expand, displaying all of its fields. A subsequent double click will cause it to contract.

Unix

If you want to see all of the local variables, use the `locals` command. To see all of the fields of the currently executing object, enter `fields` on the command line. If you want to see all of the fields of an object which is not the currently executing object use the `print` command. For instance, if there is an object named `myInstance` visible in the current scope, then you can print all of its fields by entering the command `print myInstance`. To print the value of a single variable, use the `print` command (i.e. `print myVariable`). If `myVariable` is the field of the object named `myObject`, then enter the command `print myObject.myVariable`.

3.9 Examining the Stack

Often when debugging, you want to know what was the sequence of the procedure or method calls which led to the current piece of code that is being executed. This information is continuously available in the **Call Stack** box in the main **MODSIM Debugger** window. You can also use the command line interface `traceback` command to print the call stack. This requested information is appended to the file `msdebug.tra`. The methods and procedures which comprise the call chain are numbered starting at 0 for the current method or procedure and ending at main with the highest number.



For a more in-depth examination of any of the methods or procedures on the stack, use **up**, **down**, and **frame** commands to focus on a particular frame.

3.10 Recording and Playing Back Commands

It is often a good idea to record all of the debugging commands that are entered in a debugging session. Once you discover a bug, you can fix it, and then verify that the fix was successful by playing back the sequence of commands that originally uncovered the bug.

The **record** command copies all of the commands that you subsequently enter to a file. To playback these commands use the **playback** command.

3.11 Specifying Source File Search Path

The debugger keeps a list of directories which contain debuggable source code for a program. To add directories to this list, use the option (or the **dir**) command.

3.12 Animating Code Execution

To watch source code as your program is executing, simply issue a **step** command with a large argument (e.g. 1000). The debugging display window will indicate every context change and each line of source code as it is being executed.

3.13 Displaying Methods of an Object Type

Use the **print** command to display all of the methods of an object type. For example, if there is an object type **myObjectType** in your program, enter the command **print myObjectType**.

3.14 Displaying Fields of an Object Instance

The fields window is constantly updated with the fields of the object that is currently executing or with the object which is in focus as a result of selecting another method on the call stack. Use the **show fields** command to print all of the fields of an object instance to the transcript window. The **print** command can be used to display the fields of an object that is in the scope of the current context. For example, **print myObject** will print all of the fields of **myObject**, if it is a local variable, a field of the object that is currently executing, or a global variable. **print SELF** will generate the same result as **show fields**.

3.15 Command Reference

Break

Synopsis:

Creates a breakpoint at a specified source location.

Abbreviations:

b, br, break, brkpt

Usage:

```
break
break <method or procedure name>
break <module name>.<procedure name>
break <module name>.<object type>.<method name>
break <line number>
break <module name> <line number>
```

Notes:

To set a breakpoint at the next executable line, use **break** without any arguments. If a line number is specified without any module name, then a break point will be set in the module that has source code for the current context.

If the name of a procedure and method name is specified, then a break point will be set at the first executable line of the method or procedure. You can forego a complete specification of the module name and object type name if the method that you want to break in is a member function of the currently executing object.

Continue

Synopsis:

Continues execution until the next breakpoint.

Abbreviations:

c, cont, continue

Usage:

```
continue
continue <number of breakpoints to ignore>
```

Notes:

The **continue** command will cause the program to stop at the next breakpoint if no optional argument is given. Otherwise, the specified number of breakpoints will be ignored.

Delete**Synopsis:**

Deletes a breakpoint.

Abbreviations:

de, del, delete

Usage:

delete

delete all

delete <break point id>

Notes:

The **delete** command will permanently remove a breakpoint from the list of breakpoints for your program. It cannot be restored with the **enable** command.

Entering **delete** or **delete all** will permanently remove all of breakpoints which have been previously defined.

Disable**Synopsis:**

Disables a breakpoint.

Abbreviations:

d, di, dis, disable

Usage:

disable

disable all

disable <breakpoint id>

Notes:

Entering **disable** or **disable all** will disable all of the breakpoints which have been set in your program. To disable a particular breakpoint, find its **id**

using the `show breakpoints` or `Show_Breakpoints` command. Then give the `id` as an argument to the `disable` command.

Down

Synopsis:

Moves the focus context forward in the calling chain towards the method or procedure that is currently executing.

Abbreviations:

`dn`, `down`

Usage:

```
down
down <number of frames>
```

Notes:

Down moves the focus context forward in the **calling chain** toward the method or procedure that is currently executing. By giving an argument to the command, you can make larger jumps down the stack. **Up** is used in conjunction with **down** to browse up and down the stack.

Enable

Synopsis:

Enables a particular breakpoint or all breakpoints.

Synonyms and Abbreviations

`e`, `en`, `enable`

Usage:

```
enable <breakpoint id>
enable
enable all
```

Notes:

To enable a particular breakpoint, you must use its breakpoint `id`. This can be found by using `show breakpoints` (abbreviated to `sh b`, if desired). To enable all breakpoints, just use `enable` by itself or append the keyword `all` (i.e. `enable all`).

Fields

Synopsis:

Displays all the fields of the object which is currently executing.

Abbreviations and synonyms

fields, fi, sh fields, info fields, show fields

Usage:

fields

Notes:

If the current context is a method, then all of the fields of the object will be displayed. Otherwise, an error message will indicate that the current context is not a method.

Frame

Synopsis:

Sets the focus context to a particular stack frame.

Abbreviations:

f, fr, frame

Usage:

frame

frame <frame number>

Notes:

Entering **frame** without any arguments, sets the focus context to frame 0 and displays all of its local variables. Otherwise, by giving an argument to the frame command, you can set the focus context to any particular frame.

Globals

Synopsis:

Displays all of the object types, record types, constants, free procedures, and module level variables in your program.

Abbreviations:

g, gl, glo, globals, shg, info globals, show globals

Notes:

This command displays all of the outer level symbols visible in the modules which have been compiled with debugging. If an object type that you are interested in debugging is not displayed in this list, then you must compile its module with debugging before you will be able to examine its fields or step through its methods.

List**Synopsis:**

Lists source code.

Abbreviations:

l, li, list

Usage:

```
list
list <method or procedure name>
list <module name>.<procedure name>
list <module name>.<object type>.<method name>
list <line number>
list <starting line number> <ending line number>
```

Notes:

Normally, the debugger looks for source code in the directory specified when the module was compiled. If the program or the source files were moved to a different directory, then the debugger will not know where to find them. In this case use the **option** command to add an additional search path for source files.

To list the source code that is currently being executed, simply use the **list** command without any arguments. By specifying a procedure or method name, the first twenty lines of that method or procedure will be listed. Entering a carriage return will cause the next twenty lines of source code to be displayed.

A line number can also be specified as the source location that you would like to view. In this case, the display will be centered around the line you specified.

If you want to list the source code of the method that called the current procedure, first use the **up** command to move up one stack frame and then issue the **list** command.

Locals

Synopsis:

Displays the values of local variables in the current context.

Abbreviations and synonyms

`lo, locals, show locals, info locals`

Usage:

`locals`

Notes:

Typically, `show locals` will display the local variables of the currently executing method or procedure (i.e. frame 0). More precisely, `show locals` will display all of the local variables of whatever **frame** is in focus. If an **up**, **down**, or **frame** command had been invoked prior to `show locals`, then the context that is in focus may be something other than frame 0. Immediately after any code has been executed, the focus always returns to frame 0.

Memstats

Synopsis:

Displays a list of the number of allocated instances of all object and record types, strings, and arrays in your program.

Abbreviations:

`me, mem, memstats`

Notes:

This command is very useful in discovering memory leaks in your program. By occasionally issuing this command and comparing results, it will become apparent if some objects are not being disposed of properly. A copy of this list will automatically be saved in the file "`msdebug.mem`", so that you can study it later, if necessary.

Next

Synopsis:

Stops program execution at the next executable line, stepping over procedures.

Abbreviations:

`n, ne, nex, next`

Usage:

`next`
`next <number>`

Notes:

Use the **next** command if you do not want to step into called methods or procedures.

Option

Synopsis:

Sets a debugging environment variable to a new value.

Abbreviations:

`opt, option`

Usage:

`option <variable name> = <new value>`

Debugging Environment Variables:

sourcedirectory

MODSIM keeps a list of directories which contain debuggable source code for a program. Normally, the only directory in this list is the directory that you specified in MODBENCH when you compiled your program. However, if you changed the location of your source code or your program, then MODSIM may not be able find your source code. Setting the **sourcedirectory** variable will add that directory as the first directory to search when looking for source code modules. Make sure that the source modules have not changed since your program was compiled. Otherwise, what MODSIM reports to be the next executable line may not correspond with what your program is actually doing. As a convenience, you can abbreviate the command string `option sourcedirectory = <new directory>` to `dir <new directory>`.

Pendinglist

Synopsis:

Displays a list of all of the objects which have activities scheduled on the pending list.

Abbreviations:

`pe, pl, pending, pendinglist`

Notes:

This command simply calls the MODSIM `PendingListDump` procedure. A copy of the pending list is also copied to the file `msdebug.pen` for later viewing.

Playback

Synopsis:

Executes debugging commands from a file.

Abbreviations and Synonyms:

`pl, play, playback, readcmd, readcmds, replay`

Usage:

```
playback
playback <filename>
```

Notes:

If no filename is given, commands will be executed from the file `msdebug.log`, if it exists. As soon as all of the commands in the file have been executed, you can issue commands from the command line or by pressing one of the execute buttons: **Step**, or **Next**.

Print

Synopsis:

Outputs the value of a variable or information about a type.

Abbreviations :

`p, print`

Usage:

```
print <identifier>
```



```
print <object or record instance>.<field
    identifier>.<field identifier> etc.
print <object type name>
```

Notes:

The current context is used to identify the variable. The identifier is searched for first in the local scope, then object scope, and finally in global scope. If the identifier is an object type, all of the methods of the object class will be displayed. If the identifier is an object instance, then the values of all of the fields of the object instance will be displayed.

To display the field of an object which is a field of another object which is a field of yet another object use the `.` notation (i.e. `print object.anotherObject.field`).

Quit**Synopsis:**

Quits the program.

Abbreviations and Synonyms:

`q`, `quit`, `bye`, `exit`

Notes:

The `quit` command terminates your program. If there are breakpoints or environmental variables that you would like to preserve over various debugging sessions, you can save the appropriate commands in a file and use the `playback` command to reinstall them for each debugging session.

Record**Synopsis:**

Records all of the commands entered in a debugging session to a file.

Abbreviations and Synonyms:

`rec`, `record`, `log`

Usage:

```
record
record <filename>
```

Notes:

Recording a log of all commands issued in a debugging session is a convenient way to return to the location of a previous bug. After you have fixed the bug, simply play back the log file using the **playback** command. This will help verify that the fix was indeed successful.

Show Breakpoints**Synopsis:**

Displays all of the breakpoints and their status.

Abbreviations and Synonyms:

shb, info breakpoints, show breakpoints

Notes:

Breakpoints are given a unique **id** when they are created. The **id** is used to specify a breakpoint that you wish to **disable**, **enable**, or **delete**.

If you wish to set certain breakpoints every time you debug a particular program, you can create a command file with the name **msdebug.ini** in the working directory. Each line of the command file should contain a **break** command with an explicit description of where you want to break. This command file can be created with a text editor or by using the **record** command.

Show Modules**Synopsis:**

Displays all of the modules and the pathnames of the Implementation modules in your program.

Abbreviations:

shm, sh modules, info modules, show modules

Usage:

show modules

Notes:

This command will display where MODSIM currently thinks the source code for your program is located. If this is incorrect, you can specify where to find source code with the **option sourcedirectory** option command.

Simtime

Synopsis:

Displays the current simulation time.

Abbreviations:

`sim, time, simtime`

Step

Synopsis:

Stops program execution at the next executable line, stepping into procedures.

Abbreviations:

`s, st, ste, step`

Usage:

`step`

`step <number>`

Notes:

Use the `step` command if you want to step into called methods or procedures. Unlike the `next` command, the `step` command will cause the program to stop in a called procedure. An integer argument after `step` instructs MODSIM to execute the step command `<number>` times. Giving a large number as an argument to the `step` command creates an animation effect. This is particularly useful in graphical simulation applications, since you can watch the graphics animation in one window and the corresponding code being executed in another window.

Traceback

Synopsis:

Displays the program stack.

Abbreviations and Synonyms:

`t, tb, bt, back, where, backtrace, stack, traceback, calls`

Notes:

The traceback displays a list of the methods and procedures on the program execution stack. These frames are numbered starting at 0 with the method or

procedure which is currently executing. The highest numbered frame is main which is the code in the **MAIN MODULE** between **BEGIN** and **END MODULE**.

To display the values of local variables in a particular frame, use the **frame** or **up** or **down** commands to focus on that frame. The **fields** command will display all of the object fields if the frame is an object method.

Up

Synopsis:

Moves the focus context backwards in the calling chain towards main.

Abbreviations:

u, up

Usage:

up

up <number of frames>

Notes:

To find the procedure or method that called the current procedure or method, use the **up** command. By giving an argument to the command, you can make larger jumps up the stack. **Up** is used in conjunction with **down** to browse up and down the stack.

4. Command Line Interface to MODSIM III Compiler

The MODSIM III compiler was designed to be managed by the **mscomp** compilation manager. The manager provides a high level Graphical User Interface (GUI). There may be occasions when you require direct access to the MODSIM III compiler. This chapter documents the command line interface to the compiler for such situations

The procedure would be as follows:

- Compile MODSIM source code to C++ using the command line interface to the MODSIM compiler.
- Using **mscomp**'s **Other** option, perform a single-module compile of the C++ code.
- Using **mscomp**'s **Other** option, perform a **Link All** to build an executable.

You give up the interactive support of **mscomp** but gain the ability to operate on a machine with limited memory availability

4.1 MODSIM III Compiler Command Line Options

Usage: `modsim <options> <imod>`

Directory options:

- i <dir> = search this directory for local imp modules
- d <dir> = search this director for local def modules
- L <dir> = search this directory for def mods, this option can be repeated for multiple directories.

Code Generation options:

- T = generate indented code
- H = generate header file only

Debugger options:

- t0 = no debugging
- t1 = minimal debugging (traceback only)
- t2 = partial debugging (library browse)
- t3 = full debugging
- s = turn OFF subrange checking
- r = turn OFF reference checking

General options:

-w0 = no compiler warnings
-w1 to 5 = set compiler warning level

4.2 An Example of Command Line Compilation

To compile the MODSIM module **ITank.mod** which is located in a directory above the current working directory.

On PC:

```
> modsim3 -t3 -T -L c:\modsim\fulldef -d .. .. \ITank.mod
```

On UNIX:

```
> modsim -t3 -T -L /installed/modsim3/lib -d .. ..  
/ITank.mod
```

5. MODSIM III's Standard Modules

MODSIM supports the following standard modules:

OSMod	Operating System interface
SimMod	Simulation objects and procedures
RandMod	Random number objects and procedures
GrpMod	Group objects and procedures
IOMod	IO objects and procedures
UtilMod	Utility procedures
MathMod	Math support procedures
Debug	Support utilities and metrics for debugging.
StatMod	Simulation statistics objects and procedures
ResMod	Resource object support for simulation

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