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RabbitCore RCM2000

C-Programmable Module

Getting Started Manual

019-0080 • 040515-F

RabbitCore RCM2000 Getting Started Manual

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1. OVERVIEW

The RabbitCore RCM2000 series is an advanced line of modules that incorporates the powerful Rabbit 2000 microprocessor, flash memory, and static RAM, all on a PCB not much larger than the size of a business card.

The RCM2000 series modules are designed for use on a motherboard that supplies power and interfaces with real-world I/O devices. Up to 40 pins of I/O and four serial ports are available for system interfacing.

To accommodate a variety of user and production needs, the RCM2000 family includes versions with varying amounts of onboard memory. All modules within the family are pin-for-pin compatible and may be installed or swapped in a matter of minutes.

1.1 RCM2000 Series Description

There are three production models in the RCM2000 series. Their standard features are summarized in Table 1.

Table 1. RCM2000 Features

Model	Features
RCM2000	Full-featured RabbitCore module with 256K flash memory and 512K SRAM
RCM2010	RCM2000 with 128K SRAM
RCM2020	RCM2000 with 18.432 MHz clock and 128K SRAM

The RCM2000 is the version that is included in the Development Kit.

1.3 Development Software

The RCM2000 series of modules 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.

1.4 How to Use This Manual

This *Getting Started* manual is intended to give users a quick but solid start with the RCM2000 series modules. It does not contain detailed information on the module 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 RCM2000 to effective use.

1.4.1 Additional Product Information

Detailed information about the RabbitCore RCM2100 series is provided in the *RabbitCore RCM2000 User's Manual*, which is available on the accompanying CD-ROM in both HTML and Adobe PDF format.

Some advanced users may choose to skip the rest of this introductory manual and proceed directly with the detailed hardware and software information in the *User's Manual*.

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

1.4.2 Additional Reference Information

In addition to the product-specific information contained in the *RabbitCore RCM2000 User's Manual*, 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 RCM2100 series modules:

- *Dynamic C User's Manual*
- *Rabbit 2000 Microprocessor User's Manual*

1.4.3 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.

2. HARDWARE SETUP

This chapter describes the RCM2000 hardware in more detail, and explains how to set up the accompanying Prototyping Board.

NOTE: This chapter (and this manual) assume that you have the RabbitCore RCM2000 Development Kit. If you purchased an RCM2000 series module by itself, you will have to adapt the information in this chapter and elsewhere to your test and development setup.

2.1 Development Kit Contents

The RCM2000 series Development Kit contains the following items:

- RCM2020 module with 256K flash memory and 128K SRAM.
- RCM2000 Prototyping Board with accessory hardware and components.
- Wall transformer power supply, 12 V DC, 500 mA (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 Overview of the Prototyping Board

The Prototyping Board included in the Development Kit makes it easy to connect an RCM2000 module to a power supply and a PC workstation for development. It also provides an array of basic I/O peripherals (switches and LEDs), as well as a prototyping area for more advanced hardware development.

For the most basic level of evaluation and development, the Prototyping Board can be used without modification.

As you progress to more sophisticated experimentation and hardware development, modifications and additions can be made to the board without modifying or damaging the RCM2000 itself.

The Prototyping Board is shown in Figure 2 below, with its main features identified.

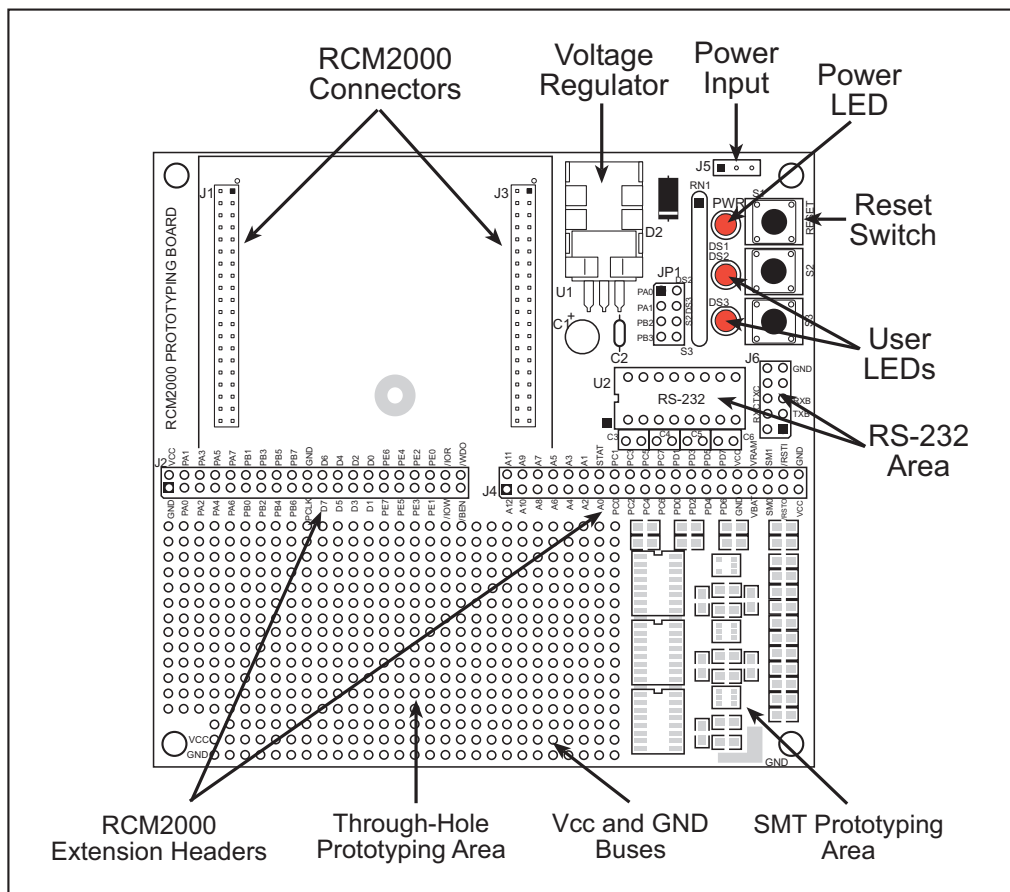


Figure 2. RCM2000 Prototyping Board

2. Connect RCM2000 to PC

Connect the 10-pin connector of the programming cable labeled **PROG** to header J3 on the RCM2000 module as shown in Figure 4 below. 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.)

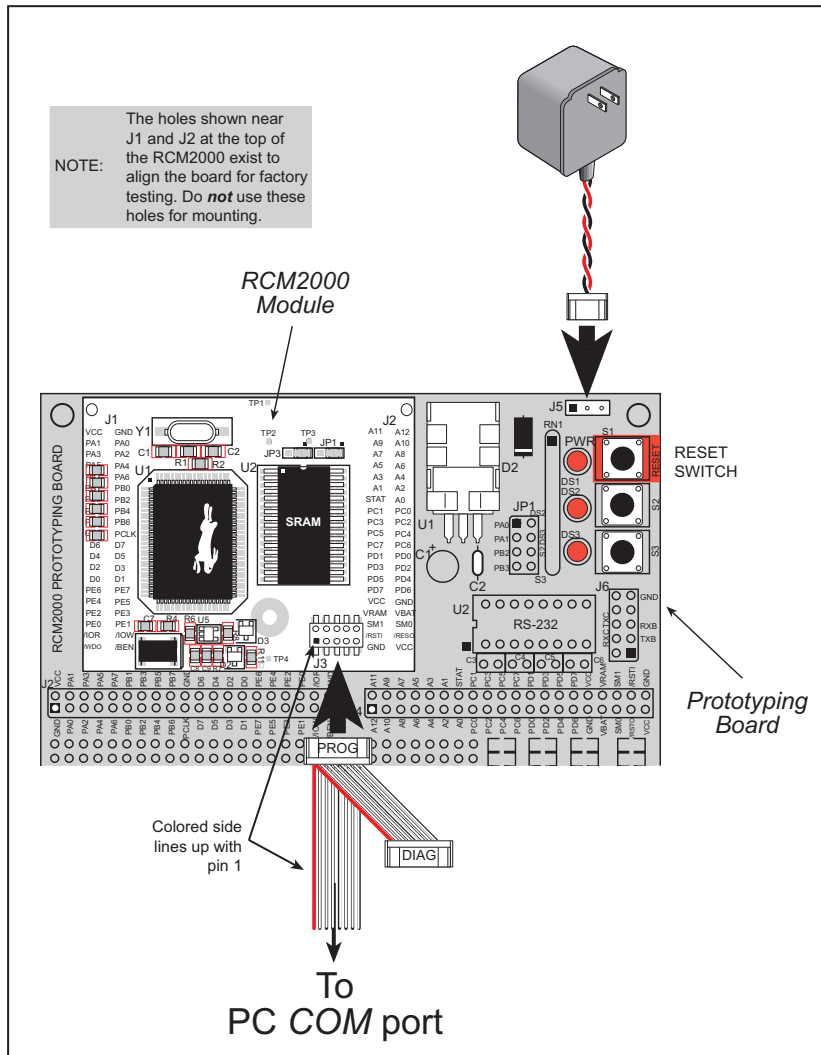


Figure 4. RCM2000 Power and Programming Connections

3. Power Supply Connections

Hook up the connector from the wall transformer to header J5 on the Prototyping Board as shown above. The orientation of this connector is not important since the VIN (positive) voltage is the middle pin, and GND is available on both ends of the three-pin header J5.

Plug in the wall transformer. The power LED on the Prototyping Board should light up. The RCM2000 and the Prototyping Board are now ready to be used.

NOTE: A RESET button is provided on the Prototyping Board to allow a hardware reset.

2.4 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 RCM2000 and the Prototyping Board are 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 RCM2000's capabilities.
2. For further development, refer to the *RabbitCore RCM2000 User's Manual* for details of the module's hardware and software components.

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.

2.4.1 Technical Support

NOTE: If you purchased your RCM2000 through a distributor or through a Z-World or Rabbit Semiconductor partner, contact the distributor or 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 RCM2000 series (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 RCM2000 series.

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

3.2.1 Hardware Requirements

The PC on which you install Dynamic C for development of RCM2000-based systems 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 (serial) port for communication with the target systems
- A CD-ROM drive (for software installation)

3.3 Installing Dynamic C

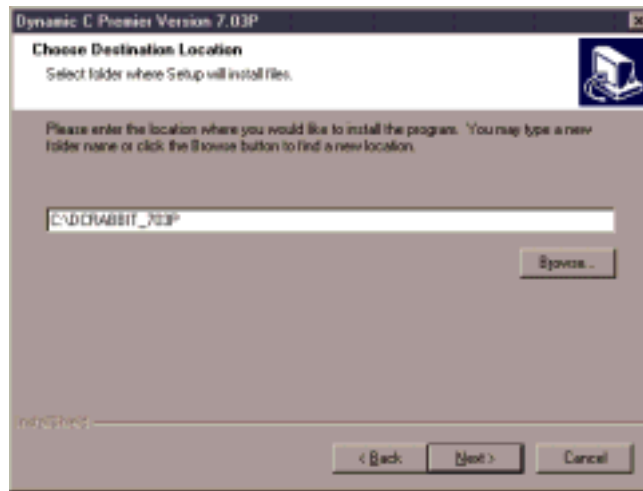
Insert the Dynamic C CD-ROM in the drive on your PC. If autorun is enabled, the CD installation will begin automatically.

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.)

3.3.1 Program & Documentation File Location

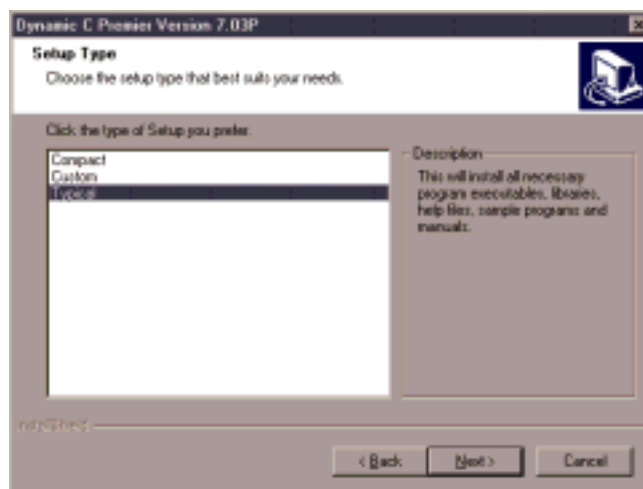
Dynamic C's application, library and documentation files can be installed in any convenient location on your workstation's hard drives.



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.

3.3.2 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).

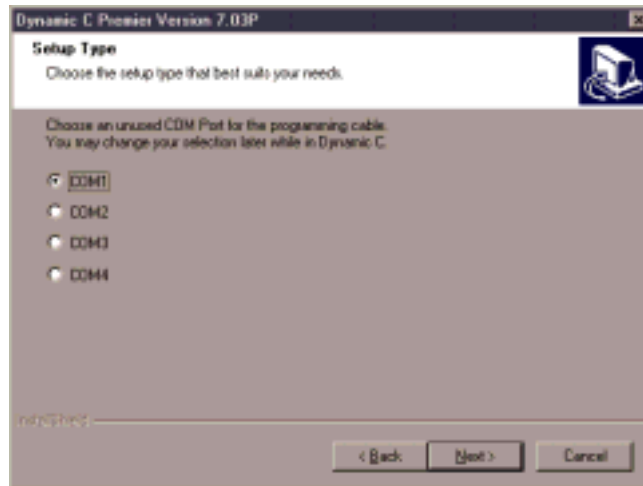


The installation type is selected in the installation menu shown above. The options are:

- **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.

3.3.3 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.

3.3.4 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.

3.4 Starting Dynamic C

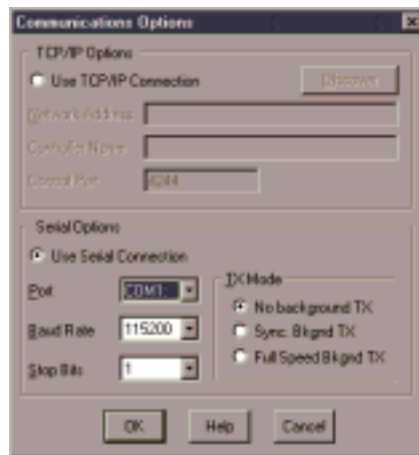
Once the RCM2000 module is set up and connected as described in Chapter 2 and Dynamic C has been installed, start Dynamic C by double-clicking on the Dynamic C icon. Dynamic C should start, then look for the target system on the COM port you specified during installation (by default, COM1). Once detected, Dynamic C should go through a sequence of steps to cold-boot the module and compile the BIOS.

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

3.4.1 Communication Error Messages

If you receive the message “No Rabbit Processor Detected,” the programming cable may be connected to a different COM port, a connection may be faulty, or the target system may not be powered up. First, check to see that the power LED on the Prototyping Board is lit. If it is, check both ends of the programming cable to ensure that it is firmly plugged into the PC and the RCM2000’s programming port. If you are using the Prototyping Board, ensure that the module is firmly and correctly installed in its connectors.

If there are no faults with the hardware, select a different COM port within Dynamic C. From the **Options** menu, select **Project Options**, then select **Communications**. The dialog shown should appear.



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.

If Dynamic C appears to compile the BIOS successfully, but you then receive a communication error message, it is possible that your PC cannot handle the 115,200 bps baud rate. Try changing the baud rate to 57,600 bps as follows.

- Locate the **Serial Options** dialog in the Dynamic C **Options > Project Options > Communications** menu. Change the baud rate to 57,600 bps.

If you are using Dynamic C version 7.04 or earlier, modify the BIOS source code as follows. Skip these three steps if your version of Dynamic C is 7.05 or later.

1. Open the BIOS source code file named **RABBITBIOS.C**, which can be found in the **BIOS** directory.
2. Change the line

```
#define USE115KBAUD 1 // set to 0 to use 57600 baud
```

to read as follows.

```
#define USE115KBAUD 0 // set to 0 to use 57600 baud
```

3. Save the changes using **File > Save**.

Now press **<Ctrl-Y>**. You should receive the “BIOS successfully compiled ...” message indicating that the target is now ready to compile a program. You should then continue with the sample programs in the next chapter.

4. SAMPLE PROGRAMS

To help familiarize you with the RCM2000 modules, several sample Dynamic C programs have been included. Loading, executing and studying these programs will give you a solid hands-on overview of the RCM2000's capabilities, as well as a quick start with Dynamic C as an application development tool.

4.1 Sample Program Overview

Dynamic C comes with a large number of sample programs that illustrate many of its features. These programs are intended to serve as tutorials, but then can also be used as starting points or building blocks for your own applications.

NOTE: It is assumed in this section that you have at least an elementary grasp of ANSI C. If you do not, see the introductory pages of the *Dynamic C User's Manual* for a suggested reading list.

Sample programs are provided in the Dynamic C **SampLes** folder, which is shown below.

