

# BORLAND® C++

## USER'S GUIDE

- INTEGRATED ENVIRONMENT
- OPTIMIZATION
- COMMAND-LINE COMPILER
- INSTALLATION

**B O R L A N D**

*Borland*<sup>®</sup> C++

Version 3.1

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User's Guide

BORLAND INTERNATIONAL, INC. 1800 GREEN HILLS ROAD  
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Windows, as used in this manual, refers to Microsoft's  
implementation of a windows system.

PRINTED IN THE USA.  
10 9 8 7 6 5

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# I N T R O D U C T I O N

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*Borland C++ fully supports  
Windows 3.1.*

Borland C++ is a professional optimizing compiler for C++ and C developers. With Borland C++, you get both C++ (AT&T version 3.0 compliant) and ANSI C. It is a powerful, fast, and efficient compiler with which you can create practically any application, including Microsoft Windows applications.

C++ is an object-oriented programming (OOP) language, and allows you to take advantage of OOP's advanced design methodology and labor-saving features. It's the next step in the natural evolution of C. It is portable, so you can easily transfer application programs written in C++ from one system to another. You can use C++ for almost any programming task, anywhere.

## What's in Borland C++

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*Chapter 1 tells you how to  
install Borland C++. This  
Introduction tells you where  
you can find out more about  
each of these features.*

Borland C++ includes the latest features programmers have asked for:

- **C and C++:** Borland C++ offers you the full power of C and C++ programming, with a complete implementation of the AT&T version 3.0 specification as well as a 100% ANSI C compiler. Borland C++ also provides a number of useful C++ class libraries, plus the first complete commercial implementation of templates, which allow efficient collection classes to be built using parameterized types.
- **Global optimization:** A full suite of state-of-the-art optimization options gives you complete control over code generation, so you can program in the style you find most convenient, yet still produce small, fast, highly efficient code.
- **Faster compilation speed:** Borland C++ cuts compilation time for C++ by up to half. Precompiled headers significantly

shorten recompilation time. Optimizations are also performed at high speed, so you don't have to wait for high-quality code.

- **DPMI compiler:** Compile huge programs limited only by the memory on your system. Borland C++ now uses industry-standard DPMI (DOS Protected Mode Interface) to allow the compiler (as well as the IDE, the linker, and other programs) to run in protected mode under DOS or Windows 386 Enhanced mode.
- **Microsoft Windows programming:** Borland C++ provides complete support for developing Windows applications, including dynamic link libraries (DLLs). Supports Standard and 386 Enhanced mode under Windows 3.0 and 3.1. Added support for Windows programming includes the Resource Compiler, the Help Compiler, and the Resource Workshop. We've also included many sample C and C++ Windows applications to help get you going.
- **EasyWin:** Automatic Windows-conversion feature lets you turn many standard DOS applications using **printf**, **scanf**, and other standard I/O functions into Windows applications without changing a single line of code. Just set a single compiler switch (or select Windows Application in the IDE), and your DOS program runs in a window.
- **Programmer's Platform:** Borland C++ comes with an improved version of the Programmer's Platform, Borland's open-architecture IDE that gives you access to a full range of programming tools and utilities, including
  - a multi-file editor, featuring both an industry-standard Common User Access (CUA) interface and a familiar alternate interface that is compatible with previous versions of Borland C++
  - advanced Turbo Editor Macro Language (TEML) and compiler
  - multiple overlapping windows with full mouse support
  - color syntax highlighting to help you visually distinguish elements in your source code
  - integrated resource compiling and linking, making it easy to develop Windows applications in a single environment
  - fully integrated debugger running in DPMI, for debugging large applications
  - a built-in assembler and support for inline assembler code

*The online file SAMPLES.DOC describes each of the sample programs.*

- complete undo and redo capability with an extensive buffer and much more.
- **Windows-hosted IDE:** The Borland C++ for Windows IDE lets you edit, compile, and run your programs under Windows, so you don't have to task switch between Windows and a DOS window to create Windows programs. This greatly increases your productivity by allowing you to program, compile, link, debug, and execute completely within the Windows environment. The Borland C++ for Windows IDE also includes
  - built-in ObjectBrowser that lets you visually explore your class hierarchies, functions and variables, locate inherited function and data members, and instantly browse the source code of any element you select
  - visual SpeedBar for instant point-and-click access to frequently used menu selections
- **WinSight:** Windows message-tracing utility lets you see inside your program's interaction with Windows.
- **VROOmm:** Borland C++'s Virtual Run-time Object-Oriented Memory Manager lets you overlay your code without complexity. You select the code segments for overlaying; VROOmm takes care of the rest, doing the work needed to fit your code into 640K.
- **Help:** Online context-sensitive hypertext Help, with copy-and-paste program examples for practically every function.
- **Streams:** Borland C++ includes full support for C++ iostreams, plus special Borland extensions to the streams library that allow you to position text, set screen attributes, and perform other manipulations to streams.
- **Container classes:** Advanced container class libraries giving you sets, bags, lists, arrays, B-trees, and other reusable data structures, implemented both as templates and as object-based containers for maximum flexibility.
- **Windows API:** The complete Windows API documentation in online Help.

**Other features:**

- Over 200 new library functions for maximum flexibility and compatibility
- Complex and BCD math, fast huge arithmetic

- Heap-checking and memory-management functions, with **far** objects and **huge** arrays
- Run-time library in a DLL for Windows applications
- New BGI fonts and BGI support for the full ASCII character set
- Shared project, configuration, and desktop files to let programmers work with the same environment whether they use the Programmer's Platform or the Windows-hosted IDE
- Response files for the command-line compiler
- NMAKE compatibility for easy transition from Microsoft C

## Hardware and software requirements

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Borland C++ runs on the IBM PC compatible family of computers, including the AT and PS/2, along with all true IBM-compatible 286, 386 or 486 computers. Borland C++ requires DOS 3.31 or higher, a hard disk, a floppy drive, and at least 640K plus 1MB of extended memory; it runs on any 80-column monitor. Borland C++ for Windows requires Windows 3.0 or higher in Standard or 386 Enhanced mode, at least 2MB of extended memory, and a Windows-compatible monitor.

Borland C++ includes floating-point routines that let your programs make use of an 80x87 math coprocessor chip. Borland C++ emulates the chip if it's not available. Though it's not required to run Borland C++, the 80x87 chip can significantly enhance the performance of your programs that use floating-point math operations.

Borland C++ also supports (but does not require) any Windows-compatible mouse. The Resource Workshop requires a mouse.

## The Borland C++ implementation

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Borland C++ is a full implementation of the AT&T C++ version 3.0. It also supports the American National Standards Institute (ANSI) C standard. In addition, Borland C++ includes certain extensions for mixed-language and mixed-model programming that let you exploit your PC's capabilities. See Chapters 1 through 4 in the *Programmer's Guide* for a complete formal description of Borland C++.

# The Borland C++ package

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Your Borland C++ package consists of a set of disks and nine manuals:

*The User's Guide tells you how to use this product; the Programmer's Guide and the Library Reference focus on programming in C and C++; the Tools and Utilities Guide describes and gives you instructions for using specialized programming tools.*

- *Borland C++ User's Guide (this manual)*
- *Borland C++ Tools and Utilities Guide*
- *Borland C++ Programmer's Guide*
- *Borland C++ Library Reference*
- *Resource Workshop User's Guide*
- *Turbo Debugger User's Guide*
- *Turbo Profiler User's Guide*
- *Turbo Assembler User's Guide*
- *Turbo Assembler Quick Reference*

The Borland C++ & Application Frameworks package also contains the following manuals:

- *Turbo Vision for C++ User's Guide*
- *ObjectWindows for C++ User's Guide*

In addition to these manuals, you'll find a convenient *Quick Reference* card.

The disks contain all the programs, files, and libraries you need to create, compile, link, and run your Borland C++ programs; they also contain sample programs, many standalone utilities, context-sensitive Help files, an integrated debugger, and additional C and C++ documentation not covered in these guides.

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## The User's Guide

The *User's Guide* introduces you to Borland C++ and shows you how to create and run both C and C++ programs. It consists of information you'll need to get up and running quickly, and provides reference chapters on the features of Borland C++: Borland's Programmer's Platform, including the editor and Project Manager, as well as details on using the command-line compiler. These are the chapters in this manual:

The **Introduction** introduces you to Borland C++ and tells you where to look for more information about each feature and option.

**Chapter 1: Installing Borland C++** tells you how to install Borland C++ on your system; it also tells you how to customize the colors, defaults, and many other aspects of Borland C++.

**Chapter 2: IDE basics** introduces the features of the Programmer's Platform, giving information and examples of how to use the IDE to full advantage. It includes information on how to start up and exit from the IDE.

**Chapter 3: Menus and options reference** provides a complete reference to the menus and options in the Programmer's Platform.

**Chapter 4: Managing multi-file projects** introduces you to Borland C++'s built-in project manager and shows you how to build and update large projects from within the IDE.

**Chapter 5: The command-line compiler** tells how to use the command-line compiler. It also explains configuration files.

**Appendix A: The Optimizer** introduces the concepts of compiler optimization, and describes the specific optimization strategies and techniques available in Borland C++.

**Appendix B: Editor reference** provides a convenient command reference to using the editor with both the CUA command interface and the Borland C++ alternate interface.

**Appendix C: Using EasyWin** provides a guide to using EasyWin to quickly and easily turn your DOS programs into applications that run under Microsoft Windows.

**Appendix D: Precompiled headers** tells you how to use Borland C++'s precompiled headers feature to save substantial time when recompiling large projects, especially Windows applications.

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## The Tools and Utilities Guide

This volume introduces you to the many programming tools and utility programs provided with Borland C++. It contains information you'll need to make full use of the Borland C++ programming environment, including the Make utility, the Turbo Librarian and Linker, WinSight, and special utilities for Microsoft Windows programming.

**Chapter 1: Import library tools** tells you how to use the IMPDEF, IMPLIB, and IMPLIBW utilities to define and specify import libraries.

**Chapter 2: Make: The program manager** introduces the Borland C++ MAKE utility, describes its features and syntax, and presents some examples of usage.

**Chapter 3: TLIB: The Turbo librarian** tells you how to use the Borland C++ Turbo Librarian to combine object files into integrated library (.LIB) files.

**Chapter 4: TLINK: The Turbo linker** is a complete reference to the features and functions of the Turbo Linker (TLINK).

**Chapter 5: Using WinSight** provides instructions for using WinSight to inspect your programs running under Microsoft Windows.

**Chapter 6: RC: The Windows Resource Compiler** tells you how to use the Resource Compiler to compile .RC scripts into .RES resource files for your Windows programs.

**Chapter 7: HC: The Windows Help Compiler** contains instructions for using the Help Compiler to create help systems for your Microsoft Windows programs.

**Appendix A: Error messages** lists and explains run-time, compile-time, linker, librarian, and Help Compiler errors and warnings, with suggested solutions.

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## The Programmer's Guide

The *Programmer's Guide* provides useful material for the experienced C user: a complete language reference for C and C++, writing Windows applications, C++ streams, memory models, mixed-model programming, video functions, floating-point issues, and overlays, plus error messages.

**Chapters 1 through 4: Lexical elements, Language structure, C++ specifics, and The preprocessor** describe the Borland C++ language.

**Chapter 5: Using C++ streams** tells you how to use the C++ iostreams library, as well as special Borland C++ extensions for Windows.

**Chapter 6: The container class library** tells you how to use the Borland C++ container class library in your programs.

**Chapter 7: Converting from Microsoft C** provides some guidelines on converting your Microsoft C programs to Borland C++.

**Chapter 8: Building a Windows application** introduces you to the concepts and techniques of writing applications for Microsoft Windows using Borland C++.

**Chapter 9: DOS memory management** covers memory models, mixed-model programming, and overlays.

**Chapter 10: Math** covers floating-point and BCD math.

**Chapter 11: Video functions** is devoted to handling text and graphics in Borland C++.

**Chapter 12: BASM and inline assembly** tells how to write inline assembly language functions that can be assembled with the built-in assembler (BASM) and used within your Borland C++ program.

**Appendix A: ANSI implementation-specific standards** describes those aspects of the ANSI C standard that have been left loosely defined or undefined by ANSI, and how Borland has chosen to implement them.

## The Library Reference

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The *Library Reference* contains a detailed list and explanation of Borland C++'s extensive library functions and global variables.

**Chapter 1: The main function** describes the **main** function.

**Chapter 2: The run-time library** is an alphabetically arranged reference to all Borland C++ library functions.

**Chapter 3: Global variables** defines and discusses Borland C++'s global variables.

**Appendix A: Library cross-reference** provides a complete indexed locator reference to all Borland C++ library functions.

## Using the manuals

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The manuals are arranged so that you can pick and choose among the books and chapters to find exactly what you need to know at the time you need to know it. The spine of each manual contains a bulleted list of the major contents of that manual, making it easy to pick up the right manual from your bookshelf. The *User's Guide* provides information on how to use Borland C++ as a product;

the *Programmer's Guide* and the *Library Reference* provide material on programming issues in C and C++.

Chapter 1 of this manual (the *User's Guide*) tells you how to install Borland C++ and how to customize Borland C++'s defaults. Use the remaining chapters of the *User's Guide* as reference chapters to using Borland C++'s IDE, editor, project manager, command-line compiler, precompiled headers, and online utilities.

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## Programmers learning C or C++

*Borland also offers its Visions video training series: "World of C++" for learning C++ and "World of ObjectWindows for C++" for learning ObjectWindows.*

If you don't know C or C++, there are many good products on the market that can get you going in these languages. You can use Chapters 1 through 5 in the *Programmer's Guide* for reference on specific technical aspects of Borland C++.

Your next step is to start programming in C and C++. You'll find Chapter 2, "The run-time library," in the *Library Reference* to be a valuable reference on how to use each function. Chapter 1, "The main function," provides information about the **main** function that is seldom found elsewhere. Or, you might prefer to use the online Help; it contains much of the same information as the *Library Reference*, and includes programming examples that you can copy into your own programs. Once you've grown comfortable with programming, you might want to move into the more advanced issues covered in the *Programmer's Guide*.

---

## Experienced C and C++ programmers

If you are an experienced C or C++ programmer and you've already installed Borland C++, you'll probably want to jump immediately to the *Programmer's Guide* and to the *Library Reference*.

The *Programmer's Guide* covers certain useful programming issues, such as C++ streams, assembly language interface, memory models, video functions, overlays, and far and huge pointers. If you're interested in writing a Windows application in C++, Chapter 8, "Building a Windows application," provides an overview.

# Typefaces and icons used in these books

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All typefaces and icons used in this manual were produced by Borland's Sprint: The Professional Word Processor, on a PostScript laser printer.

- Monospaced type** This typeface represents text as it appears onscreen or in a program. It is also used for anything you must type literally (such as BC to start up Borland C++).
- ALL CAPS** We use all capital letters for the names of constants and files.
- [ ] Square brackets [ ] in text or DOS command lines enclose optional items that depend on your system. *Text of this sort should not be typed verbatim.*
- < > Angle brackets in the function reference section enclose the names of include files.
- Boldface** Borland C++ function names (such as **printf**), class, and structure names are shown in boldface when they appear in text (but not in program examples). This typeface is also used in text for Borland C++ reserved words (such as **char**, **switch**, **near**, and **cdecl**), for format specifiers and escape sequences (**%d**, **\t**), and for command-line options (**/A**).
- Italics* *Italics* indicate variable names (identifiers) that appear in text. They can represent terms that you can use as is, or indicate that you can think up new names for those terms (your choice, usually). They are also used to emphasize certain words, such as new terms.
- Keycaps** This typeface indicates a key on your keyboard. For example, "Press *Esc* to exit a menu."
-  This icon indicates keyboard actions.
-  This icon indicates mouse actions.
-  This icon indicates language items that are specific to C++. It is used primarily in the *Programmer's Guide*.
-  This icon indicates material that applies to Borland C++ for Windows, or that relates specifically to writing a Windows program.

# How to contact Borland

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Borland offers a variety of services to answer your questions about this product. Be sure to send in the registration card; registered owners are entitled to technical support and may receive information on upgrades and supplementary products.

## Resources in your package

This product contains many resources to help you:

- The manuals provide information on every aspect of the program. Use them as your main information source.
- While using the program, you can press *F1* for help.
- Many common questions are answered in the DOC files listed in the README file located in the program directory.

## Borland resources

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800-822-4269 (voice)  
TechFax

Borland Technical Support publishes technical information sheets on a variety of topics and is available to answer your questions.

TechFax is a 24-hour automated service that sends free technical information to your fax machine. You can use your touch-tone phone to request up to three documents per call.

408-439-9096 (modem)  
File Download BBS  
2400 Baud

The Borland File Download BBS has sample files, applications, and technical information you can download with your modem. No special setup is required.

Subscribers to the CompuServe, GEnie, or BIX information services can receive technical support by modem. Use the commands in the following table to contact Borland while accessing an information service.

### Online information services

Service	Command
CompuServe	GO BORLAND
BIX	JOIN BORLAND
GEnie	BORLAND

Address electronic messages to Sysop or All. Don't include your serial number; messages are in public view unless sent by a service's private mail system. Include as much information on the

question as possible; the support staff will reply to the message within one working day.

*408-438-5300 (voice)  
Technical Support  
6 a.m. to 5 p.m. PST*

Borland Technical Support is available weekdays from 6:00 a.m. to 5:00 p.m. Pacific time to answer any technical questions you have about Borland products. Please call from a telephone near your computer, and have the program running. Keep the following information handy to help process your call:

- Product name, serial number, and version number.
- The brand and model of any hardware in your system.
- Operating system and version number. (Use the DOS command VER to find the version number.)
- Contents of your AUTOEXEC.BAT and CONFIG.SYS files (located in the root directory (\) of your computer's boot disk).
- The contents of your WIN.INI and SYSTEM.INI files (located in your Windows directory).
- A daytime phone number where you can be contacted.
- If the call concerns a problem, the steps to reproduce the problem.

*408-438-5300 (voice)  
Customer Service  
7 a.m. to 5 p.m. PST*

Borland Customer Service is available weekdays from 7:00 a.m. to 5:00 p.m. Pacific time to answer any nontechnical questions you have about Borland products, including pricing information, upgrades, and order status.

## Installing Borland C++

*Your Borland C++ package includes two different versions of Borland C++: the IDE (Programmer's Platform), the DOS command-line version, and Borland C++ for Windows, which runs as a true Windows application.*

*If you don't already know how to use DOS commands, refer to your DOS reference manual before setting up Borland C++ on your system.*

Borland C++ comes with an automatic installation program called **INSTALL**. Because we use file-compression techniques, you must use this program; you can't just copy the Borland C++ files onto your hard disk. **INSTALL** automatically copies and uncompresses the Borland C++ and Borland C++ for Windows files. For reference, the **README** file on the installation disk includes a list of the distribution files.

We assume you're already familiar with DOS commands. For example, you'll need the **DISKCOPY** command to make backup copies of your distribution disks. Make a complete working copy of your distribution disks when you receive them, then store the original disks away in a safe place.

None of Borland's products use copy-protection schemes. If you're not familiar with Borland's No-Nonsense License Statement, read the agreement included with your Borland C++ package. Be sure to mail us your filled-in product registration card; this guarantees you'll be among the first to hear about the hottest new upgrades and versions of Borland C++.

This chapter contains the following information:

- installing Borland C++ and Borland C++ for Windows on your system
- accessing the **README** file
- accessing the **HELPME!** file
- using Borland's example programs

- customizing Borland C++ (setting or changing defaults, colors, and so on)

Once you've installed Borland C++, you'll be ready to start exploring it. But certain chapters and manuals were written with particular programming needs in mind. The *User's Guide Introduction* tells where to find out more about Borland C++'s features in the documentation set.

## Using INSTALL

---

*We recommend that you read the README file before installing.*

*INSTALL needs disk space to store temporary files before decompressing them. INSTALL's opening screen lists the disk-space requirements; if you don't have enough, exit INSTALL and make room. Once INSTALL is complete, those temporary files are deleted.*

*If you changed the default installation directory, you need to change this PATH setting.*

Among other things, INSTALL detects what hardware you're using and configures Borland C++ appropriately. It also creates directories as needed and transfers files from your distribution disks (the disks you bought) to your hard disk. Its actions are self-explanatory; the following text tells you all you need to know.

To install Borland C++:

1. Insert the installation disk (disk 1) into drive A. Type the following command, then press *Enter*.
2. Press *Enter* at the installation screen.
3. Follow the prompts.
4. At the end of installation, you may want to add this line to your CONFIG.SYS file:

```
A:INSTALL
```

```
FILES = 20
```

and this line to your AUTOEXEC.BAT file (or modify your existing PATH statement, if you already have one):

```
PATH = C:\BORLANDC\BIN
```

### **Important!**

When INSTALL is finished, it allows you to read the latest about Borland C++ in the README file, which contains important, last-minute information about Borland C++. The HELPME!.DOC file also answers many common technical-support questions.



The next time you start Microsoft Windows (after you exit from the README file viewer), a Borland C++ program group will be created and installed in Program Manager. The program group will contain icons for the following Borland C++ programs and utilities:

- Borland C++ DOS IDE

- Borland C++ for Windows
- Turbo Profiler
- Turbo Debugger for Windows
- Resource Workshop
- WinSight
- WinSpector
- Import Librarian
- FCONVERT utility

**Important!** INSTALL assumes that Microsoft Windows is installed in the directory you specified as your Windows directory during installation. It also assumes that the Program Manager starts up automatically as your Windows “shell” when you start Windows. If you normally use a different command shell from Program Manager, you should edit the SYSTEM.INI file in your Windows directory to include the line

```
SHELL=PROGMAN.EXE
```

Otherwise you’ll get a message saying “cannot communicate with Program Manager” when you first open Windows and Borland C++ tries to create a new Program Manager group. Once Borland C++ for Windows and the other tools are installed in a Program Manager group, you can examine their settings, then reinstall them in your alternate command shell if you want.

---

## Protected mode and memory

The Borland C++ DOS IDE and command-line compiler and tools use DPMI (DOS Protected Mode Interface) to run the compiler in protected mode, giving you access to all your computer’s memory. The protected-mode interface is completely transparent to the user, and you should never have to even think about it, with a few possible exceptions.

**DPMIINST** One such exception may be when you run Borland C++ for the very first time. Borland C++ uses an internal database of various machine characteristics to determine how to enable protected mode on your machine, and configures itself accordingly. If your machine is not recognized by Borland C++, you will receive an error message saying

```
Machine not in database (RUN DPMIINST)
```

If you get this message, simply run the DPMIINST program by typing (at the DOS prompt)

```
DPMIINST
```

and following the program's instructions. DPMIINST runs your machine through a series of tests to determine the best way of enabling protected mode, and automatically configures Borland C++ accordingly. Once you have run DPMIINST, you will not have to run it again.



Some memory managers, device drivers, and memory-resident (TSR) programs may interfere with DPMIINST's ability to analyze your machine. If DPMIINST fails, try temporarily disabling or removing these programs. That will give DPMIINST the unrestricted access it needs to determine the best way to enter protected mode.

#### DPMIMEM

By default, the Borland C++ DPMI interface will allocate all available extended and expanded memory for its own use. If you don't want all of the available memory to be taken by the DPMI kernel, you can set an environment variable to specify the maximum amount of memory to use. This variable can be entered directly at the DOS prompt or inserted as a line in your AUTOEXEC.BAT file, using the syntax

```
SET DPMIMEM=MAXMEM nnnn
```

where *nnnn* is the amount of memory in kilobytes.

For example, if you have a system with 4MB and want the DPMI kernel to use 2MB of it, leaving the other 2MB alone, the DPMIMEM variable would be set as follows:

```
SET DPMIMEM=MAXMEM 2000
```

When running under Windows in 386 Enhanced mode, it is not necessary to set the DPMIMEM variable; instead, use the supplied Windows PIF file (BORLANDC\BIN\BC.PIF) to configure the amount of memory available to Borland C++.

Under Windows Standard mode, you must load the Borland DPMI kernel before running Windows. This is done by running DPMIRES.EXE (see the discussion of DPMIRES which follows). When using DPMIRES in conjunction with Windows, always set the DPMIMEM variable to less than the maximum available memory to insure that Windows will have enough physical memory to operate.

DPMIRES DPMIRES preloads the DPMI server. Preloading the DPMI server lets you run the protected-mode tools (BC, BCC, TASM, TLINK, MAKE, etc.) in Windows Standard mode DOS windows. Also, since the tools don't need to load the DPMI server individually, they load slightly faster.

When run, DPMIRES enables DPMI and spawns a DOS command shell. The applications just mentioned load faster into this shell. Type `EXIT` to close the shell.

DPMIRES is especially useful if you are compiling with MAKER (the real mode MAKE) or with batch files, instead of using the protected mode MAKE. In this situation, it will be more efficient to run DPMIRES and then run MAKER or the batch file, since the compiler will load faster on each invocation.



If you are running under a DPMIRES shell, you may not run Windows in 386 Enhanced mode, since the DPMI server, by default, allocates all extended memory for its own use, leaving none for Windows. You must first exit the shell and then run Windows, or use the `DPMIMEM` variable to restrict the amount of memory the DPMI server allocates.

#### Extended and expanded memory

Once the DPMI kernel is loaded (either by running BC or through the DPMIRES utility), the Borland C++ IDE interacts directly with the DPMI server to allocate its memory, both to load and while operating. By default, the IDE uses all the extended memory reserved by the DPMI kernel, and uses all available EMS (expanded) memory as a swap device.

*See the earlier section "DPMIMEM" for more information on restricting how much memory the DPMI server allocates for itself.*

The Options | Environment | Startup dialog box and the `/x` and `/e` command-line switches change this default behavior. These settings do not affect the memory reserved by the kernel itself, only how much of it the IDE uses.

The Use Extended Memory item and the `/x` command-line option tell the IDE how much of the memory reserved by the DPMI kernel to use. The main reason for limiting the IDE's use of the kernel's memory is to allow running of other DPMI applications from within the IDE (using the transfer capability), or from a DOS shell opened from the IDE.

The Use EMS Memory item and the `/e` command-line option tell the IDE how many 16K EMS pages to use as a swap device.

Unless you tell the kernel to leave aside some available memory, there will be no EMS memory available to the IDE.

## Running BC

---

Once you have installed Borland C++, if you're eager to get up and running, type `BC` and press *Enter*. Or, you may wish to run Borland C++ for Windows, by clicking on the Borland C++ for Windows icon in the Program Manager. Otherwise, continue reading this chapter and the next for important start-up information.

After you have tried out the IDE, you may want to permanently customize some of the options. The Options | Environment menus make this easy to do.

## Laptop systems

---

If you have a laptop computer (one with an LCD or plasma display), in addition to carrying out the procedures given in the previous sections, you need to set your screen parameters before using Borland C++. The IDE works best if you type `MODE BW80` at the DOS command line before running Borland C++.

Although you could create a batch file to take care of this for you, you can also easily install Borland C++ for a black-and-white screen from within the IDE, using the Options | Environment | Startup option. Choose "Black and White / LCD" from the Video options group.

## The README file

---

The README file contains last-minute information that may not be in the manuals.

Borland C++ automatically places you in the README file when you run the `INSTALL` program. To access the README file at a later time, you can use the Borland C++ README program by typing this at the DOS command line:

```
CD \BORLANDC
README
```

## The FILELIST.DOC and HELPMEN!.DOC files

---

Your installation disk also contains a file called FILELIST.DOC, which lists every file on the distribution disks and a brief description of what each one contains, and HELPMEN!.DOC, which contains answers to problems that users commonly run into. Consult it if you find yourself having difficulties. You can use the README program to look at FILELIST.DOC or HELPMEN!.DOC. Type this at the command line:

```
README HELPMEN!.DOC
```

or

```
README FILELIST.DOC
```

## Example programs

---

Your Borland C++ package includes the source code for a large number of example programs in C and C++ for both DOS and Windows, including a complete spreadsheet program called Turbo Calc. These programs are located in the EXAMPLES directory (and subdirectories) created by INSTALL. The EXAMPLES directory also contains subdirectories for examples of the other tools and utilities that come with Borland C++ (like the Turbo Assembler, Debugger, and Resource Workshop). Before you compile any of these example programs, you should read the printed or online documentation for them.

## Customizing the IDE

---

*For detailed information on the menus and options in the IDE (integrated development environment), see Chapter 2, "IDE basics," and Chapter 3, "Menus and options reference."*

Borland C++ lets you completely customize your installation from within the IDE itself, using the various options that appear under the Options | Environment menu. These options let you specify the video mode, editing modes, menu colors, and default directories, among others.



## *IDE basics*

Borland's Programmer's Platform, also known as the integrated development environment or IDE, has everything you need to write, edit, compile, link, and debug your programs. It provides

- multiple, movable, resizable windows
- mouse support and dialog boxes
- color syntax highlighting
- cut, paste, and copy commands that use the Clipboard
- full editor undo and redo
- online Help
- examples ready to copy and paste from Help
- a built-in assembler
- an editor macro language
- quick transfer to other programs and back again

*Borland C++ DOS IDE only*

This chapter explains the following topics:

- starting and exiting the Borland C++ IDEs for DOS and Windows
- using IDE components
- using configuration and project files

# Starting and exiting the DOS IDE

---

*Borland C++ runs only in protected mode.*

To start the DOS IDE, type `BC` at the DOS prompt. You can follow it with one or more IDE command-line options.

## Command-line options

---

The command-line options for the Borland C++ DOS IDE are `/b`, `/d`, `/e`, `/h`, `/l`, `/m`, `/p`, `/r`, `/s`, and `/x` using this syntax:

```
BC [option [option...]] [sourcename | projectname [sourcename]]
```

where *option* can be one or more of the options, *sourcename* is any ASCII file (default extension assumed), and *projectname* is your project file (it *must* have the `.PRJ` extension). The order and case is not important.

To turn an option off, follow the option with a minus sign. For example,

```
BC /e-
```

turns off the default swap-to-expanded-memory option.

### The `/b` option

*See Chapter 4 for more information on project files.*

The `/b` (build) option causes Borland C++ to recompile and link all the files in your project, print the compiler messages to the standard output device, and then return to the operating system. This option lets you start Borland C++ from a batch file so you can automate project builds. Borland C++ determines what `.EXE` to build based on the file you specify on the command line. If it doesn't find a project file, it builds the active file loaded into the IDE edit window. It looks for project file (`.PRJ`) and source file (`.CPP`) extensions.

To specify a project file, enter the `BC` command followed by `/b` and the project file name. For example,

```
BC /b myproj.prj
```

If there is no `MYPROG.PRJ` file, the following command loads the file `MYPROG.CPP` in the editor and then compiles and links it:

```
BC MYPROG /B
```

The /d option  
*Borland C++ DOS IDE only*

The **/d** option causes Borland C++ to run in dual monitor mode if it detects two video cards installed in your computer (for example, a monochrome card and a color card); otherwise, the **/d** option is ignored. Using dual monitor mode makes it easier to watch a program's output while you debug the program.

If your system has two monitors, DOS treats one monitor as the active monitor. Use the DOS MODE command to switch between the two monitors (`MODE CO80`, for example, or `MODE MONO`). In dual monitor mode, the normal Borland C++ screen appears on the inactive monitor, and program output goes to the active monitor. When you type `BC /d` at the DOS prompt on one monitor, Borland C++ comes up on the other monitor. When you want to test your program on a particular monitor, exit Borland C++, switch the active monitor to the one you want to test with, and then issue the `BC /d` command again. Program output then goes to the monitor where you typed the `BC` command.

Keep the following in mind when using the **/d** option:

- ❑ Don't change the active monitor (by using the DOS MODE command, for example) while you're in a DOS shell (File | DOS Shell).
- ❑ User programs that directly access ports on the inactive monitor's video card are not supported, and have unpredictable results.
- ❑ Don't use this option when you run or debug programs that explicitly make use of dual monitors.

The /e option  
*Borland C++ DOS IDE only*

The **/e** option tells Borland C++ to swap to expanded memory if necessary; it is on by default. The syntax for this option is:

`/e[=n]`

where *n* equals the number of pages of expanded memory that you want the IDE to use for swapping. Each page is 16K.

The /h option  
*Borland C++ DOS IDE only*

Typing `BC /h` on the command line, you get a list of all the command-line options available. Their default values are also shown.

The `/l` option *Borland C++ DOS IDE only* Use the `/l` (lowercase l) option if you're running Borland C++ on an LCD screen.

The `/m` option *Borland C++ DOS IDE only* The `/m` option lets you do a make rather than a build. That is, only outdated source files in your project are recompiled and linked. Follow the instructions for the `/b` option, but use `/m` instead.

The `/p` option *Borland C++ DOS IDE only* If your program modifies the EGA palette registers (or has BGI do it), use the `/p` option, which controls palette swapping on EGA video adapters. The EGA palette is restored each time the screen is swapped.

The `/r` option *Borland C++ DOS IDE only* Use `/rx` to specify a swap drive, usually a RAM disk, if all your virtual memory fills up. The `x` in `/rx` is the letter of the swap drive. For example, `/rd` specifies drive D as the swap drive.

The `/s` option *Borland C++ DOS IDE only* Using the `/s` option (on by default), the compiler allows the majority of available memory to be allocated for its internal tables while compiling. If it's compiling large modules, little memory may remain for the needed overlays; therefore, the compiler may spend a long time "thrashing;" that is, swapping overlays in and out of memory.

If you specify `/s-`, the compiler won't permit its internal tables to severely restrict the overlay space in memory. As a result, if you are compiling very large modules, the compilation may fail and you'll get an out-of-memory error.

The `/x` option *Borland C++ DOS IDE only* Use the `/x` switch to tell Borland C++ how much of the available extended memory to use for its heap space. The following uses all available memory:

`/x`

The following switch, where `n` equals the amount of memory in kilobytes, lets you specify how much extended memory should be used:

`/x[=n]`

## Exiting Borland

C++

There are three ways to leave the IDE.

- Choose File | Exit to leave the IDE completely; you have to type BC again to reenter it. You'll be prompted to save your programs before exiting, if you haven't already done so.
- Choose File | DOS Shell to shell out from the IDE to enter commands at the DOS command line. When you're ready to return to the IDE, type EXIT at the command line and press *Enter*. The IDE reappears just as you left it.
- Choose a program from the System menu (≡) to temporarily transfer to another program without leaving the IDE. You can add new Transfer programs with the Options | Transfer command.

*Borland C++ DOS IDE only*

*Borland C++ DOS IDE only  
You return to the IDE after  
you exit the program you  
transferred to.*

## IDE components

There are three visible components to the IDE: the menu bar at the top, the window area in the middle, and the status line at the bottom of the screen. Many menu items also offer dialog boxes. Although there are several different ways to make selections in the IDE, they access the same commands and dialog boxes. Before we list menu items in the IDE, we'll explain these more generic components.

### The menu bar and menus

The menu bar is your primary access to all the menu commands. The menu bar is always visible except when you're viewing your program's output or transferring to another program.

If a menu command is followed by an ellipsis (...), choosing the command displays a dialog box. If the command is followed by an arrow (▶), the command leads to another menu. If the command has neither an ellipsis nor an arrow, the action occurs as soon as you choose the command.

Here is how you choose menu commands using the keyboard:



1. Press *F10*. This makes the menu bar active; the next thing you type will relate to the items on the menu bar.

To cancel an action,  
press *Esc*.

2. Use the arrow keys to select the menu you want to display. Then press *Enter*.

As a shortcut for this step, you can just press the highlighted letter of the menu title. For example, when the menu bar is active, press *E* to move to and display the Edit menu. At any time, press *Alt* and the highlighted letter (such as *Alt+E*) to display the menu you want.

3. Use the arrow keys again to select a command from the menu you've opened. Then press *Enter*.

At this point, Borland C++ either carries out the command, displays a dialog box, or displays another menu.



There are two ways to choose commands with a mouse:

Borland C++ uses only the left mouse button. You can, however, customize the right button and make other mouse option changes, by choosing *Options | Environment | Mouse*.

- Click the desired menu title to display the menu and click the desired command.
- Or, drag straight from the menu title down to the menu command. Release the mouse button on the command you want. (If you change your mind, just drag off the menu; no command will be chosen.)

Some menu commands are unavailable when it would make no sense to choose them. However, you can always get online Help about currently unavailable commands.

## Shortcuts

Borland C++ offers a number of quick ways to choose menu commands. The click-drag method for mouse users is an example. From the keyboard, you can use a number of keyboard shortcuts (or *hot keys*) to access the menu bar, choose commands, or work within dialog boxes. You need to hold down *Alt* while pressing the highlighted letter when moving from an input box to a group of buttons or boxes. Here's a list of the shortcuts available:

Input boxes are described on page 35.

Do this...	To accomplish this...
Press <i>Alt</i> plus the highlighted letter of the command (just press the highlighted letter in a dialog box). For the ≡ menu, press <i>Alt+Spacebar</i> .	Display the menu or carry out the command.
Type the keystrokes next to a menu command.	Carry out the command.

For example, to cut selected text, press *Alt+E T* (for *Edit | Cut*) or you can just press *Shift+Del*, the shortcut displayed next to it.

Command sets Borland C++ has two command sets: the Common User Access (CUA) command set and the Alternate command set popularized in previous Borland products. The set you use determines the shortcuts available to you, which keys you use within the editor, and, to some extent, how the editor works. See more about using command sets in the editor in Appendix B. A Native command set option is discussed at the end of this section.

You can select a command set by choosing Options | Environment | Preferences and then selecting the command set you prefer in the Preferences dialog box. If you are a long-time Borland language user, you may prefer the Alternate command set.

The following tables list the most-used Borland C++ hot keys in both command sets.

Table 2.1: General hot keys

CUA	Alternate	Menu item	Function
<i>F1</i>	<i>F1</i>	Help	Displays context-sensitive help screen
	<i>F2</i>	File   Save	Saves the file that's in the active edit window
	<i>F3</i>	File   Open	Brings up a dialog box so you can open a file
	<i>F4</i>	Run   Go to Cursor	Runs your program to the line where the cursor is positioned
	<i>F5</i>	Window   Zoom	Zooms the active window
<i>Ctrl+F6</i>	<i>F6</i>	Window   Next	Cycles through all open windows
<i>F7</i>	<i>F7</i>	Run   Trace Into	Runs your program in debug mode, tracing into functions
<i>F8</i>	<i>F8</i>	Run   Step Over	Runs your program in debug mode, stepping over function calls
<i>F9</i>	<i>F9</i>	Compile   Make	Invokes the Project Manager to make an .EXE file
<i>F10</i>	<i>F10</i>	(none)	Takes you to the menu bar

Table 2.2: Menu hot keys

CUA	Alternate	Menu item	Function
<i>Alt+Spacebar</i>	<i>Alt+Spacebar</i>	≡ menu	Takes you to the ≡ (System) menu
<i>Alt+C</i>	<i>Alt+C</i>	Compile menu	Takes you to the Compile menu
<i>Alt+D</i>	<i>Alt+D</i>	Debug menu	Takes you to the Debug menu
<i>Alt+E</i>	<i>Alt+E</i>	Edit menu	Takes you to the Edit menu
<i>Alt+F</i>	<i>Alt+F</i>	File menu	Takes you to the File menu
<i>Alt+H</i>	<i>Alt+H</i>	Help menu	Takes you to the Help menu
<i>Alt+O</i>	<i>Alt+O</i>	Options menu	Takes you to the Options menu
<i>Alt+P</i>	<i>Alt+P</i>	Project menu	Takes you to the Project menu
<i>Alt+R</i>	<i>Alt+R</i>	Run menu	Takes you to the Run menu
<i>Alt+S</i>	<i>Alt+S</i>	Search menu	Takes you to the Search menu

Table 2.2: Menu hot keys (continued)

<i>Alt+W</i> <i>Alt+F4</i>	<i>Alt+W</i> <i>Alt+X</i>	Window menu File   Exit	Takes you to the Window menu Exits Borland C++ to DOS
-------------------------------	------------------------------	----------------------------	--

Table 2.3: Editing hot keys

<b>CUA</b>	<b>Alternate</b>	<b>Menu item</b>	<b>Function</b>
<i>Ctrl+Ins</i> <i>Shift+Del</i>	<i>Ctrl+Ins</i> <i>Shift+Del</i>	Edit   Copy Edit   Cut	Copies selected text to Clipboard Places selected text in the Clipboard, deletes selection
<i>Shift+Ins</i>	<i>Shift+Ins</i>	Edit   Paste	Pastes text from the Clipboard into the active window
<i>Ctrl+Del</i>	<i>Ctrl+Del</i>	Edit   Clear	Removes selected text from the window but doesn't put it in the Clipboard
<i>Alt+Backspace</i>	<i>Alt+Backspace</i>	Edit   Undo	Restores the text in the active window to a previous state
<i>Alt+Shift+Backspace</i> <i>F3</i>	<i>Alt+Shift+Backspace</i> <i>Ctrl+L</i> <i>F2</i> <i>F3</i>	Edit   Redo Search   Search Again File   Save File   Open	"Undoes" the previous Undo Repeats last Find or Replace command Saves the file in the active edit window Lets you open a file

Table 2.4: Window management hot keys

<b>CUA</b>	<b>Alternate</b>	<b>Menu item</b>	<b>Function</b>
<i>Alt+#</i>	<i>Alt+#</i>		Displays a window, where # is the number of the window you want to view
<i>Alt+0</i>	<i>Alt+0</i>	Window   List All	Displays a list of open windows
<i>Ctrl+F4</i>	<i>Alt+F3</i>	Window   Close	Closes the active window
<i>Shift+F5</i>		Window   Tile	Tiles all open windows
<i>Alt+F5</i>	<i>Alt+F4</i>	Debug   Inspect	Opens an Inspector window
<i>Shift+F5</i>	<i>Alt+F5</i>	Window   User Screen	Displays User Screen
	<i>F5</i>	Window   Zoom	Zooms/unzooms the active window
<i>Ctrl+F6</i>	<i>F6</i>	Window   Next	Switches the active window
	<i>Ctrl+F5</i>		Changes size or position of active window

Table 2.5: Online Help hot keys

<b>CUA</b>	<b>Alternate</b>	<b>Menu item</b>	<b>Function</b>
<i>F1</i> <i>F1 F1</i>	<i>F1</i> <i>F1 F1</i>	Help   Contents	Opens a context-sensitive help screen Brings up Help on Help. (Just press <i>F1</i> when you're already in the Help system.)
<i>Shift+F1</i>	<i>Shift+F1</i>	Help   Index	Brings up Help index
<i>Alt+F1</i>	<i>Alt+F1</i>	Help   Previous Topic	Displays previous Help screen
<i>Ctrl+F1</i>	<i>Ctrl+F1</i>	Help   Topic Search	Calls up language-specific Help (in the active edit window)

Table 2.6: Debugging/Running hot keys

CUA	Alternate	Menu item	Function
Alt+F5	Alt+F4	Debug   Inspect	Opens an Inspector window
Alt+F7	Alt+F7	Search   Previous Error	Takes you to previous error
Alt+F8	Alt+F8	Search   Next Error	Takes you to next error
Alt+F9	Alt+F9	Compile   Compile to OBJ	Compiles to .OBJ
Ctrl+F2	Ctrl+F2	Run   Program Reset	Resets running program
	Ctrl+F3	Debug   Call Stack	Brings up call stack
	Ctrl+F4	Debug   Evaluate/Modify	Evaluates an expression
Ctrl+F5	Ctrl+F7	Debug   Add Watch	Adds a watch expression
F5	Ctrl+F8	Debug   Toggle Breakpoint	Sets or clears conditional breakpoint
Ctrl+F9	Ctrl+F9	Run   Run	Runs program
	F4	Run   Go To Cursor	Runs program to cursor position
F7	F7	Run   Trace Into	Executes one line, tracing into functions
F8	F8	Run   Step Over	Executes one line, skipping function calls
F9	F9	Compile   Make	Makes (compiles/links) program

### Native option

If you choose Options | Environment | Preferences to display the Preferences dialog box, you'll notice a third command-set option: Native. This is the default setting.

If you write applications for Windows, you may do some of your development with Borland C++ and some with Borland C++ for Windows. Both IDEs use the same configuration file, TCCONFIG.TC, which determines which command set is in effect. Therefore, if you have selected the CUA command set for Borland C++ for Windows, that will be the one in effect the next time you start up the Borland C++.

*Native makes the Alternate command set the default for Borland C++, the DOS-hosted IDE, and makes the CUA command set the default for Borland C++ for Windows.*

But this may not be what you want. When you are working with the DOS product, Borland C++, you might prefer the Alternate command set, and when you use Borland C++ for Windows, you might want to use the CUA command set. The Native option lets this happen.

With Native selected, Borland C++ uses the Alternate command set, and Borland C++ for Windows uses the CUA command set.

If you change the command set in either Borland C++ or Borland C++ for Windows, you change it for both products.

While Native seems to imply that the default command set for Borland C++ is Alternate, we recommend you choose the CUA command set.

Which command set you choose also determines which keys you use within the editor, and, to some extent, how the editor works. See more about using command sets in the editor in Appendix B.

## Borland C++ windows

*If you exit Borland C++ with a file open in a window, you are returned to your desktop, open file and all, when you next use Borland C++.*

---

Most of what you see and do in the IDE happens in a *window*. A window is a screen area that you can open, close, move, resize, zoom, tile, and overlap.

You can have many windows open in the IDE, but only one window can be *active* at any time. Any command you choose or text you type generally applies only to the active window. (If you have the same file open in several windows, the action applies to the file everywhere it's open.)

You can spot the active window easily: It's the one with the double-lined border around it. The active window always has a close box, a zoom box, and scroll bars. If your windows are overlapping, the active window is always on top of all the others (the foremost one).

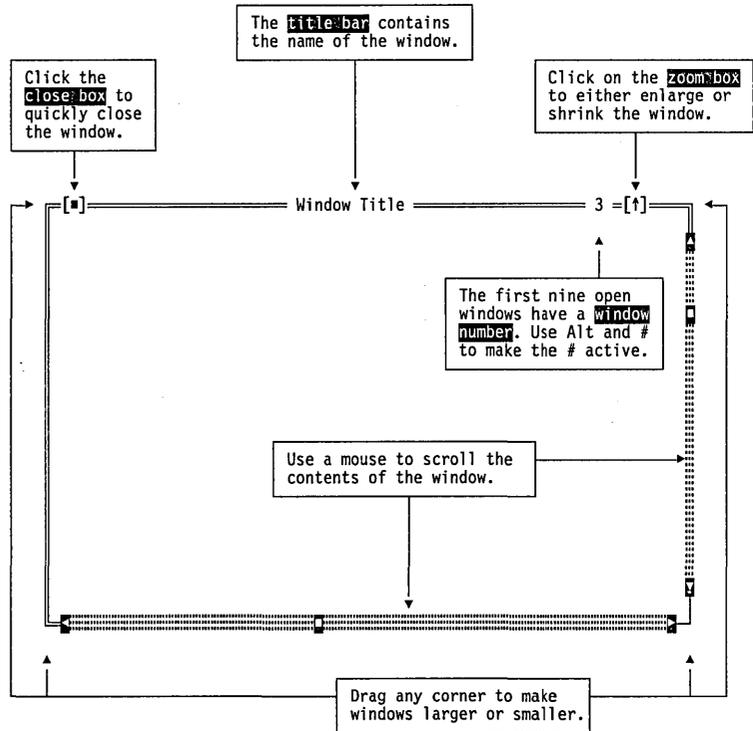
There are several types of windows, but most of them have these things in common:

- a title bar
- a close box
- scroll bars
- a zoom box
- a window number (1 to 9)

An edit window also displays the current line and column numbers in the lower left corner. If you've modified your file, an asterisk ( \* ) appears to the left of the column and line numbers.

The following figure shows a typical window:

Figure 2.1  
A typical window



The *close box* of a window is the box in the upper left corner. Click this box to quickly close the window. (Or choose Window | Close.) The Inspector and Help windows are considered temporary; you can close them by pressing *Esc*.

The *title bar*, the topmost horizontal bar of a window, contains the name of the window and the window number. Double-clicking the title bar zooms the window. You can also drag the title bar to move the window around.

**Shortcut:** Double-click the title bar of a window to zoom or restore it.



The *zoom box* of a window appears in the upper right corner. If the icon in that corner is an up arrow (↑), you can click the arrow to enlarge the window to the largest size possible. If the icon is a double-headed arrow (↕), the window is already at its maximum size. In that case, clicking it returns the window to its previous size. To zoom a window from the keyboard, choose Window | Zoom.

*Alt+0* gives you a list of all windows you have open.

The first nine windows you open in Borland C++ have a *window number* in the upper right border. You can make a window active (and thereby bring it to the top of the heap) by pressing *Alt* in

combination with the window number. For example, if the Help window is #5 but has gotten buried under the other windows, *Alt+5* brings it to the front.

*Scroll bars* are horizontal or vertical bars that look like this:



*Scroll bars also show you where you are in your file.*



You use these bars with a mouse to scroll the contents of the window. Click the arrow at either end to scroll one line at a time. (Keep the mouse button pressed to scroll continuously.) You can click the shaded area to either side of the scroll box to scroll a page at a time. Finally, you can drag the scroll box to any spot on the bar to quickly move to a spot in the window relative to the position of the scroll box.

You can drag any corner to make a window larger or smaller. To resize using the keyboard, choose *Size/Move* from the *Window* menu.

## Window management

Table 2.7 gives you a quick rundown of how to handle windows in Borland C++. Note that you don't need a mouse to perform these actions—a keyboard works just fine.

Table 2.7  
Manipulating windows

<b>To accomplish this:</b>	<b>Use one of these methods</b>
Opening an edit window	Choose <i>File   Open</i> to open a file and display it in a window.
Opening other windows	Choose the desired window from the <i>Window</i> menu.
Closing a window	Choose <i>Close</i> from the <i>Window</i> menu or click the close box of the window.
Activating a window	Click anywhere in the window, or Press <i>Alt</i> plus the window number (1 to 9, in the upper right border of the window), or Choose <i>Window   List</i> or press <i>Alt+0</i> and select the window from the list, or Choose <i>Window   Next</i> to make the next window active (next in the order you first opened them).
Moving the active window	Drag its title bar. Or choose <i>Window   Size/Move</i> and use the arrow keys to place the window where you want it, then press <i>Enter</i> .

Table 2.7: Manipulating windows (continued)

Resizing the active window	Drag any corner. Or choose Window   Size/Move and press <i>Shift</i> while you use the arrow keys to resize the window, then press <i>Enter</i> .
Zoom the active window	Click the zoom box in the upper right corner of the window, or Double-click the window's title bar, or Choose Window   Zoom.

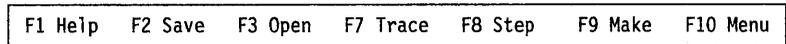
## The status line

The status line appears at the bottom of the screen to

- remind you of basic keystrokes and shortcuts (or hot keys) applicable at that moment in the active window.
- let you click the shortcuts to carry out the action instead of choosing the command from the menu or pressing the shortcut keystroke.
- tell you what the program is doing. For example, it displays *Saving filename...* when an edit file is being saved.
- offer one-line hints on any selected menu command and dialog box items.

The status line changes as you switch windows or activities. One of the most common status lines is the one you see when you're actually writing and editing programs in an edit window. Here is what it looks like:

Figure 2.2  
A typical status line



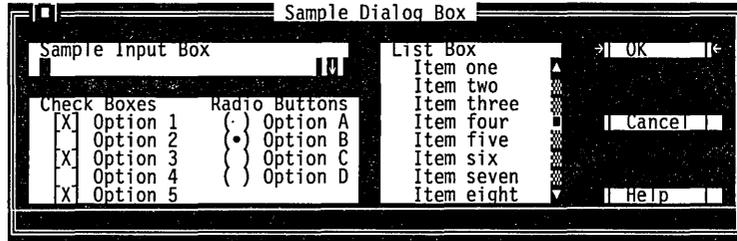
When you've selected a menu title or command, the status line changes to display a one-line summary of the function of the selected item.

## Dialog boxes

A menu command with an ellipsis (...) after it leads to a *dialog box*. Dialog boxes offer a convenient way to view and set multiple options. When you're making settings in dialog boxes, you work with five basic types of onscreen controls: action buttons, radio buttons, check boxes, input boxes, and list boxes. Here's a sample dialog box that illustrates some of these items:

Figure 2.3  
A sample dialog box

If you have a color monitor, Borland C++ uses different colors for various elements of the dialog box.



### Action buttons

This dialog box has three standard buttons: OK, Cancel, and Help. If you choose OK, the choices in the dialog box are accepted; if you choose Cancel, nothing changes, no action takes place, and the dialog box is put away. Choose Help to open a Help window about this dialog box. *Esc* is always a keyboard shortcut for Cancel (even if no Cancel button appears).

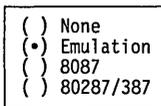


If you're using a mouse, click the dialog-box button you want. When you're using the keyboard, press *Alt* and the highlighted letter of an item to activate it. For example, *Alt+K* selects the OK button because the K in OK is highlighted. Press *Tab* or *Shift+Tab* to move forward or back from one item to another in a dialog box. Each element is highlighted when it becomes active.

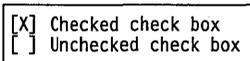
You can select another button with *Tab*; press *Enter* to choose that button.

In this dialog box, OK is the *default button*, which means you need only press *Enter* to choose that button. (On monochrome systems, arrows indicate the default; on color monitors, default buttons are highlighted.) Be aware that tabbing to a button makes that button the default.

### Radio buttons and check boxes



Radio buttons are like car-radio buttons. They come in groups, and only one radio button in the group can be on at any one time. To choose a radio button, click it or its text. From the keyboard, select *Alt* and the highlighted letter, or press *Tab* until the group is highlighted, and then use the arrow keys to choose a particular radio button. Press *Tab* or *Shift+Tab* again to leave the group with the new radio button chosen.



Check boxes differ from radio buttons in that you can have any number of check boxes checked at any time. When you select a check box, an *x* appears in it to show you it's on. An empty box indicates it's off. To change the status of a check box, click it or its text, press *Tab* until the check box is highlighted and then press *Spacebar*, or select *Alt* plus the highlighted letter.

If several check boxes apply to a topic, they appear as a group. In that case, tabbing moves to the group. Once the group is selected, use the arrow keys to select the item you want, and then press *Spacebar* to check or uncheck it. On monochrome monitors, the active check box or group of check boxes will have a chevron symbol (») to the left and right. When you press *Tab*, the chevrons move to the next group of check boxes or radio buttons.

### Input and list boxes

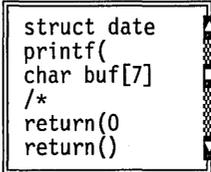
Input boxes let you type in text. Most basic text-editing keys work in the text box (for example, arrow keys, *Home*, *End*, and *Ins*). If you continue to type once you reach the end of the box, the contents automatically scroll. If there's more text than shows in the box, arrowheads appear at the end (◀ and ▶). You can click the arrowheads to scroll or drag the text. If you need to enter control characters (such as ^L or ^M) in the input box, then prefix the character with a ^P. So, for example, to enter ^L into the input box, hold down the *Ctrl* key and press *P L*. (This capability is useful for search strings.)

*You can control whether history lists are saved to the desktop using Options | Environment | Desktop.*

If an input box has a down-arrow icon (↓) to its right, there is an associated *history list*. Click the ↓ to display the list. You'll find text you typed the last few times you used the input box. Press *Enter* to choose an item from this list. The Find box, for example, has such a history list, which keeps track of the text you searched for previously. Try choosing a previous search string. You can also edit an entry in the history list. Press *Esc* to exit from the history list without making a selection.

Here is what a history list for the Find text box might look like if you had used it six times previously:

Text to find 



```
struct date
printf(
char buf[7]
/*
return(0
return()
```

A final component of many dialog boxes is a *list box*, which lets you scroll through and select from variable-length lists (often file names) without leaving a dialog box. If a blinking cursor appears in the list box and you know what you're looking for, you can

type the word (or the first few letters of the word) and Borland C++ will search for it.

You make a list box active by clicking it or by choosing the highlighted letter of the list title (or press *Tab* until it's highlighted). Once a list box is displayed, you can use the scroll box to move through the list or press  $\uparrow$  or  $\downarrow$  from the keyboard.

## Configuration and project files

---

With configuration files, you can specify how you want to work within the IDE. Project files contain all the information necessary to build a project, but don't affect how you use the IDE.

### The configuration file

The IDE configuration file, `TCCONFIG.TC`, contains only environmental (or global) information, including

- editor-key binding and macros
- editor-mode setting
- mouse preferences
- auto-save flags

The configuration file is not needed to build programs defined by a project. The project (`.PRJ`) file handles those details.

When you start a programming session, Borland C++ looks for `TCCONFIG.TC` first in the current directory and then in the directory that contains `BC.EXE`. Borland C++ for Windows also looks in the current directory but, if it doesn't find `TCCONFIG.TC`, it looks in the directory that contains `BCW.EXE`.

### Project files

The IDE places all information needed to build a program into a binary project file, a file with a `.PRJ` extension. Project files contain the settings for:

- compiler, linker, make, and librarian options
- directory paths
- the list of all files that make up the project
- special translators (such as Turbo Assembler)

In addition, the project file contains other general information on the project, such as compilation statistics (shown in the project window) and cached autodependency information.

IDE .PRJ project files correspond to the .CFG configuration files that you supply to the command-line compiler (the default command-line compiler configuration file is TURBOC.CFG). The PRJCFG utility can convert .PRJ files to .CFG files and .CFG files to .PRJ files.

You can load project files in any of three ways:

1. When starting Borland C++, give the project name with the .PRJ extension after the BC command; for example,

```
BC myproj.PRJ
```

You must use the .PRJ extension to differentiate it from source files.

2. If there is only one .PRJ file in the current directory, the IDE assumes this directory is dedicated to the project and automatically loads it.
3. To load a project from within the IDE, select Project | Open Project.

### The project directory

When a project file is loaded from a directory other than the current directory, the current DOS directory is set to where the project is loaded from. This allows your project to be defined in terms of relative paths in the Options | Directories dialog box and also allows projects to move from one drive to another or from one directory branch to another.



Changing directories after loading a project may make the relative paths incorrect and your project unbuildable. If this happens, change the current directory back to where the project was loaded from.

### Desktop files

Each project file has an associated desktop file (*prjname.DSK*) that contains state information about the associated project. While none of its information is needed to build the project, all of the information is directly related to the project. The desktop file includes

*You can set some of these options on or off using Options | Environment | Desktop.*

- the context information for each window of the desktop (for example, your positions in the files or bookmarks)

- the history lists for various input boxes (for example, search strings or file masks)
- the layout of the windows on the desktop
- the contents of the Clipboard
- watch expressions
- breakpoints

### Changing project files

Because each project file has its own desktop file, changing to another project file causes the newly loaded project's desktop to be used, which can change your entire window layout. When you create a new project (by using Project | Open Project and typing in a new .PRJ file name), the new project's desktop inherits the previous desktop. When you select Project | Close Project, the default project is loaded and you get the default desktop and project settings.

### Default files

When no project file is loaded, there are two default files that serve as global placeholders for project- and state-related information: TCDEFW.DPR and TCDEFW.DSK files, collectively referred to as the *default project*.

*In Borland C++ for Windows, the default files are TCDEFW.DPR and TCDEFW.DSK.*

These files are usually stored in the same directory as BC.EXE, and are created if they are not found. When you run the IDE from a directory without loading a project file, you get the desktop and settings from these files. These files are updated when you change any project-related options (for example, compiler options) or when your desktop changes (for example, the window layout).

When you start a new project, the options you set for your previous project will be in effect.

## The Borland C++ for Windows IDE

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The Borland C++ for Windows IDE has everything you need to write, edit, compile, and link your programs in a Windows-hosted environment. You can even start up the powerful Turbo Debugger for Windows without leaving the IDE.

The Borland C++ for Windows IDE is based on Windows Multiple Document Interface (MDI). If you are familiar with other Windows programs, you'll feel right at home with the IDE.

## Starting Borland C++ for Windows

---

As you do with other Windows products, double-click the Borland C++ for Windows icon in the Program Manager to start Borland C++ for Windows.

If you have more than one project, you might want to create an icon for each project. Here's how to create a project icon in the Windows Program Manager:

- Choose File | New.
- Select Program Item and the New Program Object dialog box appears.
- Type in a description for your project, and, in the command-line text box, type `BCW` followed by the project file name including the full path.

Now when you double-click the icon in the Program Manager, your project will load into Borland C++ for Windows.

### Command-line options

You can specify two command-line options when you start Borland C++ for Windows: `/b` for building a project or `/m` for doing a make on a project. To specify either of these options:

- Select the Borland C++ for Windows icon in the Program Manager.
- Choose File | Run.
- Add the command-line option you want to the command line in the command-line text box and choose OK.

When you use either of these options, your messages are appended to a file named the same as your project file except it carries the extension `.MSG`. For example, if your project file is `MYPROJ.PRJ`, the message file is `MYPROJ.MSG`.

## Command sets

---

Just as the Borland C++ DOS IDE does, Borland C++ for Windows has two command sets: the Common User Access (CUA) command set used by most Windows programs, and the Alternate command set. The menu shortcuts available to you differ depending on which command set you use. You can select a command set by choosing Options | Preferences and then selecting the command set you prefer in the Preferences dialog box.

Here are the menu shortcuts in the Borland C++ for Windows IDE:

Table 2.8: General hot keys

CUA	Alternate	Menu item	Function
	F2	File   Save	Saves the file that's in the active edit window
	F3	File   Open	Brings up a dialog box so you can open a file
Alt+F4	Alt+X	File   Exit	Exits Borland C++ for Windows
Alt+Space	Alt+Space	(none)	Takes you to the Control menu

Table 2.9: Editing hot keys

CUA	Alternate	Menu item	Function
Ctrl+Ins	Ctrl+Ins	Edit   Copy	Copies selected text to Clipboard
Shift+Del	Shift+Del	Edit   Cut	Places selected text in the Clipboard, deletes selection
Shift+Ins	Shift+Ins	Edit   Paste	Pastes text from the Clipboard into the active window
Ctrl+Del	Ctrl+Del	Edit   Clear	Removes selected text from the window and doesn't put it in the Clipboard
Alt+Backspace	Alt+Backspace	Edit   Undo	Restores the text in the active window to a previous state.
Alt+Shft+Backspace	Alt+Shft+Backspace	Edit   Redo	"Undoes" the previous Undo.
F3	Ctrl+L	Search   Search Again	Repeats last Find or Replace command

Table 2.10: Online Help hot keys

CUA	Alternate	Menu item	Function
Shift+F1	Shift+F1	Help   Index	Brings up Help index
Ctrl+F1	Ctrl+F1	Help   Topic Search	Calls up language-specific Help in the active edit window

Table 2.11: Compiling/Running hot keys

CUA	Alternate	Menu item	Function
Alt+F7	Alt+F7	Search   Previous Error	Takes you to previous error
Alt+F8	Alt+F8	Search   Next Error	Takes you to next error
Ctrl+F9	Ctrl+F9	Run   Run	Runs program
F9	F9	Compile   Make	Invokes Project Manager to make an .EXE, .DLL, or .LIB file
Alt+F9	Alt+F9	Compile   Compile	Compiles file in active edit window

Although there are only two command sets, there is a third command-set option: Native. Its purpose is to make switching between the Borland C++ and the Borland C++ for Windows IDEs easier. See page 29 for information about the Native option.

Which command set you choose also determines which keys you use within the editor, and, to some extent, how the editor works. See more about using command sets in the editor in Appendix B.

---

## Configuration and project files

Borland C++ for Windows handles project management just as the Borland C++ DOS IDE does. See page 36 for information about configuration, project, and desktop files.

---

## Using the SpeedBar



Borland C++ for Windows has a SpeedBar you can use to quickly choose menu commands and other actions with your mouse. The first time you start Borland C++ for Windows, the SpeedBar is a horizontal grouping of buttons just under the menu bar. You can use it as it is, change it to a vertical bar that appears on the left side of the Borland C++ for Windows desktop window, or change it to a pop-up palette you can move anywhere on your screen. You can also turn it off. To reconfigure the SpeedBar, choose Options | Environment | Desktop, and select the option you want.

The buttons on the SpeedBar represent menu commands. They are shortcuts for your mouse, just as certain key combinations are shortcuts when you use your keyboard. To choose a command, click a button with your mouse. If you click the File | Open button, for example, Borland C++ for Windows responds just as if you chose the Open command on the File menu.

The SpeedBar is context sensitive: Which buttons appear on it and whether they're enabled or dimmed depend on which window is active: the Borland C++ for Windows desktop window, an edit window, the Project window, or the Message window. Some buttons always appear.

Global buttons These buttons always appear, regardless of which type of window is active:



Help



Open a file



Make

Desktop window



Exit Borland C++ for Windows

Edit windows



Save file



Paste from Clipboard



Search for text



Undo



Search again



Compile



Cut to Clipboard



View include files



Copy to Clipboard

Project window



Compile



View include files



Edit source file



Add item to project



Delete item from project



Local Options

Message window



Compile



Edit source file



View file with  
error

Some of the buttons on the SpeedBar are occasionally dimmed, just as some of the menu commands are. This means that, in the current context, the command the button represents is not available. For example, the Paste from Clipboard button will be dimmed if there is nothing in your Clipboard.



## Menus and options reference

This chapter provides a reference to each menu option in the IDE. It's arranged in the order that the menus appear on the screen. For information on starting and exiting the IDE, using the IDE command-line options, and general information on how the IDE works, see Chapter 2.

Next to some of the menu option descriptions in this reference you'll see keyboard shortcuts, or hot keys. If a command set appears above the hot key, the hot key is valid only in that command set. If no command set appears, the hot key works in both command sets. For example,

CUA

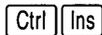


this means *Alt+F4* is a hot key in the CUA command set,

Alternate



this means *Alt+X* is a hot key in the Alternate command set,



and this means *Ctrl+Ins* is a hot key in both command sets.

If you are also using Borland C++ for Windows, you'll find the IDE very similar to the Borland C++ DOS IDE. Throughout this menu reference, we've noted the major differences between the two IDEs:

*Borland C++ DOS IDE only*

■ This note indicates the feature occurs only in Borland C++.



■ The Windows icon indicates the discussion is relevant only to Borland C++ for Windows.

- If neither of these items appear next to the text, the text is relevant to both IDEs.

## ≡ (System) menu

---

*Borland C++ DOS IDE only*



The ≡ menu appears on the far left of the menu bar. *Alt+Spacebar* is the fastest way to get there. When you pull down this menu, you see the Repaint Desktop command and the names of programs you've installed with the Options | Transfer command.



Borland C++ for Windows has a Control menu on the far left of the Title bar. *Alt+Spacebar* is the shortcut key. The Control menu primarily lets you manage windows through menu commands instead of using a mouse. It is the standard Windows Control menu.

---

## Repaint Desktop

*Borland C++ DOS IDE only*

Choose ≡ | Repaint Desktop to have Borland C++ redraw the screen. You may need to do this, for example, if a memory-resident program has left stray characters on the screen, or possibly if you have screen-swapping turned off (Options | Debugger and you've selected None for the Display swapping option) and you're stepping through a program.

---

## Transfer items

*Borland C++ DOS IDE only*

A program that appears here on the ≡ menu can be run directly from the IDE. You install programs here with the Options | Transfer command. To run one of these programs, choose its name from the ≡ menu.

If you have more than one program installed with the same shortcut letter on this menu, the first program listed with that shortcut will be selected. You can select the second item by clicking it or by using the arrow keys to move to it and then pressing *Enter*.

## File menu

**Alt F**

The File menu lets you open and create program files in edit windows. The menu also lets you save your changes, perform other file functions, and quit the IDE.

### New

The File | New command lets you open a new edit window with the default name NONAME $xx$ .CPP (the  $xx$  stands for a number from 00 to 31). These NONAME files are used as a temporary edit buffer; the IDE prompts you to name a NONAME file when you save it.

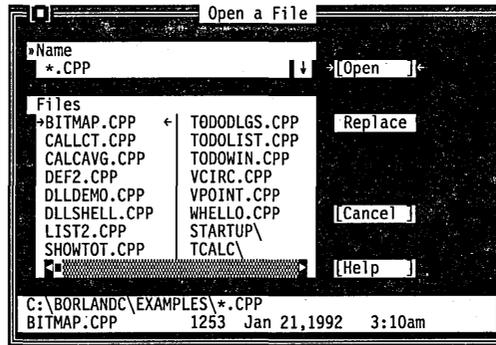
### Open

Alternate

**F3**

The File | Open command displays a file-selection dialog box for you to select a program file to open in an edit window. Here is what the box looks like:

Figure 3.1  
The Open a File dialog box



The dialog box contains an input box, a file list, buttons labeled Open, Replace, Cancel, and Help, and an information panel that describes the selected file. Now you can do any of these actions:

- Type in a full file name and choose Replace or Open. Open loads the file into a new edit window. Replace saves the file in the active window and replaces it with the contents of the selected file. An edit window must be active if you choose Replace.
- Type in a file name with wildcards, which filters the file list to match your specifications.

- Press ↓ to choose a file specification from a history list of file specifications you've entered earlier.
- View the contents of different directories by selecting a directory name in the file list.

The input box lets you enter a file name explicitly or enter a file name with standard DOS wildcards (\* and ?) to filter the names appearing in the history list box. If you enter the entire name and press *Enter*, Borland C++ opens it. (If you enter a file name that Borland C++ can't find, it automatically creates and opens a new file with that name.)

If you press ↓ when the cursor is blinking in the input box, a history list drops down below the box. This list displays the last 15 file names or file-name masks you've entered. Choose a name from the list by double-clicking it or selecting it with the arrow keys and pressing *Enter*.

*If you choose Replace instead of Open, the selected file replaces the file in the active edit window instead of opening up a new window.*

Once you've typed in or selected the file you want, choose the Open button (choose Cancel if you change your mind). You can also just press *Enter* once the file is selected, or you can double-click the file name in the file list.

The Borland C++ for Windows Open a File dialog box doesn't have the Replace button; therefore, you can only open another edit window rather than replace the contents of the file in the window with the contents of another file.



---

## Using the File list

### box

*In Borland C++, you can also type a lowercase letter to search for a file name or an uppercase letter to search for a directory name.*

The File list box displays all file names in the current directory that match the specifications in the input box, displays the parent directory, and displays all subdirectories. Click the list box or press *Tab* until the list-box name is highlighted. You can now press ↓ or ↑ to select a file name, and then press *Enter* to open it. You can also double-click any file name in the box to open it. You might have to scroll the box to see all the names. If you have more than one pane of names, you can also use → and ← .

*Borland C++ DOS IDE only*

The file information panel at the bottom of the Open a File dialog box displays path name, file name, date, time, and size of the file you've selected in the list box. As you scroll through the list box, the panel is updated for each file.

---

## Save

Alternate

**F2**

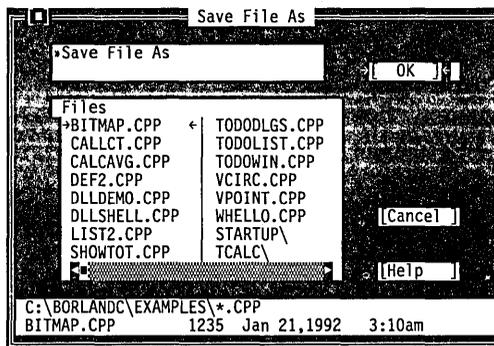
The File | Save command saves the file in the active edit window to disk. (This menu item is disabled if there's no active edit window.) If the file has a default name (NONAME00.CPP, or the like), the IDE opens the Save File As dialog box to let you rename and save it in a different directory or on a different drive. This dialog box is identical to the one opened for the Save As command, described next.

---

## Save As

The File | Save As command lets you save the file in the active edit window under a different name, in a different directory, or on a different drive. When you choose this command, you see the Save File As dialog box:

Figure 3.2  
The Save File As dialog box



Enter the new name, optionally with drive and directory, and click or choose OK. All windows containing this file are updated with the new name.

---

## Save All

The File | Save All command works just like the Save command except that it saves the contents of all modified files, not just the file in the active edit window. This command is disabled if no edit windows are open.

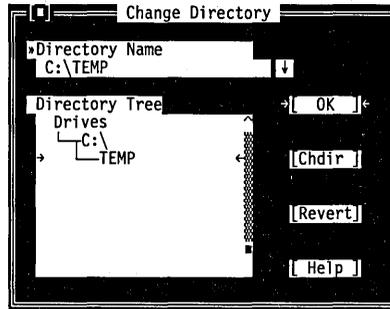
## Change Dir

*Borland C++ DOS IDE only*

The File | Change Dir command lets you specify a drive and a directory to make current. The current directory is the one Borland C++ uses to save files and search for files. (When using relative paths in Options | Directories, they are relative to this current directory only.)

Here is what the Change Directory dialog box looks like:

Figure 3.3  
The Change Directory dialog box



There are two ways to change directories:

- Type in the path of the new directory in the input box and press *Enter*.
- Choose the directory you want in the Directory tree (if you're using the keyboard, press *Enter* to make it the current directory), then choose *OK* or press *Esc*.

If you choose the *OK* button, your changes are made and the dialog box is closed. If you choose the *Chdir* button, the Directory Tree list box changes to the selected directory and displays the subdirectories of the currently highlighted directory (pressing *Enter* or double-clicking on that entry gives you the same result). If you change your mind about the directory you've picked and you want to go back to the previous one (*and* you've yet to exit the dialog box), choose the *Revert* button.

Opening a project in another directory automatically changes directories, so you don't have to change directories before you open another project.

---

## Print

*In the DOS IDE, you can also print the contents of the Output window.*

The File | Print command lets you print the contents of the active edit window or the Message window. This command is disabled if the active window can't be printed.

---

## Printer Setup



The Printer Setup command displays a Windows dialog box you can use to set up your printer. When you installed Windows on your system, you probably also installed one or more printer drivers so you could print from Windows. The Printer Setup command lets you select which printer you want to use.

*Use this option if you want to change your printer setup from its normal configuration.*

If you choose Setup in the Printer Setup dialog box, another dialog box appears allowing you to select a paper size, specify a particular font, and so forth. The options available depend on the capabilities of your printer.

---

## DOS Shell

*Borland C++ DOS IDE only*

The File | DOS Shell command lets you temporarily exit Borland C++ to enter a DOS command or program. To return to Borland C++, type `EXIT` and press *Enter*.

You may find when you're debugging that there's not enough memory to execute this command. If that's the case, terminate the debug session by choosing Run | Program Reset.



Don't install any TSR programs (like SideKick) or print a file with the DOS print command while you've shelled to DOS, because memory may be misallocated.

In dual-monitor mode, the DOS command line appears on the Borland C++ screen rather than the User Screen. This allows you to switch to DOS without disturbing the output of your program.

You can also use the transfer items on the  $\equiv$  (System) menu to quickly switch to another program without leaving Borland C++.

### Exit

---

CUA



The File | Exit command exits the IDE and removes it from memory. If you have made any changes you haven't saved, the IDE asks if you want to save them before exiting.

Alternate



### Closed file listing

---



If you have opened files and then closed them, you'll see the last five files listed at the bottom of the File menu. If you select the file name on the menu, the file opens. When you work with many open files, you can close some, then open them again quickly using the list and reduce the clutter on your desktop.

## Edit menu

---



The Edit menu lets you cut, copy, and paste text in edit windows. If you make mistakes, you can undo changes and even reverse the changes you've just undone. You can also open a Clipboard window to view or edit its contents, and copy text from the Message and Output windows.

Before you can use most of the commands on this menu, you need to know about selecting text (because most editor actions apply to selected text). Selecting text means highlighting it. You can select text either with keyboard commands or with a mouse; the principle is the same even though the actions are different.



#### From the keyboard:

- Press *Shift* while pressing any key that moves the cursor.

See page 195 in Appendix B for additional text selection commands.



#### With a mouse:

- To select text with a mouse, drag the mouse pointer over the desired text. If you need to continue the selection past a

window's edge, just drag off the side and the window automatically scrolls.

- To select a single word, double-click it.
- To extend or reduce the selection, *Shift*-click anywhere in the document (that is, hold *Shift* and click).

Once you selected text, the Cut and Copy commands in the Edit menu become available.

The Clipboard is the magic behind cutting and pasting. It's a special window that holds text you cut or copied, so you can paste it elsewhere. The Clipboard works in close concert with the commands in the Edit menu.

Here's an explanation of each command in the Edit menu.

---

## Undo

**Alt** **Backspace**

The Edit | Undo command restores the file in the current window to the way it was before the most recent edit or cursor movement. If you continue to choose Undo, the editor continues to reverse actions until your file returns to the state it was in when you began your current editing session.

Undo inserts any characters you deleted, deletes any characters you inserted, replaces any characters you overwrote, and moves your cursor back to a prior position. If you undo a block operation, your file appears as it did before you executed the block operation.

Undo doesn't change an option setting that affects more than one window. For example, if you use the *Ins* key to change from Insert to Overwrite mode, then choose Undo, the editor won't change back to Insert mode.

*Undo can undo groups of commands.*

The Group Undo option in the Editor Options dialog box (Options | Environment | Editor) affects Undo and Redo. See page 116 for information on Group Undo.

---

## Redo

**Alt** **Shift** **Backspace**

The Edit | Redo command reverses the effect of the most recent Undo command. The Redo command only has an effect immediately after an Undo command or after another Redo command. A series of Redo commands reverses the effects of a series of Undo commands.

---

## Cut



The Edit | Cut command removes the selected text from your document and places the text in the Clipboard. You can then paste that text into any other document (or somewhere else in the same document) by choosing Paste. The text remains selected in the Clipboard so that you can paste the same text many times.

---

## Copy



The Edit | Copy command leaves the selected text intact but places an exact copy of it in the Clipboard. You can then paste that text into any other document by choosing Paste.

If the Output or Message window is the active window when you select Edit | Copy, the entire contents of the window buffer (including any invisible portion) are copied to the Clipboard.

*Borland C++ DOS IDE only*

You can also copy text from a Help window: With the keyboard, use *Shift* and the arrow keys; with the mouse, click and drag the text you want to copy.



To copy text from a Help window in Borland C++ for Windows, display the text you want to copy, then select Edit | Copy. The entire contents of the window are copied to the Clipboard.

---

## Paste



The Edit | Paste command inserts text from the Clipboard into the current edit window at the cursor position. The text that is pasted is the currently marked block in the Clipboard window.

---

## Clear



The Edit | Clear command removes the selected text but does not put it into the Clipboard. This means you can't paste the text as you could if you had chosen Cut or Copy. The cleared text is not retrievable unless you use the Edit | Undo command. Clear is useful if you want to delete text but you don't want to overwrite text being held in the Clipboard. You can clear the Clipboard itself by selecting all the text in the Clipboard, then choosing Edit | Clear.

## Copy Example

*Borland C++ DOS IDE only*

The Edit | Copy Example command copies the preselected example text in the current Help window to the Clipboard. The examples are already predefined as blocks you can paste, so you don't need to mark the example.



To copy a Help example in Borland C++ for Windows, follow these steps:

1. Display the example you want to copy in the Help window.
2. Choose Edit | Copy. All the text in the Help window is copied to the Clipboard.
3. Make the window you want the example copied to the active window.
4. Choose Edit | Paste.

## Show Clipboard

*Borland C++ DOS IDE only*

The Edit | Show Clipboard command opens the Clipboard window, which stores the text you cut and copy from other windows. The text that's currently selected (highlighted) is the text Borland C++ uses when you choose Paste.

You can think of the Clipboard window as a history list of your cuts and copies. You can edit the Clipboard so that the text you paste is precisely the text you want. Borland C++ uses whatever text is selected in the Clipboard when you choose Paste.

*You can save the Clipboard contents across sessions in Borland C++. Choose Options | Environment | Desktop and select the Clipboard option.*

The Clipboard window is just like other edit windows; you can move it, resize it, and scroll and edit its contents. The only difference you'll find in the Clipboard window is when you choose to cut or copy text. When you select text in the Clipboard window and choose Cut or Copy, the selected text immediately appears at the bottom of the window. (Remember, any text you cut or copy is appended to the end of the Clipboard and highlighted—so you can paste it later.)



The Edit | Show Clipboard option doesn't appear in the Borland C++ for Windows IDE. Of course, you can display the Clipboard at any time using the Windows Clipboard Viewer.

## Search menu

---

**Alt S**

The Search menu lets you search for text, function declarations, and error locations in your files.

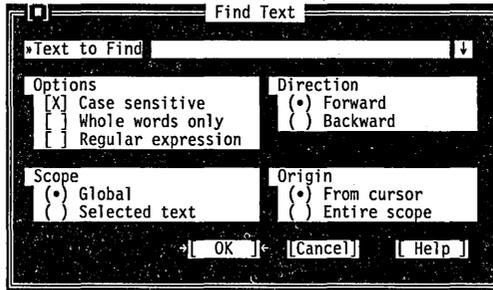
### Find

**Ctrl Q F**

The Search | Find command displays the Find Text dialog box, which lets you type in the text you want to search for and set options that affect the search.

Figure 3.4  
The Find Text dialog box

*You can set up your right mouse button to Find Text. Choose Options | Environment | Mouse and select the Search option.*



The Find Text dialog box contains several buttons and check boxes:

Case sensitive

Check the Case Sensitive box if you do want the IDE to differentiate uppercase from lowercase.

Whole words only

Check the Whole Words Only box if you want the IDE to search for words only. (That is, the string must have punctuation or space characters on both sides.)

Regular expression

Check the Regular Expression box if you want the IDE to recognize GREP-like wildcards in the search string. The wildcards are `^`, `$`, `.`, `*`, `+`, `[]`, and `\`. Here's what they mean:

`^` A circumflex at the start of the string matches the start of a line.

`$` A dollar sign at the end of the expression matches the end of a line.

`.` A period matches any character.

`*` A character followed by an asterisk matches any number of occurrences (including zero) of that character. For example, `bo*` matches `bot`, `b`, `boo`, and also `be`.

To search for ")," include it as the first character in brackets. For example, "( )ab)" will search for ")," "a," and "b."

- + A character followed by a plus sign matches any number of occurrences (but not zero) of that character. For example, *bo+* matches *bot* and *boo*, but not *be* or *b*.
- [ ] Characters in brackets match any one character that appears in the brackets but no others. For example *[bot]* matches *b*, *o*, or *t*.
- [^ ] A circumflex at the start of the string in brackets means *not*. Hence, *[^bot]* matches any characters except *b*, *o*, or *t*.
- [ - ] A hyphen within the brackets signifies a range of characters. For example, *[b-o]* matches any character from *b* through *o*.
- \ A backslash before a wildcard character tells Borland C++ to treat that character literally, not as a wildcard. For example, *\^* matches *^* and does not look for the start of a line.

Enter the string in the input box and choose OK to begin the search, or choose Cancel to not do it. If you want to enter a string that you searched for previously, press ↓ (or *Alt+↓* in Borland C++ for Windows) to show a history list to choose from.

You can also pick up the word your cursor is currently on in the edit window and use it in the Find Text box by simply invoking Find from the Search menu. In the DOS IDE, you can take additional characters from the text by pressing →.

Direction
<input checked="" type="radio"/> Forward
<input type="radio"/> Backward

Choose from the Direction radio buttons to decide which direction you want the IDE to search—starting from the origin (which you can set with the Origin radio buttons).

Scope
<input checked="" type="radio"/> Global
<input type="radio"/> Selected text

Choose from the Scope buttons to determine how much of the file to search in. You can search the entire file (Global) or only the text you've selected.

Origin
<input checked="" type="radio"/> From cursor
<input type="radio"/> Entire scope

Choose from the Origin buttons to determine where the search begins. When Entire Scope is chosen, the Direction radio buttons determine whether the search starts at the beginning or the end of the scope. You choose the range of scope with the Scope radio buttons.

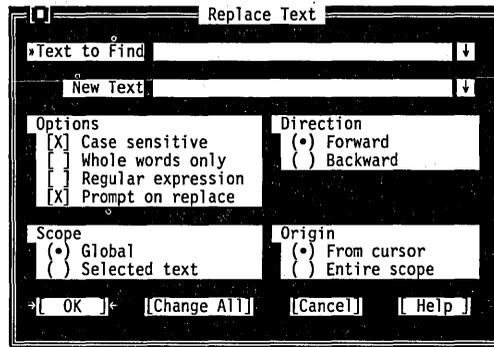
## Replace

Alternate

Ctrl Q A

The Search | Replace command displays a dialog box that lets you type in the text you want to search for and the text you want to replace it with.

Figure 3.5  
The Replace Text dialog box



The Replace Text dialog box contains several radio buttons and check boxes—many of which are identical to the Find Text dialog box, discussed previously. An additional checkbox, Prompt on Replace, controls whether you're prompted for each change.

Enter the search string and the replacement string in the input boxes and choose OK or Change All to begin the search, or choose Cancel to not do it. If you want to enter a string you used previously, press ↓ (or Alt+↓ in Borland C++ for Windows) to show a history list to choose from.

If the IDE finds the specified text and Prompt on Replace is on, it asks you if you want to make the replacement. If you choose OK, it will find and replace only the first instance of the search item. If you choose Change All, it replaces all occurrences found, as defined by Direction, Scope, and Origin.

## Search Again

CUA

F3

Alternate

Ctrl L

The Search | Search Again command repeats the last Find or Replace command. All settings you made in the last dialog box used (Find or Replace) remain in effect when you choose Search Again.

---

## Go to Line Number

The Search | Go to Line Number command prompts you for the line number you want to find.

The IDE displays the current line number and column number in the lower left corner of every edit window.

---

## Previous Error

**Alt** **F7**

The Search | Previous Error command moves the cursor to the location of the previous error or warning message. This command is available only if there are messages in the Message window that have associated line numbers.

---

## Next Error

**Alt** **F8**

The Search | Next Error command moves the cursor to the location of the next error or warning message. This command is available only if there are messages in the Message window that have associated line numbers.

---

## Locate Function

*Borland C++ DOS IDE only*

The Search | Locate Function command displays a dialog box for you to enter the name of a function to search for. This command is available only during a debugging session.

Enter the name of a function or press ↓ to choose a name from the history list. As opposed to the Find command, this command finds the declaration of the function, not instances of its use.

---

## Run menu.

---

**Alt** **R**

The Run menu's commands run your program, start and end debugging sessions in Borland C++, and start Turbo Debugger for Windows in the Borland C++ for Windows IDE.

---

## Run

**Ctrl** **F9**

The Run | Run command runs your program, using any arguments you pass to it with the Run | Arguments command. If the source code has been modified since the last compilation, it

also invokes the Project Manager to recompile and link your program. (The Project Manager is a program-building tool incorporated into the IDE; see Chapter 3, “The Project menu,” for more on this feature.)



If you’re using Borland C++ for Windows and aren’t planning to debug your program with Turbo Debugger for Windows, you can compile and link it with Source Debugging unchecked in the Options | Linker dialog box. Your program will link faster.



The rest of this discussion about Run | Run applies only to the Borland C++ DOS IDE.

*Borland C++ DOS IDE only*

If you don’t want to debug your program in Borland C++, you can compile and link it with the Source Debugging radio button set to None (which makes your program link faster) in the Options | Debugger dialog box. If you compile your program with Source Debugging set to On, the resulting executable code contains debugging information that affects the behavior of the Run | Run command in the following ways:

*If you want to have all Borland C++’s features available, set Source Debugging to On.*

Source code the same

If you have not modified your source code since the last compilation,

- the Run | Run command causes your program to run to the next breakpoint, or to the end if no breakpoints have been set.

Source code modified

If you have modified your source code since the last compilation, and

- if you’re already stepping through your program using the Run | Step Over or Run | Trace Into commands, Run | Run asks if you want to rebuild your program:
  - If you answer yes, the Project Manager recompiles and links your program, then sets it to run from the beginning.
  - If you answer no, your program runs to the next breakpoint, or to the end if no breakpoints are set.
- if you are not in an active debugging session, the Project Manager remakes your program, then sets it to run from the beginning.

Pressing *Ctrl+Break* causes the IDE to stop execution on the next source line in your program. If the IDE is unable to find a source

line, a second *Ctrl+Break* terminates the program and returns you to the IDE.



You can't run or debug Windows applications within the DOS IDE. If you try to do so, an error dialog box appears.

---

## Program Reset

*Borland C++ DOS IDE only*

**Ctrl** **F2**

The Run | Program Reset command stops the current debugging session, releases memory your program has allocated, and closes any open files your program was using. Use this command when you want to cancel a debugging session, or if there's not enough memory to run transfer programs or invoke a DOS shell.

---

## Go to Cursor

*Borland C++ DOS IDE only*

*Alternate*

**F4**

The Run | Go to Cursor command runs your program from the beginning of the program (or the last executed statement if you're in the middle of a debugging session) to the line the cursor is on in the current edit window. If the cursor is at a line that does not contain an executable statement, the command displays a warning.

Go to Cursor does not set a permanent breakpoint, but it does allow the program to stop at a permanent breakpoint if it encounters one before the line the cursor is on. If this occurs, you must move the cursor back to where it was and choose the Go to Cursor command again.

Use Go to Cursor to advance the run bar (the highlighted line of code that represents the next statement to be executed) to the part of your program you want to debug. If you want your program to stop at a certain statement every time it reaches that point, set a breakpoint on that line.



If you position the cursor on a line of code that is not executed, your program will run to the next breakpoint or to the end if no breakpoints are encountered. You can always use *Ctrl+Break* to stop a running program.

---

## Trace Into

*Borland C++ DOS IDE only*

**F7**

The Run | Trace Into command runs your program statement-by-statement. If you Trace Into a function call, the run bar stops on the first line of the function instead of executing the function as a single step (see Run | Step Over). If a statement contains no calls to

functions accessible to the debugger, Trace Into stops at the next executable statement.

Use the Trace Into command to enter a function called by the function you are now debugging. The next section illustrates the differences between the Trace Into and Step Over commands.

If the statement contains a call to a function accessible to the debugger, Trace Into halts at the beginning of the function's definition. Subsequent Trace Into or Step Over commands run the statements in the function's definition. When the debugger leaves the function, it resumes evaluating the statement that contains the call; for example,

```
if (func1() && func2())
    do_something();
```

When the run bar is on the **if** statement, *F7* (Trace Into) traces into **func1**; when the run bar is on the return in **func1**, *F7* traces into **func2**. With the run bar on the **if** statement, *F8* (Step Over) steps over **func2** and stops on *do\_something*.



The Trace Into command recognizes only functions defined in a source file compiled with these two options on:

- In the Advanced Code Generation dialog box (Options | Compiler), Debug Info in OBJs must be checked.
- In the Options | Debugger dialog box, Source Debugging must be set to On.

---

## Step Over

*Borland C++ DOS IDE only*

**F8**

The Run | Step Over command executes the next statement in the current function. It does not trace into calls to lower-level functions, even if they are accessible to the debugger.

Use Step Over to run the function you are now debugging, one statement at a time without branching off into other functions.

Here is an example of the difference between Run | Trace Into and Run | Step Over. These are the first 12 lines of a program loaded into an edit window:

```
int findit(void)      /* Line 1 */
{
    return(2);
}
```

```

void main(void)          /* Line 6 */
{
    int i, j;

    i = findit();        /* Line 10 */
    printf("%d\n", i);   /* Line 11 */
    j = 0;               /* Line 12 */
    :
}

```

**findit** is a user-defined function in a module that has been compiled with debugging information. Suppose the run bar is on line 10 of your program. To position the run bar on line 10, place the cursor on line 10 and either press *F4* or select Run | Go to Cursor.

- If you now choose Run | Trace Into, the run bar moves to the first line of the **findit** function (line 1 of your program), allowing you to step through the function.
- If you choose Run | Step Over, the **findit** function executes and the run bar moves to line 11.

If the run bar had been on line 11 of your program, it would have made no difference which command you chose; Run | Trace Into and Run | Step Over both would have executed the **printf** function and moved the run bar to line 12. This is because the **printf** function does not contain debug information.

---

## Arguments

The Run | Arguments command allows you to give your running programs command-line arguments exactly as if you had typed them on the DOS command line. DOS redirection commands are ignored.

When you choose this command, a dialog box appears with a single input box. You only need to enter the arguments here, not the program name. Arguments take effect when your program starts.

*Borland C++ DOS IDE only*

If you are already debugging and want to change the arguments, select Program Reset and Run | Run to start the program with the new arguments.

---

### Debugger



The Run | Debugger command starts Turbo Debugger for Windows so you can debug your program. Borland C++ for Windows tells Turbo Debugger which program to debug. Before you can use Turbo Debugger for Windows to debug your program you must:

1. Choose Options | Compiler. In the Advanced Code Generation dialog box, check the Debug Info in OBJs option.
2. Choose Options | Linker and set Source Debugging on.

---

### Debugger Options



The Run | Debugger Options command lets you pass arguments to Turbo Debugger for Windows when you choose the Run | Debugger command. See the *Turbo Debugger User's Guide* for a description of all options.

---

## Compile menu



Use the commands on the Compile menu to compile the program in the active window or to make or build your project. To use the Compile, Make, Build, and Link commands, you must have a file open in an active edit window or a project defined.

---

### Compile



The Compile | Compile command compiles the file in the active edit window. If the Project or Message Window is active, Compile | Compile compiles the highlighted file.

When the compiler is compiling, a status box displays the compilation progress and results. When compilation is complete, press any key to remove this box. In Borland C++ for Windows, press *Enter* or choose *OK*. If any errors or warnings occurred, the Message window becomes active and displays and highlights the first error.

---

## Make

**F9**

The Compile | Make command invokes the Project Manager to compile and link your source code to the target executable or library file.

Compile | Make rebuilds only the files that aren't current.

The .EXE file name listed is derived from one of two names in the following order:

*If no project is open, the IDE uses the options in the default project file (TCDEF.DPR for the DOS IDE and TCDEFW.DPR for the Windows IDE).*

- If a project is open, the .EXE is named after the .PRJ file.
- If no project is open, the .EXE is named after the file in the active edit window.

---

## Link

The Compile | Link command takes the files defined in the current project file or the defaults and links them.

---

## Build

This command is similar to Compile | Make except it rebuilds all the files in the project whether or not they are current. It performs the following steps:

1. It deletes the appropriate precompiled header (.SYM) file, if it exists.
2. It deletes any cached autodependency information in the project.
3. It sets the date and time of all the project's .OBJ files to zero.
4. Finally, it does a make.

If you abort a Build command by pressing *Ctrl+Break* in the DOS IDE, pressing *Esc* or choosing *Cancel* in Borland C++ for Windows, or you get errors that stop the build, you can pick up where it left off simply by choosing *Compile | Make*.

## Information

The Compile | Information command displays a dialog box with information on the current file or project. The information is for display only; you can't change it in the dialog box. The following table tells you what each line in the File Information dialog box means and where you can go to change the settings.

Table 3.1  
Information settings

*You'll see only some of these settings in Borland C++ for Windows.*

Setting	Meaning
Current directory	The default directory.
Current file	File in the active window.
Expanded memory in use	Amount of expanded memory reserved by Borland C++.
Lines compiled	Number of lines compiled.
Total warnings	Number of warnings issued.
Total errors	Number of errors generated.
Total time	Amount of time your program has run (debugger only).
Program loaded	Debugging status.
Program exit code	DOS termination code of last terminated program.
Available memory	Amount of memory available to Borland C++ in bytes.

## Remove Messages

The Compile | Remove Messages command removes all messages from the Message window.

## Debug menu

*Borland C++ DOS IDE only*



The Debug menu appears in the Borland C++ DOS IDE only. The commands on the Debug menu control all the features of the integrated debugger. You specify if debugging information is generated in the Options | Debugger dialog box.



You can't run or debug Windows applications within the Borland C++ IDE. If you try to do so, you'll get an error dialog box to that effect. You must run them under Microsoft Windows and use Turbo Debugger for Windows.



To debug applications in the Borland C++ for Windows IDE, use Turbo Debugger for Windows. Start Turbo Debugger with the Run | Debugger command.

## Qualifying expressions

When a data element you wish to examine (in a Watch or Inspector window, for example) isn't currently in scope, you'll need to qualify the name so the integrated debugger can find it. Three common cases and their qualified names:

Table 3.2  
Expression qualifiers

To examine...	Use this format
Static variables in another module	<i>.module.variable</i>
Local variables in a global function	<i>function.variable</i>
Local variables in a static function	<i>.module.function.variable</i>

For example, suppose your program has two modules: FIRSTMOD and MODULE2:

```
// FIRSTMOD.CPP
#include <iostream.h>

void myFunc(void);

int a = 1;

int main(void)
{
    int b = 2;
    myFunc();
    cout << a;
}

// MODULE2.CPP
#include <iostream.h>

static int e = 3;

static void localFunc(void)
{
    int d = 4;
    cout << "End of the road" << endl;
}

void myFunc(void)
{
    int c = 5;
    localFunc();
}
```

Some samples of expressions:

To examine...	Use this expression
Global variable <i>a</i>	<code>a</code>
Local variable <i>b</i> in <b>main</b>	<code>main.b</code>
Local variable <i>c</i> in <b>myFunc</b>	<code>myFunc.c</code>
Local variable <i>d</i> in <b>static localFunc</b>	<code>.module2.localFunc.d</code>
Static variable <i>e</i> in module <b>MODULE2</b>	<code>.module2.e</code>

The need for qualifying an expression depends on the current scope. If the program is running inside **main**, there's no need to qualify *b* with the function name **main**. Likewise, if the program is running inside **MODULE2**, it's not necessary to qualify *e* with the module name.

You can't examine **auto** (local) variables in an inactive scope. Since **myFunc** calls **localFunc**, you can watch **myFunc**'s local variables when inside of **localFunc**. However, once **myFunc** returns to **main**, you can no longer view its local variables, since local variables are discarded when the function returns to its caller.

## Inspect

Alternate



The Debug | Inspect command opens an Inspector window that lets you examine and modify values in a data element. The type of element you're inspecting determines the type of information presented in the window. There are two ways to open an Inspector window:

*You can set up your right mouse button to inspect. Choose Options | Environment | Mouse and select the Inspect option.*

- You can position the cursor on the data element you want to inspect, then press **Alt+F4** (while in the Alternate command set).
- You can also choose Debug | Inspect to bring up the Inspector dialog box, then type in the variable or expression you want to inspect. Alternatively, you can position the cursor on an expression, select Debug | Inspect, and while in this dialog box, press **→** to bring in more of the expression. Press **Enter** to inspect it.

To close an Inspector window, make sure the window is active (topmost) and press **Esc** or choose Window | Close.

Here are some additional inspection operations you can perform:

- *Subinspecting*: Once you're in an Inspector window, you can inspect certain elements to isolate the view. When an inspector

item is inspectable, the status line displays the message “**Inspect**.” To subinspect an item, you move the inspect bar to the desired item and press *Enter*.

- *Modifying inspector items*: When an inspector item can be modified, the status line displays “**Alt+M Modify Field**.” Move the cursor to the desired item and press *Alt+M*; a dialog box will prompt you for the new value.
- *Inspect range*: When you are inspecting certain elements, you can change the range of values displayed. For example, you can range-inspect pointer variables to tell Borland C++ how many elements the pointer points to. You can range-inspect an inspector when the status line displays the message “**Set index range**” and with the command *Alt+I*.

The following sections briefly describe the eight types of Inspector windows.

#### Ordinal Inspector windows

Ordinal Inspector windows show you the value of simple data items, such as

```
char x = 4;
unsigned long y = 123456L;
```

These Inspector windows only have a single line of information following the top line (which usually displays the address of the variable, though it may display the word “constant” or have other information in it, depending on what you’re inspecting). The type of the scalar variable (**char**, **unsigned long**, and so forth) appears to the left, and to the right appears its present value. The value can be displayed as decimal, hex, or both. It’s usually displayed first in decimal, with the hex values in parentheses (using the standard C hex prefix of 0x).

If the variable being displayed is of type **char**, the character equivalent is also displayed. If the present value does not have a printing character equivalent, the backslash (\) followed by a hex value displays the character value. This character value appears before the decimal or hex values.

#### Pointer Inspector windows

Pointer Inspector windows show you the value of data items that point to other data items, such as

```
char *p = "abc";
int *ip = 0;
int **ipp = &ip;
```

Pointer Inspector windows usually have a top line that contains the address of the pointer variable and the address being pointed to, followed by a single line of information.

To the left appears [0], indicating the first member of an array. To the right appears the value of the item being pointed to. If the value is a complex data item such as a structure or an array, as much of it as possible is displayed, with the values enclosed in braces ({ and }).

If the pointer is of type **char** and appears to be pointing to a null-terminated character string, more information appears, showing the value of each item in the character array. To the left in each line appears the array index ([1], [2], and so on), and the value appears to the right as it would in a scalar Inspector window. In this case, the entire string is also displayed on the top line, along with the address of the pointer variable and the address of the string that it points to.

#### Array Inspector windows

Array Inspector windows show you the value of arrays of data items, such as

```
long thread[3][4][5];
char message[] = "eat these words";
```

There is a line for each member of the array. To the left on each line appears the array index of the item. To the right appears the value of the item being pointed to. If the value is a complex data item such as a structure or array, as much of it as possible is displayed, with the values enclosed in braces ({ and }).

#### Structure and Union Inspector windows

Structure and Union Inspector windows show you the value of the members in your structure, class, and union data items. For example,

```
struct date {
    int year;
    char month;
    char day;
} today;

union {
    int small;
    long large;
} holder;
```

Structures and unions appear the same in Inspector windows. These Inspector windows have as many items after the address as there are members in the structure or union. Each item shows the name of the member on the left and its value on the right, displayed in a format appropriate to its data type.

**Function Inspector windows** Function Inspector windows show the return type of the function at the bottom of the inspector. Each parameter that a function is called with appears after the memory address at the top of the list.

Function Inspector windows give you information about the calling parameters, return data type, and calling conventions for a function.

**Class Inspector windows** The Class (or object) Inspector window lets you inspect the details of a class variable. The window displays names and values for members and methods defined by the class.

The window can be divided into two panes horizontally, with the top pane listing the data fields or members of the class, and the bottom pane listing the member function names and the function addresses. Press *Tab* to move between the two panes.

If the highlighted data field is a class or a pointer to a class, pressing *Enter* opens another Class Inspector window for the highlighted type. In this way, you can quickly inspect complex nested structures of classes with a minimum of keystrokes.

**Constant Inspector window** Constant Inspector windows are much like Ordinal Inspector windows, but they have no address and can never be modified.

**Type Inspector window** The Type Inspector window lets you examine a type. There is a Type Inspector window for each kind of instance inspector. The difference between them is that instance inspectors display the *value* of a field and Type inspectors display the *type* of a field.

---

## Evaluate/Modify

*Alternate*

**Ctrl** **F4**

The Debug | Evaluate/Modify command evaluates a variable or expression, displays its value, and if appropriate, lets you modify the value. The command opens a dialog box containing three fields: the Expression field, the Result field, and the New Value field.

## Debug | Evaluate/Modify

*The Evaluate button is the default button; when you tab to the New Value field, the Modify button becomes the default.*

The Expression field shows a default expression consisting of the word at the cursor in the Edit window. You can evaluate the default expression by pressing *Enter*, or you can edit or replace it first. You can also press *→* to extend the default expression by copying additional characters from the Edit window.

You can evaluate any valid C expression that doesn't contain

- function calls
- symbols or macros defined with **#define**
- local or static variables not in the scope of the function being executed

If the debugger can evaluate the expression, it displays the value in the Result field. If the expression refers to a variable or simple data element, you can move the cursor to the New Value field and enter an expression as the new value.

Press *Esc* to close the dialog box. If you've changed the contents of the New Value field but do not select *Modify*, the debugger ignores the New Value field when you close the dialog box.

Use a repeat expression to display the values of consecutive data elements. For example, for an array of integers named *xarray*,

- `xarray[0],5` displays five consecutive integers in decimal
- `xarray[0],5x` displays five consecutive integers in hexadecimal

An expression used with a repeat count must represent a single data element. The debugger views the data element as the first element of an array if it isn't a pointer, or as a pointer to an array if it is.

The Debug | Evaluate/Modify command displays each type of value in an appropriate format. For example, it displays an **int** as an integer in base 10 (decimal), and an array as a pointer in base 16 (hexadecimal). To get a different display format, precede the expression with a comma followed by one of the format specifiers shown in Table 3.3 on page 74.

## Call Stack

---

Alternate

**Ctrl** **F3**

The Debug | Call Stack command opens a dialog box containing the call stack. The Call Stack window shows the sequence of functions your program called to reach the function now running. At the bottom of the stack is **main**; at the top is the function that's now running.

Each entry on the stack displays the name of the function called and the values of the parameters passed to it.

Initially the entry at the top of the stack is highlighted. To display the current line of any other function on the call stack, select that function's name and press *Enter*. The cursor moves to the line containing the call to the function next above it on the stack.

For example, suppose the call stack looked like this:

```
func2 ()
func1 ()
main ()
```

This tells you that **main** called **func1**, and **func1** called **func2**. If you wanted to see the line of **func1** that called **func2**, you could select **func1** in the call stack and press *Enter*. The code for **func1** would appear in the Edit window, with the cursor positioned on the call to **func2**.

To return to the current line of the function now being run (that is, to the run position), select the topmost function in the call stack and press *Enter*.

*Compiling with Standard Stack Frame unchecked (O | C | Entry/Exit Code) causes some functions to be omitted from the call stack. For more details, see page 92.*

Table 3.3: Format specifiers recognized in debugger expressions

Character	Function																						
C	<b>Character.</b> Shows special display characters for control characters (ASCII 0 through 31); by default, such characters are shown using the appropriate C escape sequences ( <code>\n</code> , <code>\t</code> , and so on). Affects characters and strings.																						
S	<b>String.</b> Shows control characters (ASCII 0 through 31) as ASCII values using the appropriate C escape sequences. Since this is the default character- and string-display format, the <b>S</b> specifier is only useful in conjunction with the <b>M</b> specifier.																						
D	<b>Decimal.</b> Shows all integer values in decimal. Affects simple integer expressions as well as arrays and structures containing integers.																						
H or X	<b>Hexadecimal.</b> Shows all integer values in hexadecimal with the <code>0x</code> prefix. Affects simple integer expressions as well as arrays and structures containing integers.																						
F <i>n</i>	<b>Floating point.</b> Shows <i>n</i> significant digits ( <i>n</i> is an integer between 2 and 18). The default value is 7. Affects only floating-point values.																						
M	<b>Memory dump.</b> Displays a memory dump, starting with the address of the indicated expression. The expression must be a construct that would be valid on the left side of an assignment statement, that is, a construct that denotes a memory address; otherwise, the <b>M</b> specifier is ignored.  By default, each byte of the variable is shown as two hex digits. Adding a <b>D</b> specifier with the <b>M</b> causes the bytes to be displayed in decimal. Adding an <b>H</b> or <b>X</b> specifier causes the bytes to be displayed in hex. An <b>S</b> or a <b>C</b> specifier causes the variable to be displayed as a string (with or without special characters). The default number of bytes displayed corresponds to the size of the variable, but a repeat count can be used to specify an exact number of bytes.																						
P	<b>Pointer.</b> Displays pointers in <i>seg:ofs</i> format with additional information about the address pointed to, rather than the default hardware-oriented <i>seg:ofs</i> format. Specifically, it tells you the region of memory in which the segment is located, and the name of the variable at the offset address, if appropriate. The memory regions are as follows: <table border="1"> <thead> <tr> <th>Memory region</th> <th>Evaluate message</th> </tr> </thead> <tbody> <tr> <td>0000:0000-0000:03FF</td> <td>Interrupt vector table</td> </tr> <tr> <td>0000:0400-0000:04FF</td> <td>BIOS data area</td> </tr> <tr> <td>0000:0500-Borland C++</td> <td>MS-DOS/TSRs</td> </tr> <tr> <td>Borland C++—User Program PSP</td> <td>Borland C++ User Process PSP</td> </tr> <tr> <td>User Program—top of RAM</td> <td>Name of a static user variable if its address falls inside the variable's allocated memory; otherwise nothing</td> </tr> <tr> <td>A000:0000-AFFF:FFFF</td> <td>EGA/VGA Video RAM</td> </tr> <tr> <td>B000:0000-B7FF:FFFF</td> <td>Monochrome Display RAM</td> </tr> <tr> <td>B800:0000-BFFF:FFFF</td> <td>Color Display RAM</td> </tr> <tr> <td>C000:0000-EFFF:FFFF</td> <td>EMS Pages/ Adaptor BIOS ROMs</td> </tr> <tr> <td>F000:0000-FFFF:FFFF</td> <td>BIOS ROMs</td> </tr> </tbody> </table>	Memory region	Evaluate message	0000:0000-0000:03FF	Interrupt vector table	0000:0400-0000:04FF	BIOS data area	0000:0500-Borland C++	MS-DOS/TSRs	Borland C++—User Program PSP	Borland C++ User Process PSP	User Program—top of RAM	Name of a static user variable if its address falls inside the variable's allocated memory; otherwise nothing	A000:0000-AFFF:FFFF	EGA/VGA Video RAM	B000:0000-B7FF:FFFF	Monochrome Display RAM	B800:0000-BFFF:FFFF	Color Display RAM	C000:0000-EFFF:FFFF	EMS Pages/ Adaptor BIOS ROMs	F000:0000-FFFF:FFFF	BIOS ROMs
Memory region	Evaluate message																						
0000:0000-0000:03FF	Interrupt vector table																						
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0000:0500-Borland C++	MS-DOS/TSRs																						
Borland C++—User Program PSP	Borland C++ User Process PSP																						
User Program—top of RAM	Name of a static user variable if its address falls inside the variable's allocated memory; otherwise nothing																						
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B000:0000-B7FF:FFFF	Monochrome Display RAM																						
B800:0000-BFFF:FFFF	Color Display RAM																						
C000:0000-EFFF:FFFF	EMS Pages/ Adaptor BIOS ROMs																						
F000:0000-FFFF:FFFF	BIOS ROMs																						
R	<b>Structure/Union.</b> Displays field names as well as values, such as { <i>X:1, Y:10, Z:5</i> }. Affects only structures and unions.																						

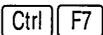
## Watches

---

The Debug | Watches command opens a pop-up menu of commands that control the use of watch expressions. Watch expressions can be saved across sessions; see Options | Environment | Desktop. The following sections describe the commands in this pop-up menu.

**Add Watch** The Add Watch command inserts a watch expression into the Watch window.

*CUA*  
 When you choose this command, the debugger opens a dialog box and prompts you to enter a watch expression. The default expression is the word at the cursor in the current Edit window. There's also a history list available if you want to quickly enter an expression you've used before.

*Alternate*  


When you type a valid expression and press *Enter* or click OK, the debugger adds the expression and its current value to the Watch window. If the Watch window is the active window, you can insert a new watch expression by pressing *Ins*.

**Delete Watch** The Delete Watch command deletes the current watch expression from the Watch window. To delete a watch expression other than the current one, select the desired watch expression by highlighting it. Then choose Delete Watch. When the Watch Window is active, you can press *Del* or *Ctrl+Y* to delete a watch.

**Edit Watch** The Edit Watch command allows you to edit the current watch expression in the Watch window. A history list is available to save you time retyping.

When you choose this command, the debugger opens a dialog box containing a copy of the current watch expression. Edit the expression and press *Enter*. The debugger replaces the original version of the expression with the edited one.

You can also edit a watch expression from inside the Watch window by selecting the expression and pressing *Enter*.

## Debug | Watches | Remove All Watches

**Remove All Watches** The Remove All Watches command deletes all watch expressions from the Watch window.

---

## Toggle Breakpoint

CUA

**F5**

Alternate

**Ctrl F8**

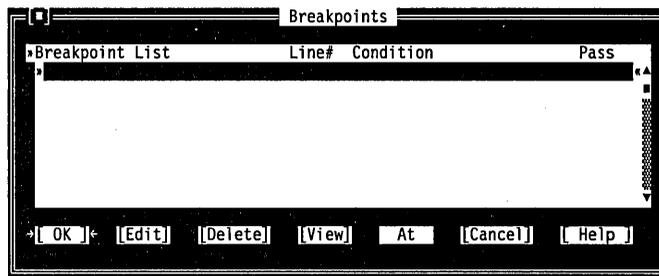
The Debug | Toggle Breakpoint command lets you set or clear an unconditional breakpoint on the line where the cursor is positioned. When a breakpoint is set, it is marked by a breakpoint highlight. Breakpoints can be saved across sessions using Options | Environment | Desktop.

---

## Breakpoints

The Debug | Breakpoints command opens a dialog box that lets you control the use of breakpoints—both conditional and unconditional ones. Here is what the dialog box looks like:

Figure 3.6  
The Breakpoints dialog box

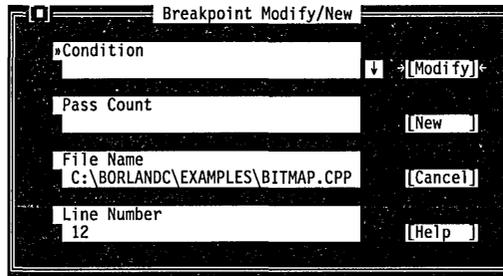


The dialog box shows you all set breakpoints, their line numbers, and the conditions. The condition has a history list so you can select a breakpoint condition you've used before.

The row of buttons at the bottom of the dialog box give you several options:

- Choose Delete to remove a highlighted breakpoint from your program.
- Choose View to display the source code where the selected breakpoint is set.
- Choose At to set a breakpoint at a particular function. You must be debugging to choose At.
- Choose Edit to add a new breakpoint or modify an existing one. The Breakpoint Modify/New dialog box appears:

Figure 3.7  
The Breakpoint Modify/New dialog box



If you choose New, a breakpoint is set at the location of your cursor in the active Edit window. You can modify a breakpoint by making changes in this dialog box.

The Condition text box accepts any expression that evaluates to either true or false. When your program reaches that condition while you're debugging, it stops executing.

You can specify when the debugger should stop on the breakpoint. In the Pass Count text box, type in a number. If you enter a 1, the debugger stops the first time the breakpoint is reached. If you enter a 2, the debugger stops the second time the breakpoint is reached, and so on.

Generally you will not change the file name, but you can if you want. You can also specify a new line number. The primary purpose of these two options is to identify a breakpoint you have already set.

When you are done modifying your breakpoint, choose Modify and the IDE accepts the new settings.

When a source file is edited, each breakpoint "sticks" to the line where it is set. Breakpoints stay set until you

- delete the source line a breakpoint is set on
- clear a breakpoint with Toggle Breakpoint

Borland C++ continues to track breakpoints until

- you edit a file containing breakpoints and then don't save the edited version of the file.
- you edit a file containing breakpoints and then continue the current debugging session without remaking the program. (Borland C++ displays the warning prompt "Source modified, rebuild?")

Before you compile a source file, you can set a breakpoint on any line, even a blank line or a comment. When you compile and run the file, Borland C++ validates any breakpoints that are set and gives you a chance to remove, ignore, or change invalid breakpoints. When you are debugging the file, Borland C++ knows which lines contain executable statements, and warns you if you try to set invalid breakpoints.

You can set an unconditional breakpoint without going through the dialog box by choosing the Debug | Toggle Breakpoint command.

## Project menu

---



The Project menu contains all the project-management commands to

- create a project
- add or delete files from your project
- specify which program your source file should be translated with
- set options for a file in the project
- specify which command-line override options to use for the translator program
- specify what the resulting object module is to be called, where it should be placed, whether the module is an overlay, and if the module should contain debug information
- view included files for a specific file in the project

*Borland C++ DOS IDE only*

*Borland C++ DOS IDE only*

## Open Project

---

The Open Project command displays the Open Project File dialog box, where you select and load a project or create a new project by typing in a name.

This dialog box lets you select a file name in a similar way to the File | Open dialog box, discussed on page 47. The file you select will be used as a project file, which is a file that contains all the information needed to build your project's executable. Borland C++ uses the project name when it creates the .EXE, .DLL, or .LIB file and .MAP file. A typical project file has the extension .PRJ.

## Close Project

---

Choose Project | Close Project when you want to remove your project and return to the default project.

## Add Item

---

Choose Project | Add Item when you want to add a file to the project's file list. This brings up the Add to Project List dialog box.

*When the Project Window is active, you can press **Ins** to add a file. In Borland C++ for Windows, you can also use the SpeedBar.*

This dialog box is set up much like the Open a File dialog box (File | Open). Choosing the Add button puts the currently highlighted file in the Files list into the Project window. The chosen file is added to the Project window File list immediately before the highlight bar in the Project window. The highlight bar is advanced each time a file is added.

## Delete Item

---

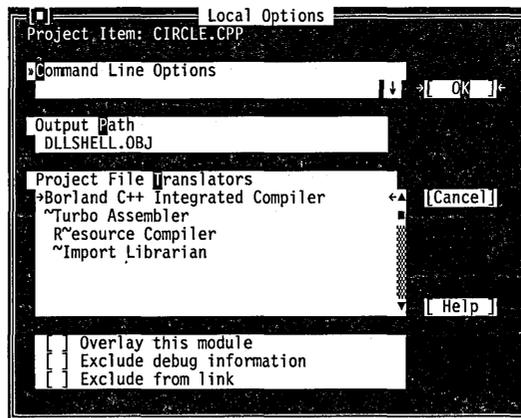
Choose Project | Delete Item when you want to delete the highlighted file in the Project window. When the Project window is active, you can press *Del* to delete a file.

## Local Options

---

The Local Options command opens the following dialog box in the Borland C++ DOS IDE:

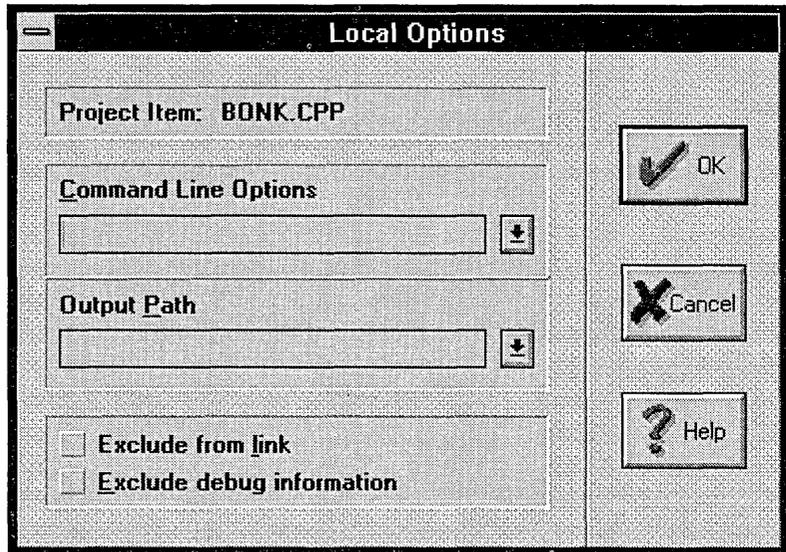
Figure 3.8  
The Local Options dialog box



The Borland C++ for Windows IDE has the following Local Options dialog box:

## Project | Local Options

Figure 3.9  
The Borland C++ for Windows  
Local Options dialog box



*These command-line options  
are not supported: c, E, e, l,  
L, I, M, Q, y.*

*Borland C++ DOS IDE only*

Overlay this module

*Borland C++ DOS IDE only*

Exclude debug information

Exclude from link

The Local Options dialog box lets you include command-line override options for a particular project-file module. It also lets you give a specific path and name for the object file.

The DOS IDE also lets you choose a translator for the module. Any program you installed in the Transfer dialog box with the Translator option checked appears in the list of Project File Translators (see page 102 for information on the Transfer dialog box).

Check Overlay This Module if you want the selected project item to be overlaid. This item is local to one file. It is ignored if the Overlaid DOS EXE option is not selected in the Output radio button in Options | Linker | Settings.

Check Exclude Debug Information to prevent debug information included in the module you've selected from going into the .EXE.

Use this switch on modules of large programs that you've already debugged. You can change which modules have debug information by checking this box and then relinking (no compiling is required).

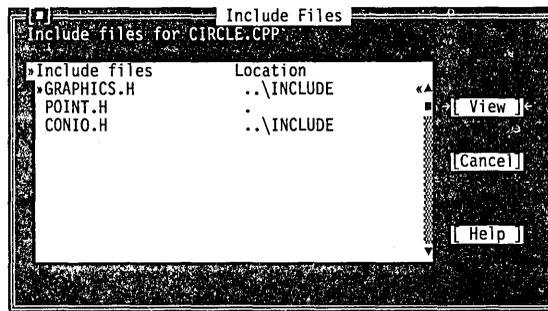
Check the Exclude from Link option if you don't want this module linked in.

## Include Files

Choose Project | Include Files to display the Include Files dialog box or, if you're in the Project window, press the *Spacebar*. If you haven't built your project yet, the Project | Include Files command is disabled.

The Include Files dialog box in the DOS IDE looks like this:

Figure 3.10  
The Include Files dialog box



You can scroll through the list of files displayed. Select the file you want to view and press *Enter*.

## Browse menu



The Browse menu in the Borland C++ for Windows IDE gives you access to the ObjectBrowser so you can visually browse through the class hierarchies, functions, and variables in your Windows applications. Turbo Debugger offers browsing features for DOS programs.

*You must check Options | Compiler | Advanced Code Generation | Browser Info In OBJs to use the Object-Browser.*

Before you can use the ObjectBrowser, you must compile your program so that browsing information is included in your executable file. Open the related project file in the IDE before using the ObjectBrowser.

*To browse with your mouse, choose Options | Environment | Mouse and select the Browse Right Mouse Button option.*

You can access the ObjectBrowser either through the Browse menu or directly from your source code by clicking the right mouse button on the class, function, or variable you wish to inspect.

The ObjectBrowser has buttons on the title bar of the Object-Browser window. Choose them by clicking them with your mouse or using specific key combinations. By choosing one of

these buttons, you tell the ObjectBrowser to perform some action. Not all of the buttons are available at all times. These are the buttons you will see, their keyboard equivalents, and the action they perform:



*F1* Help



*Ctrl+G* Go to the source code for the selected item



*Ctrl+I* Inspect (view the details of) the selected item



*Ctrl+R* Rewind the ObjectBrowser to the previous view



*Ctrl+O* Show an overview of the class hierarchy

---

## Classes

The Browse | Classes command opens an ObjectBrowser window that displays all the classes in your application, arranged as a horizontal “tree” to show parent-child relationships. The window is automatically sized to display as much of your class hierarchy as possible. If the entire image does not fit within the window, use the scroll bars to move the image to view hidden sections. You can highlight any class in the display by using the arrow keys, or by clicking directly on the class name. Using the buttons at the top of the ObjectBrowser window, you can

- exit the ObjectBrowser
- go to the source code that defines the highlighted class
- inspect the functions and data elements of the highlighted class

---

## Functions

The Functions command opens a window that lists every function in your program, in alphabetical order. Class-member functions are listed together by class (for example, **MyClass::MyFunc**). In addition, an incremental search field is provided at the bottom of the dialog box that lets you quickly search through the function

*Press Tab or Ctrl+S to move the focus to the search field.*

list by typing the first few letters of the function name. As you type, the selections in the list change to match the characters you have typed in. Using the buttons at the top of the ObjectBrowser window, you can

- exit the ObjectBrowser
- go to the source code that defines the highlighted function
- inspect the declaration of the highlighted function

---

## Variables

The Variables command opens a window that lists every global variable in your program, in alphabetical order. This dialog box also contains an incremental search field. Using the buttons at the top of the ObjectBrowser window, you can

- exit the ObjectBrowser
- open an edit window on the source code that defines the highlighted variable
- inspect the declaration of the highlighted variable

---

## Symbols

*You can also inspect a symbol by clicking it in your source code with your right mouse button. Set up your mouse this way with Options | Environment | Mouse and select Browse.*

The Symbol at Cursor command opens an ObjectBrowser window for the symbol the cursor is on in the active edit window. The symbol may be any class, function, or variable symbol that is defined in your source code.

---

## Rewind

The Rewind command takes the ObjectBrowser back to the previous view. Choosing the Rewind command is the same as choosing the Rewind button.

---

## Overview

The Overview command shows an overview. An overview of classes is the class hierarchy. An overview of functions is a list of all functions. An overview of variables is a list of all variables. Choosing the Overview command is the same as choosing the Overview button.

### Inspect

---

The Inspect command displays the detail of the selected item. Choosing the Inspect command is the same as choosing the Inspect button.

### Goto

---

The Goto command takes you to the source code for the selected item. Choosing the Goto command is the same as choosing the Goto button.

## Options menu

---



The Options menu contains commands that let you view and change various default settings in Borland C++. Most of the commands in this menu lead to a dialog box.

When you first view the settings in any of the Options dialog boxes, you will see certain settings are already selected. These are the *default* settings, which Borland C++ uses if you don't make any changes. These default settings are illustrated in the screen diagrams in this chapter. You can change any of the default settings by making the desired changes and selecting save project on the Options | Save dialog box. Alternatively, if you check the Project box in the Autosave group on the Options | Environment | Preferences menu, your changes are automatically saved when you exit from Borland C++.

### The Set Application Options dialog box

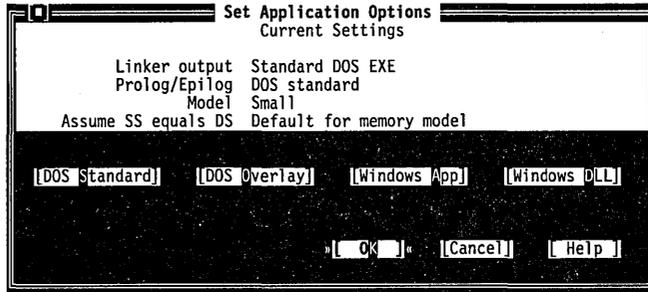
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The Options | Application menu choice brings up the Set Application Options dialog box. This dialog box provides the easiest and safest way to set up compilation and linking for a DOS or Windows executable. To use this dialog box, simply click one of the buttons. Borland C++ will verify and, if necessary, change some of the settings in the Code Generation, Entry/Exit Code Generation, and Linker dialog boxes. See page 91 (Entry/Exit Code) for detailed information on the code generated. Use this dialog box for initial setup only.



In the Borland C++ for Windows environment, only the Windows App and Windows DLL options are available. Standard DOS and DOS overlay applications must be compiled with the Borland C++ DOS IDE (or using the Borland C++ command-line compiler).

Figure 3.11  
The Set Application Options dialog box



The standard options for applications and libraries each accomplish a set of tasks. You can choose only one button at a time. The current settings fields are updated when you set the button.

*Borland C++ DOS IDE only*

#### **DOS Standard:**

- sets the Small memory-model radio button in the Code Generation dialog box
- sets Assume SS equals DS to Default for memory model in the Code Generation dialog box
- sets the DOS Standard radio button in the Entry/Exit Code Generation dialog box
- sets the Standard DOS .EXE radio button in the Linker | Settings dialog box

*Borland C++ DOS IDE only*

#### **DOS Overlay:**

- sets the Medium memory-model button in the Code Generation dialog box
- sets Assume SS equals DS to Default for memory model in the Code Generation dialog box
- sets the DOS Overlay button in the Entry/Exit Code Generation dialog box
- sets the Overlaid DOS .EXE button in the Linker | Settings dialog box

### Windows App:

- sets the Small memory-model button in the Code Generation dialog box
- sets Assume SS equals DS to Default for memory model in the Code Generation dialog box
- sets the Windows All Functions Exportable button in the Entry/Exit Code Generation dialog box
- sets the Windows .EXE button in the Linker | Settings dialog box
- unchecks the Graphics Library option in the Libraries dialog box

### Windows DLL:

- sets the Compact memory-model button in the Code Generation dialog box
- sets Assume SS equals DS to Never in the Code Generation dialog box
- sets the Windows DLL All Functions Exportable button in the Entry/Exit Code Generation dialog box
- sets the Windows .DLL button in the Linker | Settings dialog box
- unchecks the Graphics Library option in the Libraries dialog box

---

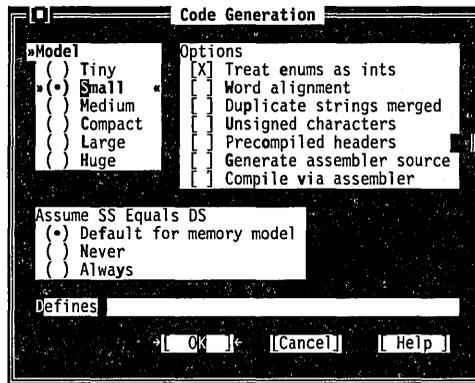
## Compiler

The Options | Compiler command displays a pop-up menu that gives you several options that affect code compilation. The following sections describe these commands.

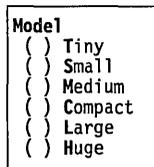
### Code Generation

The Code Generation command displays a dialog box with settings that tell the compiler to prepare the object code in certain ways. The dialog box looks like this:

Figure 3.12  
The Code Generation dialog  
box



Here are what the various buttons and check boxes mean:

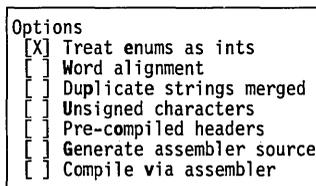


The Model buttons determine which memory model you want to use. The default memory model is Small. The memory model chosen determines the normal method of memory addressing. Refer to Chapter 9, “DOS memory management,” in the *Programmer’s Guide* for more information about memory models in general.



There are some restrictions about which memory models you can use for Windows executables. The Borland C++ for Windows IDE allows you to select Small, Medium, Compact, and Large memory models. Tiny and Huge are not supported.

The options control various code-generation defaults.



- When checked, Treat Enums As Ints causes the compiler to always allocate a whole word for variables of type **enum**. Unchecked, this option tells the compiler to allocate an unsigned or signed byte if the minimum and maximum values of the enumeration are both within the range of 0 to 255 or -128 to 127, respectively.
- Word Alignment (when checked) tells Borland C++ to align noncharacter data (within structures and unions only) at even addresses. When this option is off (unchecked), Borland C++ uses byte-aligning, where data (again, within structures and unions only) can be aligned at either odd or even addresses, depending on which is the next available address.  
Word alignment increases the speed with which 80x86 processors fetch and store the data.

See Appendix D for more on precompiled headers.

Borland C++ DOS IDE only

Borland C++ DOS IDE only

- Duplicate Strings Merged (when checked) tells Borland C++ to merge two strings when one matches another. This produces smaller programs, but can introduce bugs if you modify one string.
- Unsigned Characters (when checked) tells Borland C++ to treat all **char** declarations as if they were **unsigned char** type.
- Check Precompiled Headers when you want the IDE to generate and use precompiled headers. Precompiled headers can dramatically increase compilation speeds, though they require a considerable amount of disk space. When this option is off (the default), the IDE neither generates nor uses precompiled headers. Precompiled headers are saved in `PROJECTNAME.SYM`.
- Check Generate Assembler Source to tell Borland C++ to produce an `.ASM` assembly language source file as its output, rather than an `.OBJ` object module.
- Compile Via Assembler allows you to specify that the compiler should produce assembly language output, then invoke TASM to assemble the output.

Assume SS Equals DS <input checked="" type="radio"/> Default for memory model <input type="radio"/> Never <input type="radio"/> Always
---

If the Default For Memory Model radio button is set, whether the stack segment (SS) is assumed to be equal to the data segment (DS) is dependent on the memory model used. Usually, the compiler assumes that SS is equal to DS in the Small, Tiny, and Medium memory models (except for DLLs).

When the Never radio button is set, the compiler does not assume SS is equal to DS.

The Always button tells the compiler to always assume that SS is equal to DS. It causes the IDE to substitute the `C0Fx.OBJ` startup module for `C0x.OBJ` to place the stack in the data segment.

Defines
---------

Use the Defines input box to enter macro definitions to the preprocessor. You can separate multiple defines with semicolons (;) and assign values with an equal sign (=); for example,

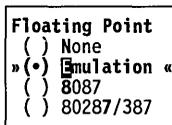
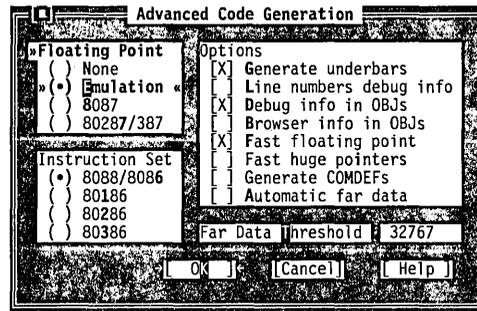
```
TESTCODE;PROGCONST=5
```

Leading and trailing spaces are stripped, but embedded spaces are left intact. If you want to include a semicolon in a macro, you must place a backslash (\) in front of it.

## Advanced Code Generation

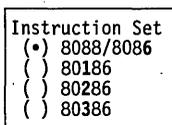
The Advanced Code Generation menu option opens the Advanced Code Generation dialog box. Here's what that dialog box looks like:

Figure 3.13  
The Advanced Code Generation dialog box

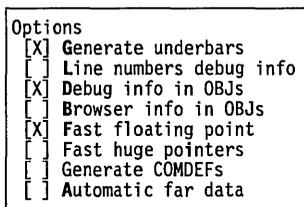


The Floating Point buttons let you decide how you want Borland C++ to generate floating-point code.

- Choose None if you're not using floating point. (If you choose None and you use floating-point calculations in your program, you get undefined symbols, such as FIWRQQ, at link time.)
- Choose Emulation if you want your program to detect if your computer has an 80x87 coprocessor (and to use it if you do). If it is not present, your program will emulate the 80x87.
- Choose 8087 or 80287/387 to generate direct inline code for the appropriate math coprocessor.



The Instruction Set radio buttons let you choose which instruction set to generate code for. The default instruction set, 8088/8086, works with all PCs. Since Windows protected mode requires an 80286 or higher, only those options are available in Borland C++ for Windows.



- When checked, the Generate Underbars option automatically adds an underbar, or underscore, character ( \_ ) in front of every global identifier (that is, functions and global variables). If you are linking with standard libraries, this box must be checked.
- Line Numbers Debug Info (when checked) includes line numbers in the object and object map files (the latter for use by a symbolic debugger). This increases the size of the object and map files but does not affect the speed of the executable program.

Since the compiler might group together common code from multiple lines of source text during jump optimization, or

might reorder lines (which makes line-number tracking difficult), you might want to make sure the Jump Optimization check box (Options | Compiler | Optimizations) is off (unchecked) when this option is checked.

- **Debug Info In OBJs** controls whether debugging information is included in object (.OBJ) files. The default for this check box is on (checked), which you need in order to use either the integrated debugger or the standalone Turbo Debugger.

Turning this option off allows you to link and create larger object files. While this option doesn't affect execution speed, it *does* affect compilation time.

- **Browser Info In OBJs** controls whether information needed by the Borland C++ for Windows ObjectBrowser is included in object (.OBJ) files. The default for this check box is off (unchecked). If you want to use ObjectBrowser to inspect your program (from within the Borland C++ for Windows IDE), you must turn this option on.

Leaving this option off saves space in your object files.

- **Fast Floating Point** lets you optimize floating-point operations without regard to explicit or implicit type conversions. When this option is unchecked, the compiler follows strict ANSI rules regarding floating-point conversions.

*Borland C++ DOS IDE only*  
  
*See page 157 for more details on fast huge pointers.*

- **The Fast Huge Pointers** option normalizes huge pointers only when a segment wrap-around occurs in the offset portion of the segment. This greatly speeds up the computation of huge pointer expressions, but must be used with caution, as it can cause problems for huge arrays if array elements cross a segment boundary.

- When checked, the **Generate COMDEFs** option allows a communal definition of a variable to appear in header files as long as it is not initialized. Thus a definition such as `int SomeArray[256];` could appear in a header file that is then included in many modules. The compiler will generate it as a communal variable rather than a public definition (a COMDEF record rather than a PUBDEF record). The linker will then only generate one instance of the variable so no duplicate-definition linker error will occur.

*This option is ignored if you're using the Tiny, Small, or Medium memory models.*

- **The Automatic Far Data** option and the **Far Data Threshold** type-in box work together. When checked, the Automatic far data option tells the compiler to automatically place data objects larger than a predefined size into far data segments; the

far data threshold specifies the minimum size above which data objects will be automatically made far.

### Entry/Exit Code

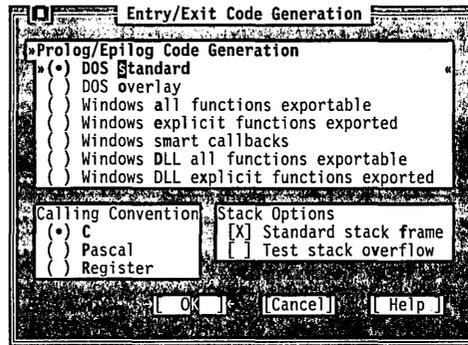
See Chapter 8 in the *Programmer's Guide* for more on prolog and epilog code.

When you compile a C or C++ program for Windows or DOS, the compiler needs to know which kind of prolog and epilog to create for each of a module's functions.

If the program is intended for Windows, the compiler generates a different prolog and epilog than it would for DOS. Because of this, you must use the Entry/Exit Code Generation dialog box to set the appropriate application. If you use the Set Application Options dialog box (described on page 84), the settings in the Entry/Exit Code dialog box already are correct for the type of application you choose.

This dialog box also allows you to select the calling convention and to set a couple of stack options. All options affect what code is generated for function calls and returns.

Figure 3.14  
The Entry/Exit Code  
Generation dialog box



If you want to set the prolog/epilog code for a DOS application, select DOS Standard or DOS Overlay.

*Borland C++ DOS IDE only*

- Set the DOS Standard radio button to tell the compiler to generate code that may not be safe for overlays. If you don't plan to create an overlaid application, use this option.

*Borland C++ DOS IDE only*

- Set the DOS Overlay radio button to tell the compiler to generate overlay-safe code. Use this option when you're creating an overlaid application.

To set the prolog/epilog code for a Windows application, you need to select one of five options.

- Windows All Functions Exportable is the most general kind of Windows executable, although not necessarily the most efficient. It assumes that all functions can be called by the

Windows kernel or by other modules, and generates the necessary overhead information for every function, whether the function needs it or not. The module-definition file controls which functions are exported.

- Use Windows Explicit Functions Exported if you have functions that will not be called by the Windows kernel; it isn't necessary to generate export-compatible prolog/epilog code information for these functions. The **\_export** keyword provides a way to tell the compiler which specific functions will be exported: Only those far functions with **\_export** will be given the special Windows prolog/epilog code.
- Set Windows Smart Callbacks to select Borland C++ smart callbacks. See Chapter 8, "Building a Windows application," in the *Programmer's Guide* for details on smart callbacks.
- Set Windows DLL All Functions Exportable to create an .OBJ file to be linked as a .DLL with all functions exportable.
- Set Windows DLL Explicit Functions Exported to create an .OBJ file to be linked as a .DLL with certain functions explicitly selected to be exported. Otherwise, this is essentially the same as Windows Explicit Functions Exported; see that discussion for more information.

Calling Convention
<input type="radio"/> C
<input type="radio"/> Pascal
<input type="radio"/> Register

The Calling Convention options cause the compiler to generate either a C or Pascal calling sequence for function calls. The differences between C and Pascal calling conventions are the way each handles stack cleanup, order of parameters, case, and prefix (underbar) of global identifiers.

*Borland C++ DOS IDE only*

In the Borland C++ IDE, you can also select Register to specify the new **fastcall** parameter-passing convention. For more information about the **fastcall** convention, see Appendix A, "The Optimizer."



*Do not change this option unless you're an expert and have read Chapter 12, "BASM and inline assembly," in the Programmer's Guide.*

Stack Options
<input checked="" type="checkbox"/> Standard stack frame
<input type="checkbox"/> Test stack overflow

- Standard Stack Frame (when checked) generates a standard stack frame (standard function entry and exit code). This is helpful when debugging—it simplifies the process of tracing back through the stack of called subroutines.

If you compile a source file with this option off (unchecked), any function that does not use local variables and has no parameters is compiled with abbreviated entry and return code. This makes the code shorter and faster, but prevents the Debug | Call Stack command from "seeing" the function. Thus,

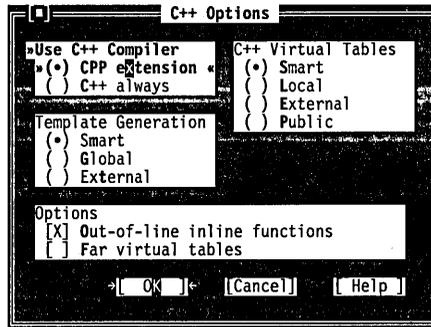
you should always check the option when you compile a source file for debugging.

This option is automatically turned off when you turn optimizations on; a duplicate of the Standard Stack Frame option also appears on the Options | Compiler | Optimization dialog box.

- When checked, the Test Stack Overflow generates code to check for a stack overflow at run time. Even though this costs space and time in a program, it can be a real lifesaver, since a stack overflow bug can be difficult to track down.

**C++ Options** The C++ Options command displays a dialog box with settings that tell the compiler to prepare the object code in certain ways when using C++.

Figure 3.15  
The C++ Options dialog box



Use C++ Compiler  
 CPP extension  
 C++ always

C++ Virtual Tables  
 Smart  
 Local  
 External  
 Public

The Use C++ Compiler radio buttons tell Borland C++ either to always compile your programs as C++ code, or as C code except when the file extension is .CPP.

The C++ Virtual Tables radio buttons let you control C++ virtual tables and the expansion of inline functions when debugging.

- The Smart option generates C++ virtual tables (and inline functions not expanded inline) so that only one instance of a given virtual table or inline function are included in the program. This produces the smallest and most efficient executables, but uses .OBJ (and .ASM) extensions only available with TLINK 3.0 and TASM 2.0 (or newer).
- The Local option generates local virtual tables (and inline functions not expanded inline) such that each module gets its own private copy of each virtual table or inline function it uses; this option uses only standard .OBJ (and .ASM) constructs, but produces larger executables.

- The External option generates external references to virtual tables; one or more of the modules comprising the program must be compiled with the Public option to supply the definitions for the virtual tables.
- The Public option generates public definitions for virtual tables.

Template Generation
<input checked="" type="radio"/> Smart
<input type="radio"/> Global
<input type="radio"/> External

The Template Generation options allow you to specify how Borland C++ generates template instances in C++. For more information about templates, see Chapter 3 “C++ specifics,” in the *Programmer’s Guide*.

- Smart generates public (global) definitions for all template instances, but if more than one module generates the same template instance, the linker automatically merges duplicates to produce a single definition. This is the default setting, and is normally the most convenient way of generating template instances.
- Global, like Smart, generates public definitions for all template instances. However, it does *not* merge duplicates, so if the same template instance is generated more than once, the linker reports public-symbol redefinition errors.
- External tells the compiler to generate external references to all template instances. If you use this option, you must make certain the instances are publicly defined elsewhere in your code.
- Use Out-of-line Inline Functions when you want to step through or set breakpoints on inline functions.

Options
<input checked="" type="checkbox"/> Out-of-line inline functions
<input type="checkbox"/> Far virtual tables

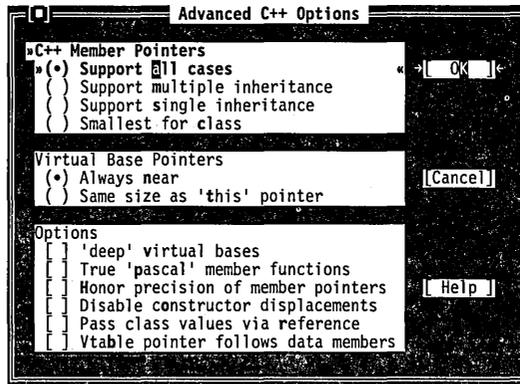
- The Far Virtual Tables option causes virtual tables to be created in the code segment instead of the data segment, and makes virtual table pointers into full 32-bit pointers (the latter is done automatically if you are using the Huge memory model).

There are two primary reasons for using this option: to remove the virtual tables from the data segment, which may be getting full, and to share objects (of classes with virtual functions) between modules that use different data segments (for example, a DLL and an executable using that DLL). You must compile all modules that can share objects either entirely with or entirely without this option. You can achieve the same effect by using the **huge** or **\_export** modifiers on a class-by-class basis.

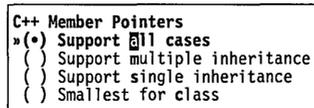
Advanced C++  
Options

The Advanced C++ Options command displays a dialog box with settings that control advanced code-generation options for C++. Since Borland C++ handles certain C++ features more efficiently (but differently) than previous versions of Borland C++, some of these options are intended primarily for backward compatibility, where it is necessary to link with object modules or libraries compiled with older versions.

Figure 3.16  
The Advanced C++ Options  
dialog box



Borland C++ supports three different kinds of member-pointer types, which you can control with these options.



- Support All Cases (the default) places no restrictions on which members can be pointed to. Member pointers will use the most general (but not always the most efficient) representation.
- Support Multiple Inheritance allows member pointers to point to members of multiple inheritance classes, with the exception of members of virtual base classes.
- Support Single Inheritance permits member pointers to point to members of base classes that use single inheritance only.
- Smallest For Class specifies that member pointers use the smallest possible representation that allows them to point to all members of their particular class.

Virtual Base Pointers
(*) Always near
( ) Same size as 'this' pointer

When a class inherits virtually from a base class, the compiler stores a hidden pointer in the class object to access the virtual base class subobject. Borland C++ always makes this hidden pointer a **near** pointer by default, to generate more efficient code. Previous versions of Borland C++ matched the size of this pointer to the size of the **this** pointer used by the class itself.

- Always Near specifies that the hidden pointer should always be **near**, for the smallest and most efficient code.
- Same Size As 'this' Pointer tells the compiler to match the size of the hidden pointer to the size of the **this** pointer in the instance class, for backward compatibility.

Options
[ ] 'Deep' virtual bases
[ ] True 'Pascal' member functions
[ ] Honor precision of member pointers
[ ] Disable constructor displacements
[ ] Pass class values via reference
[ ] Vtable pointer follows data members

Borland C++ sometimes handles pointers differently from previous versions, in order to permit greater efficiency and flexibility. In some cases, this results in behavior that is incompatible with previous versions. To permit complete compatibility, the following options are provided:

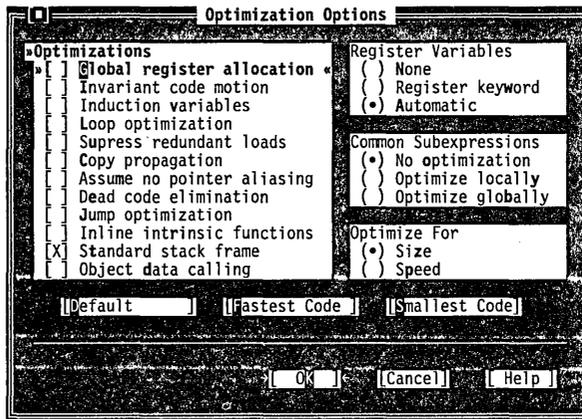
- 'Deep' Virtual Bases directs the compiler not to change the layout of any classes in order to relax the restrictions on pointers to members of base classes through multiple levels of virtual inheritance.
- True 'Pascal' Member Functions directs the compiler to pass the **this** pointer to **pascal** member functions as the first parameter on the stack. By default, Borland C++ passes the **this** pointer as the last parameter, which permits smaller and faster member function calls.
- Honor Precision Of Member Pointers tells the compiler to honor an explicit cast to a pointer to a member of a simpler base class, even though it is actually pointing to a derived class member.
- Disable Constructor Displacements instructs the compiler not to add hidden members and code to a derived class, which it does by default to prevent an erroneous value for the **this** pointer in special cases where the constructor of a derived class containing

an inherited virtual function that it overrides, calls that function using a pointer to the virtual base class. This option ensures compatibility with the behavior of previous versions.

- **Pass Class Values Via Reference** tells the compiler to use a reference to a temporary variable in order to pass arguments of type class to a function. By default Borland C++ copy-constructs the argument values directly to the stack.
- **Vtable Pointer Follows Data Members** instructs the compiler to place virtual table pointers after any nonstatic data members of the class, for compatibility with previous versions of Borland C++. The default is to place these pointers *before* any nonstatic data members, to make virtual member function calls smaller and faster.

**Optimizations** The Optimizations Options dialog box presents you with three separate categories of options, to let you fully customize the way the compiler optimizes your code. These features are listed briefly below. For your convenience, the command-line compiler switches corresponding to each option are indicated. A more complete discussion of optimization, including a description of the use and functionality of each menu option, appears in Appendix A, "The Optimizer."

Figure 3.17  
The Optimization Options dialog box



Optimizations	
<input type="checkbox"/>	Global register allocation
<input type="checkbox"/>	Invariant code motion
<input type="checkbox"/>	Induction variables
<input type="checkbox"/>	Loop optimizations
<input type="checkbox"/>	Suppress redundant loads
<input type="checkbox"/>	Copy propagation
<input type="checkbox"/>	Assume no pointer aliasing
<input type="checkbox"/>	Dead code elimination
<input type="checkbox"/>	Jump optimization
<input type="checkbox"/>	Inline intrinsic functions
<input checked="" type="checkbox"/>	Standard stack frame
<input type="checkbox"/>	Object data calling

The Optimizations Options affect how optimization of your code occurs.

- Global Register Allocation corresponds to the **-Oe** switch on the command line compiler. It enables global register allocation and variable live range analysis.
- Invariant Code Motion, corresponding to the **-Om** command line switch, moves invariant code out of loops.
- Induction Variables corresponds to the **-Ov** command line switch. It enables loop induction variables and strength-reduction optimizations.
- Loop Optimizations corresponds to **-Ol** option, and compacts loops into REP/STOSx instructions.
- Suppress Redundant Loads corresponds to the **-Z** command line switch. It suppresses reloads of values that are already in registers.
- Copy Propagation, corresponding to the **-Op** command line switch, propagates copies of constants, variables, and expressions where possible.
- Assume No Pointer Aliasing corresponds to the **-Oa** command line switch. It instructs the compiler to assume that pointer expressions are not aliased in common subexpression evaluation.
- Dead Code Elimination corresponds to the **-Ob** command line switch, and eliminates stores into dead variables.
- Jump Optimization, corresponding to the **-O** compiler switch, removes jumps to jumps, unreachable code, and unnecessary jumps.
- Inline Intrinsic Functions, corresponding to the **-Oi** compiler switch, instructs the compiler to expand common functions like **strcpy** inline.
- Standard Stack Frame instructs the compiler to generate a standard function entry/exit code, and corresponds to the **-k** compiler option.
- Object Data Calling instructs the compiler to use the Object Data calling convention, and corresponds to the **-po** compiler option. See Appendix A for more information on Object Data.

Register Variables	
<input type="checkbox"/>	None
<input type="checkbox"/>	Register keyword
<input checked="" type="checkbox"/>	Automatic

The Register Variables selections affect how the compiler handles the use of register variables. For more information about register variables see Chapter 9, "DOS memory management," in the *Programmer's Guide*.

- None instructs the compiler not to use register variables even if you have used the **register** keyword.
- Register Keyword specifies that register variables are used only if you use the **register** keyword and a register is available.
- Automatic directs the compiler to automatically assign register variables for you.

Common subexpressions
(•) No optimization
( ) Optimize globally
( ) Optimize locally

Common Subexpressions tells the compiler how to find and eliminate duplicate expressions in your code, to avoid reevaluating the same expression.

- No Optimization instructs the compiler not to eliminate common subexpressions.
- Optimize Globally corresponds to the **-Og** command line switch, and instructs the compiler to eliminate common subexpressions within an entire function.
- Optimize Locally corresponds to the **-Oc** command-line switch, and instructs the compiler to eliminate common subexpressions within basic blocks only.

Optimize For
(•) Size
( ) Speed

The Optimize For options let you change Borland C++'s code-generation strategy. For backward compatibility, these buttons correspond to the same buttons in the Borland C++ for Windows environment and in earlier versions of Borland C++. They are *not* identical to the "Smallest Code" and "Fastest Code" buttons that appear at the bottom of the Optimization dialog box.

Default
---------

Fastest Code
--------------

Smallest Code
---------------

The three buttons at the bottom of the Optimizations dialog box allow you to specify "groups" of settings by making a single selection.

- No Optimizing corresponds to the **-Od** command-line switch. It automatically disables all of the optimization options.
- Fastest Code corresponds to the **-O2** command-line switch. It automatically sets all of the optimization options to generate the fastest possible code.
- Smallest Code corresponds to the **-O1** command-line switch. It automatically sets the optimization options to produce the smallest possible code.

**Source** The Source command displays a dialog box. The settings in this box tell the compiler to expect certain types of source code. The dialog box presents the following options:

Source Options  
 Nested comments

The Nested Comments check box allows you to nest comments in Borland C++ source files. Nested comments are not allowed in standard C implementations. They are not portable.

Keywords  
 Borland C++  
 ANSI  
 UNIX V  
 Kernighan and Ritchie

The Keywords radio buttons tell the compiler how to recognize keywords in your programs.

- Choosing Borland C++ tells the compiler to recognize the Borland C++ extension keywords, including **near**, **far**, **huge**, **asm**, **cdecl**, **pascal**, **interrupt**, **\_es**, **\_export**, **\_ds**, **\_cs**, **\_ss**, and the register pseudovariables (**\_AX**, **\_BX**, and so on). For a complete list, refer to Chapter 1, "Lexical elements," in the *Programmer's Guide*.
- Choosing ANSI tells the compiler to recognize only ANSI keywords and treat any Borland C++ extension keywords as normal identifiers.
- Choosing UNIX V tells the compiler to recognize only UNIX V keywords and treat any Borland C++ extension keywords as normal identifiers.
- Choosing Kernighan and Ritchie tells the compiler to recognize only the K&R extension keywords and treat any Borland C++ extension keywords as normal identifiers.

*Note that some of the standard Borland C++ header files use Borland C++ extension keywords and are therefore incompatible with these options.*

Identifier Length 32

Use the Identifier Length input box to specify the number (*n*) of significant characters in an identifier. Except in C++, which recognizes identifiers of unlimited length, all identifiers are treated as distinct only if their first *n* characters are distinct. This includes variables, preprocessor macro names, and structure member names. The number can be from 1 to 32; the default is 32.

**Messages** The Messages command displays a submenu that lets you set several options that affect compiler error messages in the IDE.

**Display...**

Display presents a dialog box that allows you to specify how (and if) you want error messages to be displayed.

- **Errors: Stop After** causes compilation to stop after the specified number of errors have been detected. The default is 25, but you can enter any number from 0 to 255.
- **Warnings: Stop After** causes compilation to stop after the specified number of warnings have been detected. The default is 100, but you can enter any number from 0 to 255. (Entering 0 causes compilation to continue until the end of the file or until the error limit you entered has been reached, whichever comes first.)
- The **Display Warnings** options allow you to choose whether the compiler will display all warnings, only the warnings selected in the **Messages** submenu option, or no warnings.

**Portability...**

When you choose **Portability** on the **Messages** submenu, a dialog box appears that lets you specify which types of portability problems you want to be warned about.

Check the warnings you want to be notified of and uncheck the ones you don't. Choose **OK** to return to the **Compiler Messages** dialog box.

**ANSI violations...**

When you choose **ANSI Violations** on the **Messages** submenu, a dialog box appears that lets you specify which, if any, **ANSI** violations you want to be warned about.

Check the warnings you want to be notified of and uncheck the ones you don't. Choose **OK** to return to the **Compiler Messages** dialog box.

**C++ warnings...**

When you choose the **C++ Warnings** button in the **Messages** submenu, another dialog box appears that lets you determine which specific **C++** warnings you want to enable.

Check the warnings you want to be notified of and uncheck the ones you don't. Choose **OK** to return to the **Compiler Messages** dialog box.

**Frequent errors...**

When you choose **Frequent Errors** in the **Compiler Messages** dialog box, another dialog box appears that lets you specify which frequently occurring errors you want to be warned about.

Check the errors you want to be notified of and uncheck the ones you don't. Choose **OK** to return to the **Compiler Messages** dialog box.

Less frequent errors...

Choosing Less frequent errors lets you choose to be warned about several less frequently occurring errors.

Check or uncheck these errors and choose OK to return to the Messages dialog box.

**Names** The Names command brings up a dialog box that lets you change the default segment, group, and class names for code, data, and BSS sections. *Do not change the settings in this command unless you are an expert and have read Chapter 9, "DOS memory management," in the Programmer's Guide.*

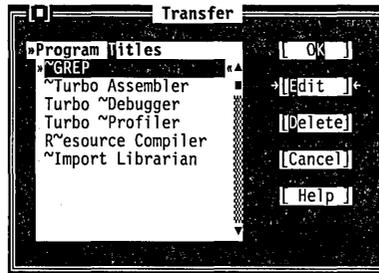
---

## Transfer

*Borland C++ DOS IDE only*

The Options | Transfer command (available in the Borland C++ DOS IDE only) lets you add or delete programs in the  $\equiv$  menu. Once you've done so, you can run those programs without actually leaving Borland C++. You return to Borland C++ after you exit the program you transferred to. The Transfer command displays this dialog box:

Figure 3.18  
The Transfer dialog box



The Transfer dialog box has two sections:

- the Program Titles list
- the Transfer buttons

The Program Titles section lists short descriptions of programs that have been installed and are ready to execute. You might need to scroll the list box to see all the programs available.

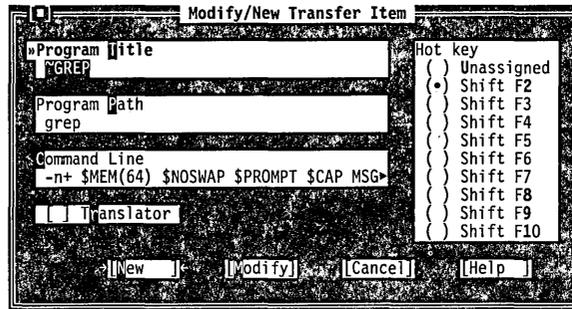
The Transfer buttons let you edit and delete the names of programs you can transfer to, as well as cancel any changes you've made to the transfer list. There's also a Help button to get more information about using the Transfer dialog box.

Edit

Choose Edit to add or change the Program Titles list that appears in the  $\equiv$  menu. The Edit button displays the Modify/New Transfer Item dialog box.

If you're positioned on a transfer item when you select Edit, the input boxes in the Modify/New dialog box are automatically filled in; otherwise they're blank.

Figure 3.19  
The Modify/New Transfer  
Item dialog box



Using the Modify/New Transfer Item dialog box, you take these steps to add a new file to the Transfer dialog box:

1. Type a short description of the program you're adding on the Program Title input box.  
If you want your program to have a keyboard shortcut (like the *S* in the Save command or the *t* in the Cut command), you should include a tilde (~) in the name. Whatever character follows the tilde appears in bold or in a special color in the  $\equiv$  menu, indicating that you can press that key to choose the program from the menu.
2. Tab to Program Path and enter the program name and optionally include the full path to the program. (If you don't enter an explicit path, only programs in the current directory or programs in your regular DOS path will be found.)
3. Tab to Command Line and type any parameters or macro commands you want passed to the program. Macro commands always start with a dollar sign (\$) and are entered in uppercase. For example, if you enter \$CAP EDIT, all output from the program will be redirected to a special Edit window in Borland C++.
4. If you want to assign a hot key, tab to the Hot Key options and assign a shortcut to this program. Transfer shortcuts must be *Shift* plus a function key (*Alt+Shift* in the CUA command set).

For a full description of these powerful macros, see the "Transfer macros" section in UTIL.DOC

*This step is optional.*

Keystrokes already assigned appear in the list but are unavailable.

- Now click or choose the New button to add this program to the list.

To modify an existing transfer program, cursor to it in the Program Titles list of the Transfer dialog box and then choose Edit. After making the changes in the Modify/New Transfer Item dialog box, choose the Modify button.

Translator

The Translator check box lets you put the Transfer program into the Project File Translators list (the list you see when you choose Project | Local Options). Check this option when you add a transfer program that is used to build part of your project.

Delete

The Delete button removes the currently selected program from the list and the  $\equiv$  menu.

### Transfer macros

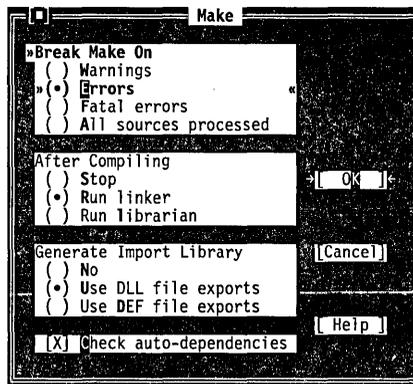
The IDE recognizes certain strings of characters called *transfer macros* in the parameter string of the Modify/New Transfer Item dialog box. The transfer macros are fully documented in the online file UTIL.DOC.

---

## Make

The Options | Make command displays a dialog box that lets you set conditions for project management. Here's what the dialog box looks like:

Figure 3.20  
The Make dialog box



Note that the Borland C++ for Windows version of the Make dialog box is slightly different from the Borland C++ version. In

Borland C++ for Windows, neither the Run Librarian nor the Generate Import Library options are available.

```
Break Make On
( ) Warnings
(•) Errors
( ) Fatal errors
( ) All sources processed
```

Set the Break Make On radio buttons to set the condition that will stop the making of a project. The default is to stop after compiling a file with errors.

```
After Compiling
( ) Stop
(•) Run linker
( ) Run librarian
```

Set the After Compiling radio buttons to specify what to do after all the source code modules defined in your project have been compiled. You can choose Stop (leave .OBJ files), Run linker to generate an .EXE file, or Run librarian to combine your projects .OBJ files into a .LIB (library) file. The default is to run the linker to generate an executable application.

*Borland C++ DOS IDE only*

```
Generate Import Library
( ) No
(•) Use DLL file exports
( ) Use DEF file exports
```

These buttons control when and how IMPLIB is executed during the MAKE process. The Use DLL File Exports option generates an import library that consists of the exports in the DLL. The Use DEF File Exports generates an import library of exports in the DEF file. If either of these options is checked, MAKE invokes IMPLIB after the linker has created the DLL. This option controls how the transfer macro \$IMPLIB is expanded.

```
[X] Check Auto-dependencies
```

When the Check Auto-dependencies option is checked, the Project Manager automatically checks dependencies for every .OBJ file on disk that has a corresponding .CPP, .C, or .ASM source file in the project list.

*Borland C++ for Windows also creates auto-dependency information for .RC resource scripts it compiles with the integrated resource compiler.*

*The IDEs also store the auto-dependency information in the project file to increase performance.*

The Project Manager opens the .OBJ file and looks for information about files included in the source code. This information is always placed in the .OBJ file by both Borland C++ and Borland C++ for Windows, as well as the command-line version of Borland C++ when the source module is compiled. Then every file that was used to build the .OBJ file is checked for time and date against the time and date information in the .OBJ file. The source file is recompiled if the dates are different. This is called an *autodependency check*. If this option is off (unchecked), no such file checking is done.

*See the \$DEP transfer macro in UTIL.DOC.*

After the C++ or C source file is successfully compiled, the project file contains valid dependency information for that file. Once that information is in the project file, the Project Manager uses it to do its autodependency check. This is much faster than reading each .OBJ file.

## Linker

The Options | Linker command lets you make several settings that affect linking. The Linker command opens a submenu containing the choices Settings and Libraries.

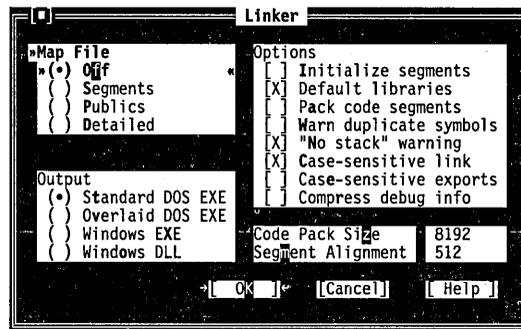


Note that the Borland C++ and Borland C++ for Windows environments provide slightly different linker options. This is because Borland C++ for Windows is a "Windows only" programming environment; therefore, DOS-oriented options aren't supported.

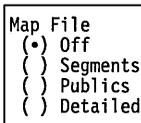
## Settings

In Borland C++ the Settings command opens this dialog box:

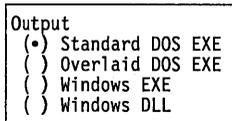
Figure 3.21  
The Linker dialog box



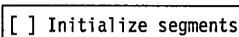
This dialog box has several check boxes and radio buttons. The following sections contain short descriptions of what each does.



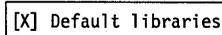
Set the Map File radio buttons to choose the type of map file to be produced. For settings other than Off, the map file is placed in the output directory defined in the Options | Directories dialog box. The default setting for the map file is Off.



Set these radio buttons to select your application type. Standard DOS EXE produces a normal executable that runs under DOS. Overlaid DOS EXE produces an executable capable of being overlaid. Windows EXE produces a Windows application, while Windows DLL produces a Windows dynamic link library.



If checked, Initialize Segments tells the linker to initialize uninitialized segments. (This is normally not needed, and makes your .EXE files larger.)



Some compilers place lists of default libraries in the .OBJ files they produce. If Default Libraries is checked, the linker tries to find

any undefined routines in these libraries as well as in the default libraries supplied by Borland C++. When you're linking with modules created by a compiler other than Borland C++, you may wish to leave this option off (unchecked).

Pack code segments

This option applies only to Windows applications and DLLs. When it's checked, the linker minimizes the number of code segments by packing multiple code segments together; typically, this improves performance. This option never creates segments greater than 64K.

Warn duplicate symbols

The Warn Duplicate Symbols option affects whether the linker warns you about previously encountered symbols in .LIB files.

"No stack" warning

The "No stack" Warning option affects whether the linker generates the "No stack" message. It's normal for a program generated under the Tiny model to display this message if the message is not turned off.

*Borland C++ DOS IDE only*

The "No Stack" Warning option does not appear in the Borland C++ for Windows IDE, since Windows does not support the Tiny model.

Case-sensitive Link

The Case-sensitive Link option affects whether the linker is case-sensitive. Normally, this option should be checked, since C and C++ are both case-sensitive languages.

Case-sensitive exports

By default, the linker ignores case with the names in the IMPORTS and EXPORTS sections of the module-definition file. If you want the linker to be case-sensitive in regard to these names, check this option. This option is useful when you export noncallback functions from DLLs—as in exported C++ member functions. It's not necessary for normal Windows callback functions (declared FAR PASCAL).

Compress debug info

The Compress Debug Info option instructs the linker to compress the debugging information in the output file. This option slows down the linker, and should only be checked in the event of a "Debugger information overflow" error when linking.

Code Pack Size	8192
Segment Alignment	512

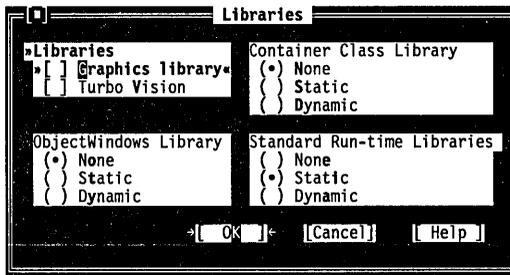
You can change the default code-packing size to anything between 1 and 65,536 with Code Pack Size. See Chapter 4 in the *Tools and Utilities Guide* for a more in-depth discussion of desirable sizes.

With Segment Alignment, you can set the segment alignment. The alignment factor will be automatically rounded up to the nearest

power of 2 (meaning if you enter 650, it is rounded up to 1,024). The numbers you enter must fall in the range of 2 to 65,535.

**Libraries** The Libraries dialog box has several radio buttons that let you choose which libraries are automatically linked into your application.

Figure 3.22  
The Libraries dialog box



Graphics library

The Graphics Library option controls the automatic searching of the BGI graphics library. When this option is checked, you can build and run single-file graphics programs without using a project file. Unchecking this option speeds up the link step because the linker doesn't have to search in the BGI graphics library file.

*Borland C++ DOS IDE only*

The BGI Graphics library is not Windows-compatible, so this option does not appear in the Borland C++ for Windows IDE.



You can uncheck this option and still build programs that use BGI graphics, provided you add the name of the BGI graphics library (GRAPHICS.LIB) to your project list.

Turbo Vision

The Turbo Vision library option instructs the linker to automatically include the Turbo Vision application framework library when linking your application.

*Borland C++ DOS IDE only*

Turbo Vision is a DOS character-mode application framework. It is not Windows-compatible, and this option does not appear in the Borland C++ for Windows IDE.

Container class library  
 None  
 Static  
 Dynamic

The Container class library option tells the linker to automatically link in the Borland C++ container class library, which is available in both static (.LIB) and dynamic (.DLL) form. These radio buttons tell the linker which, if either, form of the Container class library you want to automatically link in with your application.

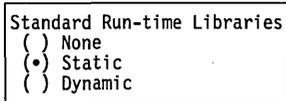


ObjectWindows is a Windows application framework available in both static (.LIB) and dynamic (.DLL) form. These radio buttons tell the linker which, if either, form of the ObjectWindows library you want to automatically link in with your application.

To use the DLL version of the container class library or ObjectWindows, you must:

- choose Options | Compiler | Code Generation | Large
- choose Options | Linker | Settings | Case-sensitive Link
- choose Options | Linker | Settings | Case-sensitive Exports
- choose Options | Compiler | Entry/Exit Code | Windows Smart Callbacks
- define the macro `__CLASSDLL`

*The easiest way to define this macro is to include it in the Options | Compiler | Code Generation | Defines input box.*



The standard run-time libraries are available in both static (.LIB) and dynamic (.DLL) form. Choosing the dynamic form can help to reduce the size of your Windows executable file, and can also reduce the overhead of loading these libraries more than once if they will be called by more than one application running simultaneously.

To use the DLL version of the run-time library, you must choose Dynamic and:

- choose Options | Compiler | Code Generation | Large
- choose Options | Linker | Settings | Case-sensitive Link
- choose Options | Linker | Settings | Case-sensitive Exports
- define the macro `__RTL DLL`

*The easiest way to define this macro is to include it in the Options | Compiler | Code Generation | Defines input box.*



When you use DLL versions of the libraries, you might also have to use the DLL versions of other libraries. See the following table for more information.

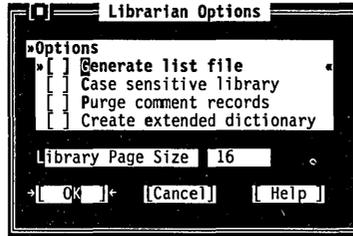
Table 3.4  
DLL interdependencies

Library	Other libraries required
Run-time library	None
Container class library	Run-time library
ObjectWindows	Run-time library, container class library

## Librarian

The Options | Librarian command lets you make several settings affecting the use of the built-in Librarian. Like the command-line librarian (TLIB), the built-in Librarian combines the .OBJ files in your project into a .LIB file.

Figure 3.23  
The Librarian Options dialog box



- The Generate List File check box determines whether the Librarian automatically produces a list file (.LST) listing the contents of your library when it is created.
- The Case Sensitive Library check box tells the Librarian to treat case as significant in all symbols in the library (this means that CASE, Case, and case, for example, would be treated as different symbols).
- The Purge Comment Records check box tells the Librarian to remove all comment records from modules added to the library.
- The Create Extended Dictionary check box determines whether the Librarian will include, in compact form, additional information that will help the linker to process library files faster.

### Library Page Size

The Library Page Size option allows you to set the number of bytes in each library “page” (dictionary entry). The page size determines the maximum size of the library: it cannot exceed 65,536 pages. The default page size, 16, allows a library of about 1MB in size. To create a larger library, change the page size to the next higher value (32).

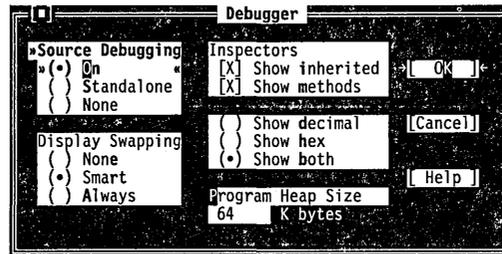
## Debugger

*Borland C++ DOS IDE only*

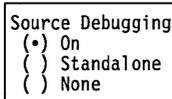
The Options | Debugger command lets you make several settings affecting the integrated debugger. (Borland C++ for Windows does not contain an integrated debugger, so this option does not

appear in the Borland C++ for Windows IDE.) This command opens this dialog box:

Figure 3.24  
The Debugger dialog box



The following sections describe the contents of this box.

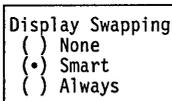


The Source Debugging radio buttons determine whether debugging information is included in the executable file and how the .EXE is run under Borland C++.

Programs linked with this option set to On (the default) can be debugged with either the integrated debugger or the standalone Turbo Debugger. Set this On when you want to debug in the IDE.

If you set this option to Standalone, programs can be debugged only with Turbo Debugger, although they can still be run in Borland C++.

If you set this option to None, programs cannot be debugged with either debugger, because no debugging information has been placed in the .EXE file.



The Display Swapping radio buttons let you set when the integrated debugger will change display windows while running a program.

If you set Display Swapping to None, the debugger does not swap the screen at all. You should only use this setting for debugging sections of code that you're certain do not output to the screen.

When you run your program in debug mode with the default setting of Smart, the debugger looks at the code being executed to see whether it will generate output to the screen. If it does (or if it calls a function), the screen is swapped from the IDE screen to the User Screen long enough for output to be displayed, then is swapped back. Otherwise, no swapping occurs.



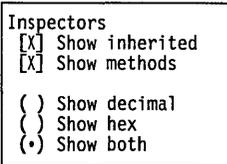
Be aware of the following with smart swapping:

- It swaps on any function call, even if the function generates no screen output.
- In some situations, the IDE screen might be modified without being swapped; for example, if a timer-interrupt routine writes to the screen.

If you set Display Swapping to Always, the debugger swaps screens every time a statement executes. You should choose this setting any time the IDE screen is likely to be overwritten by your running program.

**Note**

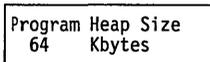
If you're debugging in dual-monitor mode (that is, you used the Borland C++ command-line `/d` option or specified Dual monitor mode on the Options | Environment | Startup dialog box), you can see your program's output on one monitor and the Borland C++ screen on the other. In this case, Borland C++ never swaps screens and the Display Swapping setting has no effect.



In the Inspectors check boxes, when Show Inherited is checked, it tells the integrated debugger to display all member functions and methods—whether they are defined within the inspected class or inherited from a base class. When this option is not checked, only those fields defined in the type of the inspected object are displayed.

When checked, the Show Methods option tells the integrated debugger to display member functions when you inspect a class.

Check the Show Decimal, Show Hex, or Show Both radio buttons when you want to control how the values in inspectors are displayed. Show both is on by default.



You can use the Program Heap Size input box to input how much memory Borland C++ should assign a program when you debug it. The actual amount of memory that Borland C++ gives to the program equals the size of the executable image plus the amount you specify here.

*It's only meaningful to increase heap size when working with large data models.*

The default value for the program heap size is 64K. You may want to increase this value if your program uses dynamically allocated objects.

## Directories

---

The Options | Directories command lets you tell Borland C++ where to find the files it needs to compile, link, output, and debug. This command opens the following dialog box containing four input boxes:

- The Include Directories input box specifies the directory that contains your include files. Standard include files are those given in angle brackets (<>) in an **#include** statement (for example, **#include <myfile.h>**). These directories are also searched for quoted Includes not found in the current directory. Multiple directory names are allowed, separated by semicolons.
- The Library Directories input box specifies the directories that contain your Borland C++ startup object files (CO?.OBJ), run-time library files (.LIB files), and any other libraries that your project may use. Multiple directory names are allowed, separated by semicolons.
- The Output Directory input box specifies the directory that stores your .OBJ, .EXE, and .MAP files. Borland C++ looks for and writes files to that directory when doing a make or run, and to check dates and times of .OBJS and .EXEs. If the entry is blank, the files are stored in the current directory.
- The Source Directories input box specifies the directories where the Borland C++ integrated debugger looks for the source code to libraries that do not belong to the open project (for example, container class libraries). Multiple directories can be entered, separated by semicolons. If the entry is blank, the current directory is searched.

*Borland C++ DOS IDE only*

Use the following guidelines when entering directories in these input boxes:

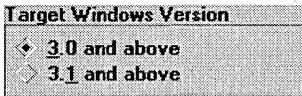
- If an input box supports multiple directory-path names, you must separate them with a semicolon (;). You can use up to a maximum of 127 characters (including whitespace).
- Whitespace before and after the semicolon is allowed but not required.
- Relative and absolute path names are allowed, including path names relative to the logged position in drives other than the current one. For example,

```
C:\C\LIB;C:\C\MYLIBS;A:\BORLANDC\MATHLIBS;A:..\VIDLIBS
```

## Resources

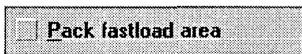


See *Options | Transfer* on page 102.



The Options | Resources command in Borland C++ for Windows sets several options for how resources are compiled and bound to your application by the integrated resource compiler and resource linker. In the Borland C++ DOS IDE, you can set these options by modifying the Transfer program entry for the Resource Compiler.

The Target Windows Version group of radio buttons sets the earliest version of Windows under which your application can run. If you're using any features specific to Windows 3.1, you should check Windows 3.10 and Above to ensure that your application won't run under Windows 3.0.



The Pack Fastload Area check box causes the resource linker to optimize how resources and segments are arranged in the executable file. When this box is checked, the resource linker will cause all data segments, nondiscardable code segments, and the entry-point code segment to be preloaded and written to a contiguous area in the executable file. No such optimizations will be done if this box is unchecked.

## Environment

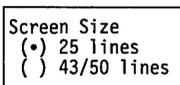
The Options | Environment command lets you make environment-wide settings. This command opens a menu that lets you choose settings from Preferences, Editor, Mouse, Desktop, Startup, and Colors.

You can customize edit window colors in the *Options | Environment | Highlight* dialog box.

In the Borland C++ for Windows environment, the Startup and Colors options are not available. In addition, some of the other selections are slightly different from their Borland C++ equivalents.

### Preferences

*Borland C++ DOS IDE only*



The Screen Size radio buttons let you specify whether your IDE screen is displayed in 25 lines or 43/50 lines. One or both of these buttons will be available, depending on the type of video adapter in your PC.

When set to 25 lines (the default), Borland C++ uses 25 lines and 80 columns. This is the only screen size available to systems with a monochrome display or Color Graphics Adapter (CGA).

If your PC has EGA or VGA, you can set this option to 43/50 lines. The IDE is displayed in 43 lines by 80 columns if you have an EGA, or 50 lines by 80 columns if you have a VGA.

Source Tracking
<input checked="" type="radio"/> New window
<input type="radio"/> Current window

When stepping source or viewing the source from the Message window, the IDE opens a new window whenever it encounters a file that is not already loaded. Selecting Current Window causes the IDE to replace the contents of the topmost Edit window with the new file instead of opening a new Edit window.

Command Set
<input type="radio"/> CUA
<input type="radio"/> Alternate
<input checked="" type="radio"/> Native

The Command Set options allow you to choose either the CUA or the alternate command set as your editor interface. You can also select Native, which specifies that the CUA interface will be used for the Borland C++ for Windows IDE, and Alternate will be used for the Borland C++ IDE. For more information about the CUA and alternate editor command sets, see Chapter 2, "IDE basics."

Auto Save
<input type="checkbox"/> Editor Files
<input checked="" type="checkbox"/> Environment
<input checked="" type="checkbox"/> Desktop
<input checked="" type="checkbox"/> Project

You can use the Auto Save check boxes to tell the IDE to save changed files when there's a danger that you will lose work. Editor Files includes all files in all open edit windows. Environment is the environment-wide configuration file. Desktop consists of window positions and sizes and history lists. Project includes your project, autodependency, and module settings.

Auto Save for all these options is invoked whenever you:

- exit the IDE
- shell to DOS
- use a transfer item
- choose any option under the Run menu

*Borland C++ DOS IDE only*  
*Borland C++ DOS IDE only*

Auto Save for editor, desktop, and project files is invoked whenever you:

- close a project
- open a new project
- switch projects

<input type="checkbox"/> Save Old Messages
--

When Save Old Messages is checked, Borland C++ saves the error messages currently in the Message window, and messages from future compiles are added. Messages are not saved from one session to the next. By default, Borland C++ automatically clears messages before a compile, a make, or a transfer that uses the Message window.

The supplied Borland text editor font (BorlandTE) supports italic and bold characters when you have syntax highlighting enabled.

Editor If you choose Editor from the Environment menu, these are the options you can pick from:

Editor Options	
<input checked="" type="checkbox"/>	Create backup files
<input checked="" type="checkbox"/>	Insert mode
<input checked="" type="checkbox"/>	Autoindent mode
<input checked="" type="checkbox"/>	Use tab character
<input checked="" type="checkbox"/>	Optimal fill
<input checked="" type="checkbox"/>	Backspace unindents
<input checked="" type="checkbox"/>	Cursor through tabs
<input type="checkbox"/>	Group undo
<input checked="" type="checkbox"/>	Persistent blocks
<input type="checkbox"/>	Overwrite blocks
<input checked="" type="checkbox"/>	Syntax highlighting

- When Create Backup Files is checked (the default), Borland C++ automatically creates a backup of the source file in the Edit window when you choose File | Save and gives the backup file the extension .BAK.
- When Insert Mode is not checked, any text you type into Edit windows overwrites existing text. When the option is checked, text you type is inserted (pushed to the right). Pressing *Ins* toggles Insert mode when you're working in an Edit window.
- When Autoindent Mode is checked, pressing *Enter* in an Edit window positions the cursor under the first nonblank character in the preceding nonblank line. This can be a great aid in typing readable program code.
- When Use Tab Character is checked, Borland C++ inserts a true tab character (ASCII 9) when you press *Tab*. When this option is not checked, Borland C++ replaces tabs with spaces. If there are any lines with characters on them prior to the current line, the cursor is positioned at the first corresponding column of characters following the next whitespace found. If there is no "next" whitespace, the cursor is positioned at the end of the line. After the end of the line, each *Tab* press is determined by the Tab Size setting.
- When you check Optimal Fill, Borland C++ begins every autoindented line with the minimum number of characters possible, using tabs and spaces as necessary. This produces lines with fewer characters than when Optimal Fill is not checked.
- When Backspace Unindents is checked (which is the default) and the cursor is on a blank line or the first nonblank character of a line, the *Backspace* key aligns (outdents) the line to the previous indentation level. This option is only effective when Cursor Through Tabs is also selected.
- When you check Cursor Through Tabs, the arrow keys will move the cursor space by space through tabs; otherwise the cursor jumps over tabs.
- When Group Undo is unchecked, choosing Edit | Undo reverses the effect of a single editor command or keystroke. For example, if you type ABC, it will take three Undo commands to delete C, then B, then A.

If Group Undo is checked, Undo reverses the effects of the previous command and all immediately preceding commands of the same type. The types of commands that are grouped are insertions, deletions, overwrites, and cursor movements. For example, if you type ABC, one Undo command deletes ABC.

For the purpose of grouping, inserting a carriage return is considered an insertion followed by a cursor movement. For example, if you press *Enter* and type ABC, choosing Undo once will delete the ABC, and choosing Undo again moves the cursor to the new carriage return. Choosing Edit | Redo at that point would move the cursor to the following line. Another Redo would insert ABC. (See page 53 for more information about Undo and Redo.)

- When Persistent Blocks is checked (the default), marked blocks behave as they always have in Borland's C and C++ products; that is, they remain marked until deleted or unmarked (or until another block is marked). With this option unchecked, moving the cursor after a block is selected deselects the entire block of text.
- When Overwrite Blocks is checked *and* Persistent Blocks is unchecked, marked blocks behave differently in these instances:
  1. Pressing the *Del* key or the *Backspace* key clears the entire selected text.
  2. Inserting text (pressing a character or pasting from clipboard) replaces the entire selected text with the inserted text.
- When Syntax Highlighting is checked, you can control the colors in an Edit window of various elements in your C or C++ code. In the DOS IDE, you can select these colors in the Options | Environment | Colors dialog box. In the Windows IDE, use the Options | Environment | Highlight dialog box.

Tab Size 8
------------

When you press *Tab*, Borland C++ moves the cursor to the next tab stop. The Tab Size input box allows you to dictate how many characters to move for each tab stop. Legal values are 2 through 16; the default is 8.

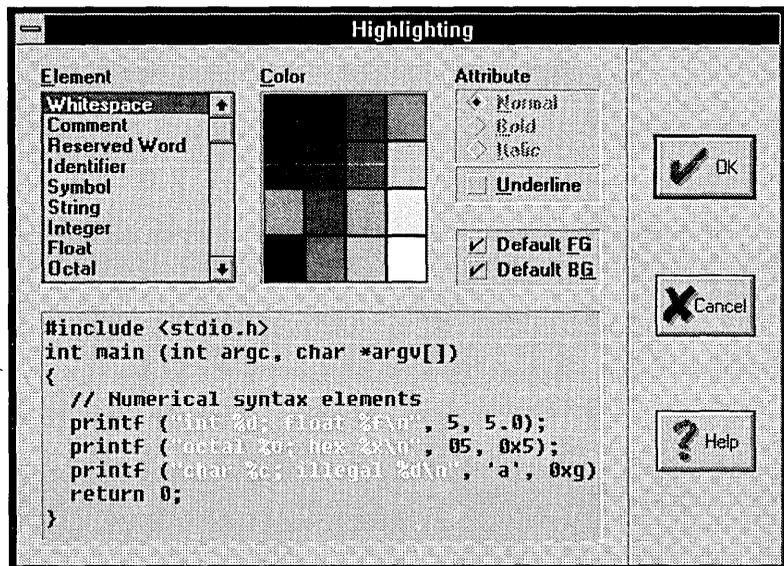
To change the way tabs are displayed in a file, just change the tab size value to the size you prefer. Borland C++ redisplay all tabs in that file in the size you chose. You can save this new tab size in your configuration file by choosing Options | Save Options.

Default Extension CPP

The Default Extension input box lets you tell Borland C++ which extension to use as the default when compiling and loading your source code. The IDE uses the default extension to name new files and in file-selection dialog boxes.

**Highlight** You can boldface, italicize, underline, or change the color of code elements. Choose Options | Environment | Highlight and the Highlighting dialog box appears.

Figure 3.25  
The Highlighting dialog box



The list box on the left lists the elements of C and C++ code.

### Coloring your text

To change the color of an element, follow these steps:

1. Select the element you want to change in the Element list box, or click a sample of that element in the code sample.
2. Select the colors you want in the Color dialog box.

The current foreground color is marked with the letters FG; the current background color is marked with the letters BG. If the foreground and background colors are the same, you'll see the letters FB on the color square.

- To select a foreground color with your mouse, click it. To select the color with your keyboard, press *Tab* until the Color matrix is selected, use the arrow keys to move around the Color matrix, and when you're on the color of your choice, press *F*.
- To select a background color with your mouse, click it with the right mouse button. To select the color with your keyboard, press *Tab* until the Color matrix is selected, use the arrow keys to move around the Color matrix, and when you're on the color of your choice, press *B*.

As soon as you select a color, you'll see the results reflected in the sample code.

3. Choose OK.

### Using the Windows system colors

Windows uses a window-background color and a text color, and most Windows applications use these same colors. To change the Windows system colors, use the Control Panel in the Program Manager.

You can choose to use the Windows system colors with the Highlighting dialog box. To use the Windows system foreground color for an element, follow these steps:

1. From the Highlighting dialog box, select the element in the Element list box.
2. Check the Default FG option.

Follow the same steps to change the background color, except choose the Default BG option.

### Changing text attributes

To select the attribute of an element, follow these steps:

1. From the Highlighting dialog box, select the element in the Element list box.
2. Select the attribute from the Attributes options.

As soon as you make an attribute selection, you'll see it reflected in the sample code window.

*To boldface or italicize text, the editor must use the BorlandTE font. To change fonts, choose Options | Editor and select the Font option you want.*



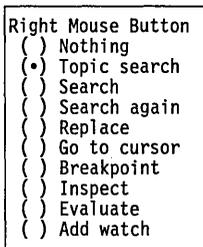
You can also select an element to change by simply clicking an occurrence of it in the sample code window. For example, if you click the reserved word **return**, you'll see that the element Reserved Word is selected in the Element list box. Changing colors or attributes will change all the reserved words in the sample code.



Remember that you must check Options | Environment | Editor | Syntax Highlighting to enable syntax highlighting.



When you choose Mouse from the Environment menu, the Mouse Options dialog box is displayed, which contains all the settings for your mouse. These are the options available to you:



The Right Mouse Button radio buttons determine the effect of pressing the right button of the mouse (or the left button, if the Reverse Mouse Buttons option is checked). Topic Search is the default.

Here's a list of what the right button would do if you choose something other than Nothing:

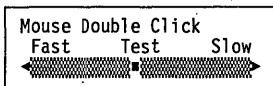
Topic Search	Same as Help   Topic Search
Search	Same as Search   Find
Search again	Same as Search   Search Again
Replace	Same as Search   Replace
Go to Cursor	Same as Run   Go To Cursor
Breakpoint	Same as Debug   Toggle Breakpoint
Inspect	Same as Debug   Inspect
Evaluate	Same as Debug   Evaluate
Add Watch	Same as Debug   Watches   Add Watch



In the Borland C++ for Windows IDE, which does not support integrated debugging, the options from Go to Cursor and below are not available. The Borland C++ for Windows environment, however, has an additional option, Browse, which sets the right mouse button to have the same effect as selecting Browse | Symbol from the menu.

*Borland C++ DOS IDE only*

The remaining mouse options, Mouse Double Click and Reverse Mouse Buttons, are available in the Borland C++ DOS IDE only. In the Windows IDE, you can set these options in the Windows Control Panel.



In the Mouse Double Click box, you can change the slider control bar to adjust the double-click speed of your mouse by using the arrow keys or the mouse.



Moving the scroll box closer to Fast means Borland C++ requires a shorter time between clicks to recognize a double click. Moving the scroll box closer to Slow means Borland C++ still recognizes a double click even if you wait longer between clicks.

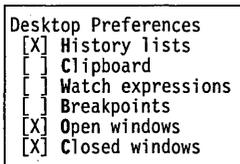
If you want to experiment with different settings, you can double-click the Test button above the scroll bar. When you successfully double-click the bar it becomes highlighted.

Reverse Mouse Buttons

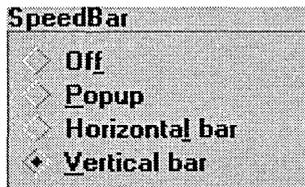
When Reverse Mouse Buttons is checked, the active button on your mouse is the rightmost one instead of the leftmost. Note, however, that the buttons won't actually be switched until you choose the OK button.

Depending on how you hold your mouse and whether you're right- or left-handed, the right mouse button might be more comfortable to use than the left.

#### Desktop



The Desktop Preferences dialog box lets you set whether history lists, the contents of the Clipboard, watch expressions, breakpoints, and open and closed windows are saved across sessions. History lists and open windows are saved by default; because watch expressions and breakpoints may not be meaningful across sessions, they are not saved by default, nor are windows that you have closed. You can change these defaults by unchecking or checking the respective options.



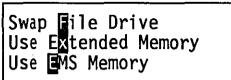
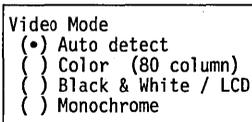
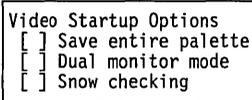
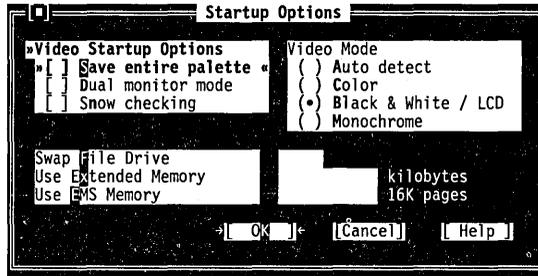
The Borland C++ for Windows IDE does not offer the Watch expressions and Breakpoints options. However, it provides an additional set of radio buttons to control the appearance of the SpeedBar. You may turn the SpeedBar off entirely, or have it appear as a pop-up, a vertical bar, or a horizontal bar. For more information about the SpeedBar, see Chapter 2, "IDE basics."

#### Startup

The Startup Options dialog box lets you set startup options for the Borland C++ DOS IDE.

Borland C++ DOS IDE only

Figure 3.26  
The Startup Options dialog box



- When Borland C++ switches between graphics and text mode to run or debug a graphics program, the video display may become corrupted unless the entire EGA or VGA video palette is saved in a separate buffer during the switch. Save entire palette should be left *unchecked* if you will not be running or debugging graphics programs, since saving the palette slows down execution speed.
- Dual monitor mode lets you run your program on one monitor while debugging in the IDE on another monitor.
- Snow checking tells Borland C++ to check for video “snow.” This usually occurs only on older CGA video adapters. Disable this option if your display driver doesn’t have a “snow” problem.
- Auto detect (the default) tells Borland C++ to check your hardware on startup and set its video mode automatically
- Color specifies that Borland C++ should always run CGA/EGA/VGA/XGA monitors in color mode.
- Black & White / LCD tells Borland C++ to run CGA/EGA/VGA/XGA monitors always in black-and-white mode. This mode should be used for most laptop LCD monitors.
- Monochrome tells Borland C++ to run always in monochrome mode.

Swap File Drive lets you specify a disk drive to use as a swap file in the event that Borland C++ runs out of memory while compiling or linking your project. If you have a RAM drive, you should specify this as your swap drive, to improve speed.

Use Extended Memory allows you to tell Borland C++ how much extended memory (in Kilobytes) to reserve for its use.

Use EMS Memory allows you to tell Borland C++ how many expanded memory (EMS) pages to reserve for its use when swapping.

### Colors

*Borland C++ DOS IDE only*

*In Borland C++ for Windows, you can use the Options | Environment | Highlight dialog box to customize the colors used in edit windows. You can set other colors in the Windows Control Panel.*

The Colors dialog box allows you to set your color preferences for each component of the DOS IDE. Select any Group and any Item within that Group, and the available Foreground and Background colors appear in the respective sections of the dialog box. A sample of the currently selected scheme appears in the Item Color box. To change the default color for that item, select your preferences from the Foreground and Background palettes. When you have modified all the items you wish to change, select OK to exit and save your changes. To exit without recording any changes, select Cancel.

You can select colors for syntax elements under Item for the Edit Window group. If you checked Syntax Highlight in the Options | Environment | Editor dialog box, those elements appear in the colors you selected. (See page 118 for more information about syntax elements.)

Figure 3.27  
The Colors dialog box



### Save

The Options | Save command brings up a dialog box that lets you save settings you've made in both the Find and Replace dialog boxes (off the Search menu) and in the Options menu (which includes all the dialog boxes that are part of those commands) for IDE, Desktop, and Project items. Options are stored in three files, which represent each of these categories. If it doesn't find the files, Borland C++ looks in the Executable directory (from which BC.EXE is run) for the same file.

## Window menu

---



The Window menu contains window-management commands. Most of the windows you open from this menu have all the standard window elements like scroll bars, a close box, and zoom boxes. Refer to page 30 for information on these elements and how to use them.



The Windows IDE Window menu differs somewhat from that of DOS IDE. Although not as many window-management commands are on the Borland C++ for Windows Window menu, the same functionality exists. If you know how to use Windows, you'll know how to manage windows within the Borland C++ for Windows IDE; just use the same commands you'd use in other Windows applications.

---

### Size/Move

*Borland C++ DOS IDE only*  
Alternate



Choose Window | Size/Move to change the size or position of the active window.

When you choose this command, the active window moves in response to the arrow keys. When the window is where you want, press *Enter*. You can also move a window by dragging its title bar.

If you press *Shift* while you use the arrow keys, you can change the size of the window. When it's the size you want, press *Enter*. If a window has a resize corner, you can drag that corner or any other corner to resize it.

---

### Zoom

*Borland C++ DOS IDE only*  
Alternate



Choose Window | Zoom to resize the active window to the maximum size. If the window is already zoomed, you can choose this command again to restore it to its previous size. You can also double-click anywhere on the top line (except where an icon appears) of a window to zoom or unzoom it.

---

### Tile

CUA



Choose Window | Tile to tile all your open windows.

---

## Cascade

CUA



Choose Window | Cascade to stack all open windows.

---

## Arrange Icons



Choosing Window | Arrange Icons will rearrange any icons on the Borland C++ for Windows desktop so they are evenly spaced, beginning at the lower left corner of the desktop.

---

## Next

*Borland C++ DOS IDE only*

CUA



Alternate



Choose Window | Next to make the next window active, which makes it the topmost open window.

---

## Close

*Borland C++ DOS IDE only*

CUA



Alternate



Choose Window | Close to close the active window. You can also click the close box in the upper left corner to close a window.

---

## Close All

In Borland C++, choose Close All to close all windows and clear all history lists. This command is useful when you're starting a new project. In Borland C++ for Windows, Close All closes all open windows on the Borland C++ for Windows desktop. History lists are not saved.

---

## Message

*In Borland C++, you can display transfer program output in the Message window.*

Choose Window | Message to open the Message window and make it active. The Message window displays error and warning messages, which you can use for reference, or you can select them and have the corresponding location be highlighted in the edit

window. When a message refers to a file not currently loaded, you can press the *Spacebar* to load that file. When an error is selected in the Message window, press *Enter* to show the location of the error in the edit window and make the edit window active at the point of error.

To close the window, click its close box or choose Window | Close.

---

## Output

*Borland C++ DOS IDE only*

Choose Window | Output to open the Output window and make it active. The Output window displays text from any DOS command-line and any text (but no graphics) generated by your program.

The Output window is handy while debugging because you can view your source code, variables, and output all at once. This is especially useful when you've set the Options | Environment dialog box to a 43/50 line display and you are running a standard 25-line mode program. In that case, you can see almost all of the program output and still have plenty of lines to view your source code and variables.

If you would rather see your program's text on the full screen—or if your program generates graphics—choose the Window | User Screen command instead.

To close the window, click its close box or choose Window | Close.

---

## Watch

*Borland C++ DOS IDE only*

Choose Window | Watch to open the Watch window and make it active. The Watch window displays expressions and their changing values so you can keep an eye on how your program evaluates key values.

You use the commands in the Debug | Watches pop-up menu to add or remove watches from this window. Refer to the section on this menu for information on how to use the Watch window (page 75).

To close the window, click its close box or choose Window | Close.

---

## User Screen

*Borland C++ DOS IDE only*

CUA

Shift F5

Alternate

Alt F5

Choose Window | User Screen to view your program's full-screen output. If you would rather see your program output in a Borland C++ window, choose the Window | Output command instead.

Clicking or pressing any key returns you to the IDE.

---

## Register

*Borland C++ DOS IDE only*

Choose Window | Register to open the Register window and make it active.

The Register window displays CPU registers and is used most often when debugging inline ASM and TASM modules in your project.

To close the window, click its close box or choose Window | Close.

---

## Project

Choose Window | Project to open the Project window, which lets you view the list of files you're using to create your program.

---

## Project Notes

*Borland C++ DOS IDE only*

Choose Window | Project Notes to write down any details, make to-do lists, or list any other information about your project files.

---

## List All

*Borland C++ DOS IDE only*

Alt O

Choose Window | List All to see a list of all the windows you've opened. The list contains the names of all files currently open as well as any of the last eight files you've opened in an edit window but have since closed. A recently closed file appears in the list prefixed with the word *closed*.

When you choose an already open file from the list, Borland C++ brings the window to the front and makes it active. When you choose a closed file from the list, Borland C++ reopens the file in an edit window in the same size and location as when the window was closed. The cursor is positioned at its last location.



In Borland C++ for Windows, you can see a list of recently closed files at the bottom of the File menu, and you can see a list of open windows at the bottom of the Window menu. Choosing a closed file name reopens the file in a new edit window. Choosing an open window makes that window active.

## Help menu

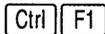
---

The Help menu gives you access to online help in a special window. There is help information on virtually all aspects of the IDE and Borland C++. (Also, one-line menu and dialog box hints appear on the status line whenever you select a command.)

To open the Help window, do one of these actions:



- Press *F1* at any time (including from any dialog box or when any menu command is selected).



- When an edit window is active and the cursor is positioned on a word, press *Ctrl+F1* to get language Help on that word.

- Click Help whenever it appears on the status line or in a dialog box.

*Borland C++ DOS IDE only*

To close the Help window, press *Esc*, click the close box, or choose Window | Close. You can keep the Help window onscreen while you work in another window unless you opened the Help window from a dialog box or pressed *F1* when a menu command was selected.

*When getting help in a dialog box or menu, you cannot resize the window or copy to the clipboard. In this instance, Tab takes you to dialog-box controls, not the next keyword.*

Help screens often contain *keywords* (highlighted text) that you can choose to get more information. Press *Tab* to move to any keyword; press *Enter* to get more detailed help. (As an alternative, move the cursor to the highlighted keyword and press *Enter*.) With a mouse, you can double-click any keyword to open the Help text for that item.

You can also cursor around the Help screen and press *Ctrl+F1* on *any* word to get help. If the word is not found, an incremental search is done in the index and the closest match is displayed.

When the Help window is active, you can copy from the window and paste that text into an edit window. You do this the same as you would in an edit window: Select the text first, choose Edit | Copy, move to an edit window, then choose Edit | Paste.

To select text in the Help window, drag across the desired text or, when positioned at the start of the block, press *Shift+* →, ←, ↑, ↓ to mark a block.

You can also copy preselected program examples from Help screens by choosing the Edit | Copy Example command.



Borland C++ for Windows uses the Windows Help system. See your Windows manual for more information on the Windows Help system.

---

## Contents

*Borland C++ DOS IDE only*

The Help | Contents command opens the Help window with the main table of contents displayed. From this window, you can branch to any other part of the help system.



You can get help on Help by pressing *F1* when the Help window is active. You can also reach this screen by clicking on the status line.

---

## Index



The Help | Index command displays a full list of Help keywords (the special highlighted text in Help screens that let you quickly move to a related screen).

*Borland C++ DOS IDE only*

You can scroll the list or you can incrementally search it by pressing letters from the keyboard. For example, to see what's available under "printing," you can type *p r i*. When you type *p*, the cursor jumps to the first keyword that starts with *p*. When you type *r*, the cursor moves to the first keyword that starts with *pr*. When you type *i*, the cursor moves to the first keyword that starts with *pri*, and so on.

*You can also tab to a keyword to select it.*

When you find a keyword that interests you, choose it by cursoring to it and pressing *Enter*. (You can also double-click it.)

---

## Topic Search



The Help | Topic Search command displays language Help on the currently selected item.

To get language Help, position the cursor on an item in an edit window and choose Topic Search. You can get help on things like function names (**printf**, for example), header files, reserved words,

and so on. If an item is not in the Help system, the Help index displays the closest match.

---

### Previous Topic

*Borland C++ DOS IDE only*



The Help | Previous Topic command opens the Help window and redisplay the text you last viewed.

Borland C++ lets you back up through 20 previous Help screens. You can also click on the status line to view the last Help screen displayed.

---

### Help on Help

*Borland C++ DOS IDE only*



The Help | Help on Help command opens up a text screen that explains how to use the Borland C++ Help system. If you're already in Help, you can display this screen by pressing *F1*.



The Help | Using Help option in Borland C++ for Windows is very similar to the Help on Help command in Borland C++.

---

### Active File

*Borland C++ DOS IDE only*

The Help | Active File command displays a dialog box that lets you select the Help file you want the IDE to use. These are the topics you can get help on:

- IDE, C++ language, and Windows API
- ObjectWindows API
- Turbo Vision API

---

### About

When you choose this command, a dialog box appears that shows you copyright and version information for Borland C++ or Borland C++ for Windows. Press *Esc* or click OK (or press *Enter*) to close the box.

## *Managing multi-file projects*

Since most programs consist of more than one file, having a way to automatically identify those that need to be recompiled and linked would be ideal. Borland C++'s built-in Project Manager does just that and more.

The Project Manager allows you to specify the files belonging to the project. Whenever you rebuild your project, the Project Manager automatically updates the information kept in the project file. This project file includes

- all the files in the project
- where to find them on the disk
- the header files for each source module
- which compilers and command-line options need to be used when creating each part of the program
- where to put the resulting program
- code size, data size, and number of lines from the last compile

Using the Project Manager is easy. To build a project,

- pick a name for the project file (from Project | Open Project)
- add source files using the Project | Add Item dialog box
- tell Borland C++ to Compile | Make

Then, with the project-management commands available on the Project menu, you can

- add or delete files from your project

- set options for a file in the project
- view included files for a specific file in the project

All the files in this chapter are in the *EXAMPLES* directory.

Let's look at an example of how the Project Manager works.

## Sampling the Project Manager

---

Suppose you have a program that consists of a main source file, *MYMAIN.CPP*, a support file, *MYFUNCS.CPP*, that contains functions and data referenced from the main file, and *myfuncs.h*. *MYMAIN.CPP* looks like this:

```
#include <iostream.h>
#include "myfuncs.h"

main(int argc, char *argv[])
{
    char *s;

    if(argc > 1)
        s=argv[1];
    else
        s="the universe";
    cout << GetString() << s << "\n";
}
```

*MYFUNCS.CPP* looks like this:

```
char ss[] = "The restaurant at the end of ";

char *GetString(void)
{
    return ss;
}
```

And *myfuncs.h* looks like this:

```
extern char *GetString(void);
```

These files make up the program we'll describe to the Project Manager.

*These names can be the same (except for the extensions), but they don't have to be. The name of your executable file (and any map file produced by the linker) is based on the project file's name.*

The first step is to tell Borland C++ the name of the project file you're going to use: Call it *MYPROG.PRJ*. The name of the project file is not the same as the name of the main file (*MYMAIN.CPP*). And in this case, the executable file will be *MYPROG.EXE* (and if you choose to generate it, the map file will be *MYPROG.MAP*).

Go to the Project menu and choose Open Project. This opens the Open Project File dialog box, which lists of all the files in the current directory with the extension .PRJ. Since you're starting a new file, type in the name MYPROG in the Open Project File input box.



Once a project is opened, the Add Item, Delete Item, Local Options, and Include Files options are enabled on the Project menu.

*If the project file you load is in another directory, the current directory is set to where the project file is loaded.*

You can keep your project file in any directory; to put it somewhere other than the current directory, just specify the path as part of the file name. (You must also specify the path for source files if they're in different directories.) Note that all files and corresponding paths are relative to the directory the project file is loaded from. After you enter the project file name, you'll see a Project window.

The Project window contains the current project file name (MYPROG). Once you indicate which files make up your project, you'll see the name of each file and its path. When the project file is compiled, the Project window also shows the number of lines in the file and the amount of code and data in bytes generated by the compiler.

*The SpeedBar also has buttons to perform these common operations.*

The status line at the bottom of the screen shows which actions can be performed at this point: *F1* gives you Help, *Ins* adds files to the Project, *Del* deletes a file from the Project, *Ctrl+O* lets you select options for a file, *Spacebar* lets you view information about the include files required by a file in the Project, *Enter* opens an editor window for the currently selected file, and *F10* takes you to the main menu. You can also click on any of these items with the mouse to take the appropriate action. Press *Ins* now to add a file to the project list.

*You can change the file-name specification with the Name input box; \*.CPP is the default.*

The Add to Project List dialog box appears; this dialog box lets you select and add source files to your project. The Files list box shows all files with the .CPP extension in the current directory. (MYMAIN.CPP and MYFUNCS.CPP both appear in this list.) Three action buttons are available: Add, Done, and Help.

*If you copy the wrong file to the Project window, press Esc to return to the Project window, then Del, or click the Delete Item button on the SpeedBar to remove the currently selected file.*

Since the Add button is the default, you can place a file in the Project window by typing its name in the Name input box and pressing *Enter* or by choosing it in the Files list box and choosing OK. You can also search for a file in the Files list box by typing the first few letters of the one you want. In this case, typing *my* should take you right to MYFUNCS.CPP. Press *Enter*. You'll see that

MYFUNCS is added to the Project window and then you're returned to the Add Item dialog box to add another file. Go ahead and add MYMAIN.CPP. Borland C++ will compile files in the exact order they appear in the project.

*The Add button commits your change; pressing Esc when you're in the dialog box closes the dialog box.*

Close the dialog box and return to the Project window. Notice that the Lines, Code, and Data fields in the Project window show n/a. This means the information is not available until the modules are actually compiled.

After you've set all compiler options and directories, Borland C++ knows everything it needs about how to build the program called MYPROG.EXE using the source code in MYMAIN.CPP, MYFUNCS.CPP, and myfuncs.h. Now you'll actually build the project.

*You can also view your output by choosing Window | Output.*

Choose Compile | Make or click the Make button on the SpeedBar to make your project. Choose Run | Run to run it.

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To view your output, choose Window | User Screen, then press any key to return to the IDE.

When you leave the IDE, your project file is automatically saved on disk; you can disable this by unchecking Project in the Preferences dialog box (Options | Environment).

*For more information on .PRJ and .DSK files, refer to the section "Configuration and project files," in Chapter 2.*

The saved project consists of two files: the project file (.PRJ) and the desktop file (.DSK). The project file contains the information required to build the project's related executable. The build information consists of compiler options, INCLUDE/LIB/OUTPUT paths, linker options, make options, and transfer items. The desktop file contains the state of all windows at the last time you were using the project.

*You can specify a project to load on the DOS command line like this: BC myprog.prj.*

The next time you use Borland C++, you can jump right into your project by reloading the project file. Borland C++ automatically loads a project file if it is the only .PRJ file in the current directory; otherwise the default project and desktop (TCDEF.\* and TCDEFW.\*) are loaded. Since your program files and their corresponding paths are relative to the project file's directory, you can work on any project by moving to the project file's directory and bringing up Borland C++. The correct file will be loaded automatically. If no project file is found in the current directory, the default project file is loaded.

## Error tracking

---

Syntax errors that generate compiler warning and error messages in multi-file programs can be selected and viewed from the Message window.

To see this, let's introduce some syntax errors into the two files, MYMAIN.CPP and MYFUNCS.CPP. From MYMAIN.CPP, remove the first angle bracket in the first line and remove the *c* in **char** from the fifth line. These changes will generate five errors and two warnings in MYMAIN.

In MYFUNCS.CPP, remove the first *r* from **return** in the fifth line. This change will produce two errors and one warning.

*Changing these files makes them out of date with their object files. Doing a make recompiles them.*

Since you want to see the effect of tracking in multiple files, you need to modify the criterion Borland C++ uses to decide when to stop the make process. This is done by setting a radio button in the Make dialog box (Options | Make).

---

## Stopping a make

You can choose the type of message you want the make to stop on by setting one of the Break Make On options in the Make dialog box (Options | Make). The default is Errors, which is normally the setting you'd want to use. However, you can have a make stop after compiling a file with warnings, errors, or fatal errors, or have it stop after all out-of-date source modules have been compiled.

The usefulness of each of these modes is determined by the way you like to fix errors and warnings. If you prefer to fix errors and warnings as soon as you see them, you should set Break Make On to Warnings or maybe to Errors. If you prefer to get an entire list of errors in all the source files before fixing them, set the radio button to Fatal Errors or to Link. To demonstrate errors in multiple files, choose Fatal Errors in the Make dialog box.

---

## Syntax errors in multiple source files

Since you've already introduced syntax errors into MYMAIN.CPP and MYFUNCS.CPP, choose Compile | Make to "make the project." The Compiling window shows the files being compiled, the number of errors and warnings in each file, and the total for the make. Press any key when the Errors: Press any key message flashes.

Your cursor is now positioned on the first error or warning in the Message window. If the file the message refers to is in the editor, the highlight bar in the edit window shows you where the compiler detected a problem. You can scroll up and down in the Message window to view the different messages.

Note that there is a “Compiling” message for each source file that was compiled. These messages serve as file boundaries, separating the messages generated by each module and its include files. When you scroll to a message generated in a different source file, the edit window tracks only in files currently loaded.

Moving to a message that refers to an unloaded file causes the edit window’s highlight bar to turn off. Press *Spacebar* to load that file and continue tracking, and the highlight bar reappears. If you choose one of these messages (that is, press *Enter* when positioned on it), Borland C++ loads the file the message references into an edit window and places the cursor on the error. If you then return to the Message window, tracking resumes in that file.

The Source Tracking options in the Preferences dialog box (Options | Environment) help you determine which window a file is loaded into. You can use these settings when you’re message tracking and debug stepping.

Both Previous Error and Next Error (on the Search menu) are affected by the Source Tracking setting. These commands will always find the next or previous error and loads the file using the method specified by Source Tracking.

---

## Saving or deleting messages

Normally, whenever you start to make a project, the Message window is cleared out to make room for new messages. Sometimes, however, it is desirable to keep messages around between makes.

Consider the following example: You have a project that has many source files and your program is set to stop on Errors. In this case, after compiling many files with warnings, one error in one file stops the make. You fix that error and want to find out if the compiler will accept the fix. But if you do a make or compile again, you lose your earlier warning messages. To avoid this, check Save Old Messages in the Preferences dialog box (Options | Environment). This way the only messages removed are the ones that result from the files you *recompile*. Thus, the old messages

for a given file are replaced with any new messages that the compiler generates.

You can always get rid of all your messages by choosing **Compile | Remove Messages**, which deletes all the current messages. Unchecking **Save Old Messages** and running another make will also get rid of any old messages.

## Autodependency checking

---

When you made your previous project, you dealt with the most basic situation: a list of C++ source file names. The Project Manager provides you with a lot of power to go beyond this simple situation.

The Project Manager collects autodependency information at compile time and caches these so that only files compiled outside the IDE need to be processed. The Project Manager can automatically check dependencies between source files in the project list (including files they themselves include) and their corresponding object files. This is useful when a particular C++ source file depends on other files. It is common for a C++ source to include several header files (.h files) that define the interface to external routines. If the interface to those routines changes, you'll want the file that uses those routines to be recompiled.

If you've checked the **Auto-Dependencies** option (**Options | Make**), Make obtains time-date stamps for all .CPP files and their included files. Then Make compares the date/time information of all these files with their date/time at last compile. If any date/time is different, the source file is recompiled.

If the **Auto-Dependencies** option is unchecked, the .CPP files are checked against .OBJ files. If earlier .CPP files exist, the source file is recompiled.

When a file is compiled, the IDE's compiler and the command-line compiler put dependency information into the .OBJ files. The Project Manager uses this to verify that every file used to build the .OBJ file is checked for time and date against the time and date information in the .OBJ file. The .CPP source file is recompiled if the dates are different.

That's all there is to dependencies. You get the power of more traditional makes while avoiding long dependency lists.

## Using different file translators

---

*Borland C++ for Windows's Project Manager doesn't use other file translators but does support other project-item options.*

So far you've built projects that use Borland C++ as the only language translator. Many projects consist of both C++ code and assembler code, and possibly code written in other languages. It would be nice to have some way to tell Borland C++ how to build such modules using the dependency checks just described. With the Project Manager, you don't need to worry about forgetting to rebuild those files when you change some of the source code, or about whether you've put them in the right directory, and so on.

For every source file you included in the list in the Project window, you can specify

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- which program (Borland C++, TASM, and so on) to use to build the target file

- which command-line options to give that program

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- whether the module is an overlay

- what to call the resulting module and where it will be placed (this information is used by the Project Manager to locate files needed for linking)

- whether the module contains debug information

- whether the module gets included in the link

By default, the Project Manager uses the IDE's compiler for each .C or .CPP module, using no command-line override options, using the Output directory for output, assuming that the module is not an overlay, and assuming that debug information is not to be excluded. The Project Manager uses Turbo Assembler for .ASM modules and the Resource Compiler for .RC and .RES files.

---

## Changing translator options

The Resource Compiler takes several optional command-line arguments. For example, the **-31** option will mark the application as requiring Windows 3.1, which can be useful if you are using Windows 3.1-specific features.

To change the options that the Project Manager passes to the Resource Compiler, choose Options | Transfer and select Resource Compiler. Move to the Command Line input box. The **\$SRC** transfer macro takes care of the required arguments, but you can add any optional arguments before it. For example, if you wanted

to pass the **-31** option to the Resource Compiler, you might use `-31 $RC`.

---

## Changing file translators

Borland C++ comes with both the Borland and Microsoft Resource Compilers. The Project Manager defaults to using the Microsoft Resource Compiler, but you can easily change your projects to use the Borland Resource Compiler. Choose **Options | Transfer**, select **Resource Compiler**, and press **OK**. **Program Path** is set to `RC`. Change it to `BRC` and choose **OK**.

---

## Assigning a new file translator

Normally the Project Manager uses the translator listed in the Resource Compiler transfer item to both compile `.RC` resource scripts and link `.RES` binary resource files. This behavior matches the way that the Resource Compiler (RC or BRC) does both jobs. However, Borland C++ also includes separate a separate Resource Compiler (BRCC) and Resource Linker (RLINK). Since using these tools separately is often faster than letting the Resource Compiler do it, you might want to set up your projects to use the tools separately. To do so, follow these steps:

1. You need to define both the Resource Compiler and Resource Linker as transfer items. Choose **Options | Transfer**, select **Resource Compiler**, and choose **Edit**. Change the **Program Title** to `Borland Resource Compiler` and the **Program Path** to `BRCC`. You can leave the **Command Line** as `$RC`. Choose **New**.
2. You'll be returned to the **Options | Transfer** dialog box. Select **Resource Compiler** and choose **Edit**. Don't change the **Program Title** or **Command Line**, but change **Program Path** to `RLINK`. Choose **Modify**.

The **Program Title** must stay `Resource Compiler`. The Project Manager looks for that title when dealing with `.RC` and `.RES` files.

3. Once again you're returned to the **Options | Transfer** dialog box. Press **Esc** or choose **Cancel**.
4. Open a project that has an `.RC` file. Select that file and press **Ctrl+O** to bring up the **Local Options** dialog box. Notice that the **Project File Translators** list now has `Borland Resource Compiler` and `Resource Compiler`. Move to that list and select `Borland Resource Compiler`. Use the **Command Line Options**

*Note that Borland Resource Compiler was added to the list of Program Titles.*



*There's only a single entry for Resource Compiler.*

*There are several Windows projects in the EXAMPLES directory.*

input box to specify any additional command-line options, such as **-31**.

The .RC file is now compiled with BRCC and linked with RLINK. The Project Manager will apply the same criteria to the .RC file when deciding whether to recompile the module during a make as it will to all the modules compiled with the IDE compiler.

## Using the Project Manager to build Windows applications

---

*Don't put .h, .BMP, .ICO, or .DLG files in your projects. Instead, the project's .RC or .RES file should include them.*

The Project Manager is especially useful when you're developing Windows applications, since a Windows application often consists of several modules of code, a module-definition file, and a resource file. For complete details, see Chapter 8 in the *Programmer's Guide*. The Project Manager's default behavior in the Borland C++ IDEs is listed in the following tables.

Table 4.1  
Project Manager defaults in the DOS IDE

File name	Behavior
<i>While compiling</i> x.RC	Transfers to the Resource Compiler to compile x.RC to x.RES
<i>While linking</i> x.DEF	The IDE linker uses the information in x.DEF while creating the .EXE
<i>After linking</i> x.RES	Transfers to the Resource Linker to bind x.RES to the .EXE

Table 4.2  
Project Manager defaults in the Windows IDE

File name	Behavior
<i>While compiling</i> x.RC	Invokes the integrated Resource Compiler to compile x.RC to x.RES
<i>While linking</i> x.DEF	The IDE linker uses the information in x.DEF while creating the .EXE
<i>After linking</i> x.RES	Invokes the integrated Resource Linker to bind x.RES to the .EXE

## Overriding libraries

---

In some cases, it's necessary to override the standard startup files or libraries. You override the startup file by placing a file called `C0x.OBJ` as the *first* name in your project file, where *x* stands for any DOS name (for example, `C0MINE.OBJ`). It's critical that the name start with `C0` and that it is the first file in your project.

To override the standard library, choose Options | Linker and, in the Libraries dialog box, select None for the Standard Run-time Library. Then add the library you want your project to use to the project file just as you would add any other item.

## More Project Manager features

---

Let's take a look at some of the other features the Project Manager has to offer. When you're working on a project that involves many source files, you want to be able to easily view portions of those files, and to record notes about what you're doing as you're working. You'll also want to be able to quickly access files that are included by others.

For example, expand `MYMAIN.CPP` to include a call to a function named **GetMyTime**:

```
#include <iostream.h>
#include "myfuncs.h"
#include "mytime.h"

int main(int argc, char *argv[])
{
    char *s;

    if(argc > 1)
        s=argv[1];
    else
        s="the universe";
    cout << GetString() << s << "\n";
    return 0;
}
```

This code adds one new include file to `MYMAIN`: `mytime.h`. Together `myfuncs.h` and `mytime.h` contain the prototypes that define the **GetString** and **GetMyTime** functions, which are called from `MYMAIN`. The `mytime.h` file contains

```

#define HOUR 1
#define MINUTE 2
#define SECOND 3
extern int GetMyTime(int);

```

Now, put the code for **GetMyTime** into a new source file called **MYTIME.CPP**:

```

#include <time.h>
#include "mytime.h"

int GetMyTime(int which)
{
    struct tm    *timeptr;
    time_t      secsnow;

    time(&secsnow);
    timeptr = localtime(&secsnow);
    switch (which) {
        case HOUR:
            return (timeptr -> tm_hour);
        case MINUTE:
            return (timeptr -> tm_min);
        case SECOND:
            return (timeptr -> tm_sec);
    }
}

```

MYTIME includes the standard header file `time.h`, which contains the prototype of the **time** and **localtime** functions, and the definition of `tm` and `time_t`, among other things. It also includes `mytime.h` in order to define `HOUR`, `MINUTE`, and `SECOND`.

Create these new files, then use **Project | Open Project** to open `MYPROG.PRJ`. The files `MYMAIN.CPP` and `MYFUNCS.CPP` are still in the Project window. Now to build your expanded project, add the file name `MYTIME.CPP` to the Project window. Press *Ins*, choose **Project | Add Item**, or click **Add Item** on the SpeedBar to open the Add Item dialog box. Use the dialog box to specify the name of the file you are adding and choose **Done**.

Now choose **Compile | Make** to make the project. `MYMAIN.CPP` will be recompiled because you've made changes to it since you last compiled it. `MYFUNCS.CPP` won't be recompiled, because you haven't made any changes to it since the make in the earlier example. `MYTIME.CPP` will be compiled for the first time.

In the `MYPROG` project window, move to `MYMAIN.CPP` and press *Spacebar* (or **Project | Include Files**) to display the Include Files dialog box. You can also click **View Includes** on the

SpeedBar. This dialog box contains the name of the selected file, several buttons, and a list of include files and locations (paths). The first file in the Include Files list box is highlighted; the list box lists all the files included by the file MYMAIN.CPP. If any of the include files are located outside of the current directory, the path to the file is shown in the Location field of the list box.

As each source file is compiled, the information about which include files are included by which source files is stored in the source file's .OBJ file. If you access the Include Files dialog box before you perform a make, it might contain no files or it might have files left over from a previous compile (which may be out of date). To load one of the include files into an edit window, highlight the file you want and press *Enter* or click the View button.

---

## Looking at files in a project

Let's take a look at MYMAIN.CPP, one of the files in the Project. Choose the file using the arrow keys or the mouse, then press *Enter*. This opens an edit window with MYMAIN.CPP loaded. Now you can make changes to the file, scroll through it, search for text, or whatever else you need to do. When you are finished with the file, save your changes if any, then close the edit window.

Suppose that after browsing around in MYMAIN.CPP, you realize what you really wanted was to look at mytime.h, one of the files that MYMAIN.CPP includes. Highlight MYMAIN.CPP in the Project window, then press *Spacebar* to bring up the Include Files dialog box for MYMAIN. (Alternatively, while MYMAIN.CPP is the active edit window, choose Project | Include Items.) Now choose mytime.h in the Include Files box and click View. This brings up an edit window with mytime.h loaded. When you're done, close the mytime.h edit window.

---

## Notes for your project

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Now that you've had a chance to see the code in MYMAIN.CPP and mytime.h, you might decide to make some changes at a later time. Choose Window | Project Notes to bring up a new edit window that is kept as part of your project file. Type in any comments you want to remember about your project.

Each project maintains its own notes file, so that you can keep notes about the project you're currently working on; they're available at the touch of a button when you select the project file.



## The command-line compiler

*The command-line compiler lets you invoke all the functions of the IDE compiler from the DOS command line.*

As an alternative to using the IDE, you can compile and run your programs with the command-line compiler (BCC.EXE). Almost anything you can do within the IDE can also be done using the command-line compiler. You can set warnings on or off, invoke TASM (or another assembler) to assemble .ASM source files, invoke the linker to generate executable files, and so on. In fact, if you *only* want to compile your C or C++ source file(s), you must use the **-c** option at the command line.

This chapter is organized into two parts. The first describes how to use the command-line compiler and provides a summary table of all the options. The second part, starting on page 152, presents the options organized functionally (with groups of related options).

The summary table, Table 5.1 (starting on page 147), summarizes the command-line compiler options and provides a page-number cross-reference to more detailed information about each option.

### Using the command-line compiler

---

The command-line compiler uses DPMI to run in protected mode on 80286, 80386, or i486 machines with 640K conventional RAM and at least 1MB extended memory.

Although Borland C++ runs in protected mode, it still generates applications that run in real mode. The advantage to using

Borland C++ in protected mode is that the compiler has *much* more room to run than in real mode, so it can compile larger projects faster and without extensive disk-swapping.

---

## DPMIINST

*For more information about running DPMIINST, see Chapter 1, "Installing Borland C++."*

The protected mode interface is completely transparent to the user. Borland C++ uses an internal database of machine characteristics to determine how to enable protected mode on your machine, and configures itself accordingly. The only time you may need to be aware of it is when running the compiler for the first time. If your machine is not recognized by Borland C++, you will need to run the DPMIINST program by typing (at the DOS prompt)

```
DPMIINST
```

and following the program's instructions. DPMIINST runs your machine through a series of tests to determine the best way of enabling protected mode.

---

## Running BCC

To invoke Borland C++ from the command line, type `BCC` at the DOS prompt and follow it with a set of command-line arguments. Command-line arguments include compiler and linker options and file names. The generic command-line format is

```
BCC [option [option...]] filename [filename...]
```

*You can also use a configuration file. See page 151 for details.*

Each command-line option may be preceded by either a hyphen (-) or slash (/), whichever you prefer. Each option must be separated from the BCC command, other options, and any following file names by at least one space.

---

## Using the options

*Compiler options are further divided into 10 groups.*

The options are divided into three types:

- compiler options, described starting on page 152
- linker options, described starting on page 171
- environment options, described starting on page 172

To see an onscreen list of the options, type `BCC` (without any options or file names) at the DOS prompt. Then press *Enter*.

Use this feature to override settings in configuration files.

In order to select command-line options, enter a hyphen (-) or slash (/) immediately followed by the option letter (for example, -I or /I). To turn an option off, add a second hyphen after the option letter. This is true for all toggle options (those that turn an option on or off): A trailing hyphen (-) turns the option off, and a trailing plus sign (+) or nothing turns it on. So, for example, -C and -C+ both turn nested comments on, while -C- turns nested comments off.

- Option-precedence rules
- The option-precedence rules are simple; command-line options are evaluated from left to right, and the following rules apply:
- For any option that is *not* an -I or -L option, a duplication on the right overrides the same option on the left. (Thus an *off* option on the right cancels an *on* option to the left.)
  - The -I and -L options on the left, however, take precedence over those on the right.

Table 5.1: Command-line options summary

Option	Page	Function
@filename	151	Read compiler options from the response file <i>filename</i>
+filename	151	Use the alternate configuration file <i>filename</i>
-1	155	Generate 80186 instructions
-1-	155	Generate 8088/8086 instructions (default)
-2	155	Generate 80286 instructions
-3	155	Generate 80386 instructions
-A	161	Use only ANSI keywords (for C) and enforce strict rules (for C++)
-A-, -AT	161	Use Borland C++ keywords (default)
-AK	161	Use only Kernighan and Ritchie keywords
-AU	161	Use only UNIX keywords
-a	155	Align word
-a-	155	Align byte (default)
-B	165	Compile and call the assembler to process inline assembly code
-b	155	Make enums always word-sized (default)
-b-	155	Make enums byte-sized when possible
-C	161	Nested comments on
-C-	161	Nested comments off (default)
-c	165	Compile to .OBJ but do not link
-Dname	154	Define <i>name</i> to the null string
-Dname=string	154	Define <i>name</i> to <i>string</i>
-d	155	Merge duplicate strings on
-d-	155	Merge duplicate strings off (default)
-Efilename	166	Use <i>filename</i> as the assembler to use
-efilename	171	Link to produce <i>filename</i> .EXE
-Fc	156	Generate COMDEFs
-Ff	156	Create far variables automatically
-Ff=size	156	Create far variables automatically; sets the threshold to <i>size</i>

Table 5.1: Command-line options summary (continued)

-Fm	156	Enables the <b>-Fc</b> , <b>-Ff</b> , and <b>-Fs</b> options
-Fs	156	Assume DS = SS in all memory models
-f	156	Emulate floating-point (default)
-f-	156	Don't do floating-point
-ff	157	Fast floating-point (default)
-ff-	157	Strict ANSI floating-point
-f87	157	Use 8087 hardware instructions
-f287	157	Use 80287/80387 hardware instructions
-G	181	Select code for speed
-G-	181	Select code for size (default)
-gn	162	Warnings: stop after <i>n</i> messages
-H	166	Causes the compiler to generate and use precompiled headers
-H-	166	Turns off generation and use of precompiled headers (default)
-Hu	166	Tells the compiler to use but not generate precompiled headers
-H= <i>filename</i>	166	Sets the name of the file for precompiled headers
-h	157	Use fast huge pointer arithmetic
-I <i>path</i>	172	Directories for include files
-in	161	Make significant identifier length to be <i>n</i>
-Jg	170	Generate definitions for all template instances and merge duplicates (default)
-Jgd	170	Generate public definitions for all template instances; duplicates result in redefinition errors
-Jgx	170	Generate external references for all template instances
-jn	162	Errors: stop after <i>n</i> messages
-K	157	Default character type <b>unsigned</b>
-K-	157	Default character type <b>signed</b> (default)
-k	158	Standard stack frame on (default)
-L <i>path</i>	172	Directories for libraries
-lx	172	Pass option <i>x</i> to the linker
-l-x	172	Suppress option <i>x</i> for the linker
-M	172	Instruct the linker to create a map file
-mc	153	Compile using compact memory model
-mh	153	Compile using huge memory model
-ml	153	Compile using large memory model
-mm	153	Compile using medium memory model
-mm!	153	Compile using medium model; assume DS != SS
-ms	153	Compile using small memory model (default)
-ms!	153	Compile using small model; assume DS != SS
-mt	153	Compile using tiny memory model
-mt!	153	Compile using tiny model; assume DS != SS
-N	158	Check for stack overflow
-n <i>path</i>	172	Set the output directory
-o <i>filename</i>	166	Set the output .OBJ file name
-O1	180	Generate smallest possible code
-O2	180	Generate fastest possible code
-Od	180	Disable all optimizations
-On	180	(Oa-Ox) Optimization options (see Appendix A for details)
-o <i>filename</i>	166	Compile source file to <i>filename.obj</i>
-P	166	Perform a C++ compile regardless of source file extension
-P <i>ext</i>	166	Perform a C++ compile and set the default extension to <i>ext</i>
-P-	166	Perform a C++ or C compile depending on source file extension (default)

Table 5.1: Command-line options summary (continued)

-P-ext	166	Perform a C++ or C compile depending on extension; set default extension to <i>ext</i>
-p	158	Use Pascal calling convention
-po	158	Use Object Data calling convention for passing <b>this</b> parameter in registers
-pr	158	Use fastcall calling convention for passing parameters in registers
-p-	158	Use C calling convention (default)
-Qe	168	Instructs the compiler to use all available EMS memory (default)
-Qe-	168	Instructs the compiler to not use any EMS memory
-Qx= <i>nnnn</i>	168	Instructs the compiler to use <i>nnnn</i> Kbytes of extended memory
-r	180	Use register variables on (default)
-r-	180	Suppresses the use of register variables
-rd	180	Only allow declared register variables to be kept in registers
-R	81	Generate ObjectBrowser information
-S	167	Produce .ASM output file
-Tstring	167	Pass <i>string</i> as an option to TASM or assembler specified with -E
-T-	167	Remove all previous assembler options
-tDe	171	Make the target a DOS .EXE file
-tDc	172	Make the target a DOS .COM file
-tW	172	Make the target a Windows module, using the same options as -W
-Uname	154	Undefine any previous definitions of <i>name</i>
-u	158	Generate underscores (default)
-u-	158	Disables underscores
-v, -v-	159	Source debugging on
-vi, -vi-	160	Controls expansion of inline functions
-V	168	Smart C++ virtual tables
-Va	173	Pass class arguments by reference to a temporary variable
-Vb	173	Make virtual base class pointer same size as <b>this</b> pointer of the class
-Vc	173	Do not add the hidden members and code to classes with pointers to virtual base class members
-Vf	169	Far C++ virtual tables
-Vmv	170	Member pointers have no restrictions (most general representation)
-Vmm	170	Member pointers support multiple inheritance
-Vms	170	Member pointers support single inheritance
-Vmd	170	Use the smallest representation for member pointers
-Vmp	170	Honor the declared precision for all member pointer types
-Vo	174	Enable all the backward compatibility -V switches (-Va, -Vb, -Vc, -Vp, -Vt, -Vv)
-Vp	173	Pass the <b>this</b> parameter to <b>pascal</b> member functions as the first parameter on the stack
-Vs	169	Local C++ virtual tables
-Vt	173	Place the virtual table pointer after nonstatic data members
-Vv	174	Do not change the layout of classes to relax restrictions on member pointers
-V0, -V1	169	External and Public C++ virtual tables
-W	167	Creates an .OBJ for Windows with all functions exportable
-WD	167	Creates an .OBJ for Windows to be linked as a .DLL with all functions exportable
-WDE	167	Creates an .OBJ for Windows to be linked as a .DLL with explicit export functions
-WE	167	Creates an .OBJ for Windows with explicit export functions
-WS	167	Creates an .OBJ for Windows that uses smart callbacks
-w	162	Display warnings on

Table 5.1: Command-line options summary (continued)

-wxxx	162	Enable xxx warning message
-w-xxx	162	Disable xxx warning message
-X	159	Disable compiler autodependency output
-Y	159	Enable overlay code generation
-Yo	159	Overlay the compiled files
-y	159	Line numbers on
-Z	188	Enable register load suppression optimization
-zAname	164	Code class
-zBname	164	BSS class
-zCname	164	Code segment
-zDname	164	BSS segment
-zEname	164	Far segment
-zFname	164	Far class
-zGname	165	BSS group
-zHname	165	Far group
-zPname	165	Code group
-zRname	165	Data segment
-zSname	165	Data group
-zTname	165	Data class
-zVname	165	Far virtual table segment
-zWname	165	Far virtual table class
-zX*	165	Use default name for X. (default)

## Syntax and file

### names

Borland C++ compiles files according to the following set of rules:

*C++ files have the extension .CPP; see page 166 for information on changing the default extension.*

FILENAME.ASM	Invoke TASM to assemble to .OBJ
FILENAME.OBJ	Include as object at link time
FILENAME.LIB	Include as library at link time
FILENAME	Compile FILENAME.CPP
FILENAME.CPP	Compile FILENAME.CPP
FILENAME.C	Compile FILENAME.C
FILENAME.XYZ	Compile FILENAME.XYZ

For example, given the following command line

```
BCC -a -f -C -O1 -emyexe oldfile1 oldfile2 nextfile
```

Borland C++ compiles OLDFILE1.CPP, OLDFILE2.CPP, and NEXTFILE.CPP to an .OBJ, linking them to produce an executable program file named MYEXE.EXE with word alignment (**-a**), floating-point emulation (**-f**), nested comments (**-C**), and generate smallest code (**-O1**) selected.

Borland C++ invokes TASM if you give it an .ASM file on the command line or if a .C or .CPP file contains inline assembly.

Here are the options that the command-line compiler gives to TASM:

```
/D_ _MODEL_ _ /D_ _LANG_ _ /ml /FLOATOPT
```

where *MODEL* is one of: TINY, SMALL, MEDIUM, COMPACT, LARGE, or HUGE. The */ml* option tells TASM to assemble with case sensitivity on. *LANG* is CDECL or PASCAL; *FLOATOPT* is *r* when you've specified **-f87** or **-f287**; *e* otherwise.

---

## Response files

*Response files allow you to have longer command strings than DOS normally allows.*

If you need to specify many options or files on the command line, you can place them in an ASCII text file, called a *response file* (you can of course name it anything you like). You can then tell the command-line compiler to read its command line from this file by including the appropriate file name prefixed with @. You can specify any number of such files, and mix them freely with other options and file names.

For example, suppose the file MOON.RSP contains STARS.C and RAIN.C. This command

```
BCC SUN.C @MOON.RSP ANYONE.C
```

causes Borland C++ to compile the files SUN.C, STARS.C, RAIN.C, and ANYONE.C in real mode. It expands to

```
BCC SUN.C STARS.C RAIN.C ANYONE.C
```

*See page 147 for rules about response-file options.*

Any options included in a response file are evaluated just as though they had been typed in on the command line.

---

## Configuration files

*TURBOC.CFG is not the same as TCCONFIG.TC, which is the default IDE version of a configuration file.*

If you use a set of options repeatedly, you can list them in a configuration file, called TURBOC.CFG by default. If you have a TURBOC.CFG configuration file, you don't need to worry about using it. When you run BCC, it automatically looks for TURBOC.CFG in the current directory. If it doesn't find it there, Borland C++ then looks in the startup directory (where BCC.EXE resides).

You can create more than one configuration file; each must have a unique name. To specify the alternate configuration-file name, include its file name, prefixed with +, anywhere on the BCC command line. For example, to read the option settings from the file D:\ALT.CFG, you could use the following command line:

```
BCC +D:\ALT.CFG .....
```

Your configuration file can be used in addition to or instead of options entered on the command line. If you don't want to use certain options listed in your configuration file, you can override them with options on the command line.

You can create the TURBOC.CFG file (or any alternate configuration file) using any standard ASCII editor or word processor, such as Borland C++'s integrated editor. You can list options (separated by spaces) on the same line or list them on separate lines.

#### Option-precedence rules

In general, remember that command-line options override configuration-file options. If, for example, your configuration file contains several options, including the `-a` option (which you want to turn off), you can still use the configuration file but override the `-a` option by listing `-a-` in the command line. However, the rules are a little more detailed than that. The option precedence rules detailed on page 147 apply, with these additional rules:

1. When the options from the configuration file are combined with the command-line options, any `-I` and `-L` options in the configuration file are appended to the right of the command-line options. This means that the include and library directories specified in the command line are the first ones Borland C++ searches (thereby giving the command-line `-I` and `-L` directories priority over those in the configuration file).
2. The remaining configuration file options are inserted immediately after the BCC command (to the left of any command-line options). This gives the command-line options priority over the configuration file options.

## Compiler options

---

Borland C++'s command-line compiler options fall into 10 groups; the page references to the left of each group tell where you can find a discussion of each kind of option:

- |                      |  |
|----------------------|--|
| <i>See page 153.</i> | 1. <i>Memory model options</i> let you tell Borland C++ which memory model to use when compiling your program. |
| <i>See page 154.</i> | 2. <i>Macro definitions</i> let you define and undefine macros on the command line.                            |

- See page 155.* 3. *Code-generation options* govern characteristics of the generated code, such as the floating-point option, calling convention, character type, or CPU instructions.
- See Appendix A.* 4. *Optimization options* let you specify how the object code is to be optimized; a more detailed discussion of optimization options appears in Appendix A, "The Optimizer."
- See page 160.* 5. *Source-code options* cause the compiler to recognize (or ignore) certain features of the source code; implementation-specific (non-ANSI, non-Kernighan and Ritchie, and non-UNIX) keywords, nested comments, and identifier lengths.
- See page 162.* 6. *Error-reporting options* let you tailor which warning messages the compiler reports, and the maximum number of warnings and errors that can occur before the compilation stops.
- See page 164.* 7. *Segment-naming control options* allow you to rename segments and reassign their groups and classes.
- See page 165.* 8. *Compilation-control options* let you direct the compiler to
- ▣ compile to assembly code (rather than to an object module)
  - ▣ compile a source file that contains inline assembly
  - ▣ compile without linking
  - ▣ compile for Windows applications
  - ▣ use precompiled headers or not
- See page 168.* 9. *EMS options* let you control how much expanded or extended memory Borland C++ uses.
- See page 168.* 10. C++ *virtual-table options* let you control how virtual tables are handled.
- See page 169.* 11. C++ *member-pointer options* let you control how member pointers are used.
- See page 170.* 12. *Template-generation options* let you control how the compiler generates definitions or external declarations for template instances.
- See page 173.* 13. *Backward-compatibility options* let you tell the compiler to use particular code-generation strategies to insure backward compatibility with earlier versions of Borland C++.

---

## Memory model

Memory-model options let you tell Borland C++ which memory model to use when compiling your program. The memory models are tiny, small, medium, compact, large, and huge.

See Chapter 9 in the Programmer's Guide for in-depth information on the memory models (what they are, how to use them).

- mc** Compile using compact memory model
- mh** Compile using huge memory model
- ml** Compile using large memory model
- mm** Compile using medium memory model
- mm!** Compile using medium model; DS != SS
- ms** Compile using small memory model (the default)
- ms!** Compile using small model; DS != SS
- mt** Compile using tiny memory model
- mt!** Compile using tiny model; DS != SS

You can't use the **-N** option when using one of the DS != SS models.

The net effect of the **-mt!**, **-ms!**, and **-mm!** options is actually very small. If you take the address of a stack variable (auto or parameter), the default (when DS == SS) is to make the resulting pointer a near (DS relative) pointer. In this way you can assign the address to a default-sized pointer in those models without problems.

When DS != SS, the pointer type created when you take the address of a stack variable is an **\_ss** pointer. This means that the pointer can be freely assigned or passed to a far pointer or to a **\_ss** pointer. But for the memory models affected, assigning the address to a near or default-sized pointer will produce a "Suspicious pointer conversion" warning. Such warnings are usually errors, and the warning defaults to On. You should regard this kind of warning as a likely error.

---

## Macro definitions

Macro definitions let you define and undefine macros (also called *manifest* or *symbolic* constants) on the command line. The default definition is the null string.

- Dname** Defines the named identifier *name* to the null string.
- Dname=string** Defines the named identifier *name* to the string *string* after the equal sign. *string* cannot contain any spaces or tabs.
- Uname** Undefines any previous definitions of the named identifier *name*.

Borland C++ lets you make multiple **#define** entries on the command line in any of the following ways:

- You can include multiple entries after a single **-D** option, separating entries with a semicolon (this is known as “ganging” options):

```
BCC -Dxxx;yyy=1;zzz=NO MYFILE.C
```

- You can place more than one **-D** option on the command line:

```
BCC -Dxxx -Dyyy=1 -Dzzz=NO MYFILE.C
```

- You can mix ganged and multiple **-D** listings:

```
BCC -Dxxx -Dyyy=1;zzz=NO MYFILE.C
```

---

## Code-generation options

Code-generation options govern characteristics of the generated code, such as the floating-point option, calling convention, character type, or CPU instructions.

- 1** This option causes Borland C++ to generate extended 80186 instructions. It also generates 80286 programs running in real mode, such as with the IBM PC/AT under DOS.
- 1-** This option tells the compiler to generate 8088/8086 instructions (the default).
- 2** This option causes Borland C++ to generate 80286 instructions.
- 3** This option causes Borland C++ to generate 80386 instructions.
- a** This option forces integer size and larger items to be aligned on a machine-word boundary. Extra bytes are inserted in a structure to ensure member alignment. Automatic and global variables are aligned properly. **char** and **unsigned char** variables and fields can be placed at any address; all others are placed at an even-numbered address. This option is off by default (**-a-**), allowing bitwise alignment.
- b** This option (the default) tells the compiler to always allocate a whole word for enumeration types.
- b-** This option tells the compiler to allocate a signed or unsigned byte if the minimum and maximum values of the enumeration are both within the range of 0 to 255 or -128 to 127, respectively.

- d** This option tells the compiler to merge literal strings when one string matches another, thereby producing smaller programs. This option is off by default (**-d-**).
- Fc** This generates communal variables (COMDEFs) for global "C" variables that are not initialized and not declared as **static** or **extern**. The advantage of using this option is that header files included in several source files can contain declarations of global variables. So long as a given variable doesn't need to be initialized to a nonzero value, you don't need to include a definition for it in any of the source files. You can use this option when porting code that takes advantage of a similar feature with another implementation.
- Ff** When you use this option, global variables greater than or equal to the threshold size are automatically made far by the compiler. The threshold size defaults to 32,767; you can change it with the **-Ff=size** option. This option is useful for code that doesn't use the huge memory model but declares enough large global variables that their total size exceeds (or is close to) 64K. For tiny, small, and medium models this option has no effect.  
  
If you use this option in conjunction with **-Fc**, the generated COMDEFs will be **far** in the compact, large, and huge models.
- Ff=size** Use this option to change the threshold size used by the **-Ff** option.
- Fm** This option enables all the other **-F** options (**-Fc**, **-Ff** and **-Fs**). You can use it as a handy shortcut when porting code from other compilers.
- Fs** This option tells the compiler to assume that DS is equal to SS in all memory models; you can use it when porting code originally written for an implementation that makes the stack part of the data segment. When you specify this option, the compiler links in an alternate startup module (COFx.OBJ) that places the stack in the data segment.
- f** This option tells the compiler to emulate 80x87 calls at run time if the run-time system does not have an 80x87; if it does have one, the compiler calls the 80x87 chip for floating-point calculations (the default).

- f- This option specifies that the program contains no floating-point calculations. No floating-point libraries will be linked at the link step.
- ff With this option, the compiler optimizes floating-point operations without regard to explicit or implicit type conversions. Answers can be faster than under ANSI operating mode. See Chapter 10, "Math," in the *Programmer's Guide* for details.
- ff- This option turns off the fast floating-point option. The compiler follows strict ANSI rules regarding floating-point conversions.
- f87 This option tells the compiler to generate floating-point operations using inline 80x87 instructions rather than by using calls to 80x87 emulation library routines. It specifies that a math coprocessor will be available at run time; therefore, programs compiled with this option will not run on a machine without a math coprocessor.
- f287 This option is similar to **-f87**, but uses instructions that are available only with an 80287, 80387, or higher chip.
- h This option offers an alternative way of calculating huge pointer expressions; a way which is much faster but must be used with caution. When you use this option, huge pointers are normalized only when a segment wraparound occurs in the offset part. This causes problems for huge arrays if any array elements cross a segment boundary. This option is off by default.  
  
Borland C++ normalizes a huge pointer whenever adding to or subtracting from it. This ensures that, for example, if you have a huge array of **structs** that's larger than 64K, indexing into the array and selecting a **struct** field will always work with **structs** of any size. Borland C++ accomplishes this by always normalizing the results of huge pointer operations, so that the offset part contains a number that's no higher than 15. That way, a segment wraparound never occurs with huge pointers. The disadvantage of this approach is that it tends to be quite expensive in terms of execution speed. This option is automatically selected when compiling for Windows.
- K This option tells the compiler to treat all **char** declarations as if they were **unsigned char** type. This allows

*The 80287 and 80387 have the same instruction set.*

for compatibility with other compilers that treat **char** declarations as **unsigned**. By default, **char** declarations are **signed** (-K-).

- k This option generates a standard stack frame, which is useful when using a debugger to trace back through the stack of called subroutines. This option is on by default.
- N This option generates stack-overflow logic at the entry of each function, which causes a stack-overflow message to appear when a stack overflow is detected. This is costly in terms of both program size and speed but is provided as an option because stack overflows can be very difficult to detect. If an overflow is detected, the message "Stack overflow!" is printed and the program exits with an exit code of 1.
- p This option forces the compiler to generate all subroutine calls and all functions using the Pascal parameter-passing sequence. The resulting function calls are smaller and faster. Functions must pass the correct number and type of arguments, unlike normal C use, which permits a variable number of function arguments. You can use the **cdecl** statement to override this option and specifically declare functions to be C-type. This option is off by default (-p-).
- po This option forces the compiler to generate all calls to member functions using the Object Data calling convention. With Object Data enabled, member functions expect their hidden **this** parameter to be supplied in registers. You can control Object Data's use on a class-by-class basis using #pragma option -po. For more information about Object Data, see Appendix A.
- pr This option forces the compiler to generate all subroutine calls and all functions using the new **fastcall** parameter-passing convention. With this option enabled, functions expect parameters to be passed in registers. You can also individually override the **cdecl** or **pascal** calling conventions by using the **\_fastcall** modifier in declaring a function. For more information about **\_fastcall**, see Appendix A.
- u With **-u** selected, when you declare an identifier, Borland C++ automatically puts an underscore ( **\_** ) in

front of the identifier before saving the identifier in the object module.

Borland C++ treats Pascal-type identifiers (those modified by the **pascal** keyword) differently—they are uppercase and are *not* prefixed with an underscore.

Underscores for C and C++ identifiers are optional, but on by default. You can turn them off with **-u-**. However, if you are using the standard Borland C++ libraries, you will encounter problems unless you rebuild the libraries. (To do this, you will need the Borland C++ run-time library source code; contact Borland for more information.)

*Unless you are an expert, don't use **-u-**. See Chapter 12, "BASM and inline assembly," in the *Programmer's Guide* for details about underscores.*

**-X** This option disables generation of autodependency information in the output file. Modules compiled with this option enabled will not be able to use the autodependency feature of MAKE or of the IDE. Normally this option is only used for files that are to be put into .LIB files (to save disk space).

*You can't use this option if you're using any of the **-W** (Windows applications) options (and vice versa).*

**-Y** This option generates overlay-compatible code. Every file in an overlaid program must be compiled with this option; see Chapter 9, "DOS memory management," in the *Programmer's Guide* for details on overlays.

**-Yo** This option overlays the compiled file(s); see Chapter 9 in the *Programmer's Guide* for details.

**-y** This option includes line numbers in the object file for use by a symbolic debugger, such as Turbo Debugger. This increases the size of the object file but doesn't affect size or speed of the executable program. This option is useful only in concert with a symbolic debugger that can use the information. In general, **-v** is more useful than **-y** with Turbo Debugger.

The **-v** and **-vi** options

*Turbo Debugger is both a source-level (symbolic) and assembly level debugger.*

**-v** This option tells the compiler to include debugging information in the .OBJ file so the file(s) being compiled can be debugged with either Borland C++'s integrated debugger or the standalone Turbo Debugger. The compiler also passes this option on to the linker so it can include the debugging information in the .EXE file.

To facilitate debugging, this option also causes C++ inline functions to be treated as normal functions. If you want to avoid that, use **-vi**.

**-vi** With this option enabled, C++ inline functions are expanded inline.

To control the expansion of inline functions, the operation of the **-v** option is slightly different in C++. When inline function expansion is not enabled, the function will be generated and called like any other function. Debugging in the presence of inline expansion can be extremely difficult, so we provide the following options:

**-v** turns debugging on and inline expansion off

**-v-** turns debugging off and inline expansion on

**-vi** turns inline expansion on

**-vi-** turns inline expansion off

So, for example, if you want to turn both debugging and inline expansion on, use **-v -vi**.

---

## Optimization options

Borland C++ is a professional optimizing compiler, featuring a number of options that let you specify how the object code is to be optimized; for size or speed, and utilizing (or not) a wide range of optimization techniques. Appendix A, "The Optimizer," discusses these options in detail.

---

## Source-code options

Source-code options cause the compiler to recognize (or ignore) certain features of the source code; implementation-specific (non-ANSI, non-Kernighan and Ritchie, and non-UNIX) keywords, nested comments, and identifier lengths. These options are most significant if you plan to port your code to other systems.

**-A** This option is used to enforce ANSI compatible code when compiling C code: Any of the Borland C++ extension keywords are ignored and can be used as normal identifiers. These keywords include

See Chapter 1 in the  
Programmer's Guide for a  
complete list of the Borland  
C++ keywords.

<b>asm</b>	<b>_es</b>	<b>interrupt</b>	<b>_ss</b>
<b>cdecl</b>	<b>_export</b>	<b>_loadds</b>	<b>_saveregs</b>
<b>_cs</b>	<b>far</b>	<b>near</b>	<b>_fastcall</b>
<b>_ds</b>	<b>huge</b>	<b>pascal</b>	<b>_seg</b>

and the register pseudovariabes, such as `_AX`, `_BX`, `_SI`, and so on.



When compiling C++ code, this option enforces certain rules found in Ellis and Stroustrup's *The Annotated C++ Reference Manual* (Addison-Wesley, 1990, ISBN 0-201-51459-1) and the ANSI C++ working document. These rules can change some warnings to errors. Since they cause a lot of existing code to not compile, the rules aren't enforced by default.

- A-** This option tells the compiler to use Borland C++ keywords. **-AT** is an alternate version of this option.
- AK** This option tells the compiler to use only Kernighan and Ritchie keywords.
- AU** This option tells the compiler to use only UNIX keywords.
- C** This option allows you to nest comments. Comments may not normally be nested.
- in** This option causes the compiler to recognize only the first *n* characters of identifiers in C source code. (The option is ignored when compiling C++.) All identifiers, whether variables, preprocessor macro names, or structure member names, are treated as distinct only if their first *n* characters are distinct.

By default, Borland C++ uses 32 characters per identifier. Other systems, including some UNIX compilers, ignore characters beyond the first eight. If you are porting to these other environments, you may wish to compile your code with a smaller number of significant characters. Compiling in this manner will help you see if there are any name conflicts in long identifiers when they are truncated to a shorter significant length.

## Error-reporting options

Error-reporting options let you tailor which warning messages the compiler reports, and the maximum number of warnings and errors that can occur before the compilation stops.

- gn** This option tells Borland C++ to stop compiling after *n* warning messages.
- jn** This option tells the compiler to stop compiling after *n* error messages.
- w** This option causes the compiler to display warning messages. You can turn this off with **-w-**. You can enable or disable specific warning messages with **-wxxx**, described in the following paragraphs.
- wxxx** This option enables the specific warning message indicated by *xxx*. The option **-w-xxx** suppresses the warning message indicated by *xxx*. The possible options for **-wxxx** are listed here and divided into four categories: ANSI violations, frequent errors (including more-frequent errors), portability warnings, and C++ warnings. You can also use the pragma **warn** in your source code to control these options. See Chapter 4, "The preprocessor," in the *Programmer's Guide*.

For more information on these warnings, see Appendix A, "Error messages," in the *Tools and Utilities Guide*.

An asterisk (\*) after the option in the following sections indicates that the option is on by default. All others are off by default.

### ANSI violations

- wbbf** Bit fields must be **signed** or **unsigned int**.
- wbig\*** Hexadecimal value contains more than three digits.
- wdpu\*** Declare *type* prior to use in prototype.
- wdup\*** Redefinition of *macro* is not identical.
- weas** Assigning *type* to *enumeration*.
- wext\*** *Identifier* is declared as both external and static.
- wpin** Initialization is only partially bracketed.
- wret\*** Both return and return with a value used.
- wstu\*** Undefined structure *structure*.
- wsus\*** Suspicious pointer conversion.
- wvoi\*** Void functions may not return a value.
- wzdi\*** Division by zero.

Frequent errors	<ul style="list-style-type: none"> <li>-wamb Ambiguous operators need parentheses.</li> <li>-wamp Superfluous &amp; with function or array.</li> <li>-wasm Unknown assembler instruction.</li> <li>-waus* <i>Identifier</i> is assigned a value that is never used.</li> <li>-wccc* Condition is always true/false.</li> <li>-wdef Possible use of <i>identifier</i> before definition.</li> <li>-weff* Code has no effect.</li> <li>-wias* Array variable identifier is near.</li> <li>-will* Ill-formed pragma.</li> <li>-wnod No declaration for function <i>function</i>.</li> <li>-wpar* Parameter <i>parameter</i> is never used.</li> <li>-wpia* Possibly incorrect assignment.</li> <li>-wpro* Call to function with no prototype.</li> <li>-wrch* Unreachable code.</li> <li>-wrvl* Function should return a value.</li> <li>-wstv Structure passed by value.</li> <li>-wusc <i>Identifier</i> is declared but never used.</li> </ul>
Portability warnings	<ul style="list-style-type: none"> <li>-wcln Constant is long.</li> <li>-wcpt* Nonportable pointer comparison.</li> <li>-wrng* Constant out of range in comparison.</li> <li>-wrpt* Nonportable pointer conversion.</li> <li>-wsig Conversion may lose significant digits.</li> <li>-wucp Mixing pointers to <b>signed</b> and <b>unsigned char</b>.</li> </ul>
C++ warnings	<ul style="list-style-type: none"> <li>-wbei* Initializing enumeration with <i>type</i>.</li> <li>-wdsz* Array size for 'delete' ignored.</li> <li>-whid* <i>Function1</i> hides virtual function <i>function2</i>.</li> <li>-wibc* Base class <i>base1</i> is inaccessible because also in <i>base2</i>.</li> <li>-winl* Functions containing <i>identifier</i> are not expanded inline.</li> <li>-wlin* Temporary used to initialize <i>identifier</i>.</li> <li>-wlvc* Temporary used for parameter in call to <i>identifier</i>.</li> <li>-wmpc* Conversion to <i>type</i> will fail for members of virtual base class <i>base</i>.</li> <li>-wmpd* Maximum precision used for member pointer type <i>type</i>.</li> <li>-wncf* Non-const function <i>function</i> called const object.</li> <li>-wnci* Constant member <i>identifier</i> is not initialized.</li> <li>-wnst* Use qualified name to access nested type <i>type</i>.</li> <li>-wnvf* Non-volatile function <i>function</i> called for volatile object.</li> </ul>

- wobi\*** Base initialization without a class name is now obsolete.
- wofp\*** Style of function definition is now obsolete.
- wovi\*** Overload is now unnecessary and obsolete.
- wpre** Overloaded prefix operator ++/-- used as a postfix operator.

## Segment-naming control

Segment-naming control options allow you to rename segments and reassign their groups and classes.

*Don't use these options unless you have a good understanding of segmentation on the 8086 processor. Under normal circumstances, you will not need to specify segment names.*

- zAname** This option changes the name of the code segment class to *name*. By default, the code segment is assigned to class CODE.
- zBname** This option changes the name of the uninitialized data segment class to *name*. By default, the uninitialized data segments are assigned to class BSS.
- zCname** This option changes the name of the code segment to *name*. By default, the code segment is named `_TEXT`, except for the medium, large and huge models, where the name is *filename\_TEXT*. (*filename* here is the source file name.)
- zDname** This option changes the name of the uninitialized data segment to *name*. By default, the uninitialized data segment is named `_BSS`, except in the huge model, where no uninitialized data segment is generated.
- zEname** This option changes the name of the segment where far objects are put to *name*. By default, the segment name is the name of the far object followed by `_FAR`. A name beginning with an asterisk (\*) indicates that the default string should be used.
- zFname** This option changes the name of the class for far objects to *name*. By default, the name is `FAR_DATA`. A name beginning with an asterisk (\*) indicates that the default string should be used.
- zGname** This option changes the name of the uninitialized data segment group to *name*. By default, the data

*See Chapter 9, "DOS memory management," in the Programmer's Guide for more on far objects.*

group is named DGROUP, except in the huge model, where there is no data group.

- zHname** This option causes far objects to be put into group *name*. By default, far objects are not put into a group. A name beginning with an asterisk (\*) indicates that the default string should be used.
- zPname** This option causes any output files to be generated with a code group for the code segment named *name*.
- zRname** This option sets the name of the initialized data segment to *name*. By default, the initialized data segment is named `_DATA`, except in the huge model, where the segment is named *filename\_DATA*.
- zSname** This option changes the name of the initialized data segment group to *name*. By default, the data group is named DGROUP, except in the huge model, where there is no data group.
- zTname** This option sets the name of the initialized data segment class to *name*. By default the initialized data segment class is named `DATA`.
- zVname** This option sets the name of the far virtual table segment to *name*. By default far virtual tables are generated in the code segment.
- zWname** This option sets the name of the far virtual table class segment to *name*. By default far virtual table classes are generated in the `CODE` segment.
- zX\*** This option uses the default name for X. For example, **-zA\*** assigns the default class name `CODE` to the code segment.

---

## Compilation-control options

Compilation-control options allow you to control the compilation of source files, such as whether your code is compiled as C or C++, whether to use precompiled headers, and what kind of Windows executable file is created. For more detailed information on how to create an Windows application, see Chapter 8, "Building a Windows application" in the *Programmer's Guide*.

- B** This option compiles and calls the assembler to process inline assembly code.
- c** This option compiles and assembles the named .C, .CPP, and .ASM files, but does not execute a link command.
- Efilename** This option uses *name* as the name of the assembler to use. By default, TASM is used.
- H** This option causes the compiler to generate and use precompiled headers, using the default filename TCDEF.SYM.
- H-** This option turns off generation and use of pre-compiled headers (this is the default).
- Hu** This option tells the compiler to use but not generate precompiled headers.
- H=filename** This option sets the name of the file for precompiled headers, if you wish to save this information in a file other than TCDEF.SYM. This option also turns on generation and use of pre-compiled headers; that is, it also has the effect of **-H**.
- ofilename** This option compiles the named file to the specified *filename*.OBJ.
- P** This option causes the compiler to compile your code as C++ always, regardless of extension. The compiler assumes that all files have .CPP extensions unless a different extension is specified with the code.
- Pext** This option causes the compiler to compile all files as C++; it changes the default extension to whatever you specify with *ext*. This option is available because some programmers use .C or another extension as their default extension for C++ code.
- P-** This option tells the compiler to compile a file as either C or C++, based on its extension. The default extension is .CPP. This option is the default.

See Appendix D for more on precompiled headers.

This option behaves differently from the **-P** option in Turbo C++ 1.x.

- P-ext** This option also tells the compiler to compile code based on the extension (.CPP as C++ code, all other file-name extensions as C code). It further specifies what the default extension is to be.
- S** This option compiles the named source files and produces assembly language output files (.ASM), but does not assemble. When you use this option, Borland C++ includes the C or C++ source lines as comments in the produced .ASM file.
- Tstring** This option passes *string* as an option to TASM (or as an option to the assembler defined with **-E**).
- T-** This option removes all previously defined assembler options.
- W** This option creates the most general kind of Windows executable, although not necessarily the most efficient. The compiler makes every far function exportable. This does not mean that all far functions will be exported; it only means that each far function *can* be exported. In order to export one of these functions, you must either use the **\_export** keyword or add an entry for the function name in the EXPORTS section of the module-definition file.
- WD** This option creates a module for use in a .DLL with all functions exportable.
- WDE** This option creates a module for use in a .DLL with only those functions explicitly designated with **\_export** as exportable.
- WE** This option creates an object module with only those functions explicitly designated with **\_export** as exportable.
- WS** This option creates an .OBJ with functions using smart callbacks. This option is recommended if you are writing Windows applications (*not* DLLs) which can assume SS = DS (most can). This option simplifies Windows programming; for instance, using it, you no longer need **MakeProInstance** or **FreeProInstance**, nor do

*These five options (-W, -WD, -WDE, -WE, and -WS) relate to creating Windows applications. You can't use any of these options if you're using the -Y option (and vice versa).*

you need to export your window procedures or callback functions; instead, you can directly call them. Enabling this option results in faster Windows executables.

---

## Expanded and extended memory options

If you have expanded (EMS) memory, you may want to make this memory available to the compiler for “swap” space in the event that your computer’s extended (protected mode) memory is exhausted during compilation. These options give you the ability to control the compiler’s use of EMS memory. You can also control the amount of extended (protected mode) memory Borland C++ uses.



The memory options can’t appear in your TURBOC.CFG file.

- Qe** This option instructs the compiler to use all EMS memory it can find. This is on by default for the command-line compiler (BCC). It speeds up your compilations, especially for large source files.
- Qe=yyyy** This option instructs the compiler to use *yyyy* pages (in 16K page sizes) of EMS memory for itself.
- Qe-** This option instructs the compiler not to use any EMS memory.
- Qx=nnnn** This option instructs the compiler to use *nnnn*K of extended memory.

## C++ virtual tables

The **-V** option controls the C++ virtual tables. There are five variations of the **-V** option:

- V** Use this option when you want to generate C++ virtual tables (and inline functions not expanded inline) so that only one instance of a given virtual table or inline function is included in the program. This produces the smallest executables, but uses .OBJ and .ASM extensions only available with TLINK 3.0 and TASM 2.0 (or newer).
- Vs** Use this option to generate local virtual tables (and inline functions not expanded inline) such that each

module gets its own private copy of each virtual table (or inline function) it uses. This option uses only standard .OBJ (and .ASM) constructs, but produces larger executables.

**-V0, -V1** These options work together to create global virtual tables. If you don't want to use the Smart or Local options (**-V** or **-Vs**), you can use **-V0** and **-V1** to produce and reference global virtual tables. **-V0** generates external references to virtual tables; **-V1** produces public definitions for virtual tables.

When using these two options, at least one of the modules in the program must be compiled with the **-V1** option to supply the definitions for the virtual tables. All other modules should be compiled with the **-V0** option to refer to that public copy of the virtual tables.

**-Vf** You can use this option independently of or in conjunction with any of the other virtual table options. It causes virtual tables to be created in the code segment instead of the data segment (unless changed using the **-zV** and **-zW** options), and makes virtual table pointers into full 32-bit pointers (the latter is done automatically if you are using the huge memory model).

There are two primary reasons for using this option: to remove the virtual tables from the data segment, which may be getting full, and to be able to share objects (of classes with virtual functions) between modules that use different data segments (for example, a DLL and an executable using that DLL). You must compile all modules that may share objects either entirely with or entirely without this option. You can achieve the same effect by using the **huge** or **\_export** modifiers on a class-by-class basis.

---

## C++ member pointers

The **-Vm** options control C++ member-pointer types. There are five variations of the **-Vm** option:

The Borland C++ compiler supports three different kinds of member-pointer types, with varying degrees of complexity and

generality. By default, the compiler will use the most general (but in some contexts also the least efficient) kind for all member-pointer types; this default behavior can be changed via the **-Vm** family of switches.

- Vmv** Member pointers declared while this option is in effect have no restriction on which members they can point to; they use the most general representation.
- Vmm** Member pointers declared while this option is in effect are allowed to point to members of multiple inheritance classes, except that members of virtual base classes cannot be pointed to.
- Vms** Member pointers declared while this option is in effect are not allowed to point to members of some base classes of classes that use multiple inheritance (in general, they can be used with single inheritance classes only).
- Vmd** Member pointers declared while this option is in effect use the smallest possible representation that allows member pointers to point to all members of their class. If the class is not fully defined at the point where the member pointer type is declared, the most general representation has to be chosen by the compiler (and a warning is issued about this).
- Vmp** Whenever a member pointer is dereferenced or called, the compiler treats the member pointer as if it were of the least general case needed for that particular pointer type. For example, a call through a pointer to member of a class declared without any base classes treats the member pointer as having the simplest representation, regardless of how it's been declared.

This will work correctly (and produce the most efficient code) in all cases except for one: when a pointer to a derived class is explicitly cast to a pointer to a member of a "simpler" base class, when the pointer is actually pointing to a derived class member. This is a nonportable (and dubious) construct, but if you need to compile code that uses it, use the **-Vmp** option, which forces the compiler to honor the declared precision for all member-pointer types.

## Template-generation options

---

The **-Jg** option controls the generation of template instances in C++. There are three variations of the **-Jg** option:

**-Jg** Public definitions of all template instances encountered when this switch value is in effect are generated. If more than one module generates the same template instance, the linker merges them to produce a single copy of the instance. This option (the default) is the most convenient approach to generating template instances.

In order to generate the instances, however, the compiler must have available the function body (in the case of a template function) or the bodies of member functions and definitions for static data members (in the case of a template class).

**-Jgd** This option tells the compiler to generate public definitions for all template instances encountered. Unlike the **-Jg** option, however, duplicate instances are *not* merged, causing the linker to report public symbol redefinition errors if more than one module defines the same template instance.

**-Jgx** This option instructs the compiler to generate external references to template instances. If you use this option, make sure the instances are publicly defined in some other module (using the **-Jgd** option), so that the external references will be satisfied.

For more information about templates, see Chapter 3, "C++ specifics," in the *Programmer's Guide*.

## Linker options

---

See the section on *TLINK* in the *Tools and Utilities Guide* for a list of linker options.

**-efilename** This option derives the executable program's name from *filename* by adding the file extension *.EXE* (the program name is *filename.EXE*). *filename* must immediately follow the **-e**, with no intervening whitespace. Without this option, the linker derives the *.EXE* file's name from the name of the first source or object file in the file name list. The default extension is *.DLL* when you are using **-WD** or **-WDE**.

- tDe** This option specifies that the target (output) file is a DOS .EXE file.
- tDc** This option specifies that the target (output) file is a DOS .COM file.
- tW[nn]** This specifies that the target (output) file is a Windows module. It is identical to the **-W** option(s) described on 167: **-W**, **-WD**, **-WDE**, **-WE**, **-WS**, where the optional **nn** may be equal to **D**, **DE**, **E** or **S**.
- lx** This option (which is a lowercase l) passes option *x* to the linker. The option **-l-x** suppresses option *x*.
- M** This option forces the linker to produce a full link map. The default is to produce no link map.

## Environment options

---

When working with environment options, bear in mind that Borland C++ recognizes two types of library files: *implicit* and *user-specified* (also known as *explicit* library files). These are defined and discussed on page 175.

- Ipath** This option (which is an uppercase I) causes the compiler to search *path* (the drive specifier or path name of a subdirectory) for include files (in addition to searching the standard places). A drive specifier is a single letter, either uppercase or lowercase, followed by a colon (:). A directory is any valid directory or directory path. You can use more than one **-I** directory option.
- Lpath** This option forces the linker to get the C0x.OBJ start-up object file and the Borland C++ library files (Cx.LIB, MATHx.LIB, EMU.LIB, and so on) from the named directory. By default, the linker looks for them in the current directory.
- npath** This option places any .OBJ or .ASM files created by the compiler in the directory or drive named by *path*.

## Backward-compatibility options

---

*In this section, "previous" versions are those before Borland C++ version 3.0.*

Borland C++ introduces a number of improvements in the way some C++ operations are implemented, resulting in smaller, faster code with fewer restrictions and less overhead. In some cases, the new implementation is not fully compatible with previous versions of Borland C++. Where such compatibility is needed, the following options are provided:

- Va** When an argument of type class with constructors is passed by value to a function, this option instructs the compiler to create a temporary variable at the calling site, initialize this temporary with the argument value, and pass a reference to this temporary to the function. This behavior is compatible with previous versions of Borland C++. By default, Borland C++ copy-constructs such argument values directly to the stack, thus avoiding the introduction of the temporary (and also making access to the argument value faster).
- Vb** When a class inherits virtually from a base class, the compiler stores a hidden pointer in the class object to access the virtual base-class subobject. Borland C++ always makes this pointer **near**, which allows it to generate more efficient code. For backward compatibility, the **-Vb** option directs the compiler to match the hidden pointer to the size of the **this** pointer used by the class itself.
- Vc** To correctly implement the case when a derived class overrides a virtual function that it inherits from a virtual base class, and a constructor or destructor for the derived class calls that virtual function using a pointer to the virtual base class, the compiler may add hidden members to the derived class, and add more code to its constructors and destructors. This option directs the compiler *not* to add the hidden members and code, so that class instance layout is same as with previous versions of Borland C++.
- Vp** This option directs the compiler to pass the **this** parameter to **pascal** member functions as the first parameter on the stack, for compatibility with previous versions of Borland C++. By default, Borland C++ always pushes **this** as the last parameter except when compiling with the Object Data calling convention.

- Vt** This option instructs the compiler to place the virtual table pointer after any nonstatic data members of the particular class, to ensure compatibility when class instances are to be shared with non-C++ code and when sharing classes with code compiled with previous versions of Borland C++. By default, Borland C++ adds this pointer *before* any nonstatic data members of the class, thus making virtual member-function calls smaller and faster.
- Vv** This option directs the compiler not to change the layout of any classes (which it may need to do in order to allow pointers to virtual base class members, which were not supported in previous versions of Borland C++). If this option is used, the compiler can't create a pointer to a member of a base class that can only be reached from the derived class through two or more levels of virtual inheritance.
- Vo** This option is a "master switch" that turns on all of the backward-compatibility options listed in this section. It can be used as a handy shortcut when linking with libraries built with older versions of Borland C++.

## Searching for include and library files

---

Borland C++ can search multiple directories for include and library files. This means that the syntax for the library directories (**-L**) and include directories (**-I**) command-line options, like that of the **#define** option (**-D**), allows multiple listings of a given option.

Here is the syntax for these options:

**Library directories:** `-Ldirname[;dirname;...]`  
**Include directories:** `-Idirname[;dirname;...]`

The parameter *dirname* used with **-L** and **-I** can be any directory or directory path.

You can enter these multiple directories on the command line in the following ways:

- You can "gang" multiple entries with a single **-L** or **-I** option, separating ganged entries with a semicolon, like this:

```
BCC -Ldirname1;dirname2;dirname3 -Iinc1;inc2;inc3 myfile.c
```

- You can place more than one of each option on the command line, like this:

```
BCC -Ldirname1 -Ldirname2 -Ldirname3 -Iinc1 -Iinc2 -Iinc3 myfile.c
```

- You can mix ganged and multiple listings, like this:

```
BCC -Ldirname1;dirname2 -Ldirname3 -Iinc1;inc2 -Iinc3 myfile.c
```

If you list multiple **-L** or **-I** options on the command line, the result is cumulative: The compiler searches all the directories listed, in order from left to right.

**Note** The IDE also supports multiple library directories through the “ganged entry” syntax.

---

## File-search algorithms

The Borland C++ include-file search algorithms search for the **#include** files listed in your source code in the following way:

- If you put an **#include <somefile.h>** statement in your source code, Borland C++ searches for **somefile.h** only in the specified include directories.
- If, on the other hand, you put an **#include "somefile.h"** statement in your code, Borland C++ searches for **somefile.h** first in the current directory; if it does not find the header file there, it then searches in the include directories specified in the command line.

The library-file search algorithms are similar to those for include files:

- **Implicit libraries:** Borland C++ searches for implicit libraries only in the specified library directories; this is similar to the search algorithm for **#include <somefile.h>**. (Implicit library files are the ones Borland C++ automatically links in. These are the **Cx.LIB** and **CWx.LIB** files, **EMU.LIB** or **FP87.LIB**, **MATHx.LIB**, **IMPORT.LIB**, **OVERLAY.LIB**, and the start-up object files: **C0x.OBJ**, **C0Wx.OBJ**, and so forth.)
- **Explicit libraries:** Where Borland C++ searches for explicit (user-specified) libraries depends in part on how you list the library file name. (Explicit library files are the ones you list on the command line or in a project file; these are file names with a **.LIB** extension.)
  - If you list an explicit library file name with no drive or directory (like this: **mylib.lib**), Borland C++ searches for that

library in the current directory first. If the first search was unsuccessful, it looks in the specified library directories. This is similar to the search algorithm for **#include "somefile.h"**.

- If you list a user-specified library with drive and/or directory information (like this: `c:mystuff\mylib1.lib`), Borland C++ searches *only* in the location you explicitly listed as part of the library path name and not in the specified library directories.

An annotated example Here is an example of a Borland C++ command line that incorporates multiple library and include-directory options.

1. Your current drive is C:, and your current directory is C:\BORLANDC, where BCC.EXE resides. Your A drive's current position is A:\ASTROLIB.
2. Your include files (.h or "header" files) are located in C:\BORLANDC\INCLUDE.
3. Your startup files (C0T.OBJ, C0S.OBJ, ... , C0H.OBJ) are in C:\BORLANDC.
4. Your standard Borland C++ library files (CS.LIB, CM.LIB, ..., MATHS.LIB, MATHM.LIB, ... , EMU.LIB, FP87.LIB, and so forth) are in C:\BORLANDC\LIB.
5. Your custom library files for star systems (which you created and manage with TLIB) are in C:\BORLANDC\STARLIB. One of these libraries is PARX.LIB.
6. Your third-party-generated library files for quasars are in the A drive in \ASTROLIB. One of these libraries is WARP.LIB.

Under this configuration, you enter the following command:

```
BCC -mm -Llib;starlib -Iinclude orion.c umaj.c parx.lib a:\astrolib\warp.lib
```

Borland C++ compiles ORION.C and UMAJ.C to .OBJ files, searching C:\BORLANDC\INCLUDE for any #include files in your source code. It then links ORION.OBJ and UMAJ.OBJ with the medium model start-up code (COM.OBJ), the medium model libraries (CM.LIB, MATHM.LIB), the standard floating-point emulation library (EMU.LIB), and the user-specified libraries (PARX.LIB and WARP.LIB), producing an executable file named ORION.EXE.

It searches for the startup code in C:\BORLANDC (then stops because they're there); it searches for the standard libraries in C:\BORLANDC\LIB (and stops because they're there).

When it searches for the user-specified library PARX.LIB, the compiler first looks in the current directory, C:\BORLANDC. Not finding the library there, the compiler then searches the library directories in order: first C:\BORLANDC\LIB, then C:\BORLANDC\STARLIB (where it locates PARX.LIB).

Since an explicit path is given for the library WARP.LIB (A:\ASTROLIB\WARP.LIB), the compiler only looks there.



## The Optimizer

*Borland C++ is a professional optimizing compiler that gives you complete control over what kinds of optimization you want the compiler to perform.*

An optimizer is a tool for improving your application's speed or shrinking down the application's size. It's not likely that the optimizer will double or triple the speed of your application or cut its size in half, but significant increases in speed or reductions in size are common. It will allow you to program in the style you find most convenient, not in the style that your computer finds most convenient.

### When should you use the optimizer?

*In this appendix, "old" versions of Borland C++ are those before version 3.0 that didn't contain the full optimization features.*

There are several theories about the best use of the optimizer. One theory is that you should never develop a new program with the optimizer. Instead, you should compile with optimizations when your application is in its final stages of development. This theory is based on the fact that most compilers, when performing full optimizations, take two to three times longer to compile than when they are not performing any optimizations. Borland C++'s optimizer, however, takes only 50% longer to compile when performing full speed optimizations and 20% longer when performing full size optimizations, so you don't have to worry about slow compilation times.

Another theory says that you should always use the optimizer, even in the early stages of development, since the optimizer may reveal bugs in your code that do not appear when it is not optimized. Opponents of this theory argue that debugging such optimized code is a horrendous task not easily undertaken. Borland C++'s Turbo Debugger understands optimized code and

allows you to easily debug your optimized application, giving you the best of both worlds.

## Optimization options

---

The `-O` command line option controls most code optimizations. The `-O` option may be followed by one or more of the suboption letters given in the list below. For example, `-Oaxt` turns on all speed optimizations and assumes no pointer aliasing. You can turn off optimizations on the command line by placing a minus sign (-) before the optimization letter. For example, `-O2-p` turns on all speed optimizations except copy propagation. In addition, some optimizations are controlled by means other than `-O`. For example, `-Z` controls redundant load suppression.

The optimizations options follow the same rules for precedence as all other Borland C++ options. For example, `-Od` placed on the command line after a `-O2` would disable all optimizations.

Table A.1: Optimization options summary

Command-line	Function
<code>-O2</code>	Options   Compiler   Optimizations   Full Speed
<code>-Ox</code>	Generates the fastest code possible. This is the same as using the following command-line options: <code>-O -Ob -Oe -Og -Oi -Ol -Om -Op -Ot -Ov -k- -Z</code>
<code>-O1</code>	Options   Compiler   Optimizations   Full Size Generates the smallest code possible. This is the same as using the following command-line options: <code>-O -Ob -Oe -Ol -Os -k- -Z</code>
<code>-O</code>	Options   Compiler   Optimizations   Optimize Jumps Removes jumps to jumps, unreachable code, and unnecessary jumps
<code>-Oa</code>	Options   Compiler   Optimizations   Assume no pointer aliasing Assume that pointer expressions are not aliased in common subexpression evaluation
<code>-Ob</code>	Options   Compiler   Optimizations   Dead code elimination Eliminates stores into dead variables and conditional expressions whose values can be determined at compiletime
<code>-Oc</code>	Options   Compiler   Optimizations   Common Subexpressions   Optimize locally Enables common subexpression elimination within basic blocks only. The <code>-Oc</code> option and the <code>-Og</code> option are mutually exclusive
<code>-Od</code>	Options   Compiler   Optimizations   No Optimizing Disables all optimizations. Note that this is not the same as <code>-O-</code> , which merely disables jump optimizations. It is equivalent to <code>-O-cgbelmvpi -Z- -O-</code> . Also note that this option doesn't change the code-generation options for size ( <code>-Os</code> ) or speed ( <code>-O</code> ).

Table A.1: Optimization options summary (continued)

-Oe	Options   Compiler   Optimizations   Global register allocation Enables global register allocation and variable live range analysis
-Og	Options   Compiler   Optimizations   Common Subexpressions   Optimize globally Enables common subexpression elimination within an entire function. The -Og option and the -Oc option are mutually exclusive
-Oi	Options   Compiler   Optimizations   Inline intrinsics Enables inlining of intrinsic functions such as memcpy, strlen, etc.
-Ol	Options   Compiler   Optimizations   Loop optimization Compacts loops into REP/STOSx instructions
-Om	Options   Compiler   Optimizations   Invariant code motion Moves invariant code out of loops
-Op	Options   Compiler   Optimizations   Copy propagation Propagates copies of constants, variables, and expressions where possible
-Os	Options   Compiler   Optimizations   Optimize for   Size Makes code-selection choices in favor of smaller code
-Ot	Options   Compiler   Optimizations   Optimize for   Speed Selects code in favor of executable speed
-Ov	Options   Compiler   Optimizations   Induction Variables Enables loop-induction variable and strength-reduction optimizations
-Z	Options   Compiler   Optimizations   Suppress redundant loads Suppresses reloads of values which are already in registers
-po	Options   Compiler   Optimizations   Object Data Calling Enables the use of the Object Data calling convention for passing <b>this</b> in a register to member functions.
-pr	Options   Compiler   Entry/Exit Code   Calling Convention   Register Enables the use of the <b>_fastcall</b> calling convention for passing parameters in registers

Backward compatibility

In addition to these new options, all the code-generation options from Borland C++ 2.0 and Turbo C++ 1.x are obeyed. Note, however, that there is some duplication in the new and old options. In particular, **-G** and **-G-** are **-Os** and **-Ot**, respectively. In previous revisions, **-Z** performed load suppression but was documented as enabling aliasing. The optimizer detects when one register contains two expressions and suppresses extraneous loads of expression "aliases." This action is not the same as the aliases controlled by **-Oa**.

For completeness, the old **-r** (register-optimization options) are documented below.

*Unless you are an expert,  
don't use -r-.*

- r** This option enables the use of register variables (the default).
- r-** This option suppresses the use of register variables. When you use this option, the compiler won't use register variables, and it won't preserve and respect register variables (SI,DI) from any caller. For that reason, you should not have code that uses register variables call code that has been compiled with **-r-**.  
  
On the other hand, if you are interfacing with existing assembly-language code that does not preserve SI,DI, the **-r-** option allows you to call that code from Borland C++.
- rd** This option only allows declared register variables to be kept in registers.

---

## A closer look at the Borland C++ Optimizer

Conventional wisdom says there are three components to generating good code on the 80x86 processors: register allocation, register allocation, and register allocation.

### Global register allocation

Because memory references are so expensive on these processors, it is extremely important to minimize those references through the intelligent use of registers. Global register allocation both increases the speed and decreases the size of your application. You should always use global register allocation when compiling your application with optimizations on.

### Dead-code elimination

Although you may never intentionally write code to do things which are unnecessary, the optimizer may reveal possibilities to eliminate stores into variables that are not needed. In the following example, the optimizer creates a new variable to take the place of the expression `a[j]`, thereby eliminating the need for the variable `j`. Using **-Ob** will remove the code to store any result into variable `j`.

```
int goo(void), a[10];  
int f(void)  
{  
    int i, j;  
    j = i = goo();  
    for( j = 0; j < 10; j++ )  
        a[j] = goo();  
}
```

```

    return i;
}

```

Since the optimizer must determine where variables are no longer used and where their values are needed (live range analysis), you must use **-Oe** before using **-Ob**. Use **-Ob** whenever you use **-Oe**, since **-Ob** always results in smaller and faster code.

### Common subexpression elimination

Common subexpression elimination is the process of finding duplicate expressions within the target scope and storing the calculated value of those expressions once so as to avoid recalculating the expression. Although in theory this optimization could reduce code-size, in practice, it is a speed optimization and will only rarely result in size reductions. You should also use global common subexpression analysis if you like to reuse expressions rather than create explicit stack locations for them. For example, rather than code

```

temp = t->n.o.left;
if(temp->op == 0_ICON || temp->op == 0_FCON)
:

```

you could code

```

if(t->n.o.left->op == 0_ICON || t->n.o.left->op == 0_FCON)
:

```

and let the optimizer decide whether it is more efficient to create the temporary.

If you find that global common subexpression elimination is creating too many temporaries for your code-size requirements, you can force common subexpression elimination to be done within groups of statements unbroken by jumps (basic blocks) by turning on local common subexpression elimination via the **-Oc** option on the command line.

### Loop invariant code motion

Moving invariant code out of loops is a speed optimization. The optimizer uses the information about all the expressions in the function gathered during common subexpression elimination to find expressions whose values do not change inside a loop. To prevent the calculation from being done many times inside the loop, the optimizer moves the code outside the loop so that it is calculated only once. The optimizer then reuses the calculated value inside the loop. For example, in the code below,  $x * y * z$  is evaluated in every iteration of the loop.

```

int v[10];
void f(void)
{
    int i,x,y,z;
    for (i = 0; i < 10; i++)
        v[i] = x * y * z;
}

```

The optimizer rewrites the code for the loop so that it looks like:

```

int v[10];
void f(void)
{
    int i,x,y,z,t1;
    t1 = x * y * z;
    for (i = 0; i < 10; i++)
        v[i] = t1;
}

```

You should use loop invariant code motion whenever you are compiling for speed and you have used global common subexpressions, since moving code out of loops can result in enormous speed gains.

**Copy propagation** Propagating copies is primarily speed optimization, but since it never increases the size of your code, it is safe to use if you have enabled **-Og**. Like loop invariant code motion, copy propagation relies on the analysis performed during common subexpression elimination. Copy propagation means that the optimizer remembers the values assigned to expressions and uses those values instead of loading the value of the assigned expressions. Copies of constants, expressions, and variables may be propagated. In the following code, for example, the constant value 5 is used in the second assignment instead of the expression on the right side.

```

PtrParIn->IntComp = 5;
( *( PtrParIn->PtrComp ) ).IntComp = PtrParIn->IntComp;

```

**Pointer aliasing** Pointer aliasing is not an optimization in itself, but it does affect the way the optimizer performs common subexpression elimination and copy propagation. When pointer aliasing is turned on, it allows the optimizer to maintain copy propagation information across function calls and to maintain common subexpression information across some stores. Otherwise, the optimizer must discard information about copies and subexpres-

sions in these situations. Pointer aliasing might create bugs that are hard to spot, so it is only applied when you use **-Oa**.

**-Oa** controls how the optimizer treats expressions with pointers in them. When compiling with global or local common subexpressions and **-Oa** enabled, the optimizer recognizes

```
*p * x
```

as a common subexpression in function **foo**.

```
int g, y;

int foo(int *p)
{
    int x=5;
    y = *p * x;
    g = 3;
    return (*p * x);
}

void goo(void)
{
    g=2;
    foo(&g);          /* This is incorrect, since the assignment g = 3
                       invalidates the expression *p * x */
}
```

**-Oa** also controls how the optimizer treats expressions involving variables whose address has been taken. When compiling with **-Oa**, the compiler assumes that assignments via pointers only affects those expressions involving variables whose addresses have been taken and which are of the same type as the lefthand side of the assignment in question. To illustrate, consider the following function.

```
int y, z;

int f(void)
{
    int x;
    char *p = (char *)&x;

    y = x * z;
    *p = 'a';
    return (x*z);
}
```

When compiled with **-Oa**, the assignment `*p = 'a'` does not prevent the optimizer from treating `x*z` as a common subexpression, since the destination of the assignment, `*p`, is a

**char**, whereas the addressed variable is an **int**. When compiled without **-Oa**, the assignment to **\*p** prevents the optimizer from creating a common subexpression out of **x\*z**.

### Induction-variable analysis and strength reduction

Creating induction variables and performing strength reduction are speed optimizations performed on loops. The optimizer uses a mathematical technique called induction to create new variables out of expressions used inside a loop. These variables are called *induction variables*. The optimizer assures that the operations performed on these new variables are computationally less expensive (reduced in strength) than those used by the original variables.

Opportunities for these optimizations are common if you use array indexing inside loops, since a multiplication operation is required to calculate the position in the array which is indicated by the index. For example, the optimizer would create an induction variable out of the operation **v[i]** in the code below, since the **v[i]** operation would require a multiplication. This induction variable also eliminates the need to preserve the value of **i**.

```
int v[10];
void f(void)
{
    int i,x,y,z;
    for (i = 0; i < 10; i++)
        v[i] = x * y * z;
}
```

With **-Ov** enabled, the optimizer would change this code to the following:

```
int v[10];
void f(void)
{
    int i,x,y,z, *p;
    for (p = v; p < &v[10]; p++)
        *p = x * y * z;
}
```

You should use **-Ov** whenever you are compiling for speed and your code contains loops.

Loop compaction Loop compaction takes advantage of the string move instructions on the 80x86 processors by replacing the code for a loop with such an instruction.

```
int v[100];
void t(void)
{
    int i;
    for (i = 0; i < 100; i++)
        v[i] = 0;
}
```

The optimizer will reduce this to the machine instructions:

```
mov cx,100
mov di,offset DGROUP:_v
push ds
pop es
mov ax,0
rep stosw
```

You should use **-Ol** to compact loops whenever you are generating code for speed.

Depending on the complexity of the operands, the compacted loop code may also be smaller than the corresponding non-compact loop. You may wish to experiment with this optimization if you are compiling for size and have loops of this nature.

Code size versus speed optimizations You can control the selection and compaction of instructions with the **-Ot** and the **-Os** options. These options work like **-G** and **-G-** in previous versions of Borland C++ but they have been enhanced to do more. Most notable are the structure copy inlining and code compaction optimizations. Whether you use **-Ot** or **-Os** depends on what you are trying to achieve with your application.

Structure copy inlining The most visible optimization performed when compiling for speed as opposed to size is that of inlining structure copies. When you enable **-Ot**, the compiler determines whether it can safely generate code to perform a **rep movsw** instruction instead of calling a helper function to do the copy. For structures and unions of over eight bytes in length, performing this optimization produces faster structure copies than the corresponding helper function call.

**Code compaction** The most visible optimization performed when compiling for size is code compaction. In code compaction, the optimizer scans the generated code for duplicate sequences. When such sequences warrant, the optimizer replaces one sequence of code with a jump to the other, thereby eliminating the first piece of code. **switch** statements contain the most opportunities for code compaction.

**Redundant load suppression** Load suppression is both a speed and size optimization. When **-Z** is enabled, the optimizer keeps track of the values it loads into registers and suppresses loads of values which it already has in a register. For example, when compiling the following code with **-Z** enabled (and with copy propagation turned off), the optimizer would push the value of **\*x** it loaded into **ES:BX** instead of reloading the value **\*x**.

```
void f(void)
{
    int *x = 5;
    goo(*x);
}
```

You should always use this optimization whenever you are compiling with the optimizer enabled.

**Intrinsic function inlining** There are times when you would like to use one of the common string or memory functions, such as **strcpy** or **memcpy**, but you do not want to incur the overhead of a function call. By using **-Oi**, the compiler will generate the code for these functions within your function's scope, eliminating the need for a function call. The resulting code will execute faster than a call to the same function, but it will also be larger.

The following is a list of those functions that are inlined when **-Oi** is enabled.

■ <b>memchr</b>	■ <b>strcat</b>	■ <b>strncat</b>	■ <b>rotl</b>
■ <b>memcpy</b>	■ <b>strchr</b>	■ <b>strncmp</b>	■ <b>rotr</b>
■ <b>memcpy</b>	■ <b>strcmp</b>	■ <b>strcpy</b>	■ <b>fabs</b>
■ <b>memset</b>	■ <b>strcpy</b>	■ <b>strnset</b>	■ <b>alloca</b>
■ <b>strcpy</b>	■ <b>strlen</b>	■ <b>strrchr</b>	

You can control the inlining of each of these functions with the **pragma intrinsic**. For example,

```
#pragma intrinsic strcpy
```

would cause the compiler to generate inline code for all subsequent calls to **strcpy** in your function.

```
#pragma intrinsic -strcpy
```

would prevent the compiler from inlining **strcpy**. Using these pragmas in a file will override the command-line switches or IDE options used to compile that file.

When inlining any intrinsic function, you must include a prototype for that function before you use it. This is because when inlining, the compiler actually creates a macro that renames the inlined function to a function that the compiler recognizes internally. In the above example, the compiler would create a macro

```
#define strcpy __strcpy__
```

The compiler recognizes calls to functions with two leading and two trailing underscores and tries to match the prototype of that function against its own internally stored prototype. If you don't supply a prototype or the prototype you supplied doesn't match the compiler's internal prototype, the compiler rejects the attempt to inline that function and generates an error.



Inlined intrinsic functions assume that the processor direction flag is clear. This isn't a problem with code that Borland C++ generates, but if you use any assembly language routines, make sure they "clean up" after themselves.

### Register parameter passing

The Borland C++ compiler has two calling conventions where parameters are passed in registers instead of on the stack: Object Data and fastcall.

### Object Data

With Object Data enabled, the compiler compiles member functions to expect their **this** pointer to be passed in a register (or a register pair in large data models). Likewise, calls to member functions loads the register (or register pair) with **this**.

You can enable Object Data using the **-po** command-line option or with the Options | Compiler | Optimizations | Object Data Calling option. There is no language-specifier keyword.

In small data models, **this** is supplied in the SI register; large data models use DS:SI. If necessary, the compiler saves and restores

DS. All references in the member function to member data are done via the SI register.

The names of member functions compiled with Object Data are mangled differently from non-Object Data member functions, to prevent mixing the two. It's easiest to compile all classes with Object Data, but you can compile some classes with Object Data and some without, as in the following example:

```
// no -po on the command-line
class X;

#pragma option -po
class Y : X
{
:
};

class X
{
:
};
#pragma option -po.
```

*Y will use Object Data.*

*X won't use Object Data since its class declaration appeared before Object Data was turned on.*

### The `_fastcall` modifier

The compiler treats this calling convention as a new language specifier, along the lines of `_cdecl` and `_pascal`. Functions declared with either of these two languages modifiers cannot also have the `_fastcall` modifier since they use the stack to pass parameters. Likewise, the `_fastcall` modifier cannot be used together with `_export` and `_loadds`. The compiler generates a warning if you try to mix functions of these types or if you use the `_fastcall` modifier in a dangerous situation. You may, however, use functions using the `_fastcall` convention in VROOMM overlaid modules.

### Parameter rules

The compiler uses the rules given in Table A.2 when deciding which parameters are to be passed in registers. A maximum of three parameters may be passed in registers to any one function. You should not assume that the assignment of registers will reflect the ordering of the parameters to a function.

Table A.2  
Parameter types and  
possible registers used

Parameter Type	Registers
character (signed and unsigned)	AL, DL, BL
integer (signed and unsigned)	AX, DX, BX
long (signed and unsigned)	DX:AX
near pointer	AX, DX, BX

Far pointer, union, structure, and floating-point (float and double) parameters are pushed on the stack.

### Function naming

Functions declared with the `_fastcall` modifier have different names than their non-`_fastcall` counterparts. The compiler prefixes the `_fastcall` function name with an `@`. This prefix applies to both unmangled C function names and to mangled C++ function names.



## Editor reference

The editor has two command sets: CUA and Alternate. The tables in this appendix list all the available commands. You can use some commands in both modes, while others are available in only one mode. Choose Options | Environment | Preferences and select the command set you want in the Preferences dialog box.

Most of these commands need no explanation. Those that do are described in the text following Table B.1.

Table B.1  
Editing commands

*A word is defined as a sequence of characters separated by one of the following: space <> , ; . ( ) ^ ` \* + - / \$ # = | ~ ? ! " % & ' : @ \, and all control and graphic characters.*

Command	Both modes	CUA	Alternate
<b>Cursor movement commands</b>			
Character left	←		Ctrl+S
Character right	→		Ctrl+D
Word left	Ctrl+ ←		Ctrl+A
Word right	Ctrl+ →		Ctrl+F
Line up	↑		Ctrl+E
Line down	↓		Ctrl+X
Scroll up one line	Ctrl+W		
Scroll down one line	Ctrl+Z		
Page up	PgUp		Ctrl+R
Page down	PgDn		Ctrl+C
Beginning of line	Home		
	Ctrl+Q S		
End of line	End		
	Ctrl+Q D		
Top of window	Ctrl+Q E	Ctrl+E	Ctrl+Home
Bottom of window	Ctrl+Q X	Ctrl+X	Ctrl+End
Top of file	Ctrl+Q R	Ctrl+Home	Ctrl+PgUp
Bottom of file	Ctrl+Q C	Ctrl+End	Ctrl+PgDn
Move to previous position	Ctrl+Q P		

Table B.1: Editing commands (continued)

<b>Command</b>	<b>Both modes</b>	<b>CUA</b>	<b>Alternate</b>
<b>Insert and delete commands</b>			
Delete character	<i>Del</i>		<i>Ctrl+G</i>
Delete character to left	<i>Backspace</i> <i>Shift+Tab</i>		<i>Ctrl+H</i>
Delete line	<i>Ctrl+Y</i>		
Delete to end of line	<i>Ctrl+Q Y</i>	<i>Shift+Ctrl+Y</i>	
Delete word	<i>Ctrl+T</i>		
Insert line	<i>Ctrl+N</i>		
Insert mode on/off	<i>Ins</i>		<i>Ctrl+V</i>
<b>Block commands</b>			
Move to beginning of block	<i>Ctrl+Q B</i>		
Move to end of block	<i>Ctrl+Q K</i>		
Set beginning of block	<i>Ctrl+K B</i>		
Set end of block	<i>Ctrl+K K</i>		
Exit to menu bar	<i>Ctrl+K D</i>		
Hide/Show block	<i>Ctrl+K H</i>		
Mark line	<i>Ctrl+K L</i>		
Print selected block	<i>Ctrl+K P</i>		
Mark word	<i>Ctrl+K T</i>		
Delete block	<i>Ctrl+K Y</i>		
Copy block	<i>Ctrl+K C</i>		
Move block	<i>Ctrl+K V</i>		
Copy to Clipboard	<i>Ctrl+Ins</i>		
Cut to Clipboard	<i>Shift+Del</i>		
Delete block	<i>Ctrl+Del</i>		
Indent block	<i>Ctrl+K I</i>	<i>Shift+Ctrl+I</i>	
Paste from Clipboard	<i>Shift+Ins</i>		
Read block from disk	<i>Ctrl+K R</i>	<i>Shift+Ctrl+R</i>	
Unindent block	<i>Ctrl+K U</i>	<i>Shift+Ctrl+U</i>	
Write block to disk	<i>Ctrl+K W</i>	<i>Shift+Ctrl+W</i>	
<b>Marking blocks</b>			
Left one character	<i>Shift+ ←</i>		
Right one character	<i>Shift+ →</i>		
End of line	<i>Shift+End</i>		
Beginning of line	<i>Shift+Home</i>		
Same column on next line	<i>Shift+ ↓</i>		
Same column on previous line	<i>Shift+ ↑</i>		
One page down	<i>Shift+PgDn</i>		
One page up	<i>Shift+PgUp</i>		
Left one word	<i>Shift+Ctrl+ ←</i>		
Right one word	<i>Shift+Ctrl+ →</i>		
End of file	<i>Shift+Ctrl+End</i>		<i>Shift+Ctrl+PgDn</i>
Beginning of file	<i>Shift+Ctrl+Home</i>		<i>Shift+Ctrl+PgUp</i>

Table B.1: Editing commands (continued)

Command	Both modes	CUA	Alternate
<b>Other editing commands</b>			
Autoindent mode on/off	<i>Ctrl+O I</i>		
Cursor through tabs on/off	<i>Ctrl+O R</i>		
Exit the IDE		<i>Alt+F4</i>	<i>Alt+X</i>
Find place marker	<i>Ctrl+Q n *</i>	<i>Ctrl n *</i>	
Help	<i>F1</i>		
Help index	<i>Shift+F1</i>		
Insert control character	<i>Ctrl+P**</i>		
Maximize window			<i>F5</i>
Open file			<i>F3</i>
Optimal fill mode on/off	<i>Ctrl+O F</i>		
Pair matching	<i>Ctrl+Q [,</i> <i>Ctrl+Q ]</i>	<i>Alt+[,Alt+]</i>	
Save file	<i>Ctrl+K S</i>		<i>F2</i>
Search	<i>Ctrl+Q F</i>		
Search again		<i>F3</i>	<i>Ctrl+L</i>
Search and replace	<i>Ctrl+Q A</i>		
Set marker	<i>Ctrl+K n *</i>	<i>Shift+Ctrl n *</i>	
Tabs mode on/off	<i>Ctrl+O T</i>		
Topic search help	<i>Ctrl+F1</i>		
Undo	<i>Alt+Backspace</i>		
Redo	<i>Alt+Shift+Backspace</i>		
Unindent mode on/off	<i>Ctrl+O U</i>		

\* *n* represents a number from 0 to 9.

\*\* Enter control characters by first pressing *Ctrl+P*, then pressing the desired control character.

## Block commands

*The Persistent Blocks and Overwrite Blocks options in the Options | Environment | Editor dialog box affect some block operations. See page 117 for more information.*

A block of text is any amount of text, from a single character to hundreds of lines, that is selected on your screen. There can be only one block in a window at a time. Select a block with your mouse or by holding down *Shift* while moving your cursor to the end of the block with the arrow keys. Once selected, the block can be copied, moved, deleted, or written to a file. You can use the Edit menu commands to perform these operations or you can use the keyboard commands listed in the following table.

When you choose Edit | Copy or press *Ctrl+Ins*, the selected block is copied to the Clipboard. When you choose Edit | Paste or *Shift+Ins*, the block held in the Clipboard is pasted at the current cursor position. The selected text remains unchanged and is no longer selected.

If you choose Edit | Cut or press *Shift+Del*, the selected block is moved from its original position and held in the Clipboard. It is pasted at the current cursor position when you choose the Paste command.

The copying, cutting, and pasting commands are the same in both the CUA and Alternate command sets.

Table B.2: Block commands in depth

Command	CUA	Alternate	Function
Copy block	<i>Ctrl+Ins</i> , <i>Shift+Ins</i>	<i>Ctrl+Ins</i> , <i>Shift+Ins</i>	Copies a previously selected block to the Clipboard and, after you move your cursor to where you want the text to appear, pastes it to the new cursor position. The original block is unchanged. If no block is selected, nothing happens.
Copy text	<i>Ctrl+Ins</i>	<i>Ctrl+Ins</i>	Copies selected text to the Clipboard.
Cut text	<i>Shift+Del</i>	<i>Shift+Del</i>	Cuts selected text to the Clipboard.
Delete block	<i>Ctrl+Del</i>	<i>Ctrl+Del</i>	Deletes a selected block. You can “undelete” a block with Undo.
Move block	<i>Shift+Del</i> , <i>Shift+Ins</i>	<i>Shift+Del</i> , <i>Shift+Ins</i>	Moves a previously selected block from its original position to the Clipboard and, after you move your cursor to where you want the text to appear, pastes it to the new cursor position. The block disappears from its original position. If no block is marked, nothing happens.
Paste from Clipboard	<i>Shift+Ins</i>	<i>Shift+Ins</i>	Pastes the contents of the Clipboard.
Read block from disk	<i>Shift+Ctrl+R</i> <i>Ctrl+K R</i>	<i>Ctrl+K R</i>	Reads a disk file into the current text at the cursor position exactly as if it were a block. The text read is then selected as a block. When this command is issued, you are prompted for the name of the file to read. You can use wildcards to select a file to read; a directory is displayed. The file specified can be any legal file name.
Write block to disk	<i>Shift+Ctrl+W</i> <i>Ctrl+K W</i>	<i>Ctrl+K W</i>	Writes a selected block to a file. When you give this command, you are prompted for the name of the file to write to. The file can be given any legal name (the default extension is CPP). If you prefer to use a file name without an extension, append a period to the end of its name.

If you have used Borland editors in the past, you may prefer to use the block commands listed in this table; they work in both command sets.

Table B.3  
Borland-style block  
commands

*Selected text is highlighted only if both the beginning and end have been set and the beginning comes before the end.*

Command	Keys	Function
Set beginning of block	<i>Ctrl+K B</i>	Begin selection of text.
Set end of block	<i>Ctrl+K K</i>	End selection of text.
Hides/shows selected text	<i>Ctrl+K H</i>	Alternately displays and hides selected text.
Copy selected text to the cursor	<i>Ctrl+K C</i>	Copies the selected text to the position of the cursor. Useful only with the Persistent Block option.
Move selected text to the cursor	<i>Ctrl+K V</i>	Moves the selected text to the position of the cursor. Useful only with the Persistent Block option.

## Other editing commands

The next table describes certain editing commands in more detail. The table is arranged alphabetically by command name.

Table B.4: Other editor commands in depth

Command	CUA	Alternate	Function
Autoindent	<i>Ctrl+O I</i>	<i>Ctrl+O I</i>	Toggles the automatic indenting of successive lines. You can also use Options   Environment   Editor Autoindent in the IDE to turn automatic indenting on and off.
Cursor through tabs	<i>Ctrl+O R</i>	<i>Ctrl+O R</i>	The arrow keys moves the cursor to the middle of tabs when this option is on; otherwise, the cursor jumps several columns when cursoring over multiple tabs. <i>Ctrl+O R</i> is a toggle.
Find place marker	<i>Ctrl+n*</i> <i>Ctrl+Q n*</i>	<i>Ctrl+Q n*</i>	Finds up to 10 place markers ( <i>n</i> can be any number in the range 0 to 9) in text. Move the cursor to any previously set marker by pressing <i>Ctrl+Q</i> and the marker number.
Open file		<i>F3</i>	Lets you load an existing file into an edit window.
Optimal fill	<i>Ctrl+O F</i>	<i>Ctrl+O F</i>	Toggles optimal fill. Optimal fill begins every line with the minimum number of characters possible, using tabs and spaces as necessary. This produces lines with fewer characters.
Save file		<i>F2</i>	Saves the file and returns to the editor.

Table B.4: Other editor commands in depth (continued)

<b>Command</b>	<b>CUA</b>	<b>Alternate</b>	<b>Function</b>
Set place	<i>Shift+Ctrl n*</i> <i>Ctrl+K n*</i>	<i>Ctrl+K n*</i>	Mark up to 10 places in text. After marking your location, you can work elsewhere in the file and then easily return to your marked location by using the Find Place Marker command (being sure to use the same marker number). You can have 10 places marked in each window.
Show previous error	<i>Alt+F7</i>	<i>Alt+F7</i>	Moves the cursor to the location of the previous error or warning message. This command is available only if there are messages in the Message window that have associated line numbers.
Show next error	<i>Alt+F8</i>	<i>Alt+F8</i>	Moves the cursor to the location of the next error or warning message. This command is available only if there are messages in the Message window that have associated line numbers.
Tab mode	<i>Ctrl+O T</i>	<i>Ctrl+O T</i>	Toggles Tab mode. You can specify the use of true tab characters in the IDE with the Options   Environment   Editor Use Tab Character option.
Unindent	<i>Ctrl+O U</i>	<i>Ctrl+O U</i>	Toggles Unindent. You can turn Unindent on and off from the IDE with the Options   Environment   Editor Backspace Unindents option.

\* *n* represents a number from 0 to 9.

## Using EasyWin

EasyWin is an exciting new feature of Borland C++ that lets you compile standard DOS applications that use traditional “TTY style” input and output so that they will run as true Windows programs. Best of all, you don’t have to change a single line of code to use EasyWin.

### DOS to Windows made easy

---

To convert your DOS applications that use *stdio* or *iostream* functions, simply compile your program with the Windows compiler switch (**-W**), or select Windows App from the Options | Application dialog box in the IDE. Borland C++ will note that your program does not contain a **WinMain** function (normally required for Windows applications) and automatically link in the EasyWin library. When you run your program in the Windows environment, a standard window will be created, and your program will take input and produce output for that window exactly as if it were the standard screen.

Here’s an example program:

```
#include <stdio.h>
main()
{
    printf("Hello, world\n");
    return 0;
}
```

or, for C++, you could write

```
#include <iostream.h>

main()
{
    cout << "Hello, world\n";
    return 0;
}
```

That's all there is to it. The EasyWin window is used anytime input or output is requested from or to a TTY device. This means that in addition to *stdin*, *cin*, *stdout*, and *cout*, the *stderr*, *cerr*, and *stdaux* "devices" are all connected to this window.

## Using EasyWin in a Windows application

---

EasyWin was designed to convert DOS programs to Windows applications, quickly and easily. However, there may be reasons for using EasyWin from within a "true" Windows application. For example, you may want to add **printf** functions to your program code to help you debug your Windows program. You can also use EasyWin to help debug your ObjectWindows applications.

To use EasyWin from within a Windows program, simply make a call to **\_InitEasyWin** somewhere in your application. It's easiest to make the **\_InitEasyWin** call the first statement in your **WinMain**. For example:

```
#include <windows.h>
#include <stdio.h>

#pragma argsused
int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
                  LPSTR lpszCmdLine, int cmdShow)
{
    _InitEasyWin();

    /* Normal windows setup */
    printf("Hello, world\n");
    return 0;
}
```

The prototype for **\_InitEasyWin** can be found in *stdio.h*, *io.h*, and *iostream.h*.

## Added functions

---

For your convenience, EasyWin also includes five additional functions that allow you to specify the X and Y window coordinates for input and output, clear the window, or clear to the end of the current line. These functions are

- gotoxy
- wherex
- wherey
- clrscr
- clreol

These functions have the same names (and uses) as functions in `conio.h` (see the *Library Reference*). Classes in `constrea.h` provide *conio* functionality for use with C++ streams (see Chapter 5, “Using C++ streams,” in the *Programmer’s Guide* for a complete discussion).

## Limitations

---

There are some functions a DOS program can call that aren’t safe for a Windows application to call. You won’t be able to compile such programs as EasyWin applications. You can’t write any program that uses graphics, hooks interrupts, or terminates and stays resident. Run-time library functions that EasyWin doesn’t support are:

<b>absread</b>	<b>clearviewport</b>	<b>execle</b>	<b>getarccoords</b>	<b>getpalette</b>
<b>abswrite</b>	<b>closegraph</b>	<b>execlp</b>	<b>getaspectratio</b>	<b>getpalettesize</b>
<b>allocmem</b>	<b>_control87</b>	<b>execlpe</b>	<b>getbkcolor</b>	<b>getpass</b>
<b>arc</b>	<b>coreleft</b>	<b>execv</b>	<b>getcolor</b>	<b>gettext</b>
<b>bar</b>	<b>cprintf</b>	<b>execve</b>	<b>getdefaultpalette</b>	<b>gettextinfo</b>
<b>bar3d</b>	<b>cputs</b>	<b>execvp</b>	<b>getdrivername</b>	<b>gettextsettings</b>
<b>bioscom</b>	<b>cscanf</b>	<b>execvpe</b>	<b>getfillpattern</b>	<b>getviewsettings</b>
<b>biosdisk</b>	<b>delay</b>	<b>farcoreleft</b>	<b>getfillsettings</b>	<b>getx</b>
<b>_bios_disk</b>	<b>delline</b>	<b>farheapcheck</b>	<b>getgraphmode</b>	<b>gety</b>
<b>bioskey</b>	<b>detectgraph</b>	<b>farheapcheckfree</b>	<b>getimage</b>	<b>graphdefaults</b>
<b>_bios_keybrd</b>	<b>_dos_allocmem</b>	<b>farheapchecknode</b>	<b>getlinesettings</b>	<b>grapherrormsg</b>
<b>biosprint</b>	<b>_dos_freemem</b>	<b>farheapfillfree</b>	<b>getmaxcolor</b>	<b>_graphfreemem</b>
<b>_bios_printer</b>	<b>_dos_keep</b>	<b>farheapwalk</b>	<b>getmaxmode</b>	<b>_graphgetmem</b>
<b>brk</b>	<b>_dos_setblock</b>	<b>fillellipse</b>	<b>getmaxx</b>	<b>graphresult</b>
<b>cgets</b>	<b>drawpoly</b>	<b>fillpoly</b>	<b>getmaxy</b>	<b>harderr</b>
<b>circle</b>	<b>ellipse</b>	<b>floodfill</b>	<b>getmodename</b>	<b>_harderr</b>
<b>cleardevice</b>	<b>execl</b>	<b>freemem</b>	<b>getmoderange</b>	<b>hardresume</b>

<b>_hardresume</b>	<b>linerel</b>	<b>randbrd</b>	<b>setfillstyle</b>	<b>spawnlp</b>
<b>hardretn</b>	<b>lineto</b>	<b>randbwr</b>	<b>setgraphbufsize</b>	<b>spawnlpe</b>
<b>_hardretn</b>	<b>lowvideo</b>	<b>rectangle</b>	<b>setgraphmode</b>	<b>spawnv</b>
<b>heapcheck</b>	<b>moverel</b>	<b>registerbgidriver</b>	<b>setlinestyle</b>	<b>spawnve</b>
<b>heapcheckfree</b>	<b>movetext</b>	<b>registerbgifont</b>	<b>setpalette</b>	<b>spawnvp</b>
<b>heapchecknode</b>	<b>moveto</b>	<b>restorecrtmode</b>	<b>setrgbpalette</b>	<b>spawnvpe</b>
<b>heapfillfree</b>	<b>normvideo</b>	<b>sbrk</b>	<b>settextjustify</b>	<b>system</b>
<b>heapwalk</b>	<b>nosound</b>	<b>sector</b>	<b>settextstyle</b>	<b>textattr</b>
<b>highvideo</b>	<b>outtext</b>	<b>setactivepage</b>	<b>setusercharsize</b>	<b>textbackground</b>
<b>imagesize</b>	<b>outtextxy</b>	<b>setallpalette</b>	<b>setviewport</b>	<b>textcolor</b>
<b>initgraph</b>	<b>_OvrlnitEms</b>	<b>setaspectratio</b>	<b>setvisualpage</b>	<b>textheight</b>
<b>inline</b>	<b>_OvrlnitExt</b>	<b>setbkcolor</b>	<b>setwritemode</b>	<b>textmode</b>
<b>installuserdriver</b>	<b>pieslice</b>	<b>setblock</b>	<b>sleep</b>	<b>textwidth</b>
<b>installuserfont</b>	<b>putimage</b>	<b>setcolor</b>	<b>sound</b>	<b>ungetch</b>
<b>keep</b>	<b>putpixel</b>	<b>_setcursortype</b>	<b>spawnl</b>	<b>window</b>
<b>line</b>	<b>puttext</b>	<b>setfillpattern</b>	<b>spawnle</b>	

## *Precompiled headers*

Borland C++ can generate and subsequently use precompiled headers for your projects. Precompiled headers can greatly speed up compilation times.

### How they work

---

When compiling large C and C++ programs, the compiler can spend up to half of its time parsing header files. When the compiler parses a header file, it enters declarations and definitions into its symbol table. If 10 of your source files include the same header file, this header file is parsed 10 times, producing the same symbol table every time.

Precompiled header files cut this process short. During one compilation, the compiler stores an image of the symbol table on disk in a file called TCDEF.SYM by default. (TCDEF.SYM is stored in the same directory as the compiler.) Later, when the same source file is compiled again (or another source file that includes the same header files), the compiler reloads TCDEF.SYM from disk instead of parsing all the header files again. Directly loading the symbol table from disk is over 10 times faster than parsing the text of the header files.

Precompiled headers will only be used if the second compilation uses one or more of the same header files as the first one, and if a

lot of other things, like compiler options, defined macros and so on, are also identical.

If, while compiling a source file, the compiler discovers that the first included files are identical to those of a previous compilation (of the same source or a different source), it will load the binary image for those files, and parse the remaining **#include** directives.

Use of precompiled headers for a given module is an all or nothing deal: The precompiled header file is not updated for that module if compilation of any included header file fails.

---

## Drawbacks

When using precompiled headers, `TCDEF.SYM` can become very big, because it contains symbol table images for all sets of included files encountered in your sources. You can reduce the size of this file; see “Optimizing precompiled headers” on page 206.

If a header contains any code, then it can’t be precompiled. For example, while C++ class definitions may appear in header files, you should take care that only member functions that are inline are defined in the header; heed warnings such as “Functions containing for are not expanded inline”.

---

## Using precompiled headers

You can control the use of precompiled headers in any of the following ways:

- from within the IDE, using the Options | Compiler | Code Generation dialog box (see page 88). The IDE bases the name of the precompiled header file on the project name, creating `PROJECT.SYM`
- from the command line using the `-H`, `-H=filename`, and `-Hu` options (see page 166)
- or from within your code using the pragmas `hdrfile` and `hdrstop` (see Chapter 4 in the *Programmer’s Guide*)

## Setting file names

---

The compiler uses just one file to store all precompiled headers. The default file name is `TCDEF.SYM`. You can explicitly set the name with the `-H=filename` command-line option or the `#pragma hdrfile` directive.



You may notice that your `.SYM` file is smaller than it should be. If this happens, the compiler may have run out of disk space when writing to the `.SYM` file. When this happens, the compiler deletes the `.SYM` in order to make room for the `.OBJ` file, then starts creating a new (and therefore shorter) `.SYM` file. If this happens, just free up some disk space before compiling.

## Establishing identity

---

The following conditions need to be identical for a previously generated precompiled header to be loaded for a subsequent compilation.

The second or later source file must:

- ❑ have the same set of include files in the same order
- ❑ have the same macros defined to identical values
- ❑ use the same language (C or C++)
- ❑ use header files with identical time stamps; these header files can be included either directly or indirectly

In addition, the subsequent source file must be compiled with the same settings for the following options:

- ❑ memory model, including SS != DS (**-m***x*)
- ❑ underscores on externs (**-u**)
- ❑ maximum identifier length (**-iL**)
- ❑ target DOS (default) or Windows (**-W** or **-W***x*)
- ❑ generate word alignment (**-a**)
- ❑ Pascal calls (**-p**)
- ❑ treat enums as integers (**-b**)
- ❑ default char is unsigned (**-K**)
- ❑ virtual table control (**-V***x*)

## Optimizing precompiled headers

For Borland C++ to most efficiently compile using precompiled headers, follow these rules:

- Arrange your header files in the same sequence in all source files.
- Put the largest header files first.
- Prime TCDEF.SYM with often-used initial sequences of header files.
- Use `#pragma hdrstop` to terminate the list of header files at well-chosen places. This lets you make the list of header files in different sources look similar to the compiler. `#pragma hdrstop` is described in more detail in Chapter 4 in the *Programmer's Guide*.

For example, given the two source files ASOURCE.C and BSOURCE.C, both of which include windows.h and myhdr.h,

```
ASOURCE.C    #include <windows.h>
              #include "myhdr.h"
              #include "xxx.h"
              <...>
```

```
BSOURCE.C    #include "zz.h"
              #include <string.h>
              #include "myhdr.h"
              #include <windows.h>
              <...>
```

You would rearrange the beginning of BSOURCE.C to:

```
Revised BSOURCE.C    #include <windows.h>
                      #include "myhdr.h"
                      #include "zz.h"
                      #include <string.h>
                      <...>
```

Note that windows.h and myhdr.h are in the same order in BSOURCE.C as they are in ASOURCE.C. You could also make a new source called PREFIX.C containing only the header files, like this:

```
PREFIX.C    #include <windows.h>
            #include "myhdr.h"
```

If you compile PREFIX.C first (or insert a `#pragma hdrstop` in both ASOURCE.C and BSOURCE.C after the `#include "myhdr.h"` statement) the net effect is that after the initial compilation of PREFIX.C, both ASOURCE.C and BSOURCE.C will be able to load the symbol table produced by PREFIX.C. The compiler will then only need to parse xxx.h for ASOURCE.C and zz.h and string.h for BSOURCE.C.



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