RabbitCore RCM2200

C-Programmable Module with Ethernet

User's Manual

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RabbitCore RCM2200 User's Manual

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1. INTRODUCTION

The RCM2200 RabbitCore module is designed to be the heart of embedded control systems. The RCM2200 features an integrated Ethernet port and provides for LAN and Internet-enabled systems to be built as easily as serial-communication systems.

The RCM2200 has a Rabbit 2000 microprocessor operating at 22.1 MHz, static RAM, flash memory, two clocks (main oscillator and timekeeping), and the circuitry necessary for reset and management of battery backup of the Rabbit 2000's internal real-time clock and the static RAM. Two 26-pin headers bring out the Rabbit 2000 I/O bus lines, address lines, data lines, parallel ports, and serial ports.

The RCM2200 receives its +5 V power from the user board on which it is mounted. The RabbitCore RCM2200 can interface with all kinds of CMOS-compatible digital devices through the user board.

1.1 RCM2200 Features

- Small size: 1.60" × 2.30" × 0.86"
  (41 mm × 58 mm × 22 mm)

- Microprocessor: Rabbit 2000 running at 22.1 MHz

- 26 parallel I/O lines: 16 configurable for input or output, 7 fixed inputs, 3 fixed outputs

- 8 data lines (D0–D7)

- 4 address lines (A0–A3)

- Memory I/0 read, write

- External reset input

- Five 8-bit timers (cascadable in pairs) and two 10-bit timers

- 256K–512K flash memory, 128K–512K SRAM

- Real-time clock

- Watchdog supervisor

- Provision for customer-supplied backup battery via connections on header J5

- 10Base-T RJ-45 Ethernet port

- Raw Ethernet and two associated LED control signals available on 26-pin header

- Three CMOS-compatible serial ports: maximum asynchronous baud rate of 691,200 bps, maximum synchronous baud rate of 5,529,600 bps. One port is configurable as a clocked port.

- Six additional I/O lines are located on the programming port, can be used as I/O lines when the programming port is not being used for programming or in-circuit debugging—one synchronous serial port can also be used as two general CMOS inputs and one general CMOS output, and there are two additional inputs and one additional output.

Appendix A, "RabbitCore RCM2200 Specifications," provides detailed specifications for the RCM2200.

In addition, three different RCM2200 models are available. A variant of the RCM2200, the RCM2300, omits the Ethernet connectivity but offers a much smaller footprint, one-half the size of the RCM2200.

1.2 Advantages of the RCM2200

- Fast time to market using a fully engineered, "ready to run" microprocessor core.

- Competitive pricing when compared with the alternative of purchasing and assembling individual components.

- Easy C-language program development and debugging, including rapid production loading of programs.

- Generous memory size allows large programs with tens of thousands of lines of code, and substantial data storage.

- Integrated Ethernet port for network connectivity, royalty-free TCP/IP software.

1.3 Development and Evaluation Tools

A complete Development Kit, including a Prototyping Board and Dynamic C development software, is available for the RCM2200. The Development Kit puts together the essentials you need to design an embedded microprocessor-based system rapidly and efficiently.

See the *RabbitCore RCM2200 Getting Started Manual* for complete information on the Development Kit.

1.4 How to Use This Manual

This user's manual is intended to give users detailed information on the RCM2200 module. It does not contain detailed information on the Dynamic C development environment or the TCP/IP software support for the integrated Ethernet port. Most users will want more detailed information on some or all of these topics in order to put the RCM2200 module to effective use.

1.4.1 Additional Product Information

Introductory information about the RCM2200 and its associated Development Kit and Prototyping Board will be found in the printed ***RabbitCore RCM2200 Getting Started Manual,*** which is also provided on the accompanying CD-ROM in both HTML and Adobe PDF format.

We recommend that any users unfamiliar with Z-World products, or those who will be using the Prototyping Board for initial evaluation and development, begin with at least a read-through of the ***Getting Started*** manual.

In addition to the product-specific information contained in the ***RabbitCore RCM2200 Getting Started Manual*** and the ***RabbitCore RCM2200 User's Manual*** (this 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 RCM2200 modules:

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

1.4.2 Online Documentation

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, use your browser to find and load **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.

2. HARDWARE REFERENCE

Chapter 2 describes the hardware components and principal hardware subsystems of the RCM2200. Appendix A, "RabbitCore RCM2200 Specifications," provides complete physical and electrical specifications.

2.1 RCM2200 Digital Inputs and Outputs

Figure 1 shows the subsystems designed into the RCM2200.
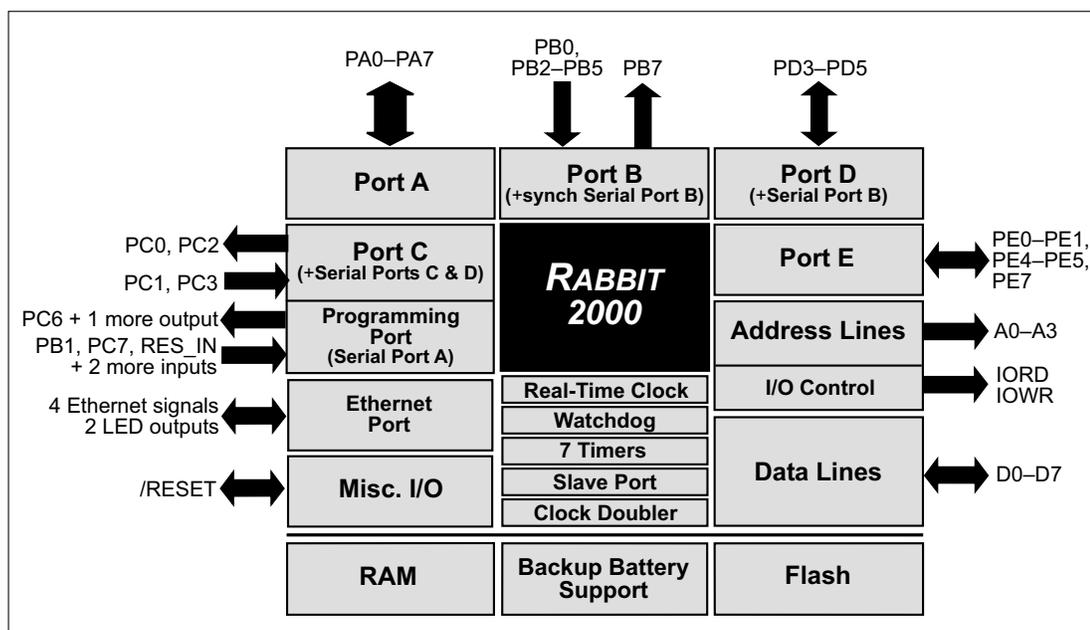
Figure 1. Rabbit Subsystems

The RCM2200 has 26 parallel I/O lines grouped in five 8-bit ports available on headers J4 and J5. The 16 bidirectional I/O lines are located on pins PA0–PA7, PD3–PD5, and PE0–PE1, PE4, PE5, and PE7. The pinouts for headers J4 and J5 are shown in Figure 2.
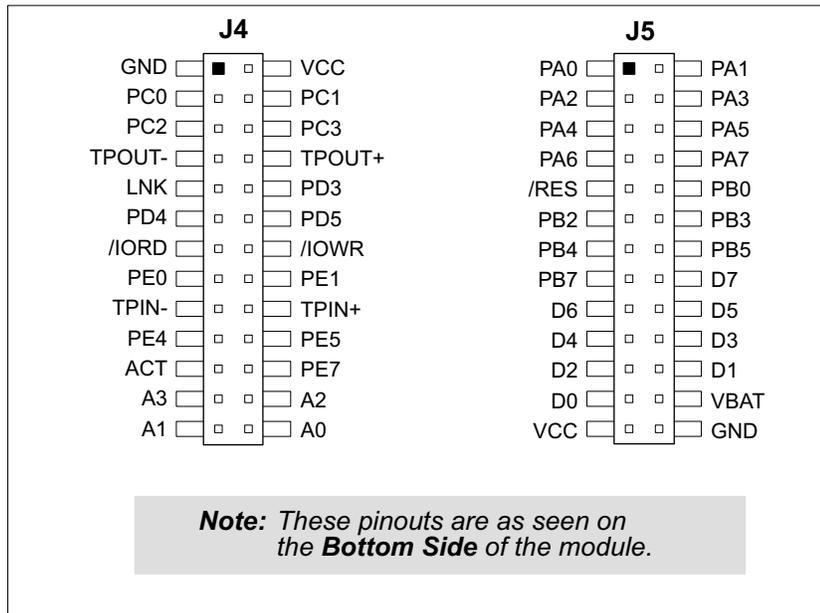
Figure 2. RCM2200 I/O Pinouts

2.1.1 Dedicated Inputs

PB0 is a general CMOS input when the Rabbit 2000 is either not using Serial Port B or is using Serial Port B in an asynchronous mode. Four other general CMOS input-only pins are located on PB2–PB5. These pins can also be used for the slave port. PB2 and PB3 are slave write and slave read strobes, while PB4 and PB5 serve as slave address lines SA0 and SA1, and are used to access the slave registers. PC1 and PC3 are general CMOS inputs only. These pins can instead be selectively enabled to serve as the serial data inputs for Serial Ports D and C.

2.1.2 Dedicated Outputs

One of the general CMOS output-only pins is located on PB7. PB7 can also be used with the slave port as the /SLAVEATTN output. This configuration signifies that the slave is requesting attention from the master. PC0 and PC2 are also output-only pins; PC0 and PC2 can instead serve as the serial data outputs for Serial Ports D and C.

2.1.3 Memory I/O Interface

Four of the Rabbit 2000 address lines (A0–A3) and all the data lines (D0–D7) are available. I/0 write (/IOWR) and I/0 read (/IORD) are also available for interfacing to external devices.

The ports on the Rabbit 2000 microprocessor used in the RCM2200 are configurable, and so the factory defaults can be reconfigured. Table 1 lists the Rabbit 2000 factory defaults and the alternate configurations.

Table 1. RCM2200 Pinout Configurations

	Pin	Pin Name	Default Use	Alternate Use	Notes
Header J4	1	GND			
	2	VCC			
	3	PC0	Output	TXD	
	4	PC1	Input	RXD	
	5	PC2	Output	TXC	
	6	PC3	Input	RXC	
	7	TPOUT–			Ethernet transmit port
	8	TPOUT+			
	9	LNK			Ethernet link (LNK) LED indicator
	10	PD3	Bitwise or parallel programmable I/O		
	11	PD4		ATXB output	
	12	PD5		ARXB input	
	13	/IORD	Input (I/O read strobe)		
	14	/IOWR	Output (I/O write strobe)		
	15	PE0	Bitwise or parallel programmable I/O	I0 control or INT0A input	
	16	PE1		I1 control or INT1A input	
	17	TPIN–			Ethernet receive port
	18	TPIN+			
	19	PE4	Bitwise or parallel programmable I/O	I4 control or INT0B input	
	20	PE5		I5 control or INT1B input	
	21	ACT			Ethernet active (ACT) LED indicator
	22	PE7	Bitwise or parallel programmable I/O	I7 control or slave port chip select /SCS	
	23–26	A[3:0]			Rabbit 2000 address bus

Table 1. RCM2200 Pinout Configurations (continued)

Pin		Pin Name	Default Use	Alternate Use	Notes
Header J5	1–8	PA[0:7]	Bytewide programmable parallel I/O	Slave port data bus SD0–SD7	
	9	/RESET	Reset output	Reset input	This weak output can be driven externally
	10	PB0	Input	Serial port clock CLKB input or output	
	11	PB2	Input	Slave port write /SWR	
	12	PB3	Input	Slave port read /SRD	
	13	PB4	Input	SA0	Slave port address lines
	14	PB5	Input	SA1	
	15	PB7	Output	Slave port attention line /SLAVEATTN	
	16–23	D[7:0]	Input/Output		Rabbit 2000 data bus
	24	VBAT	3 V battery input		
	25	VCC			
	26	GND			

2.1.4 Other Inputs and Outputs

As shown in Table 1, pins PA0–PA7 can be used to allow the Rabbit 2000 to be a slave to another processor. The slave port also uses PB2–PB5, PB7, and PE7.

PE0, PE1, PE4, and PE5 can be used for up to two external interrupts. PB0 can be used to access the clock on Serial Port B of the Rabbit microprocessor. PD4 can be programmed to be a serial output for Serial Port B. PD5 can be used as a serial input by Serial Port B.

PC4, PC5, PD0, PD1, PE2, PE3, and PE6 are used for internal communication with the RealTek Ethernet interface chip.

2.2 Serial Communication

The RCM2200 board does not have an RS-232 or an RS-485 transceiver directly on the board. However, an RS-232 or RS-485 interface may be incorporated on the board the RCM2200 is mounted on. For example, the Prototyping Board supports a standard RS-232 transceiver chip.

2.2.1 Serial Ports

There are four serial ports designated as Serial Ports A, B, C, and D. All four serial ports can operate in an asynchronous mode up to the baud rate of the system clock divided by 64. An asynchronous port can handle 7 or 8 data bits. A 9th bit address scheme, where an additional bit is sent to mark the first byte of a message, is also supported. Serial Ports A and B can also be operated in the clocked serial mode. In this mode, a clock line synchronously clocks the data in or out. Either of the two communicating devices can supply the clock. When the Rabbit 2000 provides the clock, the baud rate can be up to 80% of the system clock frequency divided by 128, or 138,240 bps for a 22.1 MHz clock speed.

Serial Port A is available only on the programming port, and so is likely to be inconvenient to interface with.

2.2.2 Ethernet Port

Figure 3 shows the pinout for the RJ-45 Ethernet port (J2). Note that some Ethernet connectors are numbered in reverse to the order used here.
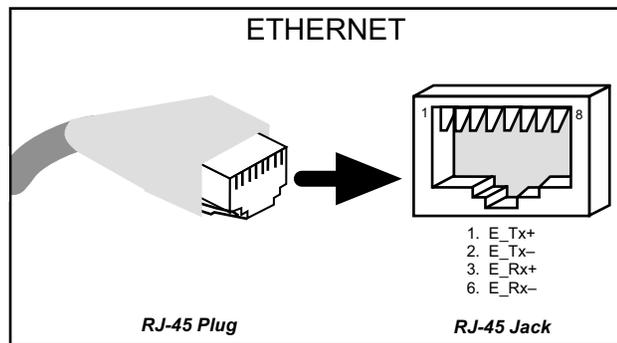
Figure 3. RJ-45 Ethernet Port Pinout

Two LEDs are placed next to the RJ-45 Ethernet jack, one to indicate an Ethernet link (**LNK**) and one to indicate Ethernet activity (**ACT**).

The Ethernet signals are also available on header J4. The **ACK** and **LNK** signals can be used to drive LEDs on the user board the RCM2200 is connected to.

The transformer/connector assembly ground is connected to the RCM2200 printed circuit board digital ground via a 0 Ω resistor, R29, as shown in Figure 4.
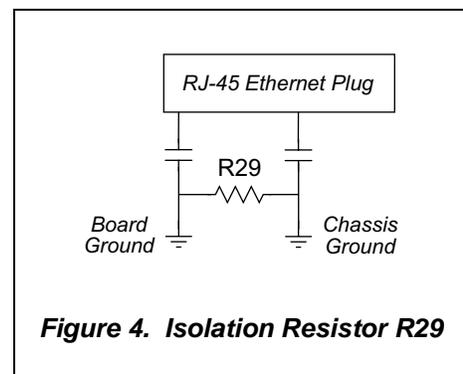
Figure 4. Isolation Resistor R29

The RJ-45 connector is shielded to minimize EMI effects to/from the Ethernet signals. Z-World recommends that an equivalent RJ-45 connector be used on the user board if the customer wishes to have an RJ-45 connector on the user board.

> **NOTE:** The RCM2210 is available without the LEDs and the RJ-45 connector if you plan to use your own RJ-45 connector on your user board.

2.2.3 Programming Port

Serial Port A has special features that allow it to cold-boot the system after reset. Serial Port A is also the port that is used for software development under Dynamic C.

The RabbitCore RCM2200 has a 10-pin program header labeled J1. The Rabbit 2000 startup-mode pins (SMODE0, SMODE1) are presented to the programming port so that an externally connected device can force the RCM2200 to start up in an external bootstrap mode. The *Rabbit 2000 Microprocessor User's Manual* provides more information related to the bootstrap mode.

The programming port is used to start the RabbitCore RCM2200 in a mode where it will download a program from the port and then execute the program. The programming port transmits information to and from a PC while a program is being debugged in-circuit.

The RabbitCore RCM2200 can be reset from the programming port via the /RESET_IN line.

The Rabbit 2000 status pin is also presented to the programming port. The status pin is an output that can be used to send a general digital signal.

The clock line for Serial Port A is presented to the programming port, which makes synchronous serial communication possible.

2.2.3.1 Alternate Uses of the Programming Port

The programming port may also be used as an application port with the **DIAG** connector on the programming cable.

All three clocked Serial Port A signals are available as

- a synchronous serial port
- an asynchronous serial port, with the clock line usable as a general CMOS input
- two general CMOS inputs and one general CMOS output.

Two startup mode pins, SMODE0 and SMODE1, are available as general CMOS inputs after they are read during the initial boot-up. The logic state of these two pins is very important in determining the startup procedure after a reset.

/RES_IN is an external input used to reset the Rabbit 2000 microprocessor.

The status pin may also be used as a general CMOS output.

See Appendix E, "Programming Cable," for more information.

2.3 Memory

2.3.1 SRAM

The RCM2200 is designed to accept 32K to 512K of SRAM packaged in an SOIC case.

2.3.2 Flash EPROM

The RCM2200 is also designed to accept 128K to 512K of flash EPROM packaged in a TSOP case.

> **NOTE:** Z-World recommends that any customer applications should not be constrained by the sector size of the flash EPROM since it may be necessary to change the sector size in the future.

Writing to arbitrary flash memory addresses at run time is also discouraged. Instead, define a "user block" area to store persistent data. The functions **writeUserBlock** and **readUserBlock** are provided for this.

A Flash Memory Bank Select jumper configuration option based on 0 Ω surface-mounted resistors exists at JP2, JP3, and JP5 (corresponding to the flash memory chips at U8 [second flash on RCM2250], U3 [RCM2200], and U7 [no flash installed on existing RCM2200 versions]). This option, used in conjunction with some configuration macros, allows Dynamic C to compile two different co-resident programs for the upper and lower halves of the 256K flash in such a way that both programs start at logical address 0000. This is useful for applications that require a resident download manager and a separate down-loaded program. See Technical Note 218, *Implementing a Serial Download Manager for a 256K Flash*, for details.

> **NOTE:** Only the Normal Mode, which corresponds to using the full code space, is supported at the present time.

2.3.3 Dynamic C BIOS Source Files

The Dynamic C BIOS source files handle different standard RAM and flash EPROM sizes automatically.

2.4 Other Hardware

2.4.1 Clock Doubler

The RCM2200 takes advantage of the Rabbit 2000 microprocessor's internal clock doubler. A built-in clock doubler allows half-frequency crystals to be used to reduce radiated emissions. The 22.1 MHz frequency is generated using an 11.0592 MHz crystal. The clock doubler is disabled automatically in the BIOS for crystals with a frequency above 12.9 MHz.

The clock doubler may be disabled if 22.1 MHz clock speeds are not required. Disabling the Rabbit 2000 microprocessor's internal clock doubler will reduce power consumption and further reduce radiated emissions. The clock doubler is disabled with a simple change to the BIOS as described below.

1. Open the BIOS source code file, **RABBITBIOS.C** in the **BIOS** directory.

2. Change the line

   ```
   #define CLOCK_DOUBLED 1 // set to 1 to double the clock if XTAL<=12.9MHz,
   ```

   to read as follows.

   ```
   #define CLOCK_DOUBLED 0 // set to 1 to double the clock if XTAL<=12.9MHz,
   ```

3. Change the serial baud rate to 57,600 bps when the RabbitCore RCM2200 is operated at 11.05 MHz.

4. Save the change using **File > Save**.

2.4.2 Spectrum Spreader

RCM2200 RabbitCore modules that have a Rabbit 2000 microprocessor labeled *IQ4T* (or higher) are equipped with a Rabbit 2000 microprocessor that has a spectrum spreader, which helps to mitigate EMI problems. By default, the spectrum spreader is on automatically for RCM2200 modules that carry the *IQ4T* (or higher) marking when used with Dynamic C 7.30 or later versions, but the spectrum spreader may also be turned off or set to a stronger setting. The means for doing so is through a simple change to the following BIOS line in a way that is similar to the clock doubler described above.

```
#define ENABLE_SPREADER 1  // Set to 0 to disable spectrum spreader
                           // 1 to enable normal spreading, or
                           // 2 to enable strong spreading.
```

> **NOTE:** The strong spectrum-spreading setting is usually not necessary for the RCM2200.

There is no spectrum spreader functionality for RCM2200 RabbitCore modules that have a Rabbit 2000 microprocessor labeled *IQ1T*, *IQ2T*, or *IQ3T*, or when using any RCM2200 with a version of Dynamic C prior to 7.30.

3. SOFTWARE REFERENCE

Dynamic C is an integrated development system for writing embedded software. It runs on an IBM-compatible PC and is designed for use with Z-World controllers and other controllers based on the Rabbit microprocessor. Chapter 3 provides the libraries, function calls, and sample programs related to the RCM2200.

3.1 More About Dynamic C

Dynamic C has been in use worldwide since 1989. It is specially designed for programming embedded systems, and features quick compile and interactive debugging in the real environment. A complete reference guide to Dynamic C is contained in the *Dynamic C User's Manual*.

You have a choice of doing your software development in the flash memory or in the static RAM included on the RCM2200. The advantage of working in RAM is to save wear on the flash memory, which is limited to about 100,000 write cycles.

> **NOTE:** An application can be developed in RAM, but cannot run standalone from RAM after the programming cable is disconnected. All standalone applications can only run from flash memory.

> **NOTE:** Do not depend on the flash memory sector size or type. Due to the volatility of the flash memory market, the RCM2200 and Dynamic C were designed to accommodate flash devices with various sector sizes.

The disadvantage of using flash memory for debug is that interrupts must be disabled for approximately 5 ms whenever a break point is set in the program. This can crash fast interrupt routines that are running while you stop at a break point or single-step the program. Flash memory or RAM is selected on the **Options > Compiler** menu.

Dynamic C Premier provides a number of debugging features. You can single-step your program, either in C, statement by statement, or in assembly language, instruction by instruction. You can set break points, where the program will stop, on any statement. You can evaluate watch expressions. A watch expression is any C expression that can be evaluated in the context of the program. If the program is at a break point, a watch expression can view any expression using local or external variables. If a periodic call to `runwatch()` is included in your program, you will be able to evaluate watch expressions by hitting **<Ctrl-U>** without stopping the program.

3.2 Programming Cable

The RCM2200 is automatically in program mode when the **PROG** connector on the programming cable is attached, and in run mode when no programming cable is attached.

The **DIAG** connector of the programming cable may be used on header J5 of the RCM2200 with the board operating in the run mode. This allows the programming port to be used as an application port. See Appendix C, "Programming Cable," for more information.

Program Mode

To PC COM Port

Run Mode

RESET RCM2200 when changing mode:
Short out pins 9 and 26 on header J5, **OR**
Press RESET *button (if using Prototyping Board),* **OR**
Remove, then reapply power
**after removing or attaching programming cable.**
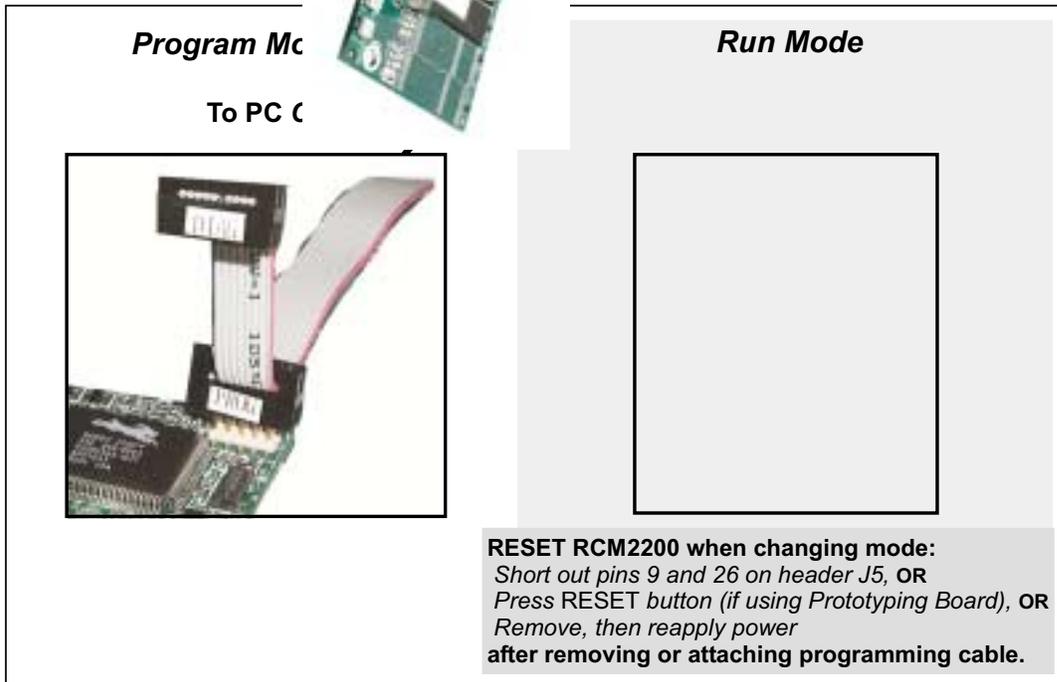
Figure 5. Switching Between Program Mode and Run Mode

3.2.1 Changing from Program Mode to Run Mode

1. Disconnect the programming cable from header J5 of the RCM2200.

2. Reset the RCM2200. You may do this as explained in Figure 5.

The RCM2200 is now ready to operate in the run mode.

3.2.2 Changing from Run Mode to Program Mode

1. Attach the programming cable to header J3 on the RCM2200.

2. Reset the RCM2200. You may do this as explained in Figure 5.

The RCM2200 is now ready to operate in the program mode.
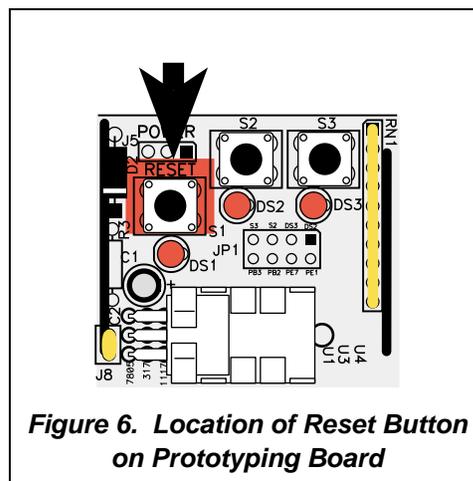
Figure 6. Location of Reset Button on Prototyping Board

3.3 Dynamic C Libraries

With Dynamic C running, click **File > Open**, and select `Lib`. The following list of Dynamic C libraries will be displayed.
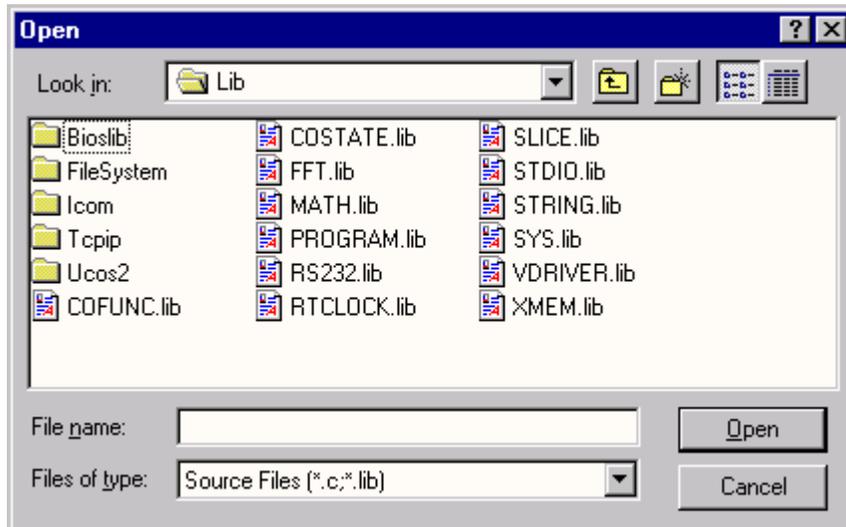
There is no unique library that is specific to the RCM2200. The functions in the above libraries are described in the *Dynamic C User's Manual*.

3.3.1 I/O

The RCM2200 was designed to interface with other systems, and so there are no drivers written specifically for the I/O. The general Dynamic C read and write functions allow you to customize the parallel I/O to meet your specific needs. For example, use

```
WrPortI(PEDDR, &PEDDRShadow, 0x00);
```

to set all the port E bits as inputs, or use

```
WrPortI(PEDDR, &PEDDRShadow, 0xFF);
```

to set all the Port E bits as outputs.

The sample programs in the Dynamic C **SAMPLES\RCM2200** directory provide further examples.

3.3.1.1 PCLK Output

The PCLK output is controlled by bits 7 and 6 of the Global Output Register (GOCR) on the Rabbit 2000 microprocessor, and so can be enabled or disabled in software. Starting with Dynamic C v 7.02, the PCLK output is disabled by default at compile time to minimize radiated emissions; the PCLK output is enabled in earlier versions of Dynamic C.

Use the following code to set the PCLK output as needed.

PCLK output driven with peripheral clock:
```
 WrPortI(GOCR, &GOCRShadow, (GOCRShadow&~0xc0));
```
PCLK output driven with peripheral clock ÷ 2:
```
 WrPortI(GOCR, &GOCRShadow, ((GOCRShadow&~0xc0)| 0x40));
```
PCLK output off (low):
```
 WrPortI(GOCR, &GOCRShadow, ((GOCRShadow&~0xc0)| 0x80));
```
PCLK output on (high):
```
 WrPortI(GOCR, &GOCRShadow, (GOCRShadow | 0xc0));
```

3.3.1.2 External Interrupts

The Rabbit 2000 microprocessor has four external interrupt inputs on Parallel Port E, which is accessed through pins PE0, PE1, PE4, and PE5 on header J4. These pins may be used either as I/O ports or as external interrupt inputs.

Earlier versions of the Rabbit 2000 microprocessor labeled *IQ1T* or *IQ2T* would occasionally lose an interrupt request when one of the interrupt inputs was used as a pulse counter. See Technical Note 301, ***Rabbit 2000 Microprocessor Interrupt Problem***, for further information on how to work around this problem if you purchased your RCM2200 before July, 2002, and the Rabbit 2000 microprocessor is labeled *IQ1T* or *IQ2T*.

> **NOTE:** Interrupts on RCM2000 series RabbitCore modules sold after July, 2002, work correctly and do not need this workaround.

3.3.2 Serial Communication Drivers

Library files included with Dynamic C provide a full range of serial communications support. The **RS232.LIB** library provides a set of circular-buffer-based serial functions. The **PACKET.LIB** library provides packet-based serial functions where packets can be delimited by the 9th bit, by transmission gaps, or with user-defined special characters. Both libraries provide blocking functions, which do not return until they are finished transmitting or receiving, and nonblocking functions, which must be called repeatedly until they are finished. For more information, see the *Dynamic C User's Manual* and Technical Note 213, *Rabbit 2000 Serial Port Software*.

3.3.3 TCP/IP Drivers

The TCP/IP drivers are located in the **TCPIP** directory.
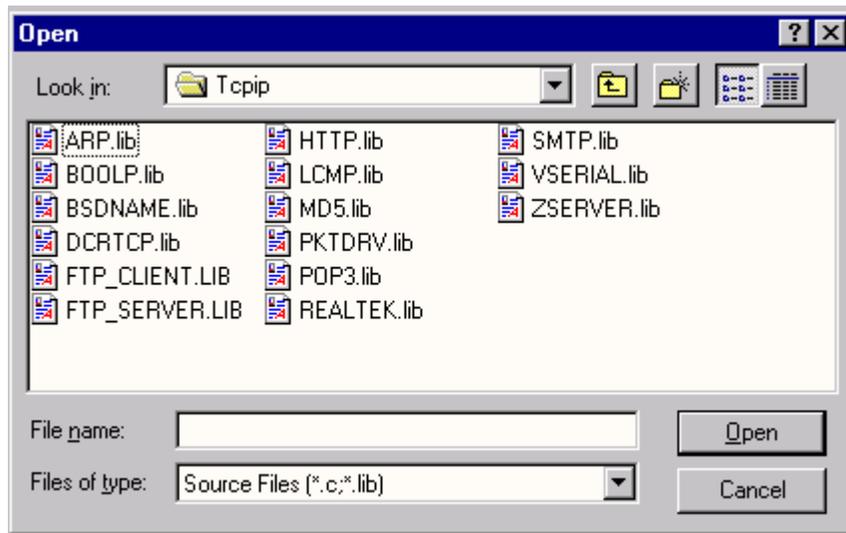
Complete information on these libraries and the TCP/IP functions is provided in the *Dynamic C TCP/IP User's Manual*.

3.4 Sample Programs

Sample programs are provided in the Dynamic C `Samples` folder, which is shown below.
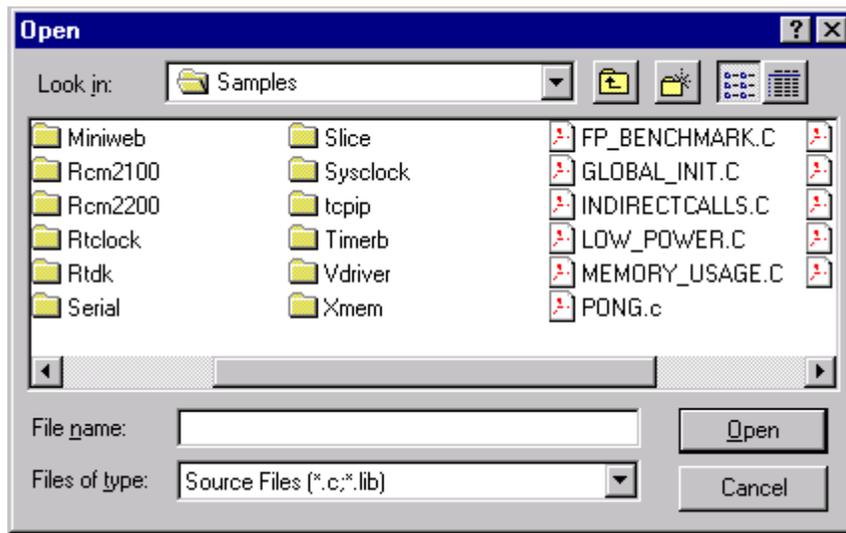
The various folders contain specific sample programs that illustrate the use of the corresponding Dynamic C libraries. For example, the sample program **PONG.C** demonstrates the output to the Dynamic C **STDIO** window.

Two folders contain sample programs that illustrate features unique to the RCM2200.

- **RCM2200**—Demonstrates the basic operation and the Ethernet functionality of the RCM2200.

- **TCPIP**—Demonstrates more advanced TCP/IP programming for Z-World's Ethernet-enabled Rabbit-based boards.

Follow the instructions included with the sample program to connect the RCM2200 and the other hardware identified in the instructions.

To run a sample 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 RCM2200 must be in Program Mode (see Section 3.2, "Programming Cable"), and must be connected to a PC using the programming cable.

More complete information on Dynamic C is provided in the *Dynamic C User's Manual*.

3.5 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/supportcenter.html

or

- www.rabbitsemiconductor.com/support.html

for the latest patches, workarounds, and bug fixes.

The default installation of a patch or bug fix is to install the file in a directory (folder) different from that of the original Dynamic C installation. Z-World recommends using a different directory so that you can verify the operation of the patch without overwriting the existing Dynamic C installation. If you have made any changes to the BIOS or to libraries, or if you have programs in the old directory (folder), make these same changes to the BIOS or libraries in the new directory containing the patch. Do ***not*** simply copy over an entire file since you may overwrite a bug fix; of course, you may copy over any programs you have written. Once you are sure the new patch works entirely to your satisfaction, you may retire the existing installation, but keep it available to handle legacy applications.

3.5.1 Upgrades

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. Dynamic C is a complete software development system, but does not include all the Dynamic C features. Z-World also offers add-on Dynamic C modules containing the popular μC/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.

APPENDIX A. RABBITCORE RCM2200 SPECIFICATIONS

Appendix A provides the specifications for the RCM2200, and describes the conformal coating.

A.1 Electrical and Mechanical Characteristics

Figure A-1 shows the mechanical dimensions for the RCM2200.

Please refer to the RCM2200 footprint diagram later in this appendix for precise header locations.
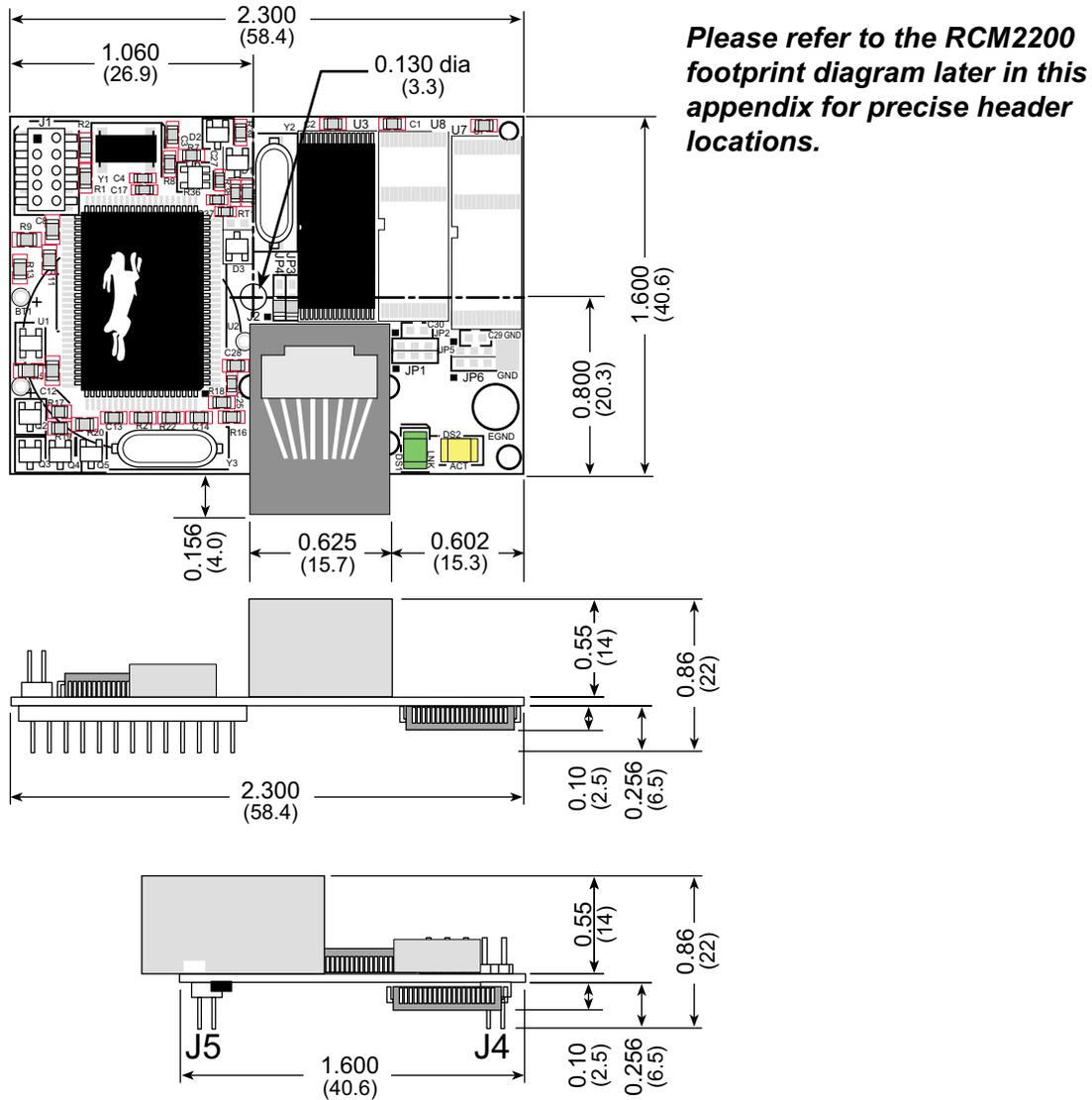
Figure A-1. RCM2200 Dimensions

It is recommended that you allow for an "exclusion zone" of 0.04" (1 mm) around the RCM2200 in all directions when the RCM2200 is incorporated into an assembly that includes other printed circuit boards. This "exclusion zone" that you keep free of other components and boards will allow for sufficient air flow, and will help to minimize any electrical or EMI interference between adjacent boards. An "exclusion zone" of 0.12" (3 mm) is recommended below the RCM2200 when the RCM2200 is plugged into another assembly using the shortest connectors for headers J4 and J5. Figure A-2 shows this "exclusion zone."
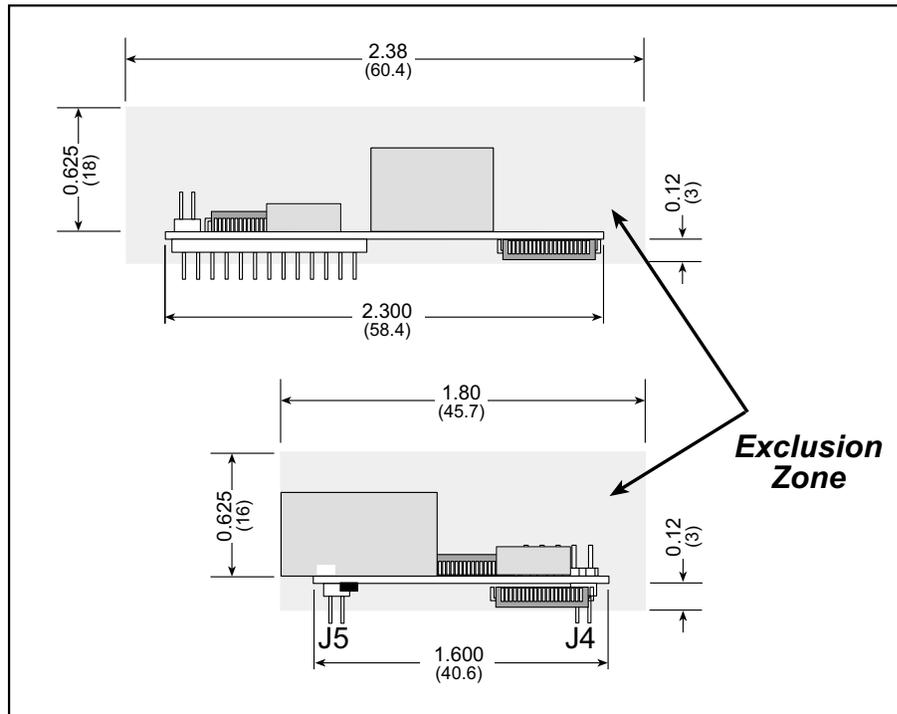
Figure A-2. RCM2200 "Exclusion Zone"

Table A-1 lists the electrical, mechanical, and environmental specifications for the RCM2200.

Table A-1. RabbitCore RCM2200 Specifications

| Parameter	RCM2200	RCM2210	RCM2250
Microprocessor	Rabbit 2000® at 22.1 MHz		
Ethernet Port	10Base-T, RJ-45, 2 LEDs	10Base-T (raw signals only)	10Base-T, RJ-45, 2 LEDs
Flash Memory	One 256K		Two 256K
SRAM	128K		512K
Backup Battery	Connection for user-supplied backup battery (to support RTC and SRAM)		
General-Purpose I/O	26 parallel I/0 lines grouped in five 8-bit ports (shared with serial ports): • 16 configurable I/O • 7 fixed inputs • 3 fixed outputs		
Additional Inputs	2 startup mode, reset		
Additional Outputs	Status, reset		
Memory, I/O Interface	4 address lines, 8 data lines, I/O read/write		
Serial Ports	Four 5 V CMOS-compatible ports. Two ports are configurable as clocked ports, one is a dedicated RS-232 programming port.		
Serial Rate	Maximum burst rate = CLK/32 Maximum sustained rate = CLK/64		
Slave Interface	A slave port allows the RCM2200 to be used as an intelligent peripheral device slaved to a master processor, which may either be another Rabbit 2000 or any other type of processor		
Real-Time Clock	Yes		
Timers	Five 8-bit timers cascadable in pairs, one 10-bit timer with 2 match registers that each have an interrupt		
Watchdog/Supervisor	Yes		
Power	4.75 V to 5.25 V DC, 134 mA		
Operating Temperature	–40°C to +70°C		
Humidity	5% to 95%, noncondensing		
Connectors	Two IDC headers 2 × 13, 2 mm pitchs		
Board Size	1.60" × 2.30" × 0.86" (41 mm × 59 mm × 22 mm)		

A.1.1 Headers

The RCM2200 uses headers at J4 and J5 for physical connection to other boards. J4 and J5 are 2 × 13 SMT headers with a 2 mm pin spacing. J1, the programming port, is a 2 × 5 header with a 2 mm pin spacing.

Figure A-3 shows the layout of another board for the RCM2200 to be plugged into. These values are relative to the header connectors.

A.1.2 Physical Mounting

A 9/32" (7 mm) standoff with a 4-40 screw is recommended to attach the RCM2200 to a user board at the hole position shown in Figure A-3. Either use plastic hardware, or use insulating washers to keep any metal hardware from shorting out signals on the RCM2200.
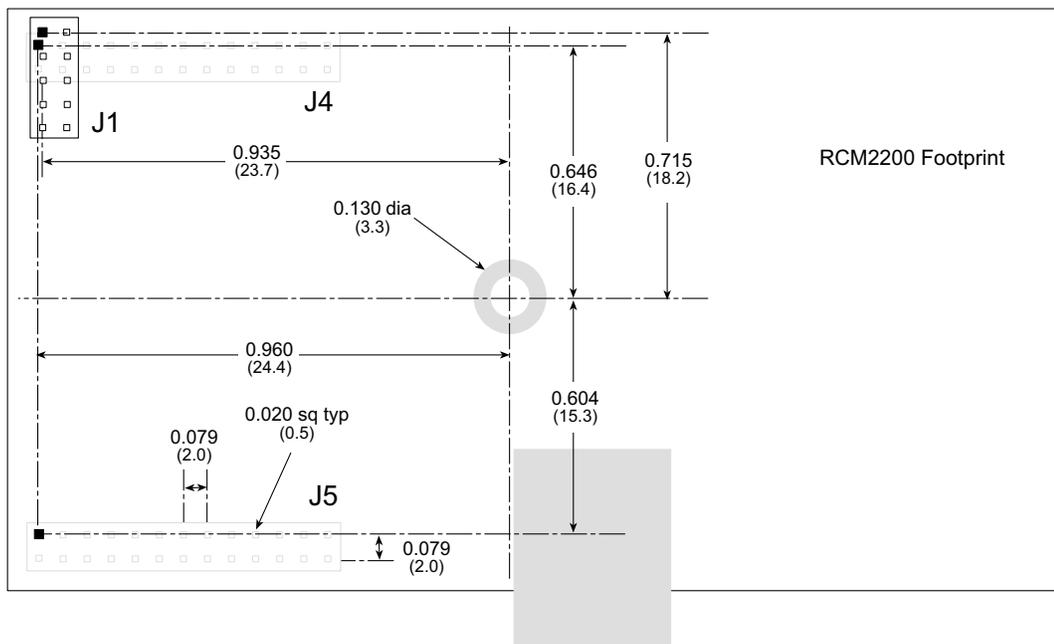
Figure A-3. User Board Footprint for RCM2200

A.2 Bus Loading

You must pay careful attention to bus loading when designing an interface to the RCM2200. This section provides bus loading information for external devices.

Table A-2 lists the capacitance for the various RCM2200 I/O ports.

Table A-2. Capacitance of Rabbit 2000 I/O Ports

I/O Ports	Input Capacitance (pF)	Output Capacitance (pF)
Parallel Ports A to E	12	14
Data Lines BD0–BD7	10	12
Address Lines BA0–BA12	4	8

Figure A-4 shows a typical timing diagram for the Rabbit 2000 microprocessor external memory read and write cycles.
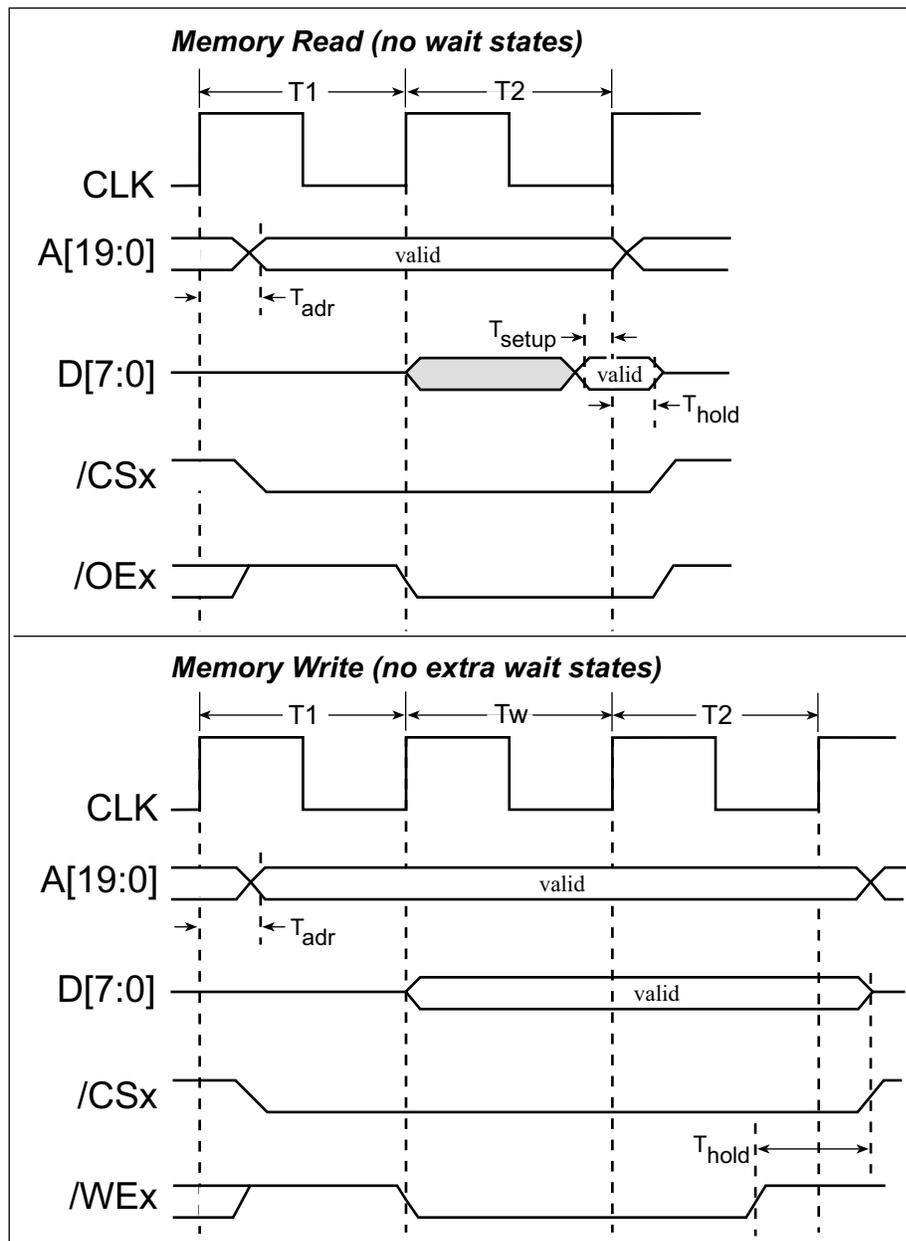
Figure A-4. Memory Read and Write Cycles

T_{adr} is the time required for the address output to reach 0.8 V. This time depends on the bus loading. T_{setup} is the data setup time relative to the clock. Tsetup is specified from 30%/70% of the V_{DD} voltage level.

Table A-3 lists the parameters shown in these figures and provides minimum or measured values.

Table A-3. Memory and External I/O Read/Write Parameters

	Parameter	Description		Value
Read Parameters	T_{adr}	Time from CPU clock rising edge to address valid	Max.	7 ns @ 20 pF, 5 V 14 ns @ 70 pF, 5 V
	T_{setup}	Data read setup time	Min.	2 ns @ 5 V
	T_{hold}	Data read hold time	Min.	0 ns
Write Parameters	T_{adr}	Time from CPU clock rising edge to address valid	Max.	7 ns @ 20 pF, 5 V 14 ns @ 70 pF, 5 V
	T_{hold}	Data write hold time from /WEx or /IOWR	Min.	½ CPU clock cycle

A.3 Rabbit 2000 DC Characteristics

Table A-4 outlines the DC characteristics for the Rabbit 2000 at 5.0 V over the recommended operating temperature range from T_a = –40°C to +85°C, V_{DD} = 4.5 V to 5.5 V.

Table A-4. 5.0 Volt DC Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{IH}	Input Leakage High	$V_{IN} = V_{DD}$, $V_{DD} = 5.5$ V			10	µA
I_{IL}	Input Leakage Low (no pull-up)	$V_{IN} = V_{SS}$, $V_{DD} = 5.5$ V	-10			µA
I_{OZ}	Output Leakage (no pull-up)	$V_{IN} = V_{DD}$ or V_{SS}, $V_{DD} = 5.5$ V	-10		10	µA
V_{IL}	CMOS Input Low Voltage				0.3 x V_{DD}	V
V_{IH}	CMOS Input High Voltage		0.7 x V_{DD}			V
V_T	CMOS Switching Threshold	$V_{DD} = 5.0$ V, 25°C		2.4		V
V_{OL}	CMOS Output Low Voltage	I_{OL} = See Table A-5 (sinking) $V_{DD} = 4.5$ V		0.2	0.4	V
V_{OH}	CMOS Output High Voltage	I_{OH} = See Table A-5 (sourcing) $V_{DD} = 4.5$ V	0.7 x V_{DD}	4.2		V

A.4 I/O Buffer Sourcing and Sinking Limit

Unless otherwise specified, the Rabbit I/O buffers are capable of sourcing and sinking 8 mA of current per pin at full AC switching speed. Full AC switching assumes a 25.8 MHz CPU clock and capacitive loading on address and data lines of less than 100 pF per pin. Address pin A0 and data pin D0 are rated at 16 mA each. Pins A1–A12 and D1–D7 are each rated at 8 mA. The absolute maximum operating voltage on all I/O is $V_{DD} + 0.5$ V or 5.5 V.

Table A-5 shows the AC and DC output drive limits of the parallel I/O buffers when the Rabbit 2000 is used in the RCM2200.

Table A-5. I/O Buffer Sourcing and Sinking Capability

Pin Name	Output Drive Sourcing[*]/Sinking[†] Limits (mA)	
Output Port Name	Full AC Switching SRC/SNK	Maximum[‡] DC Output Drive SRC/SNK
PA [7:0]	8/8	12/12
PB [7:6]	8/8	12/12
PC [6, 2, 0]	8/8	12/12
PD [5:4]	8/8	12/12
PD [3:0][**]	16/16	25/25
PE [7, 5, 4, 1, 0]	8/8	12/12

   * The maximum DC sourcing current for I/O buffers between V_{DD} pins is 112 mA.

   † The maximum DC sinking current for I/O buffers between V_{SS} pins is 150 mA.

   ‡ The maximum DC output drive on I/O buffers must be adjusted to take into consideration the current demands made my AC switching outputs, capacitive loading on switching outputs, and switching voltage.

     The current drawn by all switching and nonswitching I/O must not exceed the limits specified in the first two footnotes.

  ** The combined sourcing from Port D [7:0] may need to be adjusted so as not to exceed the 112 mA sourcing limit requirement specified in Note 1.

A.5 Jumper Configurations

Figure A-5 shows the header locations used to configure the various RCM2200 options via jumpers.
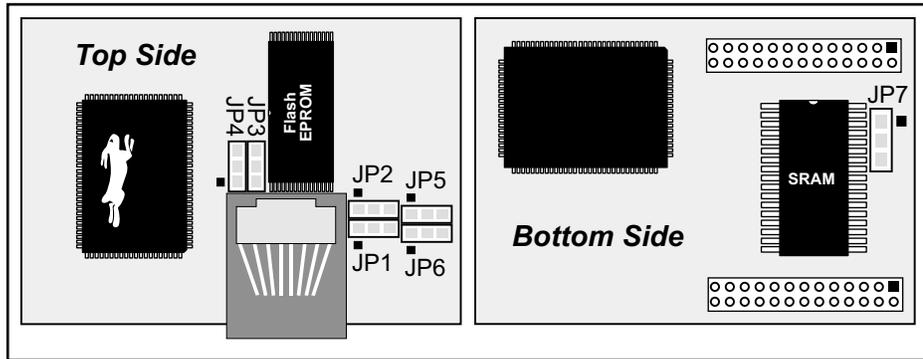
Figure A-5. Location of RCM2200 Configurable Positions

Table A-6 lists the configuration options.

Table A-6. RCM2100 Jumper Configurations

Header	Description	Pins Connected		Factory Default
JP1	Flash Memory Size (U8—RCM2250 only))	1–2	128K/256K	✕
		2–3	512K	
JP2	Flash Memory Bank Select (U8—RCM2250 only)	1–2	Normal Mode	✕
		2–3	Bank Mode	
JP3	Flash Memory Bank Select (U3)	1–2	Normal Mode	✕
		2–3	Bank Mode	
JP4	Flash Memory Size (U3)	1–2	128K/256K	✕
		2–3	512K	
JP5	Flash Memory Bank Select (U7—not installed)	1–2	Normal Mode	—
		2–3	Bank Mode	
JP6	Flash Memory Size (U7—not installed)	1–2	128K/256K	—
		2–3	512K	
JP7	SRAM Size	1–2	128K	RCM2200 RCM2210
		2–3	512K	RCM2250

NOTE: The jumper connections are made using 0 Ω surface-mounted resistors.

A.6 Conformal Coating

The areas around the 32 kHz real-time clock crystal oscillator has had the Dow Corning silicone-based 1-2620 conformal coating applied. The conformally coated area is shown in Figure A-6. The conformal coating protects these high-impedance circuits from the effects of moisture and contaminants over time.
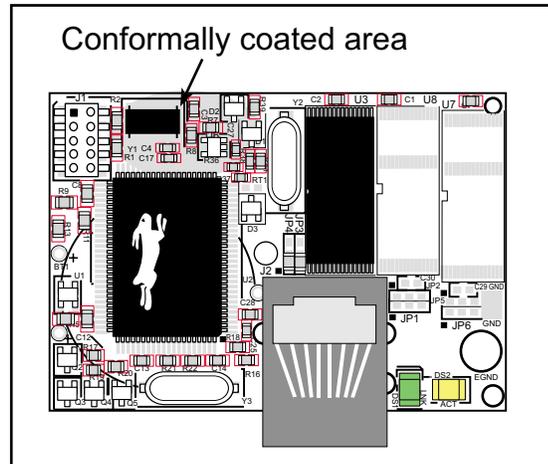
Figure A-6. RCM2200 Areas Receiving Conformal Coating

Any components in the conformally coated area may be replaced using standard soldering procedures for surface-mounted components. A new conformal coating should then be applied to offer continuing protection against the effects of moisture and contaminants.

> **NOTE:** For more information on conformal coatings, refer to Technical Note 303, *Conformal Coatings*.

APPENDIX B. PROTOTYPING BOARD

Appendix B describes the features and accessories of the Proto-typing Board, and explains the use of the Prototyping Board to demonstrate the RCM2200 and to build prototypes of your own circuits.

B.1 Mechanical Dimensions and Layout

Figure B-1 shows the mechanical dimensions and layout for the RCM2200 Prototyping Board.
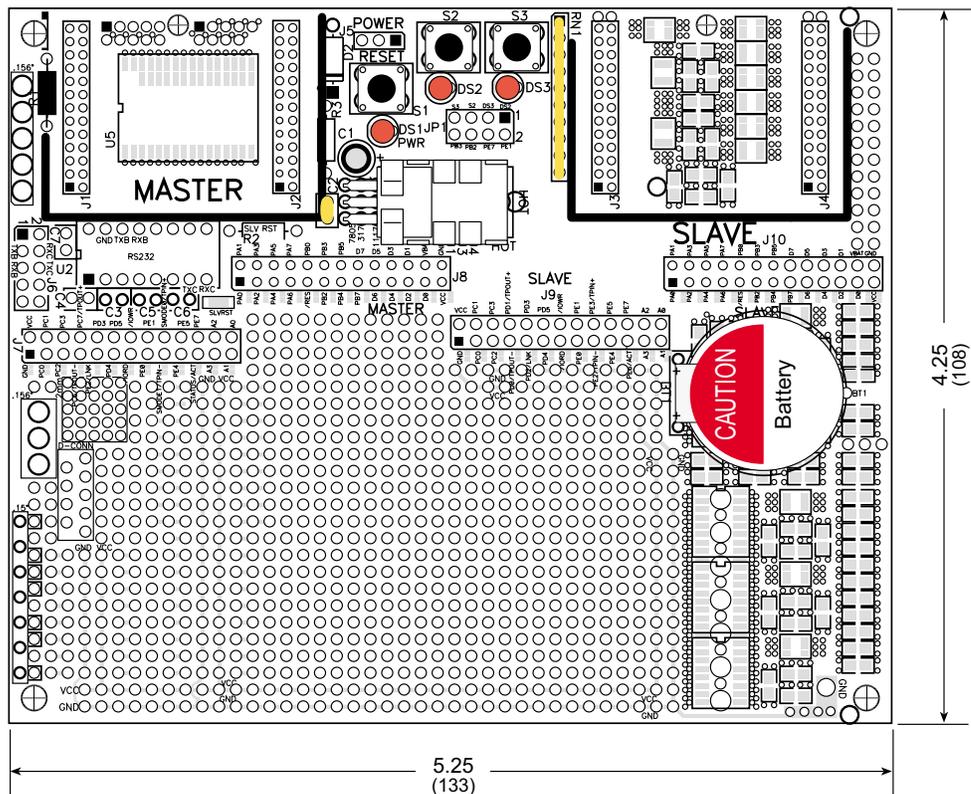
Figure B-1. RCM2200 Prototyping Board Dimensions

Table B-1 lists the electrical, mechanical, and environmental specifications for the Prototyping Board.

Table B-1. RCM2200 Prototyping Board Specifications

Parameter	Specification
Board Size	4.25" × 5.25" × 1.00" (108 mm × 133 mm × 25 mm)
Operating Temperature	–40°C to +70°C
Humidity	5% to 95%, noncondensing
Input Voltage	7.5 V to 25 V DC
Maximum Current Draw (including user-added circuits)	1 A at 12 V and 25°C, 0.7 A at 12 V and 70ºC
Prototyping Area	2.4" × 4.0" (61 mm × 102 mm) throughhole, 0.1" spacing, additional space for SMT components
Standoffs/Spacers	4, accept 6-32 × 3/8 screws

B.2 Power Supply

The RCM2200 requires a regulated 5 V ± 0.25 V DC power source to operate. Depending on the amount of current required by the application, different regulators can be used to supply this voltage.

The Prototyping Board has an onboard 7805 or equivalent linear regulator that is easy to use. Its major drawback is its inefficiency, which is directly proportional to the voltage drop across it. The voltage drop creates heat and wastes power.

A switching power supply may be used in applications where better efficiency is desirable. The LM2575 is an example of an easy-to-use switcher. This part greatly reduces the heat dissipation of the regulator. The drawback in using a switcher is the increased cost.

The Prototyping Board itself is protected against reverse polarity by a Shottky diode at D2 as shown in Figure B-2.
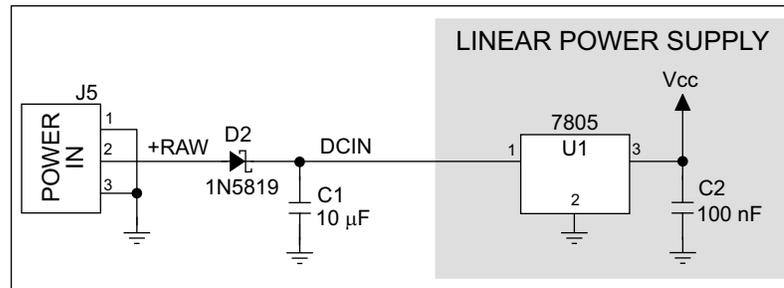
Figure B-2. Prototyping Board Power Supply

B.3 Using the Prototyping Board

The Prototyping Board is actually both a demonstration board and a prototyping board. As a demonstration board, it can be used to demonstrate the functionality of the RCM2200 right out of the box without any modifications to either board. There are no jumpers or dip switches to configure or misconfigure on the Prototyping Board so that the initial setup is very straightforward.

The Prototyping Board comes with the basic components necessary to demonstrate the operation of the RCM2200. Two LEDs (DS2 and DS3) are connected to PE1 and PE7, and two switches (S2 and S3) are connected to PB2 and PB3 to demonstrate the interface to the Rabbit 2000 microprocessor. Reset switch S1 is the hardware reset for the RCM2200.

To maximize the availability of RCM2200 resources, the demonstration hardware (LEDs and switches) on the Prototyping Board may be disconnected. This is done by cutting the traces below the silk-screen outline of header JP1 on the bottom side of the Prototyping Board. Figure B-3 shows the four places where cuts should be made. Cut the traces between the rows as shown. An exacto knife would work nicely to cut the traces. Alternatively, a small standard screwdriver may be carefully and forcefully used to wipe through the PCB traces.
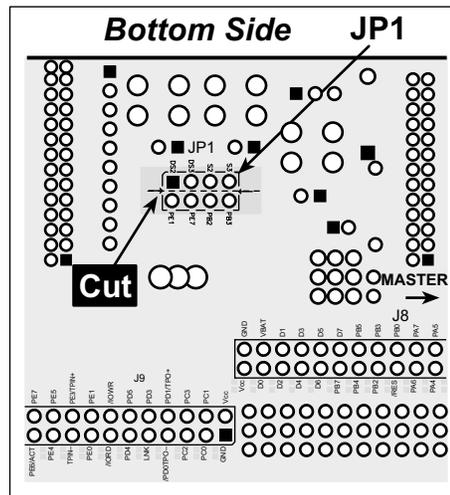
Figure B-3. Where to Cut Traces to Permanently Disable Demonstration Hardware on Prototyping Board

The power LED (PWR) and the RESET switch remain connected. Jumpers across the appropriate pins on header JP1 can be used to reconnect specific demonstration hardware later if needed.

Table B-2. Prototyping Board Jumper Settings

Header JP1	
Pins	**Description**
1–2	PE1 to LED DS2
3–4	PE7 to LED DS3
5–6	PB2 to Switch S2
7–8	PB3 to Switch S3

Note that the pinout at location JP1 on the bottom side of the Prototyping Board (shown in Figure B-3) is a mirror image of the top-side pinout.

The Prototyping Board provides the user with RCM2200 connection points brought out conveniently to labeled points at headers J7 and J8 on the Prototyping Board. Small to medium circuits can be prototyped using point-to-point wiring with 20 to 30 AWG wire between the

prototyping area and the holes at locations J7 and J8. The holes are spaced at 0.1" (2.5 mm), and 40-pin headers or sockets may be installed at J7 and J8. The pinouts for locations J7 and J8, which correspond to headers J1 and J2, are shown in Figure B-4.

J7/J9		J8/J10	
GND — VCC		PA0 — PA1	
PC0 — PC1		PA2 — PA3	
PC2 — PC3		PA4 — PA5	
TPOUT- — TPOUT+		PA6 — PA7	
LNK — PD3		/RES — PB0	
PD4 — PD5		PB2 — PB3	
/IORD — /IOWR		PB4 — PB5	
PE0 — PE1		PB7 — D7	
TPIN- — TPIN+		D6 — D5	
PE4 — PE5		D4 — D3	
ACT — PE7		D2 — D1	
A3 — A2		D0 — VBAT	
A1 — A0		VCC — GND	

Note: These pinouts correspond to the
MASTER/SLAVE positions respectively.
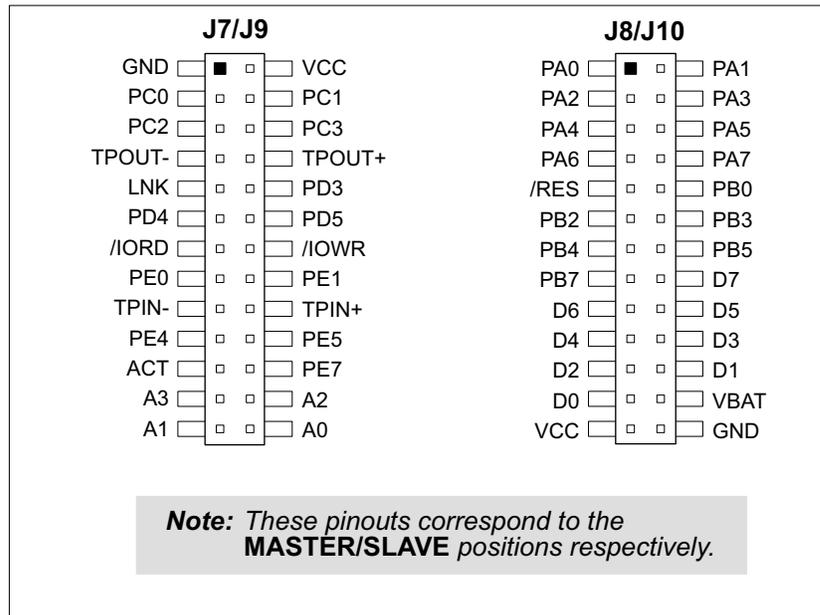
*Figure B-4. RCM2200 Prototyping Board Pinout
(Top View)*

The small holes are also provided for surface-mounted components that may be installed to the right of the prototyping area.

There is a 2.4" × 4" through-hole prototyping space available on the Prototyping Board. VCC and GND traces run along the edge of the Prototyping Board for easy access. A GND pad is also provided at the lower right for alligator clips or probes.
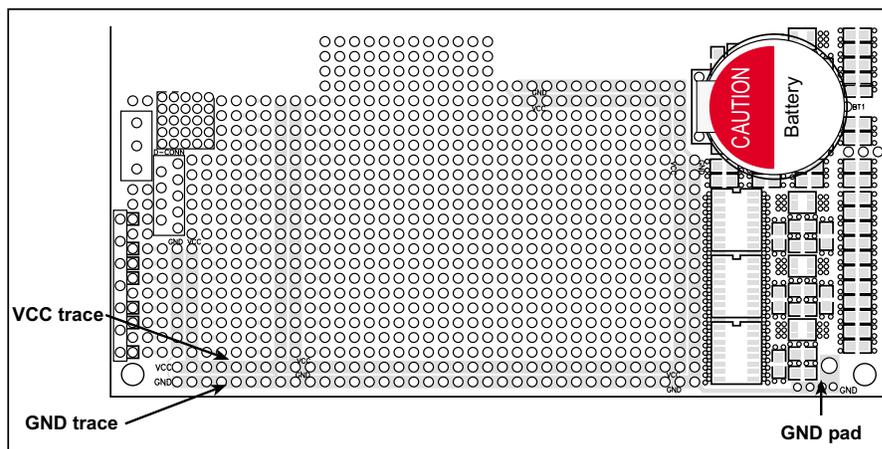
Figure B-5. VCC and GND Traces Along Edge of Prototyping Board

B.3.1 Adding Other Components

There is room on the Prototyping Board for a user-supplied RS-232 transceiver chip at location U2 and a 10-pin header for serial interfacing to external devices at location J6. A Maxim MAX232 transceiver is recommended. When adding the MAX232 transceiver at position U2, you must also add 100 nF charge storage capacitors at positions C3–C7 as shown in Figure B-6.
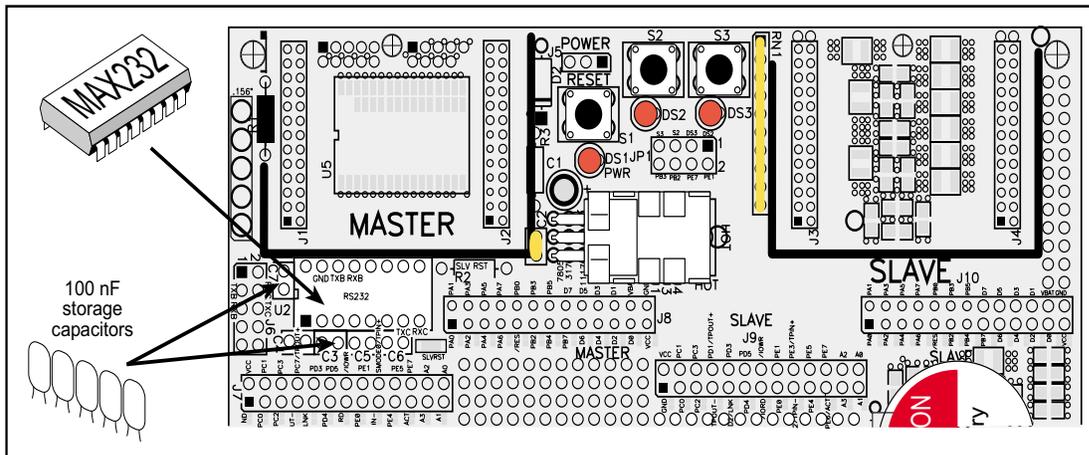
***Figure B-6. Location for User-Supplied RS-232 Transceiver
and Charge Storage Capacitors on Back Side of Prototyping Board***

> **NOTE:** The board that is supplied with the DeviceMate Development Kit already has the RS-232 chip and the storage capacitors installed, and is called the DeviceMate Demonstration Board.

There are two sets of pads that can be used for surface mount prototyping SOIC devices. The silk screen layout separates the rows into six 16-pin devices (three on each side). However, there are pads between the silk screen layouts giving the user two 52-pin (2×26) SOIC layouts with 50 mil pin spacing. There are six sets of pads that can be used for 3- to 6-pin SOT23 packages. There are also 60 sets of pads that can be used for SMT resistors and capacitors in an 0805 SMT package. Each component has every one of its pin pads connected to a hole in which a 30 AWG wire can be soldered (standard wire wrap wire can be soldered in for point-to-point wiring on the Prototyping Board). Because the traces are very thin, carefully determine which set of holes is connected to which surface-mount pad.

There is also a space above the space for the RS-232 transceiver that can accommodate a large surface-mounted SOIC component.

B.3.2 Attach Modules to Prototyping Board

Turn the RCM2200 module so that the Ethernet connector end of the module extends to the right, as shown in Figure B-7 below. Align the module headers J4 and J5 into sockets J1 and J2 (the **MASTER** slots) on the Prototyping Board. Press the module's pins firmly into the Prototyping Board headers.
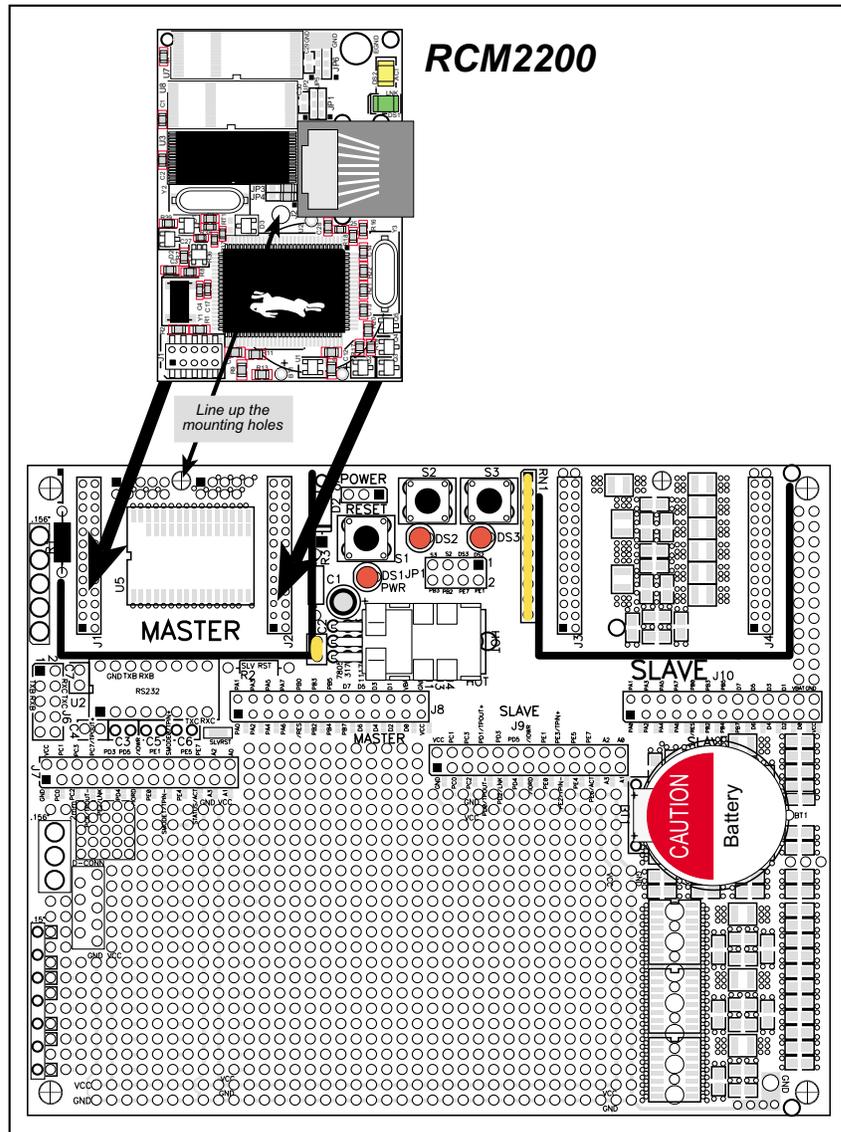
Figure B-7. Install the RCM2200 on the Prototyping Board

> **NOTE:** It is important that you line up the pins of the module headers exactly with the corresponding pins on the Prototyping Board. The header pins may become bent or damaged if the pin alignment is offset, and the module will not work. Permanent electrical damage to the module may also result if a misaligned module is powered up.

With the RCM2200 plugged into the **MASTER** slots, it has full access to the RS-232 transceiver, and can act as the "master" relative to another RabbitCore RCM2200 or RCM2300 plugged into the **SLAVE** slots, which acts as the "slave."

This master/slave relationship is *not* used in the DeviceMate Development Kit where the "target" RCM2300 is plugged into the **MASTER** slots, and the RCM2200, which is used as the DeviceMate hardware platform, is plugged into the **SLAVE** slots. The special Demonstration Board serves only as a means to connect the two RabbitCore modules together to demonstrate the DeviceMate software features in Dynamic C.

APPENDIX C. POWER SUPPLY

Appendix C provides information on the current requirements of the RCM2200, and includes some background on the chip select circuit used in power management.

C.1 Power Supplies

The RCM2200 requires a regulated 5 V ± 0.25 V DC power source. The RabbitCore design presumes that the voltage regulator is on the user board, and that the power is made available to the RabbitCore board through headers J4 and J5.

An RCM2200 with no loading at the outputs operating at 22.1 MHz typically draws 134 mA. The RCM2200 will consume an additional 10 mA when the programming cable is used to connect the programming header, J1, to a PC.

C.1.1 Battery-Backup Circuits

The RCM2200 does not have a battery, but there is provision for a customer-supplied battery to back up SRAM and keep the internal Rabbit 2000 real-time clock running.

Header J5, shown in Figure C-1, allows access to the external battery. This header makes it possible to connect an external 3 V power supply. This allows the SRAM and the internal Rabbit 2000 real-time clock to retain data with the RCM2200 powered down.
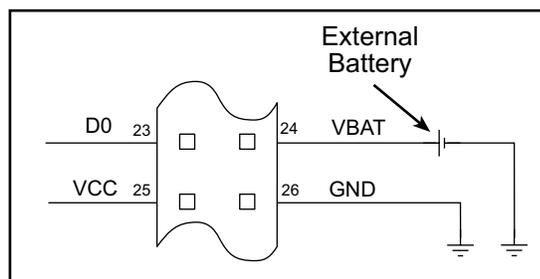
Figure C-1. External Battery Connections at Header J5

A lithium battery with a nominal voltage of 3 V and a minimum capacity of 165 mA·h is recommended. A lithium battery is strongly recommended because of its nearly constant nominal voltage over most of its life.

The drain on the battery by the RCM2200 is typically 16 μA when no other power is supplied. If a 950 mA·h battery is used, the battery can last more than 6 years:

$$\frac{950 \text{ mA·h}}{16 \text{ μA}} = 6.8 \text{ years.}$$

The actual life in your application will depend on the current drawn by components not on the RCM2200 and the storage capacity of the battery. Note that the shelf life of a lithium ion battery is ultimately 10 years. The RCM2200 does not drain the battery while it is powered up normally.

The battery-backup circuit serves three purposes:

- It reduces the battery voltage to the SRAM and to the real-time clock, thereby limiting the current consumed by the real-time clock and lengthening the battery life.

- It ensures that current can flow only *out* of the battery to prevent charging the battery.

- A voltage, VOSC, is supplied to U6, which keeps the 32.768 kHz oscillator working when the voltage begins to drop.

VRAM and Vcc are nearly equal (<100 mV, typically 10 mV) when power is supplied to the RCM2200.

Figure C-2 shows the RCM2200 battery-backup circuit.
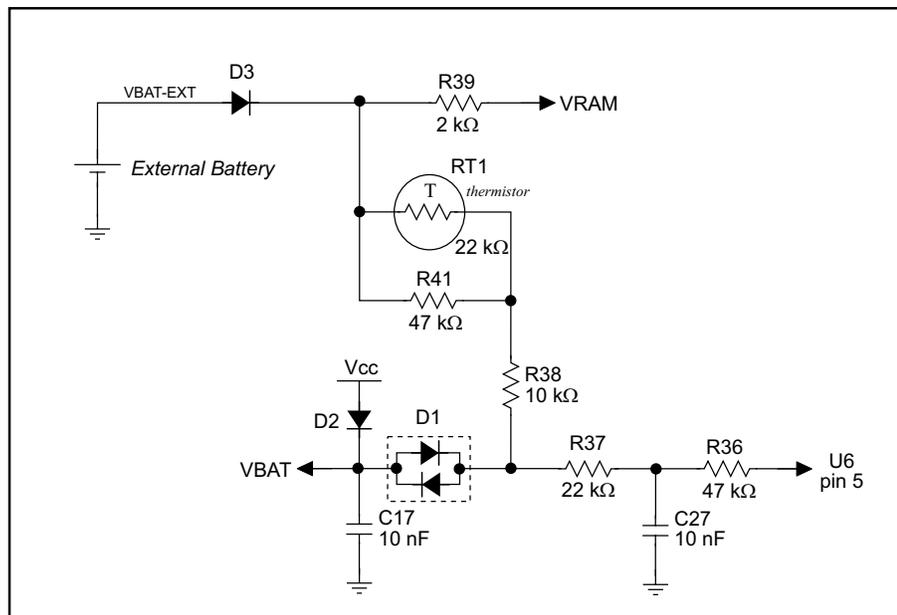
Figure C-2. RCM2200 Battery-Backup Circuit

C.1.2 Reset Generator

The RCM2200 uses a reset generator, U1, to reset the Rabbit 2000 microprocessor when the voltage drops below the voltage necessary for reliable operation. The reset occurs between 4.50 V and 4.75 V, typically 4.63 V. The RCM2200 has a reset output, pin 9 on header J5.

C.2 Chip Select Circuit

The RCM2100 has provision for battery backup, which kicks in to keep VRAM from dropping below 2 V.

When the RCM2200 is not powered, the battery keeps the SRAM memory contents and the real-time clock (RTC) going. The SRAM has a powerdown mode that greatly reduces power consumption. This powerdown mode is activated by raising the chip select (CS) signal line. Normally the SRAM requires Vcc to operate. However, only 2 V is required for data retention in powerdown mode. Thus, when power is removed from the circuit, the battery voltage needs to be provided to both the SRAM power pin and to the CS signal line. The CS control switch accomplishes this task for the CS signal line.

Figure C-3 shows a schematic of the chip select control switch.
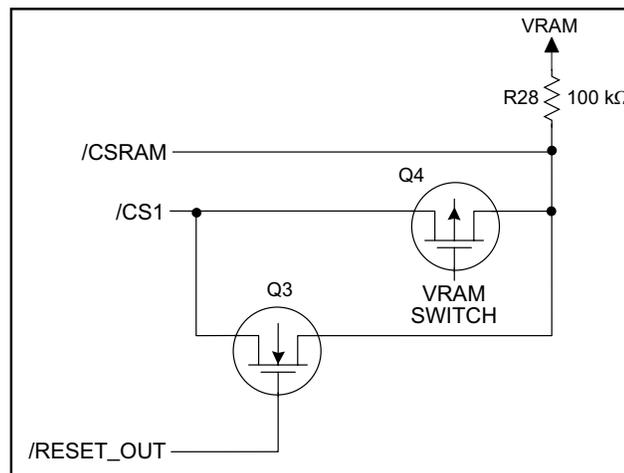
Figure C-3. Chip Select Control Switch

In a powered-up condition, the CS control switch must allow the processor's chip select signal /CS1 to control the SRAM's CS signal /CSRAM. So, with power applied, /CSRAM must be the same signal as /CS1, and with power removed, /CSRAM must be held high (but only needs to be as high as the battery voltage). Q3 and Q4 are MOSFET transistors with opposing polarity. They are both turned on when power is applied to the circuit. They allow the CS signal to pass from the processor to the SRAM so that the processor can periodically access the SRAM. When power is removed from the circuit, the transistors will turn off and isolate /CSRAM from the processor. The isolated /CSRAM line has a 100 kΩ pullup resistor to VRAM (R28). This pullup resistor keeps /CSRAM at the VRAM voltage level (which under no power condition is the backup battery's regulated voltage at a little more than 2 V).

Transistors Q3 and Q4 are of opposite polarity so that a rail-to-rail voltages can be passed. When the /CS1 voltage is low, Q3 will conduct. When the /CS1 voltage is high, Q4 will conduct. It takes time for the transistors to turn on, creating a propagation delay. This delay is typically very small, about 10 ns to 15 ns.
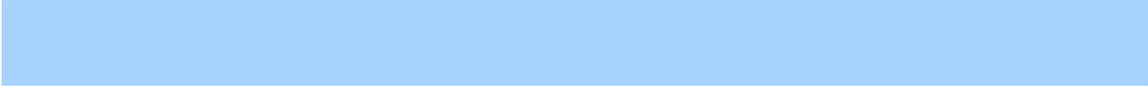
APPENDIX D. SAMPLE CIRCUITS

This appendix details several basic sample circuits that can be used with the RCM2200 modules.

- RS-232/RS-485 Serial Communication
- Keypad and LCD Connections
- External Memory
- D/A Converter

D.1 RS-232/RS-485 Serial Communication
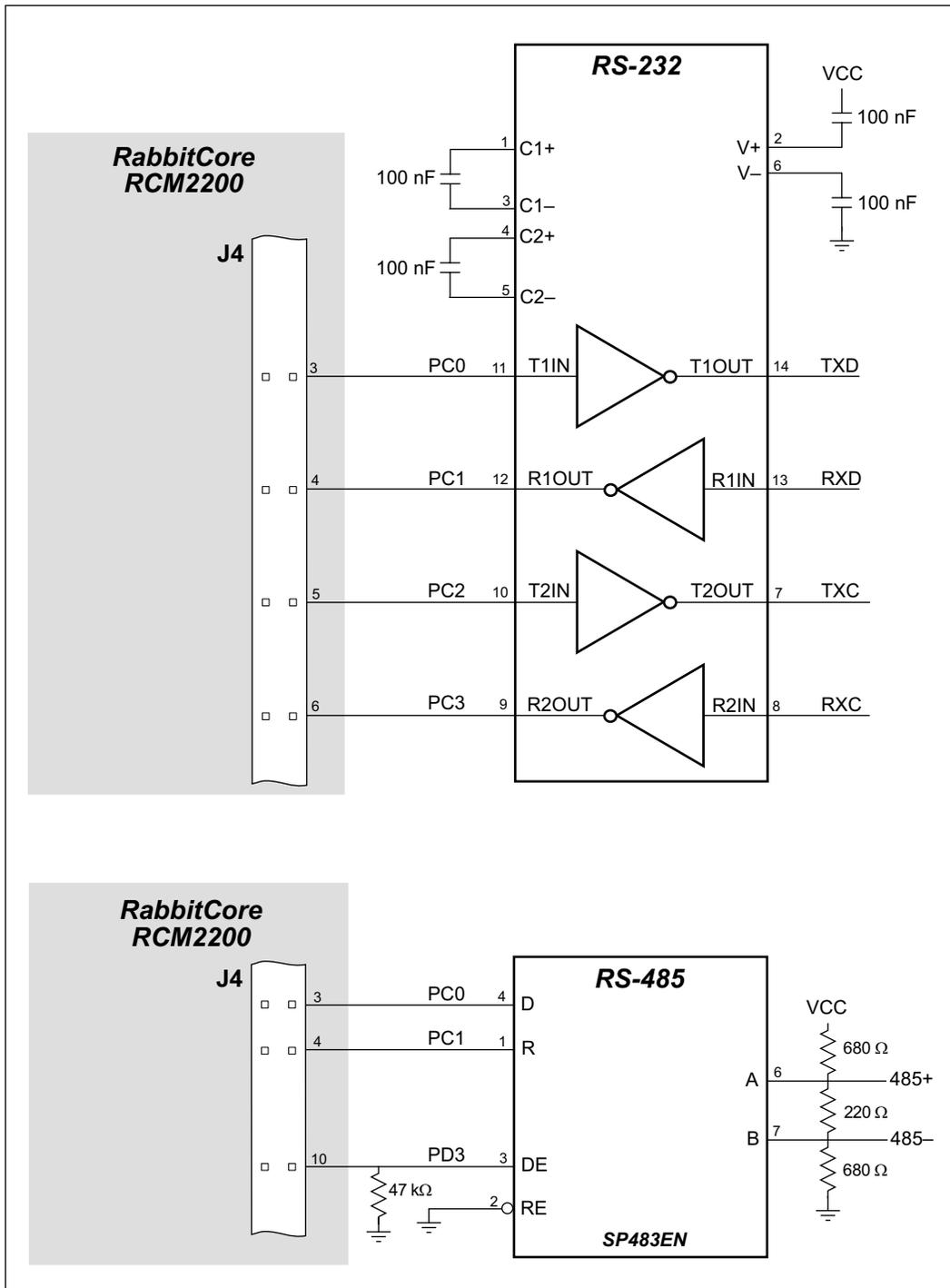
Figure D-1. Sample RS-232 and RS-485 Circuits

Sample Program: **PUTS.C** in **SAMPLES\RCM2200**.

D.2 Keypad and LCD Connections
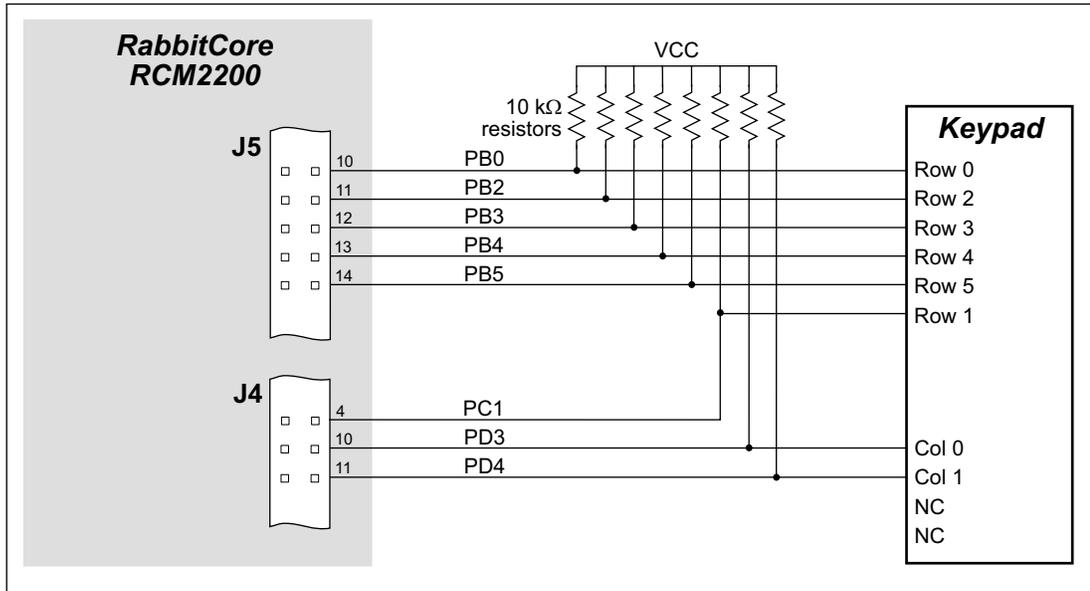
Figure D-2. Sample Keypad Connections

Sample Program: **KEYLCD.C** in **SAMPLES\RCM2200**.
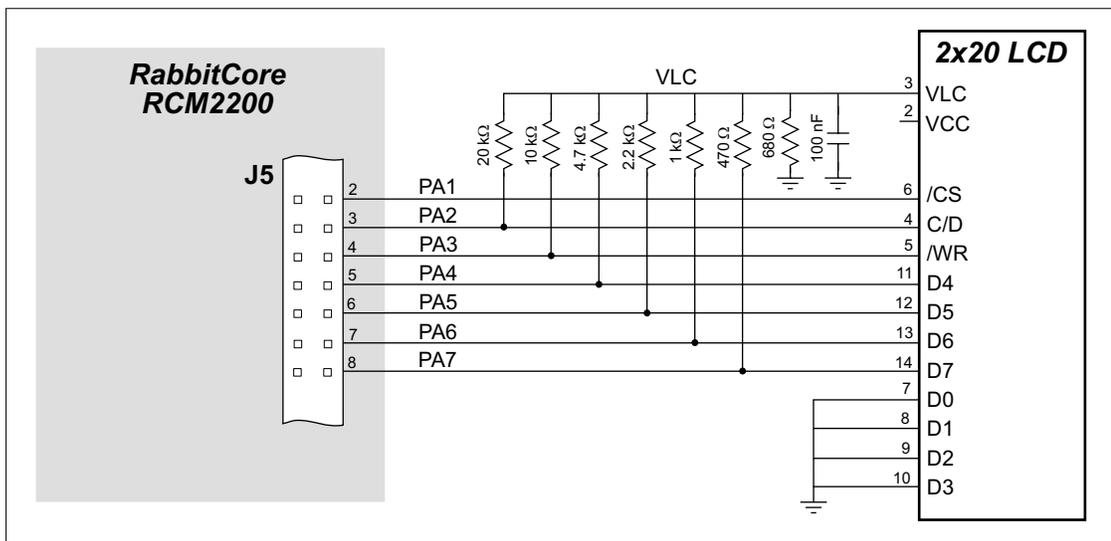
Figure D-3. Sample LCD Connections

Sample Program: **KEYLCD.C** in **SAMPLES\RCM2200**.

D.3 External Memory

The sample circuit can be used with an external 64K memory device. Larger SRAMs can be written to using this scheme by using other available Rabbit 2000 ports (parallel ports A to E) as address lines.
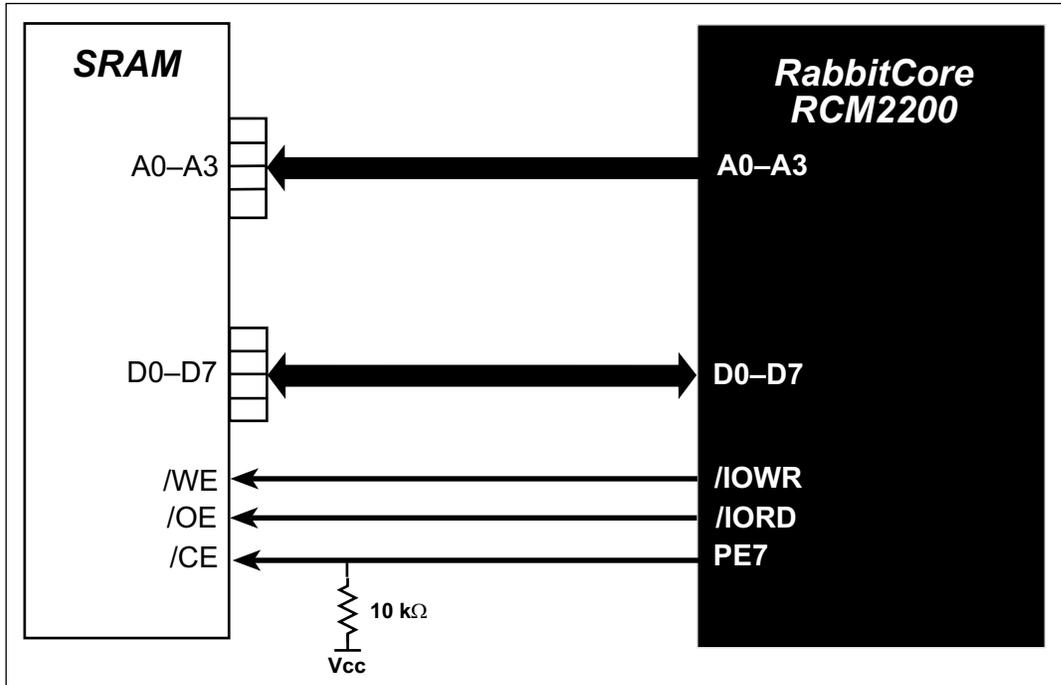
Figure D-4. Sample External Memory Connections

Sample Program: **EXTSRAM.C** in **SAMPLES\RCM2200**.

D.4 D/A Converter

The output will initially be 0 V to -10.05 V after the first inverting op-amp, and 0 V to +10.05 V after the second inverting op-amp. All lows produce 0 V out, FF produces 10 V out. The output can be scaled by changing the feedback resistors on the op-amps. For example, changing 5.11 kΩ to 2.5 kΩ will produce an output from 0 V to -5 V. Op-amps with a very low input offset voltage are recommended.
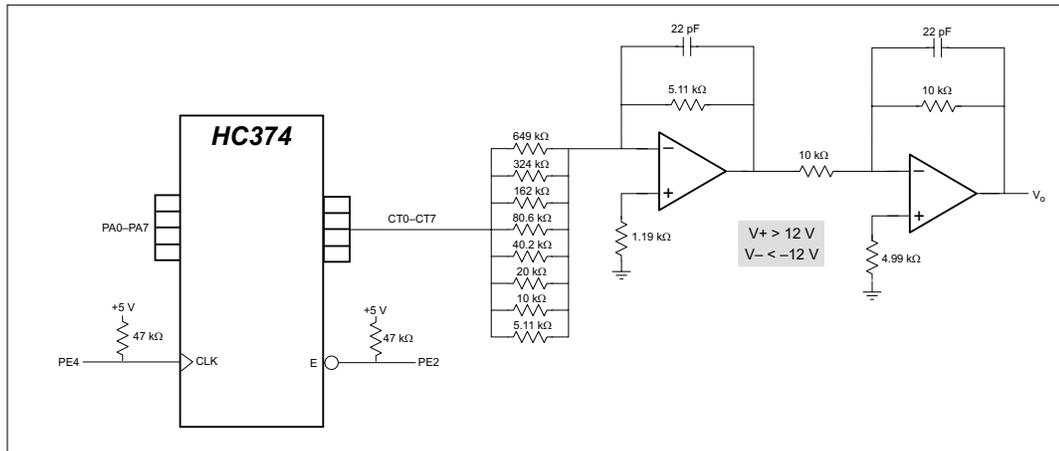
Figure D-5. Sample D/A Converter Connections

APPENDIX E. PROGRAMMING CABLE

Appendix E provides additional theoretical information for the Rabbit 2000™ microprocessor when using the **DIAG** and **PROG** connectors on the programming cable. The **PROG** connector is used only when the programming cable is attached to the programming connector (header J5) while a new application is being developed. Otherwise, the **DIAG** connector on the programming cable allows the programming cable to be used as an RS-232 to CMOS level converter for serial communication, which is appropriate for monitoring or debugging a RabbitCore system while it is running.

The programming port, which is shown in Figure E-1, can serve as a convenient communications port for field setup or other occasional communication need (for example, as a diagnostic port). If the port is simply to perform a setup function, that is, write setup information to flash memory, then the controller can be reset through the programming port and a cold boot performed to start execution of a special program dedicated to this functionality.
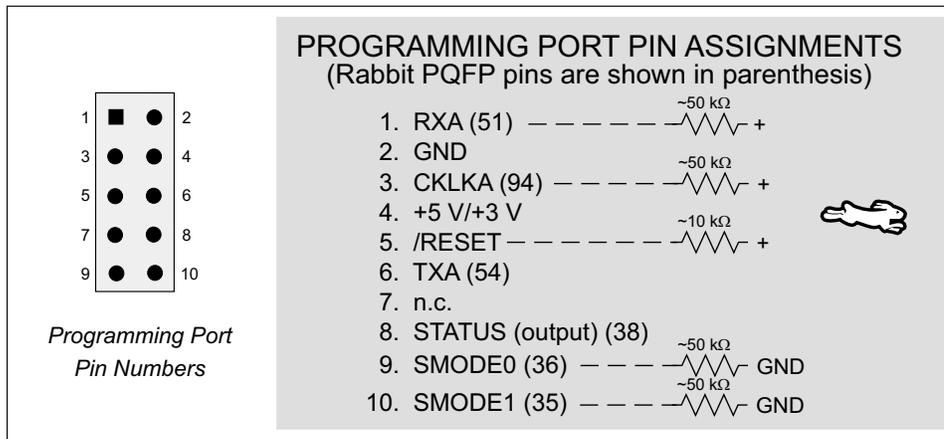
Figure E-1. Programming Port Pin Assignments

When the **PROG** connector is used, the /RESET line can be asserted by manipulating DTR and the STATUS line can be read as DSR on the serial port. The target can be restarted by pulsing reset and then, after a short delay, sending a special character string at 2400 bps. To simply restart the BIOS, the string 80h, 24h, 80h can be sent. When the BIOS is started, it can tell whether the programming cable is connected because the SMODE1 and SMODE0 pins are sensed as being high.

Alternatively, the **DIAG** connector can be used to connect the programming port. The /RESET line and the SMODE1 and SMODE0 pins are not connected to this connector. The programming port is then enabled as a diagnostic port by polling the port periodically to see if communication needs to begin or to enable the port and wait for interrupts. The pull-up resistors on RXA and CLKA prevent spurious data reception that might take place if the pins floated.

If the clocked serial mode is used, the serial port can be driven by having two toggling lines that can be driven and one line that can be sensed. This allows a conversation with a device that does not have an asynchronous serial port but that has two output signal lines and one input signal line.

The line TXA (also called PC6) is zero after reset if the cold-boot mode is not enabled. A possible way to detect the presence of a cable on the programming port is for the cable to connect TXA to one of the SMODE pins and then test for the connection by raising PC6 (by configuring it as a general output bit) and reading the SMODE pin after the cold-boot mode has been disabled. The value of the SMODE pin is read from the SPCR register.

Once you establish that the programming port will never again be needed for programming, it is possible to use the programming port for additional I/O lines. Table E-1 lists the pins available for this alternate configuration.

Table E-1. RCM2200 Programming Port Pinout Configurations

Pin		Pin Name	Default Use	Alternate Use	Notes
Header J1	1	RXA	Serial Port A	PC7—Input	
	2	GND			
	3	CLKA		PB1—Bitwise or parallel programmable input	
	4	VCC			
	5	RESET			Connected to reset generator U1
	6	TXA	Serial Port A	PC6—Output	
	8	STATUS		Output	
	9	SMODE0		Input	Must be low when RCM2200 boots up
	10	SMODE1		Input	Must be low when RCM2200 boots up

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SCHEMATICS

090-0120 RCM2200 Schematic

www.rabbitsemiconductor.com/documentation/schemat/090-0120.pdf

090-0122 RCM2200 Prototyping Board Schematic

www.rabbitsemiconductor.com/documentation/schemat/090-0122.pdf

090-0128 Programming Cable Schematic

www.rabbitsemiconductor.com/documentation/schemat/090-0128.pdf

The schematics included with the printed manual were the latest revisions available at the time the manual was last revised. The online versions of the manual contain links to the latest revised schematic on the Web site. You may also use the URL information provided above to access the latest schematics directly.