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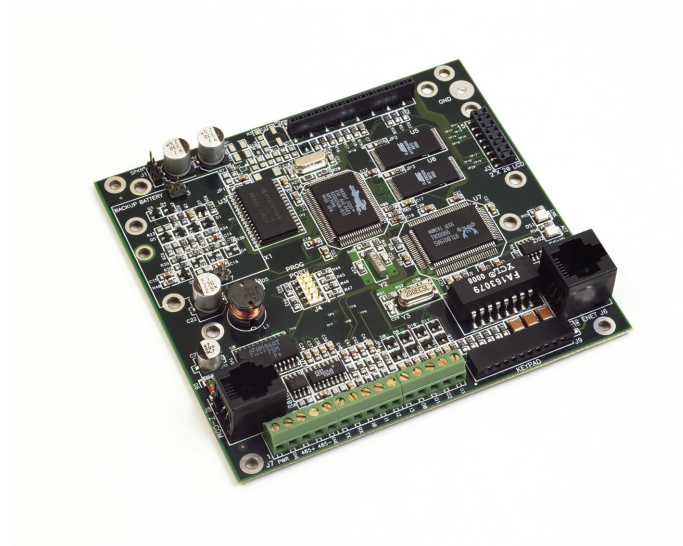
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TCP/IP Development Kit

Integrated C Development System

Getting Started Manual

019-0079 • 040531-G

TCP/IP Development Kit Getting Started Manual

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1. OVERVIEW

The TCP/IP Development Kit provides a hardware platform based on the Rabbit 2000[®] microprocessor, Dynamic C[®], and the tools necessary to develop a robust 10Base-T Ethernet application.

1.1 Description

The TCP/IP Development Kit includes a TCP/IP Development Board (with a Rabbit 2000[®] microprocessor, flash memory, SRAM, Ethernet hardware, serial ports, digital I/O), Dynamic C development software with TCP/IP stack and documentation on CD-ROM (not a trial version!), a demonstration board, a power supply, and a serial programming cable.

The TCP/IP Development Board included in the kit allows for immediate evaluation and development of TCP/IP applications using the Rabbit 2000 microprocessor. Executable code can be downloaded into flash memory or SRAM (an optional battery backup board for SRAM and the real-time clock is available). Two communication ports are available—an RS-232 port and a RS-485 port. Other features of the TCP/IP Development Board include four high-current outputs, four digital inputs, seven timers, a real-time battery-backable clock, and a 10Base-T Ethernet interface.

1.1.1 TCP/IP Development Board Features

- 18.432 MHz Rabbit 2000 Processor
- 10Base-T Ethernet interface
- 4 high-current outputs (200 mA @ 40 V DC)
- 4 digital input points (0–5 V DC nominal)
- RS-232 serial port
- RS-485 serial port (may be factory configured to second RS-232)
- 512K flash memory (2 × 256K)
- 128K SRAM
- 7 built-in timers
- Time/date real-time clock (requires battery-backup board, available separately)
- Watchdog timer

1.1.2 Key Benefits

- Ethernet ready—port to an Ethernet chip is done for the Rabbit 2000 chip.
- Cost-effective—no run-time royalties.
- Simplified development—a complete Dynamic C software package (with integrated editor, compiler and debugger) is provided. No in-circuit emulator is required.
- A head start—sample programs, including HTTP Web server and SMTP mail client, provide an advanced starting point for development.
- Quick development time—full hardware reference schematics help reduce development efforts.

1.1.3 TCP/IP Capabilities

- Socket-Level TCP (Transmission Control Protocol) provides reliable full-duplex data transmission.
- Socket-Level UDP (User Datagram Protocol)—simple protocol exchanges datagrams without acknowledgements or guaranteed delivery.
- ICMP (Internet Control Message Protocol)—network-layer Internet protocol that reports errors and provides other information relevant to IP packet processing.
- DNS (Domain Name System) client—a distributed Internet directory service that is used mostly to translate between domain names and IP addresses, and to control Internet e-mail delivery.
- DHCP (Dynamic Host Configuration Protocol) client—provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.
- HTTP (Hypertext Transfer Protocol) server—the protocol used by Web browsers and Web servers to transfer files, such as text and graphic files. Includes facilities for Server Side Includes (SSI) and CGI routines.
- SMTP (Simple Mail Transfer Protocol) client—Internet protocol providing e-mail services.
- FTP (File Transfer Protocol) server and client—application protocol, part of the TCP/IP protocol stack, used for transferring files between network nodes. Server with password support for file transfers between network nodes available on the Rabbit 2000.
- TFTP (Trivial File Transfer Protocol) server and client—simplified version of FTP that allows files to be transferred from one computer to another over a network.
- POP3 (Post Office Protocol) client.
- Serial-to-Telnet gateway.

Additional TCP/IP capabilities are added on an ongoing basis.

1.2 Physical and Electrical Specifications

Table 1 lists the basic specifications for the TCP/IP Development Board.

Table 1. TCP/IP Development Board Specifications

Specification	Data
Power Supply	9 V to 40 V DC
Board Size (with optional backup-battery board)	4.30" × 4.71" × 0.79" (109 mm × 120 mm × 20 mm)
Environmental	−40°C to 70°C, 5–95% humidity, noncondensing

The TCP/IP Development Board has 15 pins on header J7, one RJ-12 jack for RS-232 or RS-485 serial communication, and one RJ-45 Ethernet jack. The pinouts are shown in Figure 1.

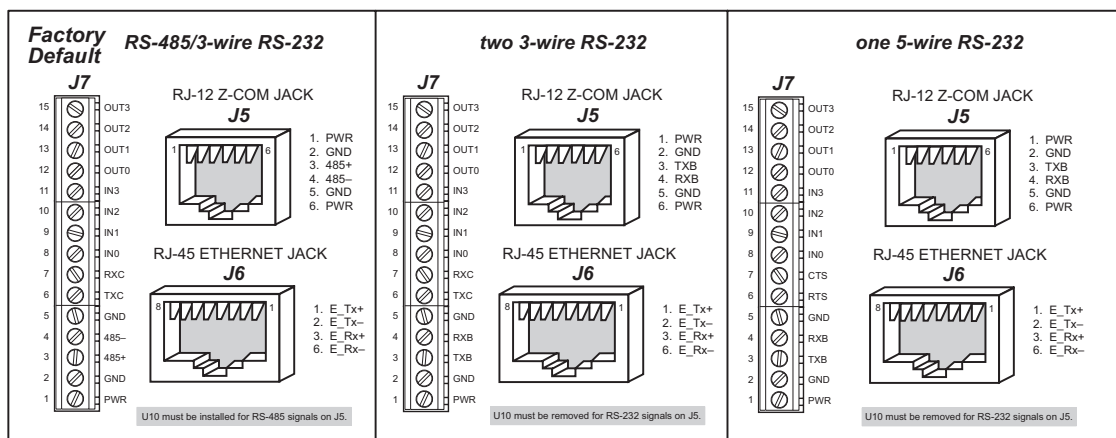


Figure 1. TCP/IP Development Board I/O Pinout

RJ-45 pinouts are sometimes numbered opposite to the way shown in Figure 1. Regardless of the numbering convention followed, the pin positions relative to the spring tab position (located at the bottom of the RJ-45 jack in Figure 1) are always absolute, and the RJ-45 connector will work properly with off-the-shelf Ethernet cables.

1.3 Development Software

The TCP/IP Development Board uses the Dynamic C development environment for rapid creation and debugging of runtime applications. Dynamic C provides a complete development environment with integrated editor, compiler and source-level debugger. It interfaces directly with the target system, eliminating the need for complex and unreliable in-circuit emulators.

Dynamic C must be installed on a Windows workstation with at least one free serial (COM) port for communication with the target system. See Chapter 3., “Installing Dynamic C,” for complete information on installing Dynamic C.

TCP/IP source code is provided in addition to the Dynamic C software on CD-ROM. ICMP, HTTP (includes facilities for SSI, CGI routines, cookies, and basic authentication), SMTP, FTP, and TFTP (client and server) capabilities are provided. Ethernet drivers for the RealTek Ethernet chip are also included. Users can directly write to TCP or UDP sockets to develop custom applications. In addition, extensive sample programs are provided to assist with development. No run-time royalties are required, leading to significant cost savings for OEMs over the life of their application.

1.4 How to Use This Manual

This *Getting Started* manual is intended to give users a quick but solid start with the TCP/IP Development Board. It does not contain detailed information on the hardware capabilities or the Dynamic C development environment. Most users will want more detailed information on some or all of these topics in order to put the TCP/IP Development Board to effective use.

TIP: We recommend that anyone not thoroughly familiar with single-board computers at least read through the rest of this manual to gain the necessary familiarity to make use of the more advanced information.

1.4.1 Additional Reference Information

Several higher level reference manuals are provided in HTML and PDF form on the accompanying CD-ROM. Advanced users will find these references valuable in developing systems based on the TCP/IP Development Board:

- *Dynamic C User's Manual*
- *Dynamic C Function Reference Manual*
- *Dynamic C TCP/IP User's Manual*
- *Rabbit 2000 Microprocessor User's Manual*
- *An Introduction to TCP/IP*

1.4.2 Using Online Documentation

We provide the bulk of our user and reference documentation in two electronic formats, HTML and Adobe PDF. We do this for several reasons.

We believe that providing all users with our complete library of product and reference manuals is a useful convenience. However, printed manuals are expensive to print, stock, and ship. Rather than include and charge for manuals that every user may not want, or provide only product-specific manuals, we chose to provide our complete documentation and reference library in electronic form with every Development Kit and with our Dynamic C development environment.

Finding Online Documents

The online documentation is installed along with Dynamic C, and an icon for the documentation menu is placed on the workstation's desktop. Double-click this icon to reach the menu. If the icon is missing, create a new desktop icon that points to **default.htm** in the **docs** folder, found in the Dynamic C installation folder.

The latest versions of all documents are always available for free, unregistered download from our Web sites as well.

Printing Electronic Manuals

We recognize that many users prefer printed manuals for some uses. Users can easily print all or parts of those manuals provided in electronic form. The following guidelines may be helpful:

- Print from the Adobe PDF versions of the files, not the HTML versions.

NOTE: The most current version of Adobe Acrobat Reader can always be downloaded from Adobe's web site at <http://www.adobe.com>. We recommend that you use version 4.0 or later.

- Print only the sections you will need to refer to often.
- Print manuals overnight, when appropriate, to keep from tying up shared resources during the work day.
- If your printer supports duplex printing, print pages double-sided to save paper and increase convenience.

NOTE: If you do not have a suitable printer or do not want to print the manual yourself, most retail copy shops (e.g., Kinkos, AlphaGraphics, etc.) will print the manual from the PDF file and bind it for a reasonable charge—about what we would have to charge for a printed and bound manual.

1.5 CE Compliance

Equipment is generally divided into two classes.

CLASS A	CLASS B
Digital equipment meant for light industrial use	Digital equipment meant for home use
Less restrictive emissions requirement: less than 40 dB $\mu\text{V}/\text{m}$ at 10 m (40 dB relative to 1 $\mu\text{V}/\text{m}$) or 300 $\mu\text{V}/\text{m}$	More restrictive emissions requirement: 30 dB $\mu\text{V}/\text{m}$ at 10 m or 100 $\mu\text{V}/\text{m}$

These limits apply over the range of 30–230 MHz. The limits are 7 dB higher for frequencies above 230 MHz. Although the test range goes to 1 GHz, the emissions from Rabbit-based systems at frequencies above 300 MHz are generally well below background noise levels.

The TCP/IP Development Board has been tested and was found to be in conformity with the following applicable immunity and emission standards. Boards that are CE-compliant have the CE mark.



NOTE: Earlier versions of the TCP/IP Development Board sold before 2003 that do not have the CE mark are *not* CE-compliant.

Immunity

The TCP/IP Development Board meets the following EN55024/1998 immunity standards.

- EN61000-4-2 (ESD)
- EN61000-4-3 (Radiated Immunity)
- EN61000-4-4 (EFT)
- EN61000-4-6 (Conducted Immunity)

Additional shielding or filtering may be required for a heavy industrial environment.

Emissions

The TCP/IP Development Board meets the following emission standards with the Rabbit 2000 spectrum spreader turned on and set to the normal mode. The spectrum spreader is only available with Rev. C or higher of the Rabbit 2000 microprocessor. This microprocessor is used on the TCP/IP Development Boards that carry the CE mark.

- EN55022:1998 Class B
- FCC Part 15 Class B

Your results may vary, depending on your application, so additional shielding or filtering may be needed to maintain the Class B emission qualification.

1.5.1 Design Guidelines

Note the following requirements for incorporating the TCP/IP Development Board into your application to comply with CE requirements.

General

- The power supply provided with the Development Kit is for development purposes only. It is the customer's responsibility to provide a CE-compliant power supply for the end-product application.
- When connecting the TCP/IP Development Board to outdoor cables, the customer is responsible for providing CE-approved surge/lighting protection.
- Rabbit Semiconductor recommends placing digital I/O or analog cables that are 3 m or longer in a metal conduit to assist in maintaining CE compliance and to conform to good cable design practices.
- When installing or servicing the TCP/IP Development Board, it is the responsibility of the end-user to use proper ESD precautions to prevent ESD damage to the TCP/IP Development Board.

Safety

- All inputs and outputs to and from the TCP/IP Development Board must not be connected to voltages exceeding SELV levels (42.4 V AC peak, or 60 V DC).
- The lithium backup battery circuit on the TCP/IP Development Board has been designed to protect the battery from hazardous conditions such as reverse charging and excessive current flows. Do not disable the safety features of the design.

1.5.2 Interfacing the TCP/IP Development Board to Other Devices

Since the TCP/IP Development Boards are designed to be connected to other devices, good EMC practices should be followed to ensure compliance. CE compliance is ultimately the responsibility of the integrator. Additional information, tips, and technical assistance are available from your authorized Rabbit Semiconductor distributor, and are also available on the Z-World Web site at www.zworld.com.

2. HARDWARE CONNECTIONS

Chapter 2 explains how to connect the power supply to the TCP/IP Development Board and how to connect the programming cable to your PC. Once you run a sample program to demonstrate that you have connected everything correctly, you will be ready to go on and finish developing your system.

2.1 Development Kit Contents

The TCP/IP Development Kit contains the following items:

- TCP/IP Development Board with 512K flash memory and 128K SRAM.
- Demonstration Board with pushbutton switches and LEDs, used to demonstrate I/O and TCP/IP capabilities.
- Wire assembly to connect Demonstration Board to TCP/IP Development Board.
- Set of 4 rubber foot pads to position TCP/IP Development Board.
- Wall transformer power supply, 12 V DC (included only with Development Kits sold for the North American market—overseas users will need a power supply compatible with their local mains power).
- 10-pin header to DE9 programming cable with integrated level-matching circuitry.
- *Dynamic C* CD-ROM, with complete product documentation on disk.
- This *Getting Started* manual.
- Registration card.

2.2 Connections

1. Attach the rubber feet to the bottom corners of the TCP/IP Development Board.

2. Connect the Programming Cable to the TCP/IP Development Board

Turn the Rabbit 2000 TCP/IP Development Board so that the Rabbit 2000 microprocessor is facing up as shown below. Connect the 10-pin **PROG** connector of the programming cable to header J4 on the TCP/IP Development Board as shown in Figure 2. Be sure to orient the red edge of the cable towards pin 1 of the connector. (Do not use the **DIAG** connector, which is used for a normal serial connection.) Connect the other end of the programming cable to a COM port on your PC.

NOTE: Some PCs now come equipped only with a USB port. If your PC has no RS-232 COM port, but has a USB port, you should buy an RS-232/USB converter from Z-World's Web store.

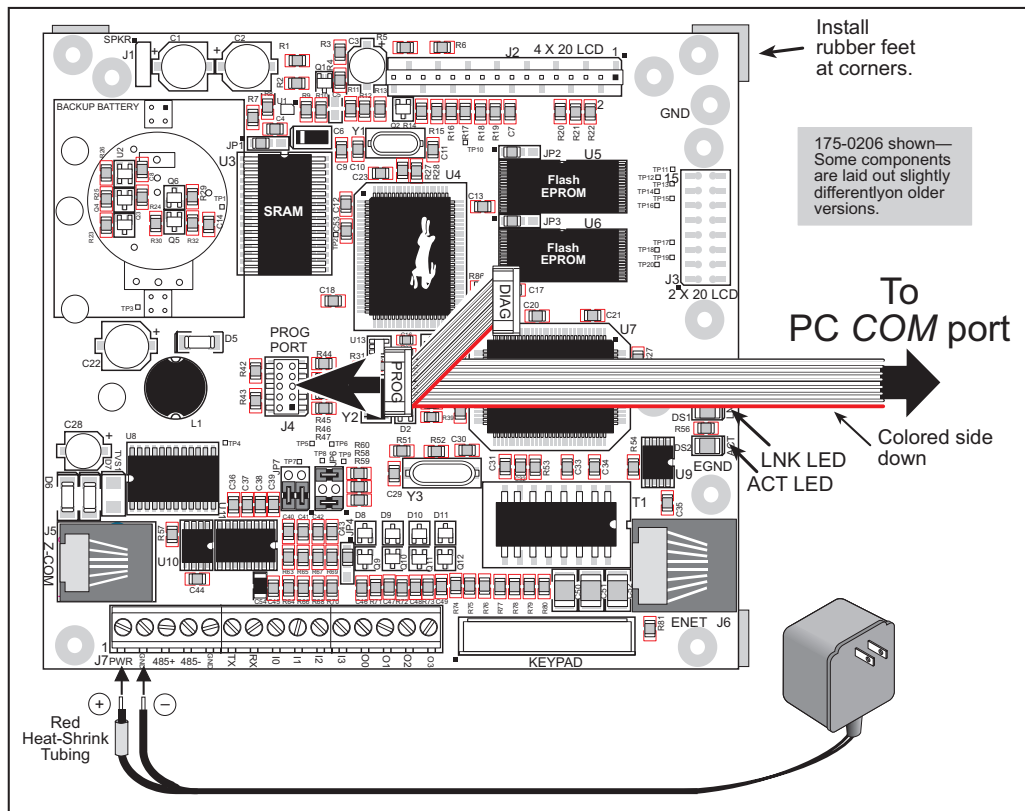


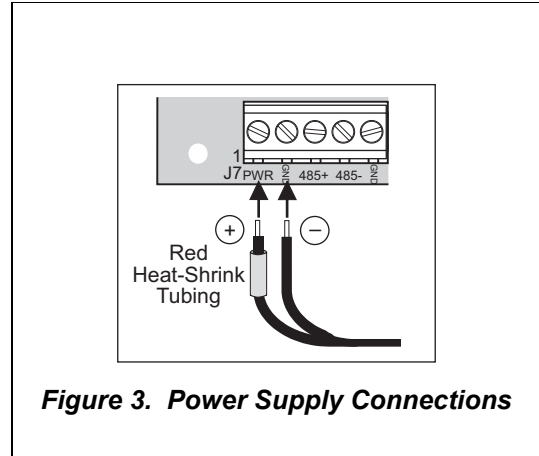
Figure 2. Connecting Power and PC to TCP/IP Development Board

3. Connect Power Supply to TCP/IP Development Board

Connect the positive lead (indicated with red heat-shrink tubing) to the PWR connector on header J7 on the TCP/IP Development Board and connect the negative lead to GND on header J7 as shown here.



NOTE: Be careful to hook up the positive and negative power leads *exactly* as described. Otherwise, the TCP/IP Development board will not function.



4. Apply Power

Plug in the wall transformer. The TCP/IP Development Board is now ready to be used.

NOTE: A hardware RESET is accomplished by unplugging the AC adapter, then plugging it back in.

2.3 Where Do I Go From Here?

We recommend that you proceed to the next chapter and install Dynamic C (if you do not already have it installed), then run the first sample program to verify that the TCP/IP Development Board is set up and functioning correctly.

If everything appears to be working, we recommend the following sequence of action:

1. Run all of the sample programs described in Chapter 4 to get a basic familiarity with Dynamic C and the TCP/IP Development Board's capabilities.
2. A documentation icon should have been installed on your workstation's desktop; click on it to reach the documentation menu. You can create a new desktop icon that points to **default.htm** in the **docs** folder in the Dynamic C installation folder.
3. For advanced development topics, refer to the *Dynamic C User's Manual*, also in the online documentation set.

2.3.1 Technical Support

NOTE: If you purchased your TCP/IP Development Board through a distributor or through a Z-World or Rabbit Semiconductor partner, contact the distributor or Z-World partner first for technical support.

If there are any problems at this point:

- Check the Z-World/Rabbit Semiconductor Technical Bulletin Board at www.zworld.com/support/bb/.
- Use the Technical Support e-mail form at www.zworld.com/support/support_submit.html.

3. INSTALLING DYNAMIC C

To develop and debug programs for the TCP/IP Development Board (and for all other Z-World and Rabbit Semiconductor hardware), you must install and use Dynamic C. This chapter takes you through the installation of Dynamic C, and then provides a tour of its major features with respect to the TCP/IP Development Board.

3.1 An Overview of Dynamic C

Dynamic C integrates the following development functions into one program:

- Editing
- Compiling
- Linking
- Loading
- Debugging

In fact, compiling, linking and loading are one function. Dynamic C does not use an In-Circuit Emulator; programs being developed are downloaded to and executed from the “target” system via an enhanced serial-port connection. Program development and debugging take place seamlessly across this connection, greatly speeding system development.

Other features of Dynamic C include:

- Dynamic C has an easy-to-use built-in text editor. Programs can be executed and debugged interactively at the source-code or machine-code level. Pull-down menus and keyboard shortcuts for most commands make Dynamic C easy to use.
- Dynamic C also supports assembly language programming. It is not necessary to leave C or the development system to write assembly language code. C and assembly language may be mixed together.
- Debugging under Dynamic C includes the ability to use **printf** commands, watch expressions, breakpoints and other advanced debugging features. Watch expressions can be used to compute C expressions involving the target’s program variables or functions. Watch expressions can be evaluated while stopped at a breakpoint or while the target is running its program.

- Dynamic C provides extensions to the C language (such as shared and protected variables, costatements and cofunctions) that support real-world embedded system development. Interrupt service routines may be written in C. Dynamic C supports cooperative and preemptive multi-tasking.
- Dynamic C comes with many function libraries, all in source code. These libraries support real-time programming, machine level I/O, and provide standard string and math functions.
- Dynamic C compiles directly to memory. Functions and libraries are compiled and linked and downloaded on-the-fly. On a fast PC, Dynamic C can load 30,000 bytes of code in 5 seconds at a baud rate of 115,200 bps.

3.2 System Requirements

To install and run Dynamic C, your system must be running one of the following operating systems:

- Windows 95
- Windows 98
- Windows NT
- Windows Me
- Windows 2000
- Windows XP

3.2.1 Hardware Requirements

The PC on which you install Dynamic C should have the following hardware:

- A Pentium or later microprocessor
- 32 MB of RAM
- At least 40 MB of free hard drive space
- At least one free COM or USB* (serial) port for communication with the target systems
- A CD-ROM drive (for software installation)

*. RS-232/USB converter required.

3.3 Upgrading Dynamic C

Dynamic C patches that focus on bug fixes are available from time to time. Check the Web sites

- www.zworld.com/support/

or

- www.rabbitsemiconductor.com/support/

for the latest patches, workarounds, and bug fixes.

3.3.1 Add-On Modules

Dynamic C installations are designed for use with the board they are included with, and are included at no charge as part of our low-cost kits. Z-World offers add-on Dynamic C modules for purchase, including the popular μ C/OS-II real-time operating system, as well as PPP, Advanced Encryption Standard (AES), and other select libraries.

In addition to the Web-based technical support included at no extra charge, a one-year telephone-based technical support module is also available for purchase.

3.4 Installing Dynamic C

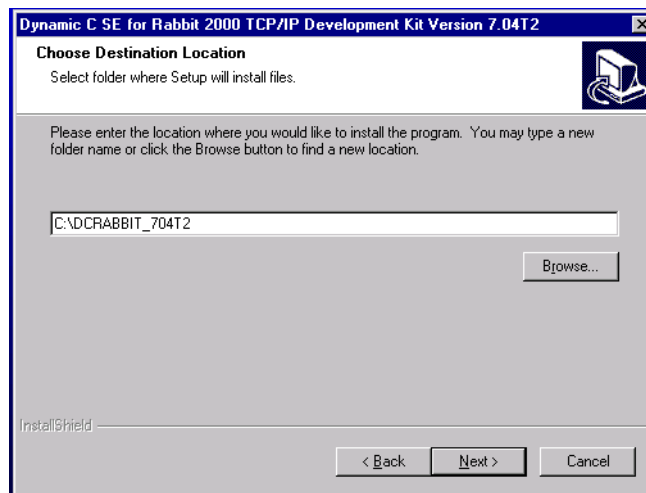
Insert the Dynamic C CD-ROM in the drive on your PC. If autorun is enabled, the CD installation will begin automatically.

If autorun is disabled or the installation otherwise does not start, use the Windows **Start > Run** menu or Windows Disk Explorer to launch **SETUP.EXE** from the root folder of the CD-ROM.

The installation program will guide you through the installation process. Most steps of the process are self-explanatory and not covered in this section. Selected steps that may be confusing to some users are outlined below. (Some of the installation utility screens may vary slightly from those shown.)

3.4.1 Program & Documentation File Location

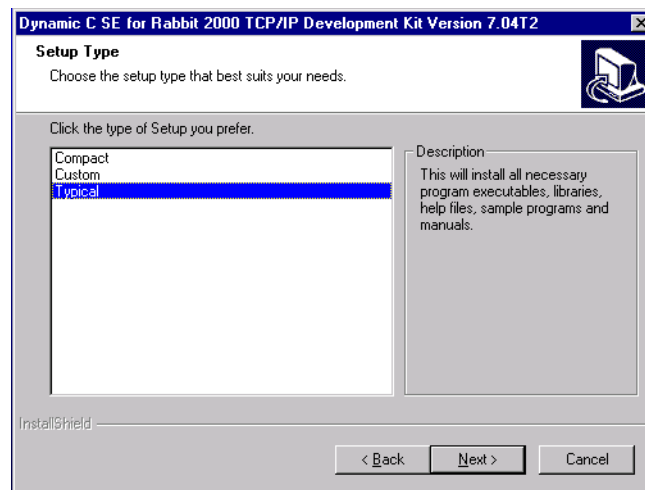
Dynamic C's application, library and documentation files can be installed in any convenient location on your workstation's hard drives.



The default location, as shown in the example above, is in a folder named for the version of Dynamic C, placed in the root folder of the C: drive. If this location is not suitable, enter a different root path before clicking **Next >**. Files are placed in the specified folder, so do not set this location to a drive's root directory.

3.4.2 Installation Type

Dynamic C has two components that can be installed together or separately. One component is Dynamic C itself, with the development environment, support files and libraries. The other component is the documentation library in HTML and PDF formats, which may be left uninstalled to save hard drive space or installed elsewhere (on a separate or network drive, for example).

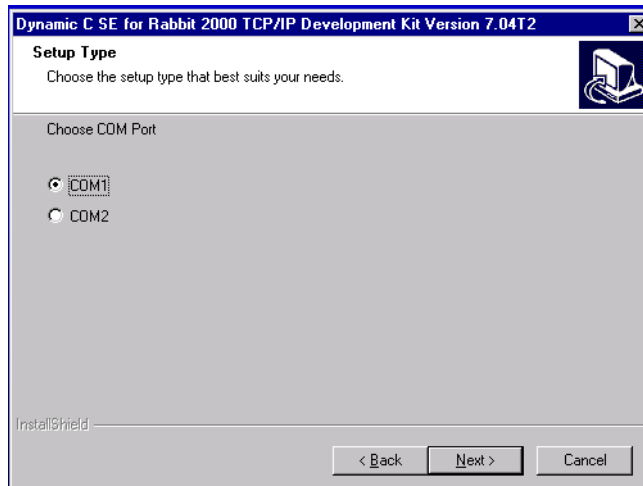


The installation type is selected in the installation menu shown above. The options are:

- **Typical Installation** — Both Dynamic C and the documentation library will be installed in the specified folder (default).
- **Compact Installation** — Only Dynamic C will be installed.
- **Custom Installation** — You will be allowed to choose which components are installed. This choice is useful to install or reinstall just the documentation.

3.4.3 Select COM Port

Dynamic C uses a COM (serial) port to communicate with the target development system. The installation allows you to choose the COM port that will be used.

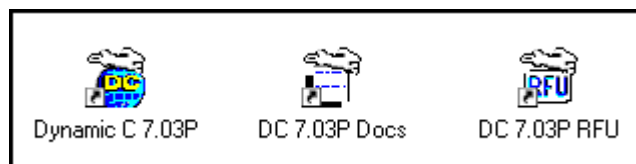


The default selection, as shown in the example above, is COM1. You may select any available port for Dynamic C's use. If you are not certain which port is available, select COM1. This selection can be changed later within Dynamic C.

NOTE: The installation utility does not check the selected COM port in any way. Specifying a port in use by another device (mouse, modem, etc.) may cause temporary problems when Dynamic C is started.

3.4.4 Desktop Icons

Once your installation is complete, you will have up to three icons on your PC desktop, as shown below.



One icon is for Dynamic C, one opens the documentation menu, and the third is for the Rabbit Field Utility, a tool used to download precompiled software to a target system.

3.5 Starting Dynamic C

Once the TCP/IP Development Board is set up and connected as described in Chapter 2 and Dynamic C has been installed, start Dynamic C by double-clicking on the Dynamic C icon. Dynamic C defaults to using the serial port on your PC that you specified during installation. If the port setting is correct, Dynamic C should detect the TCP/IP Development Board and go through a sequence of steps to cold-boot the TCP/IP Development Board and to compile the BIOS. (Some versions of Dynamic C will not do the initial BIOS compile and load until the first time you compile a program.)

If you receive the message beginning “BIOS successfully compiled ...” you are ready to continue with the sample programs in the next chapter.

3.5.1 Communication Error Messages

If you receive the message **No Rabbit Processor Detected**, the programming cable may be connected to the wrong COM port, a connection may be faulty, or the target system may not be powered up. First, check both ends of the programming cable to ensure that it is firmly plugged into the PC and the programming port.

If there are no faults with the hardware, select a different COM port within Dynamic C. From the **Options** menu, select **Communications**. Select another COM port from the list, then click OK. Press **<Ctrl-Y>** to force Dynamic C to recompile the BIOS. If Dynamic C still reports it is unable to locate the target system, repeat the above steps until you locate the active COM port. You should receive a **Bios compiled successfully** message once this step is completed successfully.

If Dynamic C appears to compile the BIOS successfully, but you then receive a communication error message when you compile and load a sample program, it is possible that your PC cannot handle the higher program-loading baud rate. Try changing the maximum download rate to a slower baud rate as follows.

- Locate the **Serial Options** dialog in the Dynamic C **Options > Communications** menu. Select a slower Max download baud rate.

If a program compiles and loads, but then loses target communication before you can begin debugging, it is possible that your PC cannot handle the default debugging baud rate. Try lowering the debugging baud rate as follows.

- Locate the **Serial Options** dialog in the Dynamic C **Options > Communications** menu. Choose a lower debug baud rate.

3.6 PONG.C

You are now ready to test your set-up by running a sample program.

Find the file **PONG.C**, which is in the Dynamic C **SAMPLES** folder. To run the program, open it with the **File** menu (if it is not still open), compile it using the **Compile** menu, and then run it by selecting **Run** in the **Run** menu. The **STDIO** window will open and will display a small square bouncing around in a box.

This program does not test the TCP/IP part of the board, but does ensure that the board is functional. The sample program in the next chapter tests the TCP/IP portion of the board.

3.7 Sample Programs

Sample programs are provided in the Dynamic C **Samples** directory. The various subdirectories contain specific sample programs that illustrate the use of the corresponding Dynamic C libraries. The sample program **PONG.C** demonstrates the output to the **STDIO** window. The **ICOM** and **TCP/IP** folders provide sample programs specific to the TCP/IP Development Board.

The sample programs illustrate the topics associated with the TCP/IP Development Board. See *An Introduction to TCP/IP* for more information on these topics.

Each sample program has comments that describe the purpose and function of the program.

3.7.1 Running Sample Program DEMOBRD1.C

This sample program will be used to illustrate some of the functions of Dynamic C.

Before running this sample program, you will have to connect the Demonstration Board from the TCP/IP Development Kit to the TCP/IP Development Board. Proceed as follows.

1. Use the wires included in the TCP/IP Development Kit to connect header J1 on the Demonstration Board to header J7 on the TCP/IP Development Board. The connections are shown in Figure 4.
2. Make sure that your TCP/IP Development Board is connected to your PC and that the power supply is connected to the TCP/IP Development Board and plugged in as described in Section 2.2.

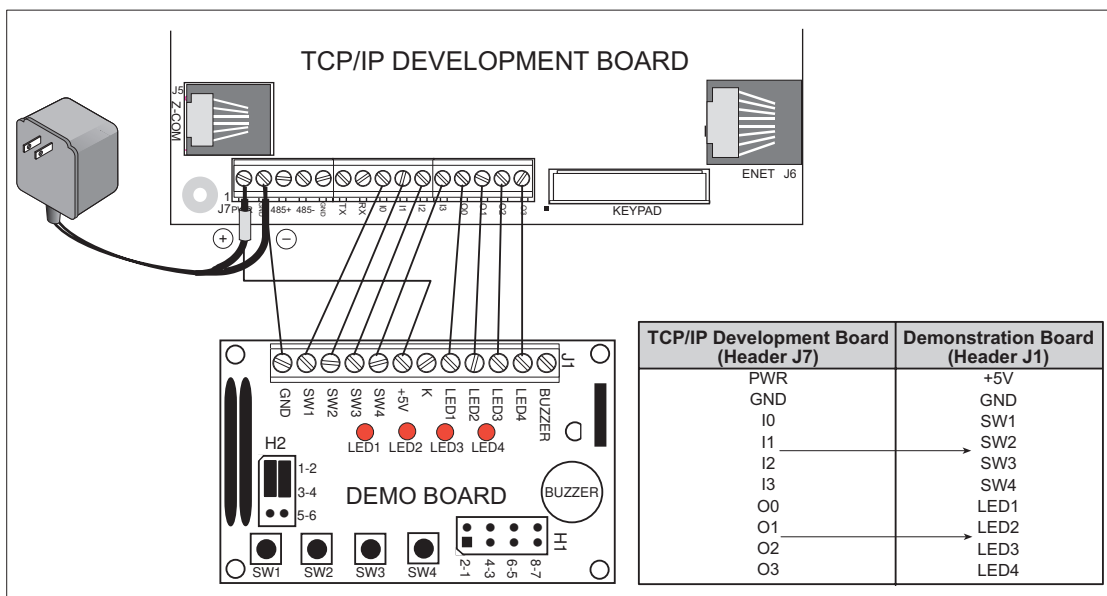


Figure 4. Connections Between TCP/IP Development Board and Demonstration Board