RabbitCore RCM2200

C-Programmable Module with Ethernet

User's Manual

019–0097 • 020201–B

RabbitCore RCM2200 User's Manual

Part Number 019-0097 • 020201–B • Printed in U.S.A.

Notice to Users

Z-WORLD PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE-SUPPORT DEVICES OR SYSTEMS UNLESS A SPECIFIC WRITTEN AGREEMENT REGARDING SUCH INTENDED USE IS ENTERED INTO BETWEEN THE CUSTOMER AND Z-WORLD PRIOR TO USE. Life-support devices or systems are devices or systems intended for surgical implantation into the body or to sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling and user's manual, can be reasonably expected to result in significant injury.

No complex software or hardware system is perfect. Bugs are always present in a system of any size. In order to prevent danger to life or property, it is the responsibility of the system designer to incorporate redundant protective mechanisms appropriate to the risk involved.

All Z-World products are 100 percent functionally tested. Additional testing may include visual quality control inspections or mechanical defects analyzer inspections. Specifications are based on characterization of tested sample units rather than testing over temperature and voltage of each unit. Z-World may qualify components to operate within a range of parameters that is different from the manufacturer's recommended range. This strategy is believed to be more economical and effective. Additional testing or burn-in of an individual unit is available by special arrangement.

Trademarks

Rabbit 2000 is a trademark of Rabbit Semiconductor.

Dynamic C is a registered trademark of Z-World Inc.

Z-World, Inc.

2900 Spafford Street
Davis, California 95616-6800
USA

Telephone: (530) 757-3737
Fax: (530) 757-3792

www.zworld.com

Rabbit Semiconductor

2932 Spafford Street
Davis, California 95616-6800
USA

Telephone: (530) 757-8400
Fax: (530) 757-8402

www.rabbitsemiconductor.com

TABLE OF CONTENTS

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 Premier 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.

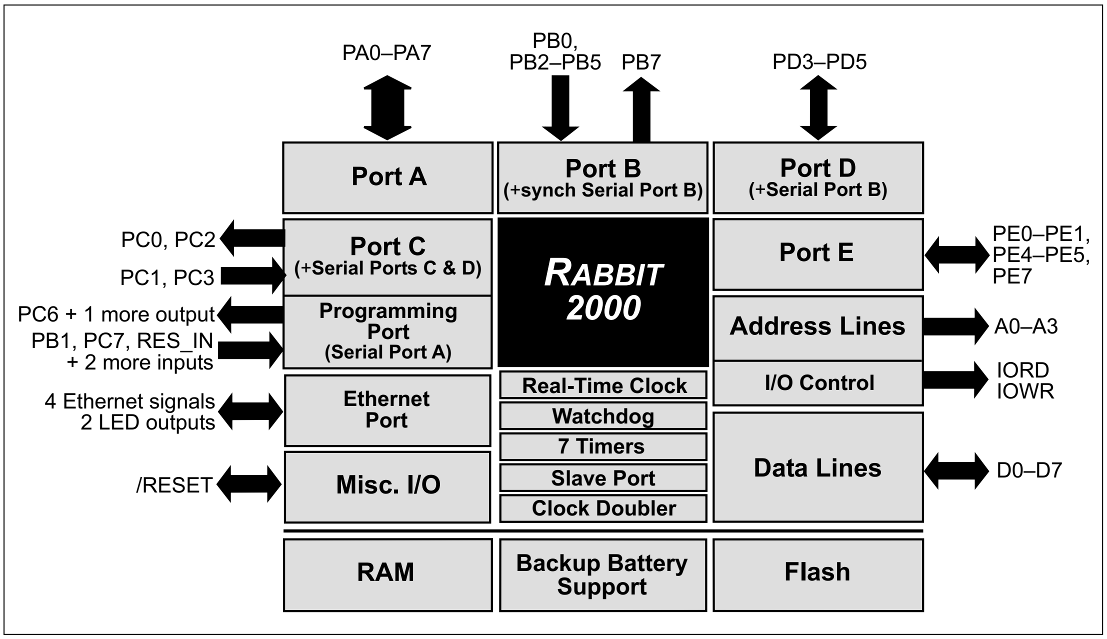


Figure 1. Rabbit Subsystems

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.

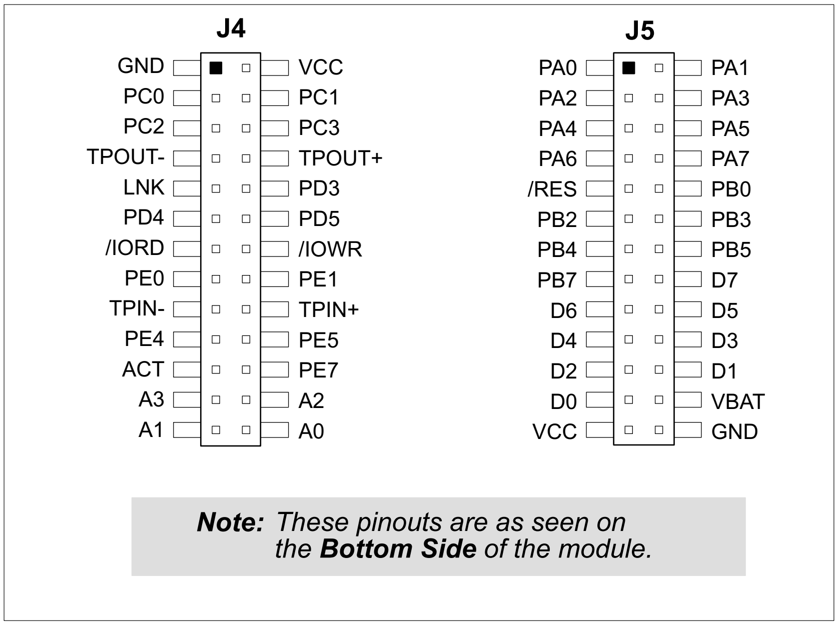


Figure 2. RCM2200 I/O Pinouts

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

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.

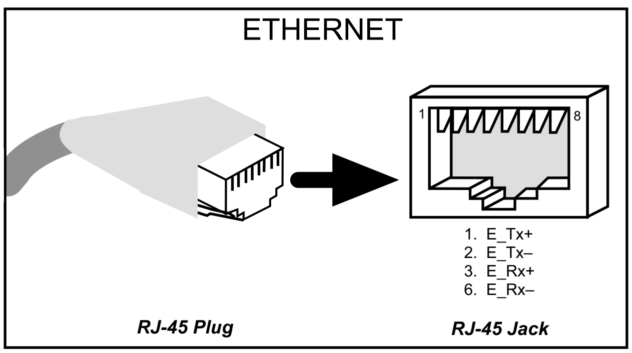


Figure 3. RJ-45 Ethernet Port Pinout

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.

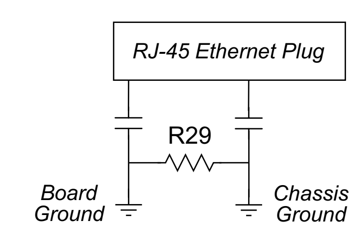


Figure 4. Isolation Resistor R29

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 Other Hardware

2.3.1 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 Memory

2.4.1 SRAM

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

The existing standard models of the RCM2200 come with 128K or 512K of SRAM. Figure 5 shows the locations and the jumper settings for the jumpers at JP7 used to set the SRAM size. The “jumpers” are 0 Ω surface-mounted resistors.

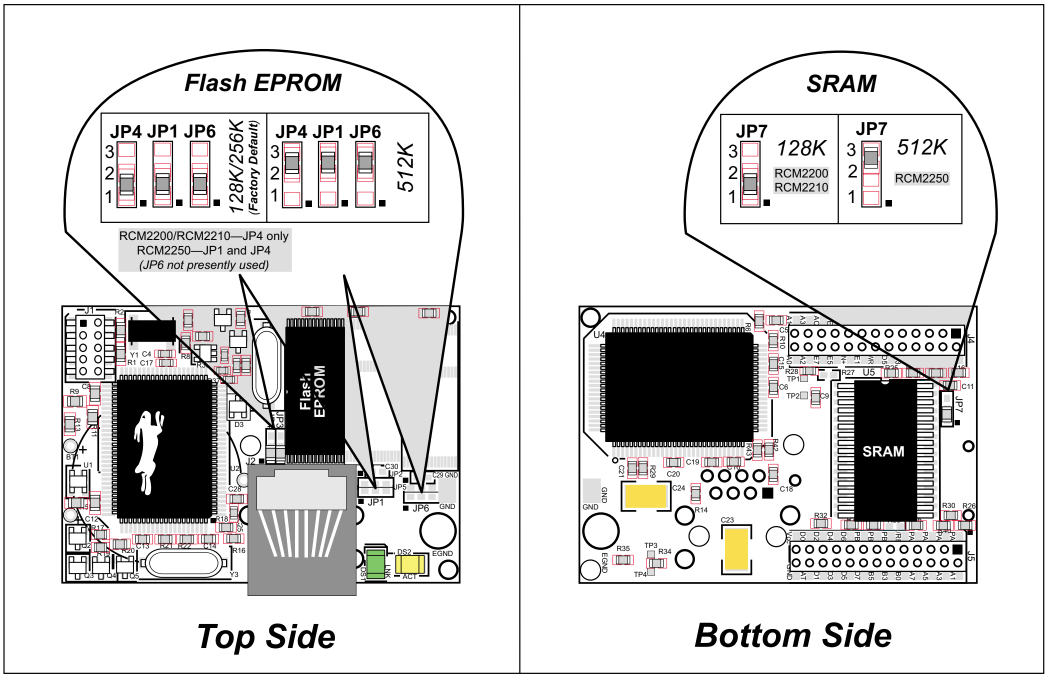


Figure 5. RCM2200 Jumper Settings for SRAM and Flash EPROM Size

2.4.2 Flash EPROM

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

The existing standard models of the RCM2200 come with one or two 256K flash EPROM. There is room at U7 for a third flash EPROM, but this configuration is not presently available as a standard RCM2200 version. Figure 5 shows the locations and the jumper settings for the jumpers at JP1, JP4, and JP6 used to set the flash EPROM size. The “jumpers” are 0 Ω surface-mounted resistors.

> **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.

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 downloaded program. See Application Note 218, ***Implementing a Serial Download Manager for a 256K Flash***, for details.

2.4.3 Dynamic C BIOS Source Files

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

3. SOFTWARE REFERENCE

Dynamic C Premier 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 Premier 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 is automatically 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 E, “Programming Cable,” for more information.

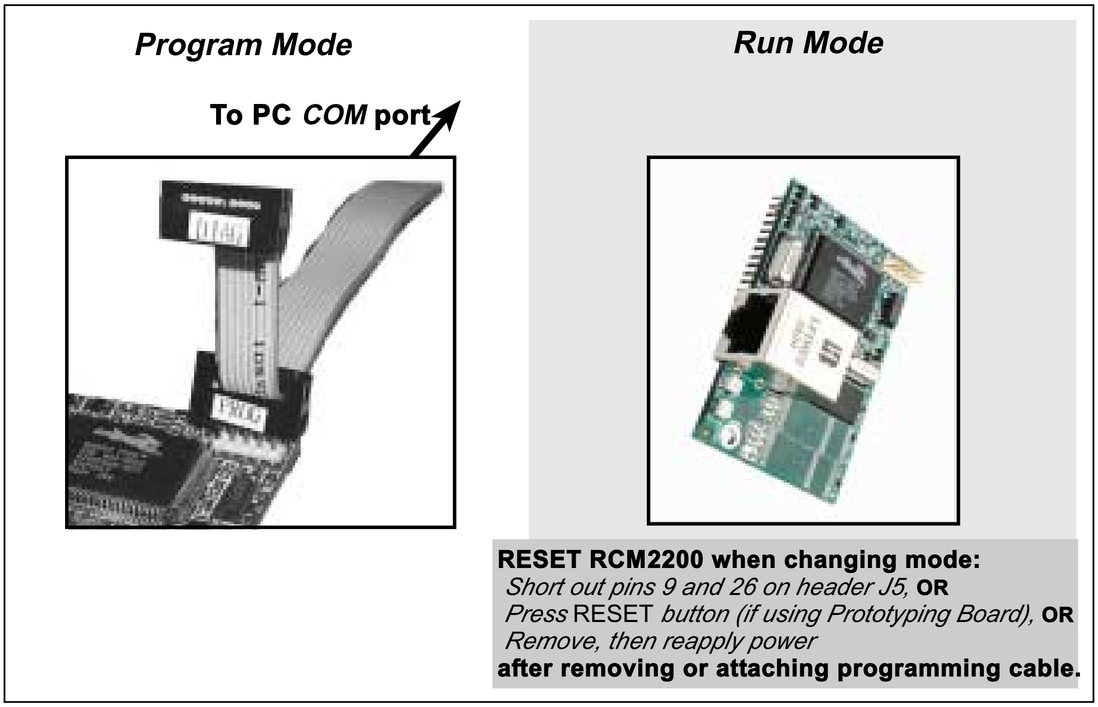


Figure 6. Switching Between Program Mode and Run Mode

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 6.

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 6.

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

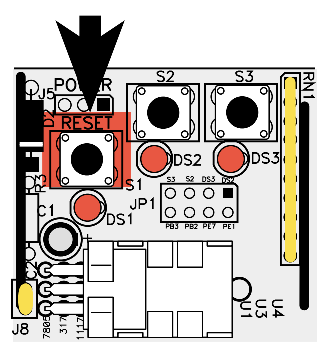
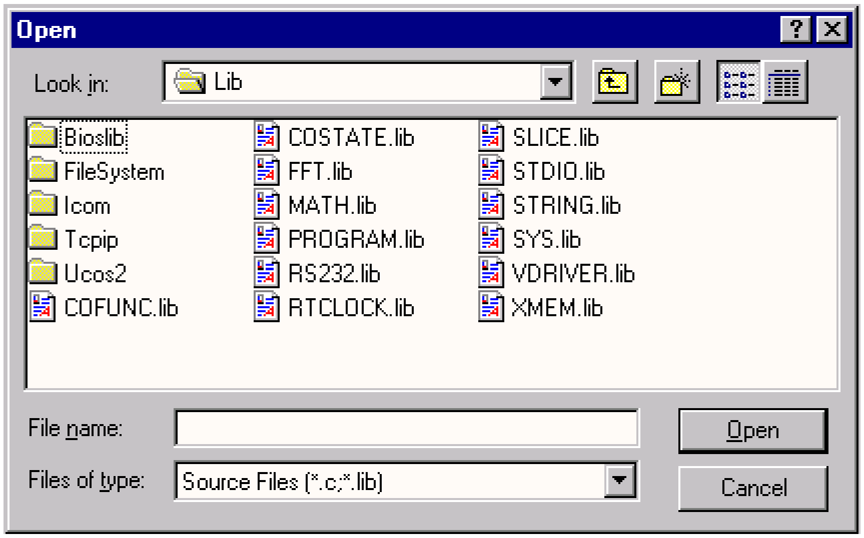


Figure 7. Location of Reset Button

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 Premier 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):

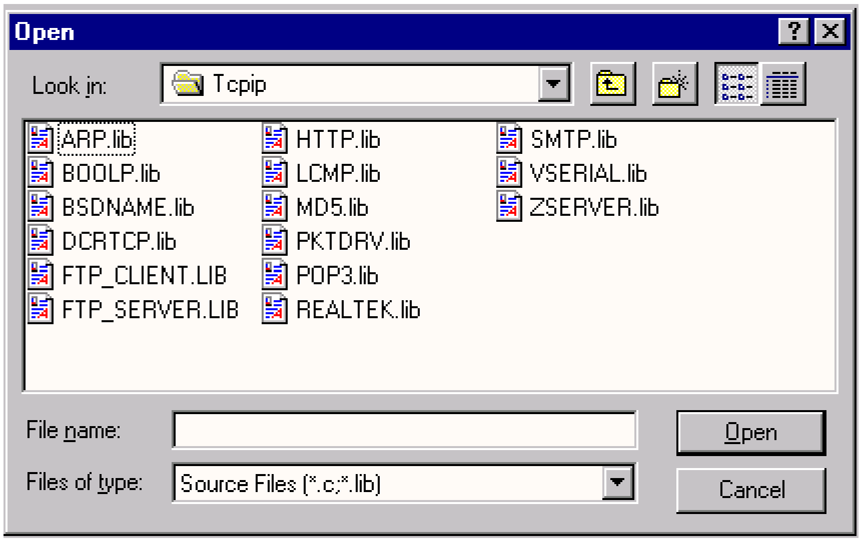
```
WrPortI(GOCR, &GOCRShadow, (GOCRShadow | 0xc0));
```

3.3.2 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 Premier User's Manual*** and Technical Note 213, ***Rabbit 2000 Serial Port Software***.

3.3.3 TCP/IP Drivers

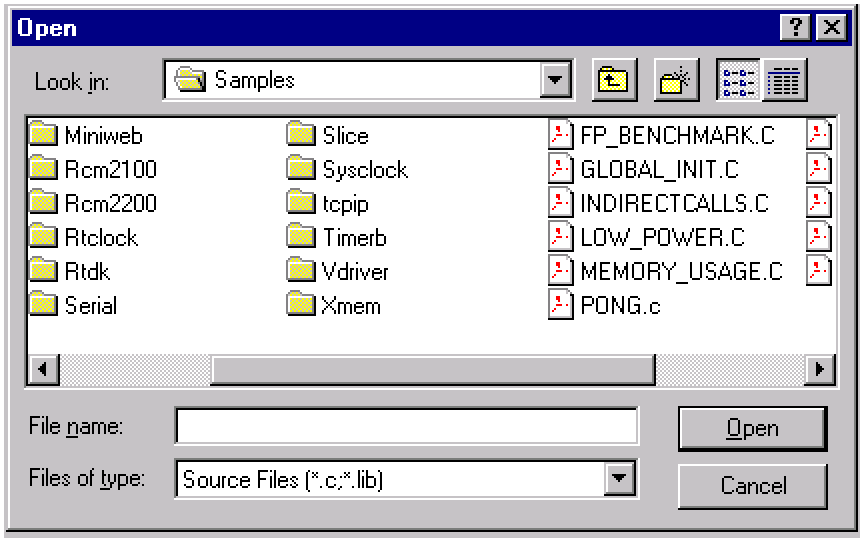
The TCP/IP drivers are located in the **TCPIP** directory.



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 , "The Dynamic C BIOS source files handle different standard RAM and flash EPROM sizes automatically.,") and must be connected to a PC using the programming cable.

More complete information on Dynamic C is provided in the ***Dynamic C Premier 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

A special edition of Dynamic C, Dynamic C SE, is included on the CD that comes with the RCM2200 Development Kit, and has been customized with all the libraries and features needed to develop and run an application on the RCM2200.

More advanced users who may need upgrades and additional capabilities for other Z-World products in the future are encouraged to consider the standard edition of Dynamic C Premier, which Z-World plans to fully supported with upgrades now and into the future.

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.

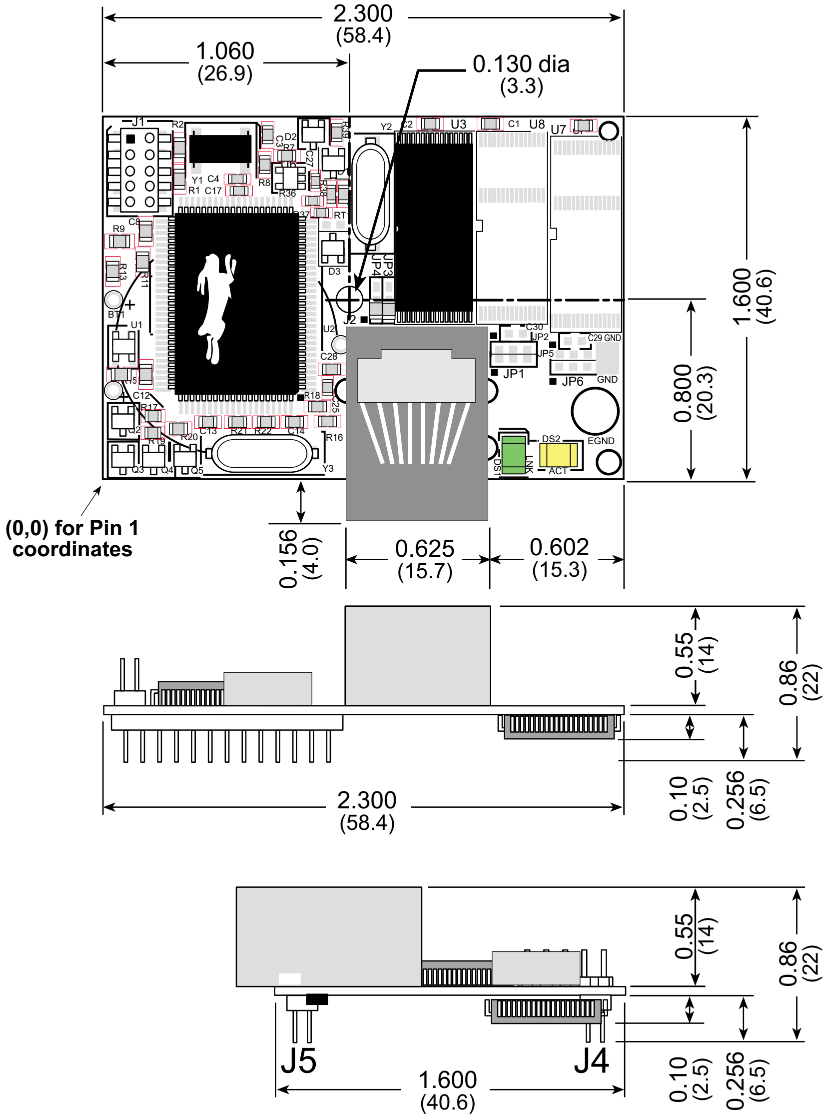


Figure A-1. RCM2200 Dimensions

Table A-1 provides the pin 1 locations for the RCM2200 headers viewed from the top side (as in Figure A-1).

Table A-1. RCM2200 Header Pin 1 Locations

Header	Description	Pin 1 (x,y) Coordinates (Inches)
J4	RabbitCore RCM2200 user board interface	(0.100, 1.446)
J5	RabbitCore RCM2200 user board interface	(0.100, 0.196)
J1	Programming header (top side)	(0.125, 1.515)
DS1	LNK LED	(1.815, 0.105)
DS2	ACT LED	(2.015, 0.105)

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."

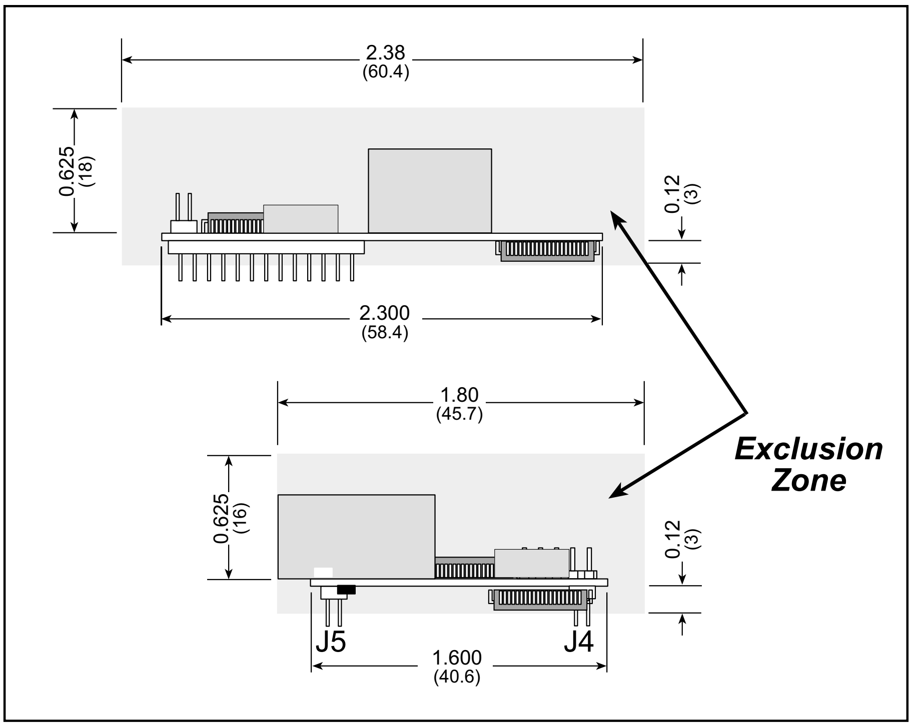


Figure A-2. RCM2200 "Exclusion Zone"

Table A-2 lists the electrical, mechanical, and environmental specifications for the RCM2200.

Table A-2. RabbitCore RCM2200 Specifications

Parameter	Specification
Board Size	1.60" × 2.30" × 0.86" (41 mm × 59 mm × 22 mm)
Operating Temperature	–40°C to +70°C
Humidity	5% to 95%, noncondensing
Input Voltage	4.75 V to 5.25 V DC
Current	134 mA at 22.1 MHz, 5 V DC; 10 mA additional with programming cable attached
General-Purpose I/O	26 parallel I/0 lines grouped in five 8-bit ports (shared with serial ports): 16 configurable for I/O, 7 fixed inputs, 3 fixed outputs
Memory, I/O Interface	4 address lines, 8 data lines, I/O read/write
Additional Digital Inputs	Startup mode (2), reset in, Serial Port A (1)
Additional Digital Outputs	Status, reset out, Serial Port A (1)
Ethernet Interface	10base-T
Microprocessor	Rabbit 2000™
Clock	22.1 MHz
SRAM	128K × 8 or 512K × 8, surface mount
Flash Memory	One or two 256K × 8, surface mount
Timers	Five 8-bit timers cascadable in pairs, one 10-bit timer with 2 match registers that each have an interrupt
Serial Ports	Three CMOS-compatible ports. One port is configurable as a clocked port, a fourth clocked pin is available on the programming port.
Serial Rate	CMOS: maximum asynchronous 691,200 bps maximum synchronous 5,529,600 bps
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
Watchdog/Supervisor	Yes
Time/Date Clock	Yes
Socket Strip (for connection to headers J4 and J5)	2x13, 2 mm pitch
Backup Battery	Provision for user-supplied backup battery (2.85 V to 3.15 V) via connections on header J5

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.

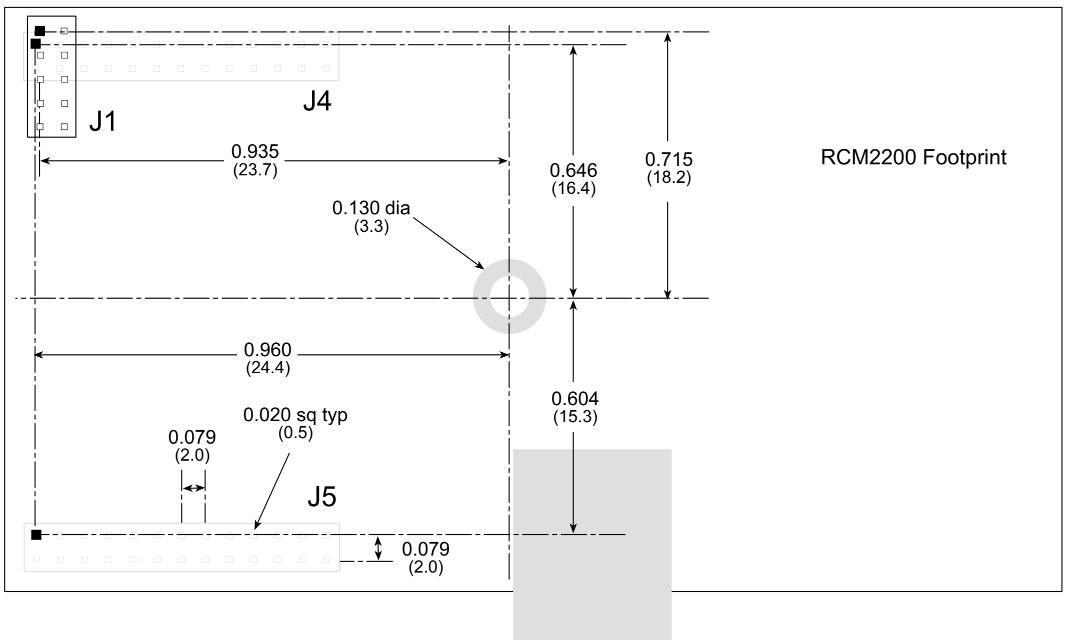


Figure A-3. User Board Footprint for RCM2200

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-3 lists the capacitance for the various RCM2200 I/O ports.

Table A-3. 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.

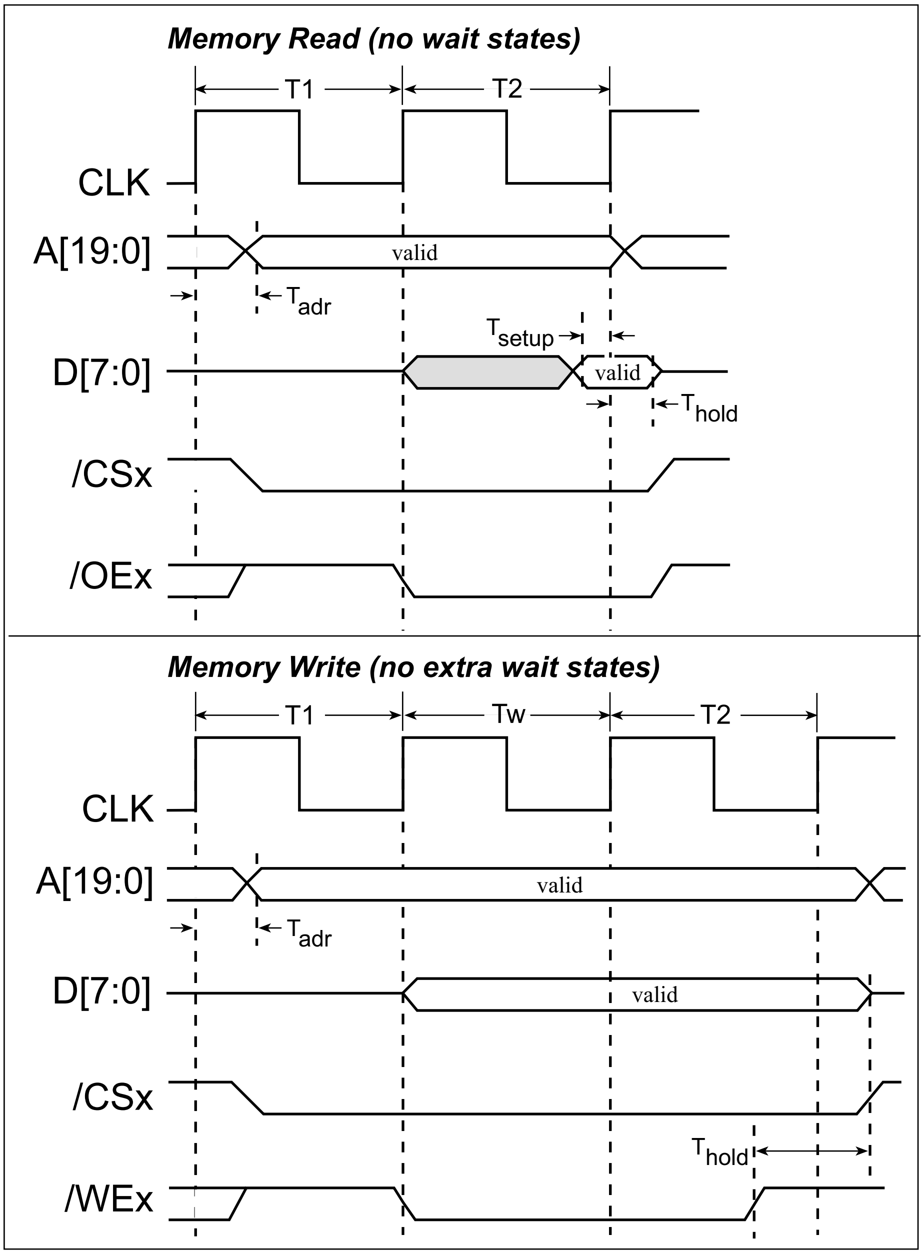


Figure A-4. Memory Read and Write Cycles

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-4 lists the parameters shown in these figures and provides minimum or measured values.

Table A-4. 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-5 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-5. 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-6 (sinking) V_{DD} = 4.5 V		0.2	0.4	V
V_{OH}	CMOS Output High Voltage	I_{OH} = See Table A-6 (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-6 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-6. 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, 1, 0]	8/8	12/12
PC [6, 2, 0]	8/8	12/12
PD [5:4]	8/8	12/12
PD3**	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 the first footnote.

A.5 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-5. The conformal coating protects these high-impedance circuits from the effects of moisture and contaminants over time.

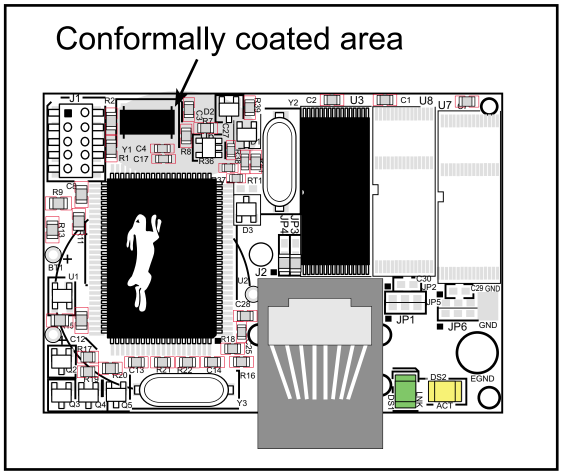


Figure A-5. RCM2200 Areas Receiving Conformal Coating

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 Prototyping 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.

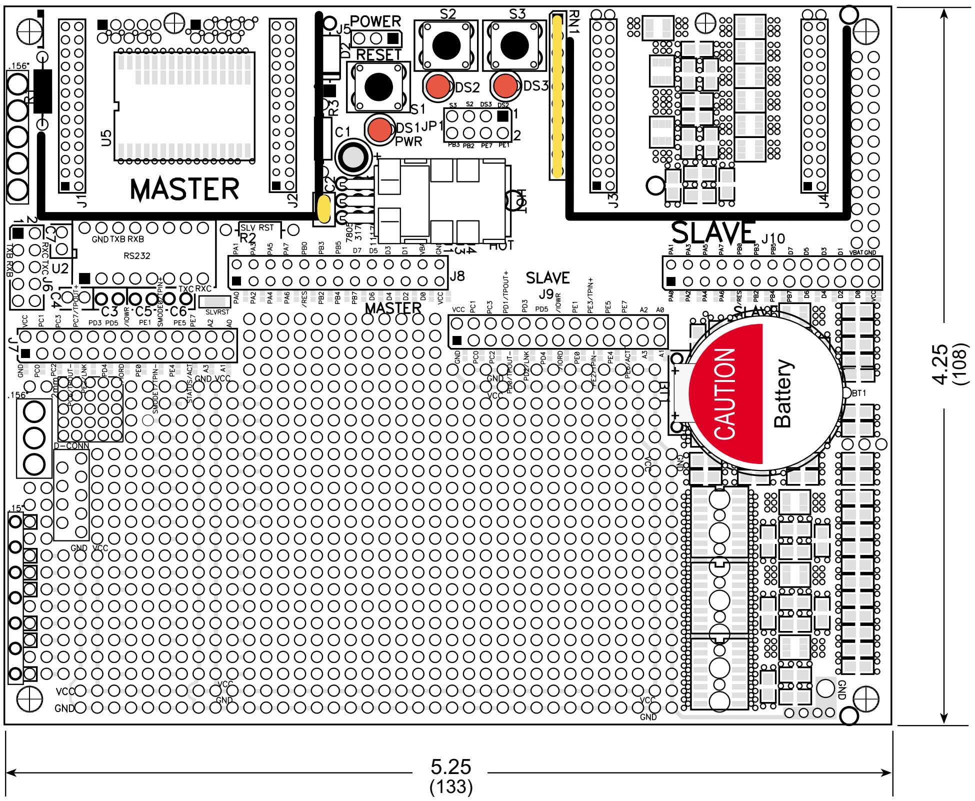


Figure B-1. RCM2200 Prototyping Board Dimensions

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.

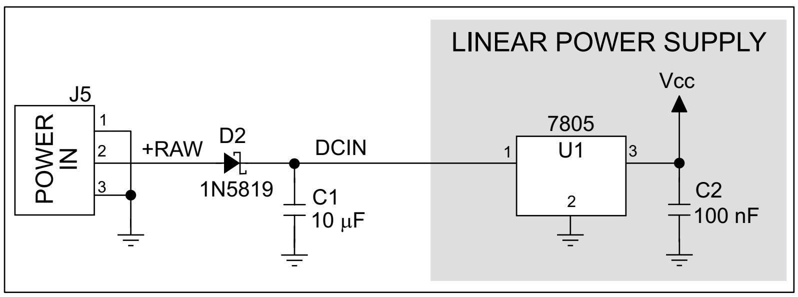


Figure B-2. Prototyping Board Power Supply

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. 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.

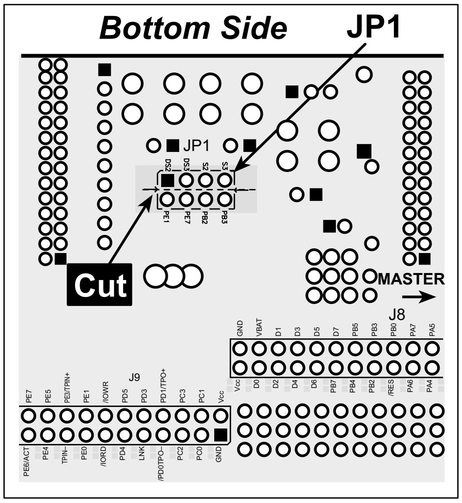


Figure B-3. Where to Cut Traces to Permanently Disable Demonstration Hardware on Prototyping Board

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), 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.

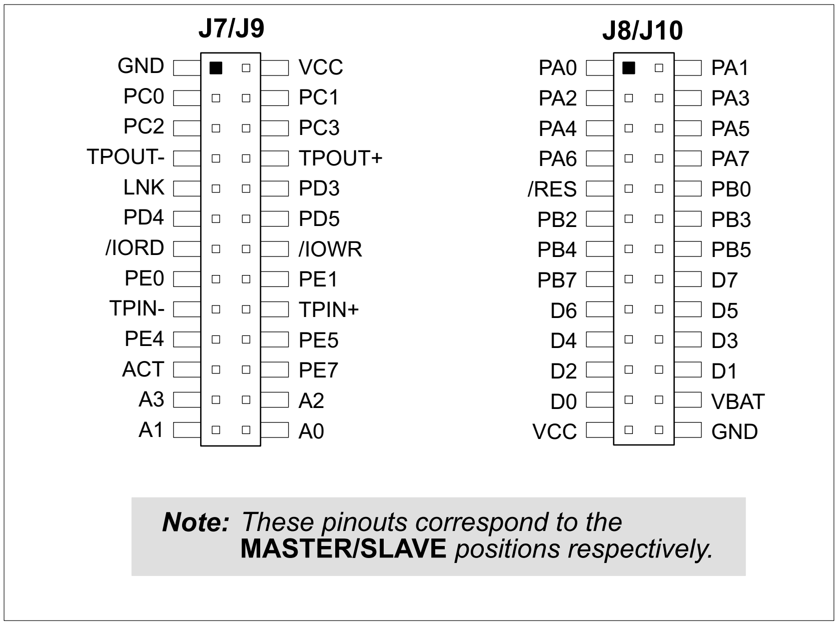


Figure B-4. RCM2200 Prototyping Board Pinout (Top View)

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.

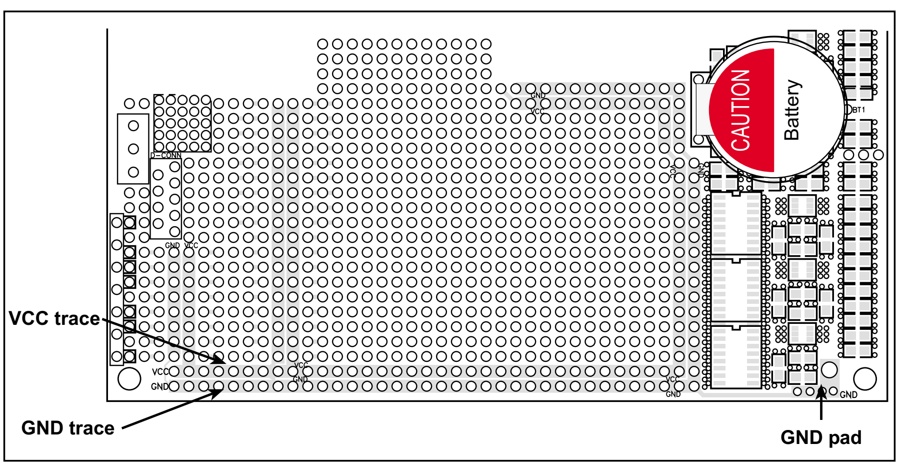


Figure B-5. VCC and GND Traces Along Edge of Prototyping Board

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.

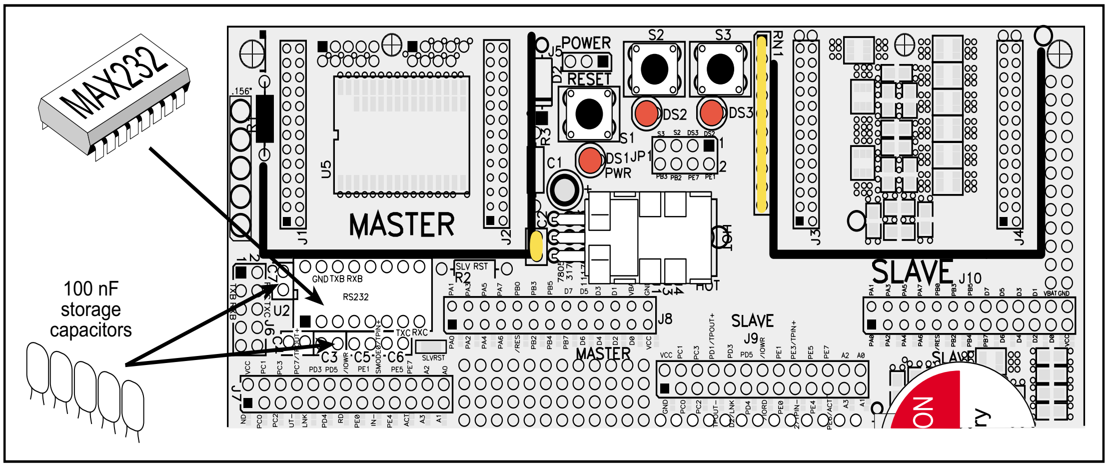


Figure B-6. Location for User-Supplied RS-232 Transceiver and Charge Storage Capacitors on Back Side of Prototyping Board

> **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.

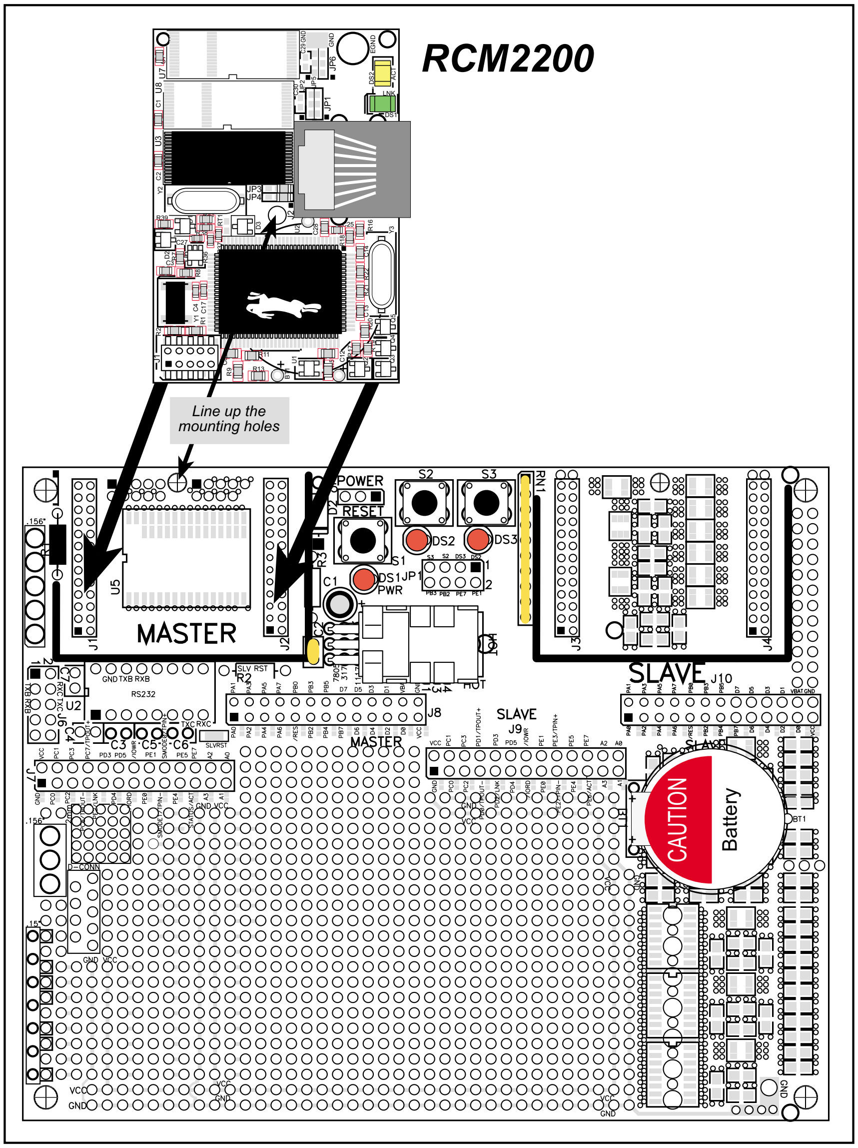


Figure B-7. Install the RCM2200 on the Prototyping Board

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 Premier.

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.

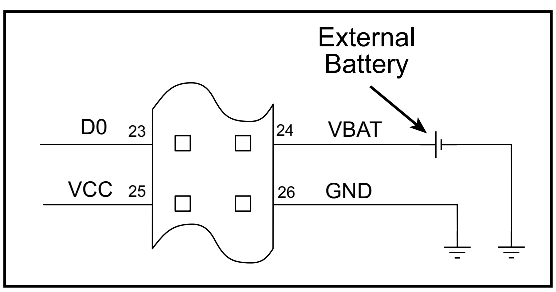


Figure C-1. External Battery Connections at Header J5

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:

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

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.

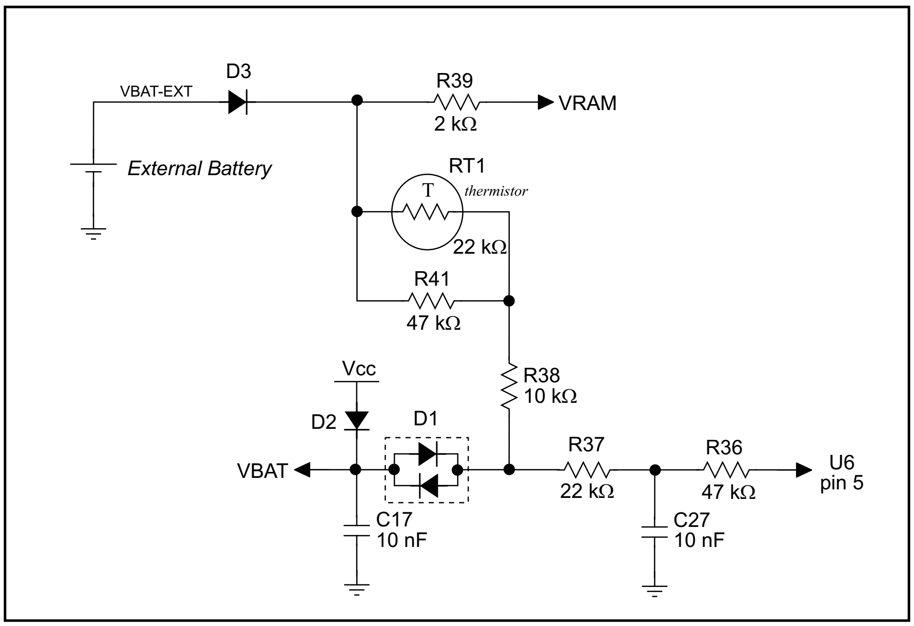


Figure C-2. RCM2200 Battery-Backup Circuit

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.

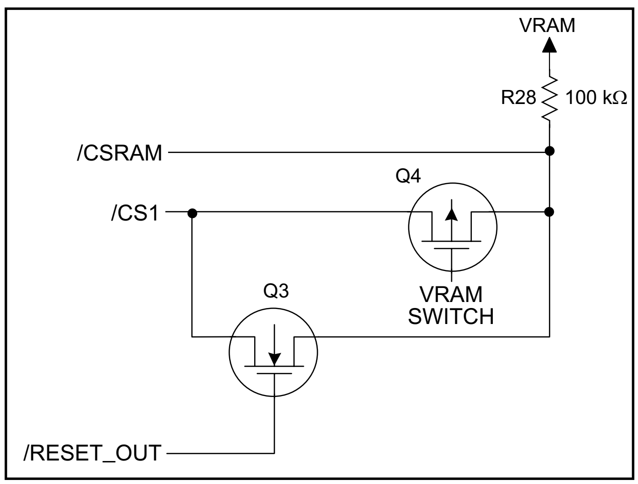


Figure C-3. Chip Select Control Switch

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
- Keypad and LCD Connections
- D/A Converter

D.1 RS-232/RS-485 Serial Communication

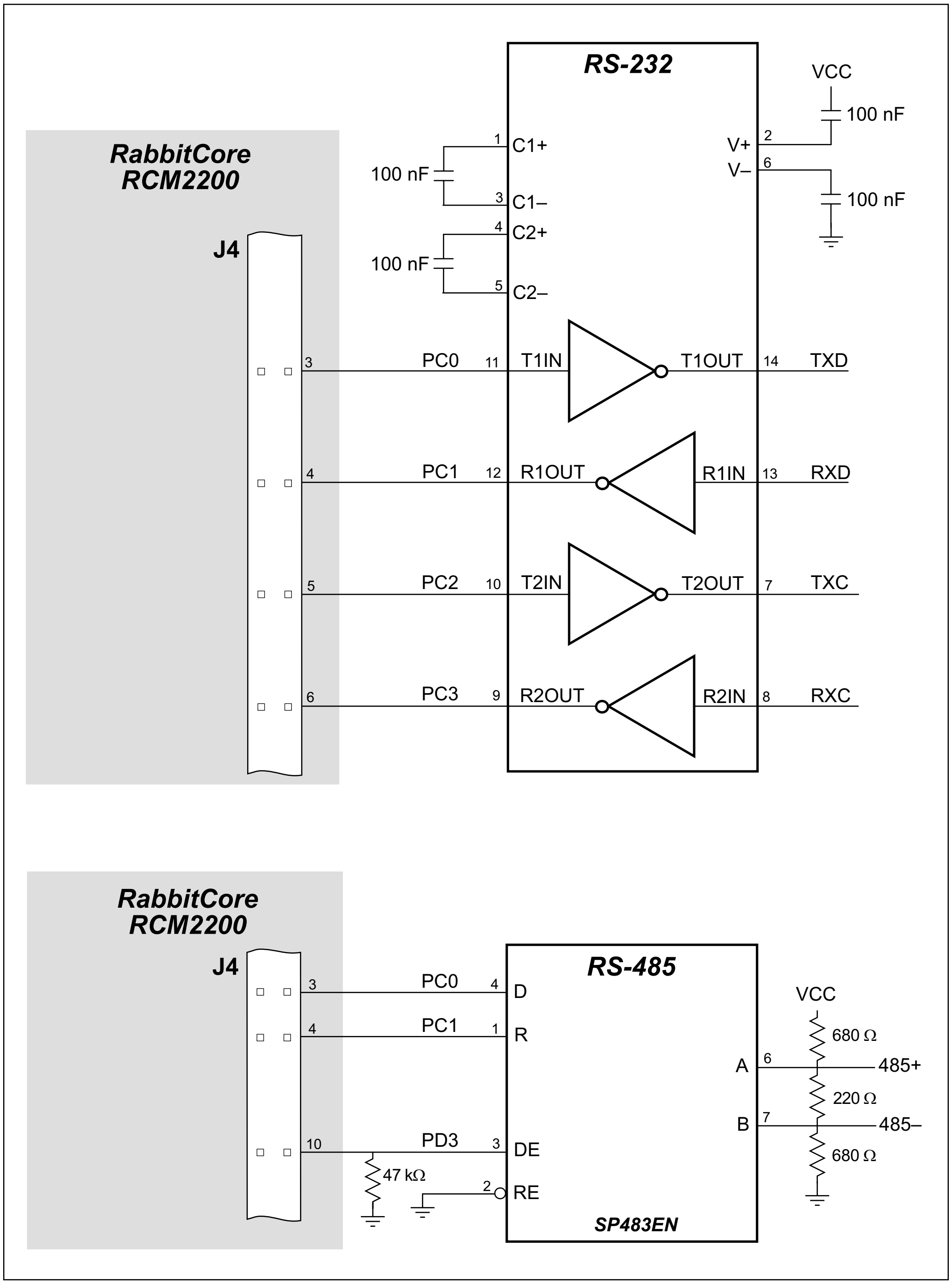


Figure D-1. Sample RS-232 and RS-485 Circuits

Sample Program: **`PUTS.C`** in **`SAMPLES/RCM2200`**.

D.2 Keypad and LCD Connections

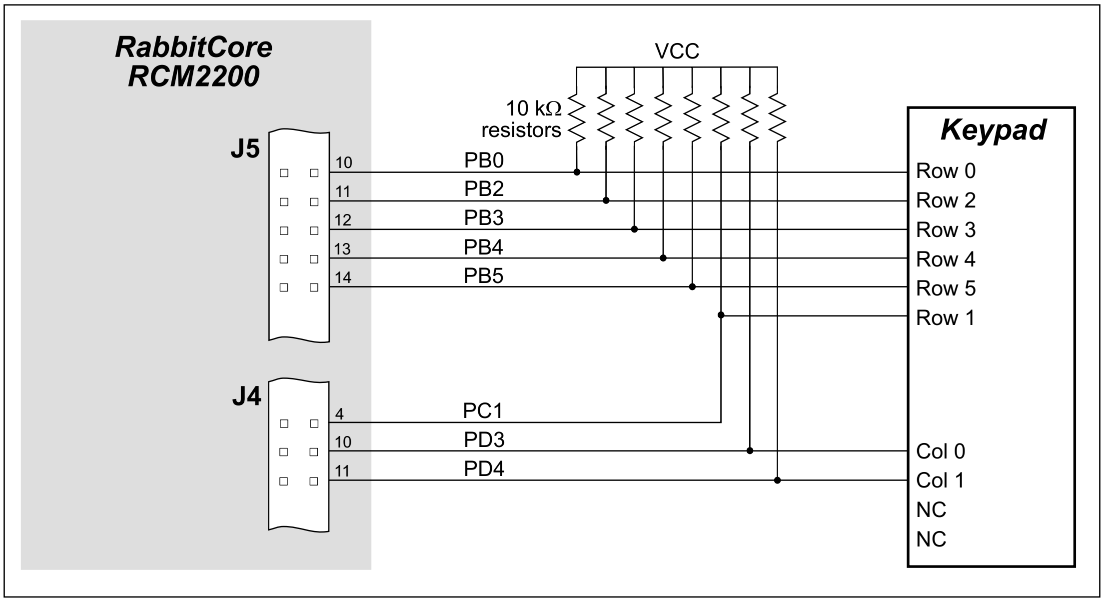


Figure D-2. Sample Keypad Connections

Sample Program: **`KEYLCD.C`** in **`SAMPLES/RCM2200`**.

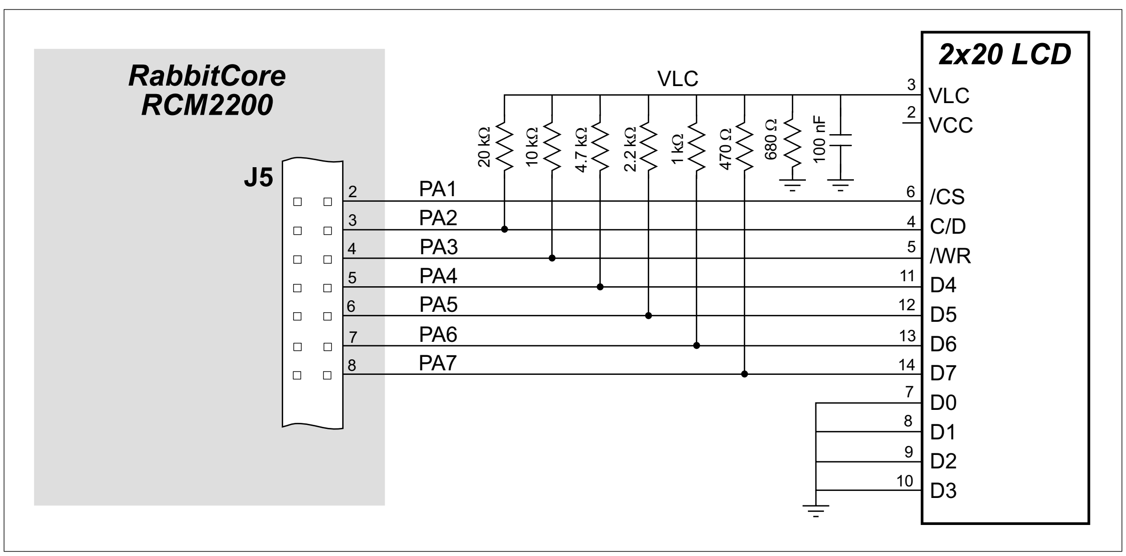


Figure D-3. Sample LCD Connections

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.

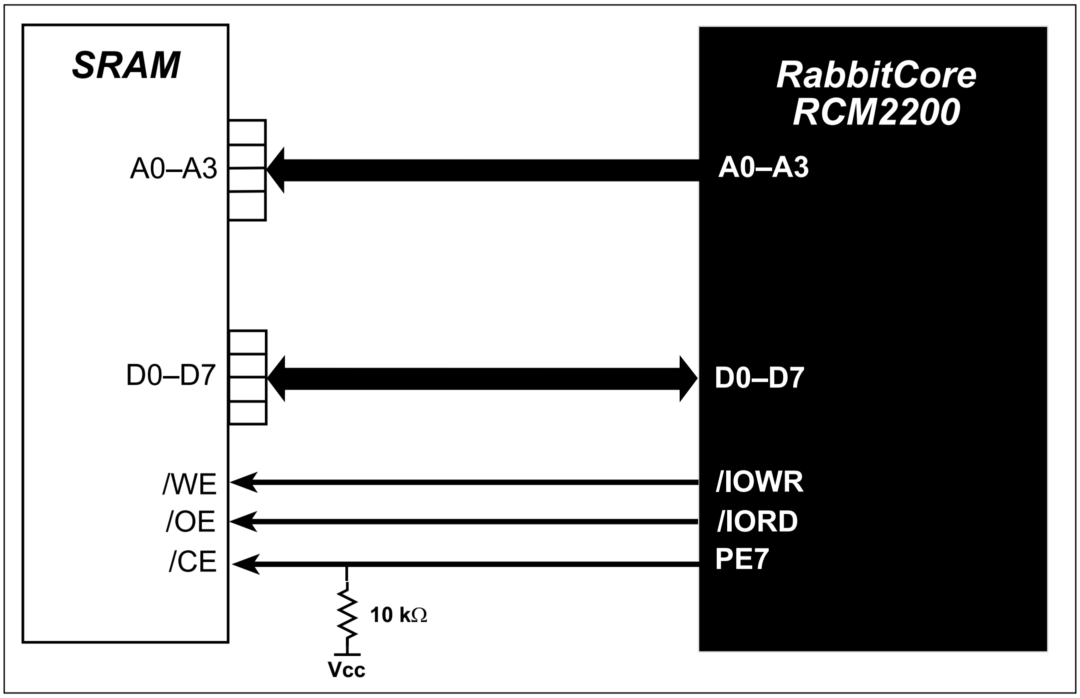


Figure D-4. Sample External Memory Connections

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.

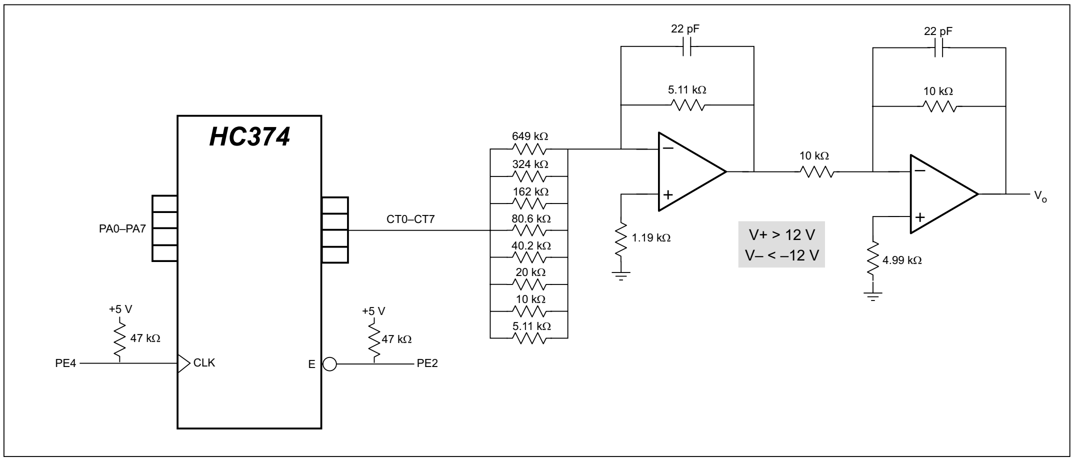


Figure D-5. Sample D/A Converter Connections

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). There are several ways that the port can be automatically integrated into software. 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.

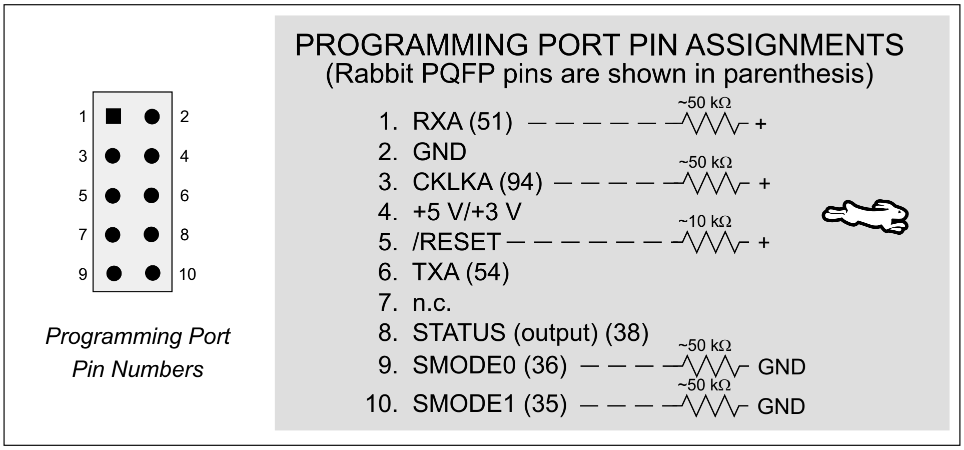


Figure E-1. Programming Port Pin Assignments

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. This will cause the Rabbit 2000 to enter the bootstrap mode. The Dynamic C programming mode then can have an escape message that will enable the diagnostic serial port function.

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	PC6—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	PC7—Output	
	8	STATUS		Output	
	9	SMODE0		Input	Must be low when RCM2200 boots up
	10	SMODE1		Input	Must be low when RCM2200 boots up

APPENDIX F. EXTERNAL INTERRUPTS

Appendix F provides information about using the RCM2200 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.

Table F-1 lists the general-purpose Parallel Port E I/O pins that can be used for external interrupts.

Table F-1. Rabbit 2000 Parallel Port E Interrupts

Pin	Default Use	Alternate Use
PE0	General-Purpose I/O	INT0A input
PE1		INT1A input
PE4		INT0B input
PE5		INT1B input

Figure F-1 shows these pins.

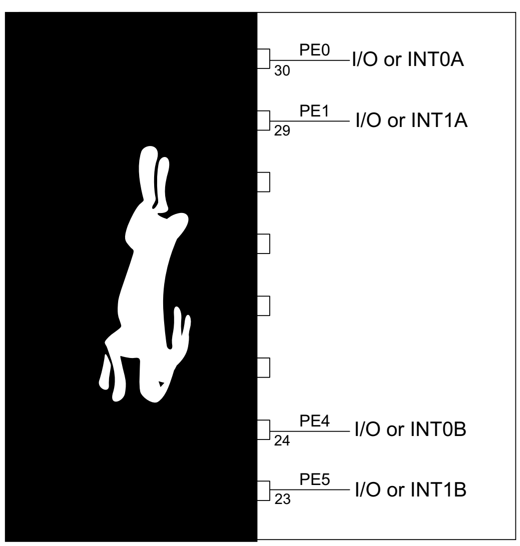


Figure F-1. Rabbit 2000 Interrupt Pins

F.1 Use of External Interrupts

Figure F-2 shows a block diagram of how the Rabbit 2000 external interrupt logic is used in general.

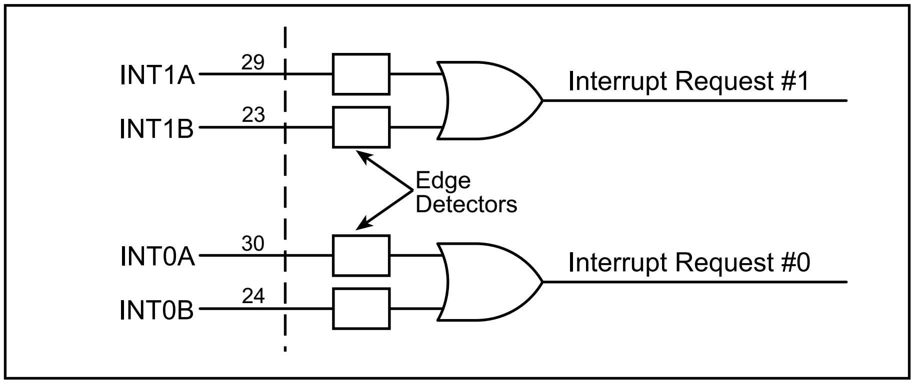


Figure F-2. Rabbit 2000 External Interrupt Logic

Interrupts on the Rabbit 2000 can take place at three priority levels from low to high priority, and are numbered 1, 2 and 3. Each on-chip device, including the two external interrupts, can be assigned a priority at which interrupts will take place. For interrupts that have been assigned the same programmed priority, there is an implicit priority with external interrupt #1 having the highest priority, external interrupt #0 the second highest, and the remaining on-chip devices having lower priorities in the order specified in Section 7.8, "Rabbit Interrupt Structure," in the ***Rabbit 2000 User's Manual***.

The two independent interrupts are generated by inputs to the four pins shown in Figure F-2. Each pin is connected to an edge detector that can be configured under program control to detect rising edges, falling edges, or both. These same pins, a part of parallel port E, support alternate functionality as reflected in Table F-1.

When the edge detector detects the rising or falling edge that it is programmed to detect, it sets a flip-flop that drives the output of the edge detector. The flip-flop should be cleared automatically when the interrupt takes place.

Instead, the flip-flop may be cleared spuriously because a different, *lower priority*, interrupt occurs nearly simultaneously (during an 8-clock window) with the occurrence of the edge that sets the flip-flop. This results in a lost interrupt.

Or the flip-flop might not be cleared when the interrupt takes place if a different, *higher priority*, interrupt is being requested nearly simultaneously (during an 8-clock window) with the occurrence of the external interrupt. This results in a spurious interrupt after the first interrupt because the interrupt request was not cleared.

In either case, precautions need to be taken if an interrupt request transitions during a short time period 8 clocks long. These sequences are shown schematically in Figure F-3.

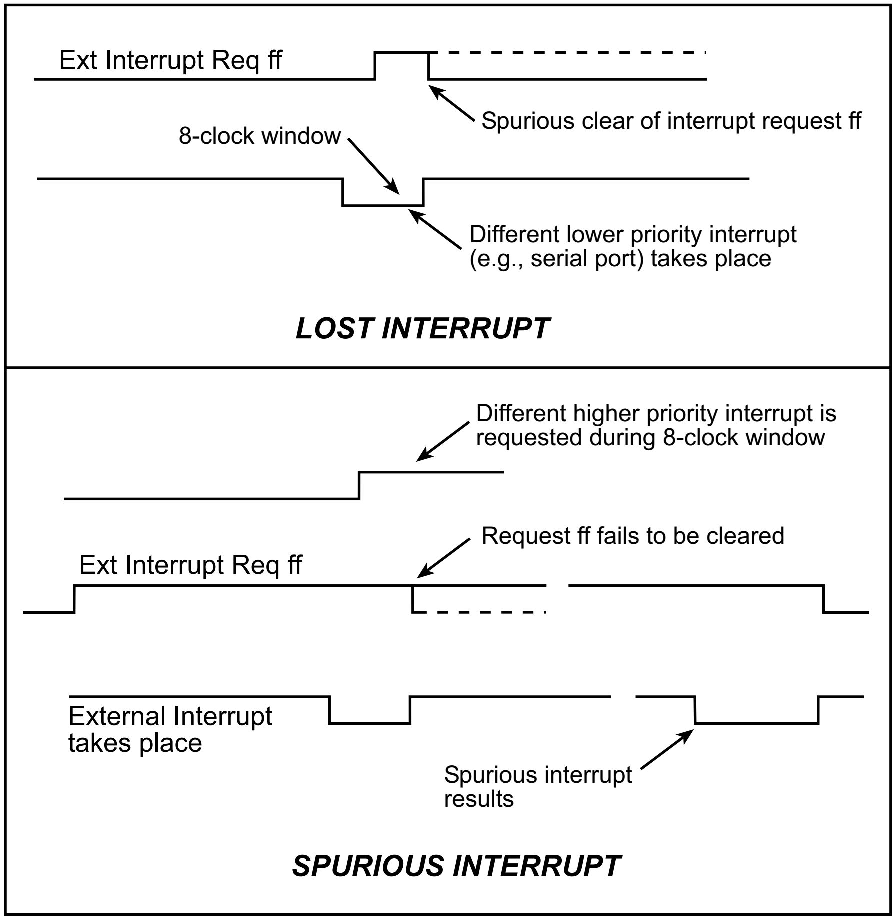


Figure F-3. Interrupt Sequences with Lost or Spurious Interrupts

F.2 Single-Interrupt Request

Tie the inputs for external interrupt #1 and #0 together by adding a 1 kΩ resistor between the two lines. Under this configuration, shown in Figure F-4, both interrupt #1 and #0 will be requested when an edge is detected. The #1 interrupt will take place first since it is of a higher priority.

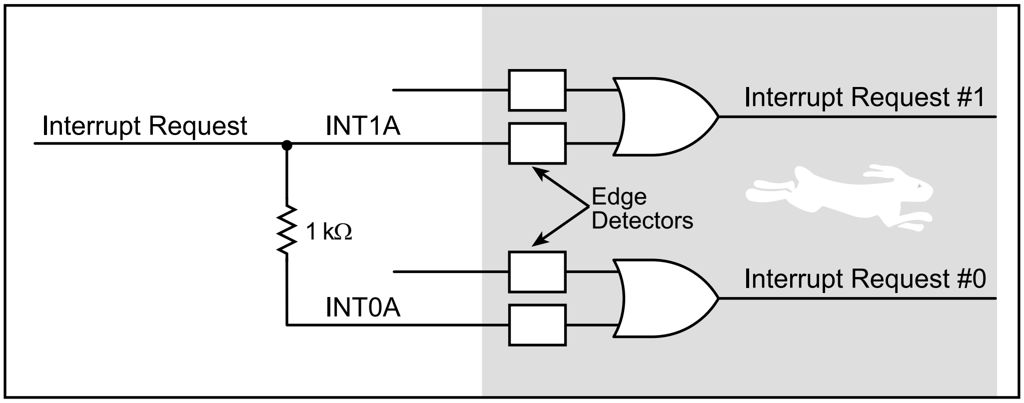


Figure F-4. RCM2200 Configuration for Single-Interrupt Request

The interrupt service routine for interrupt #1 should ignore the interrupt. The actual service routine will be the service routine for interrupt #0. If an interrupt is lost, it will always be #1 and never #0. The 1 kΩ resistor delays the edge slightly so that interrupt #1 is guaranteed to be latched earlier or simultaneously with interrupt #0. It is important that the programmed priority of interrupt #1 be higher than or equal to the programmed priority of interrupt #0. Normally they should be equal.

Spurious interrupts, which occur because of a failure to clear the request latch, are a possibility only if there are other interrupts of higher priority than external interrupt #1 and #0. These can only be the result of programming one of the on-chip peripheral interrupts to have a higher interrupt priority. This could be the case, for example, if the external interrupts are programmed to have priority 1, and one of the serial port interrupts is programmed to have priority 2. Spurious interrupts can always be eliminated by programming both external interrupts to have a priority equal to the highest priority used for another device. The priority can be reduced on entry to the service routine to avoid blocking the true high-priority interrupts. External interrupt #1 cannot cause interrupt #0 to have a spurious interrupt or vice versa. In some cases, spurious interrupts may not disturb function, but the fix is so simple that it is not usually worth the trouble to analyze this possibility.

F.3 OR’ed Interrupt Request

Tie the inputs for external interrupt #1 and #0 together by adding a 1 kΩ resistor. This configuration is shown in Figure F-5.

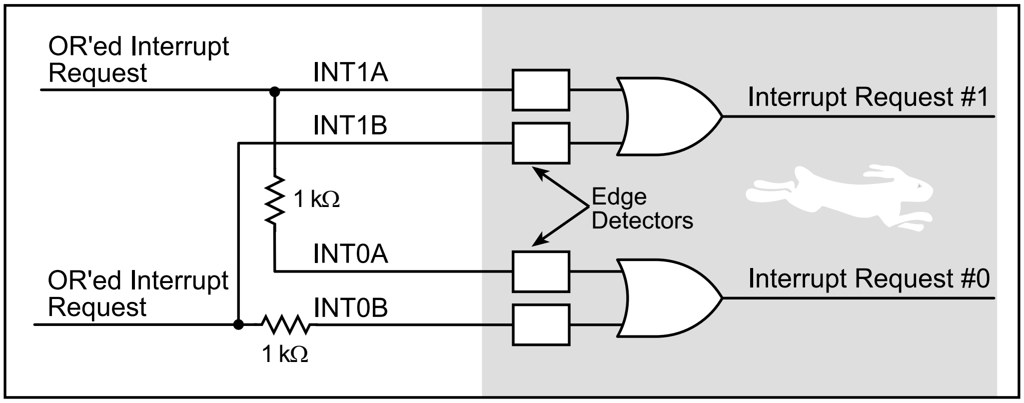


Figure F-5. RCM2200 Configuration for OR’ed Interrupt Request

INDEX

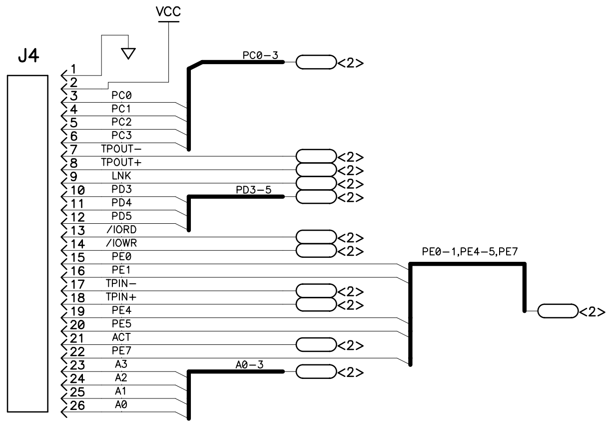
SCHEMATICS

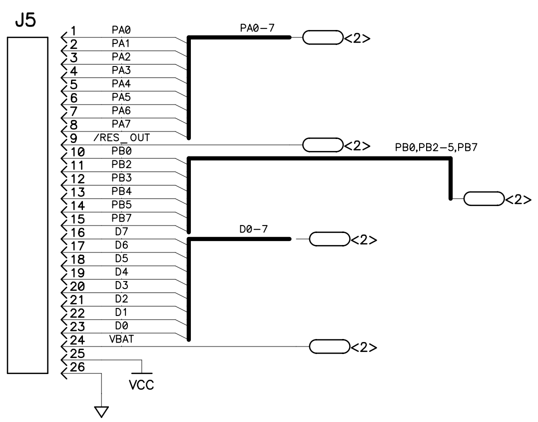
090-0120 RCM2200 Schematic

090-0122 RCM2200 Prototyping Board Schematic

090-0128 Programming Cable Schematic

REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION OF CHANGE	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
A	E11399	INITIAL RELEASE	RJH	3/22/01	KIS	3/22/01
B	E11646	ADD CAP TO THE LEFT OF R17 (PAGE 2). ADD REFERENCE TO NEW RCM2210.	RJH	9/21/01	KIS	8/29/01
C	E11570	REMOVED R12, ADDED R42,R43	RJH	9/24/01	KIS	9/21/01
D	E11787	CORRECT STUFFING TABLE SPEC FOR RCM2210 AT U5.				





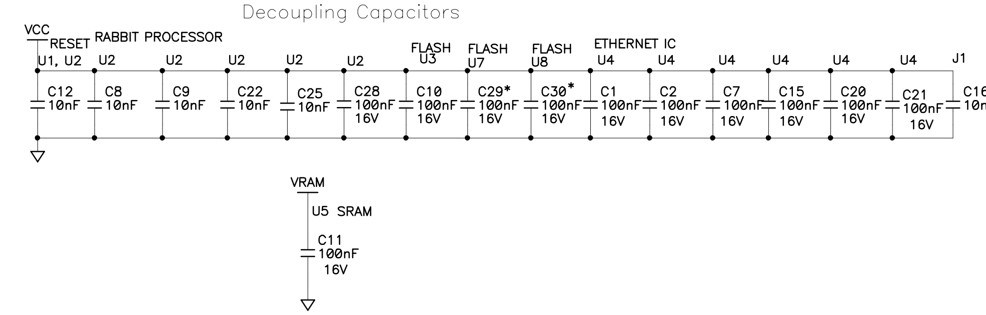
STUFFING TABLE

	CIRCUIT	PART	RCM2200	RCM2210	RCM2250
POWER TO VRAM SWITCH	WITH BATTERY BACKUP CIRCUITRY	R33	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
CS CONTROL SWITCH	WITH BATTERY BACKUP CIRCUITRY	R27	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
SRAM	MAIN	U5	128K SRAM	128K SRAM	512K SRAM
	SRAM SELECT	JP7	ZERO OHM ACROSS PINS 1–2	ZERO OHM ACROSS PINS 1–2	ZERO OHM ACROSS PINS 2–3
FLASH	FIRST	U3	256K FLASH	256K FLASH	256K FLASH
	FLASH MEMORY BANK SELECT	JP3	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2
	FLASH TYPE	JP4	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2
	CAPACITOR	C10	INSTALLED	INSTALLED	INSTALLED
	SECOND	U8	NOT INSTALLED	NOT INSTALLED	256K FLASH
	FLASH MEMORY BANK SELECT	JP2	NOT INSTALLED	NOT INSTALLED	ZERO ohm ACROSS PINS 1–2
	FLASH TYPE	JP1	NOT INSTALLED	NOT INSTALLED	ZERO ohm ACROSS PINS 1–2
	CAPACITOR	C30	NOT INSTALLED	NOT INSTALLED	INSTALLED
	THIRD	U7	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
	FLASH MEMORY BANK SELECT	JP5	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
	FLASH TYPE	JP6	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
	CAPACITOR	C29	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
ETHERNET	RJ-45 CONNECTOR WITH BUILT IN MAGNETICS	J2	INSTALLED	NOT INSTALLED	INSTALLED
	FILTER CAPACITORS	C18	INSTALLED	NOT INSTALLED	INSTALLED
		C19	INSTALLED	NOT INSTALLED	INSTALLED
		C23	INSTALLED	NOT INSTALLED	INSTALLED
		C24	INSTALLED	NOT INSTALLED	INSTALLED
	LEDS	DS1	INSTALLED	NOT INSTALLED	INSTALLED
		DS2	INSTALLED	NOT INSTALLED	INSTALLED
		R34	INSTALLED	NOT INSTALLED	INSTALLED
		R35	INSTALLED	NOT INSTALLED	INSTALLED
BATTERY	ON BOARD BATTERY	BT1	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED

TABLE A

REF DES	DEVICE	DEVICE VOLTAGE INFORMATION				DEVICE: FILTER CAP REF DES(s)
			GND	VCC	VRAM	
U1	ETC811L		1	4		C12
U2	RABBIT 2000		2,27,39 52,77,89	3,28,53, 78,92		C8,C9,C12,C22,C25,C28
U3	FLASH		24	8		C10
U8	FLASH		24	8		C30
U7	FLASH		24	8		C29
U4	RTL8019AS		14,28,44 52,83,86	6,17,47 57,70,89		C1,C2,C7,C15,C20,C21
U5	SRAM 128K X 8		16		32	C11

Decoupling Capacitors



NOTES: UNLESS OTHERWISE SPECIFIED;

1. ALL RESISTOR VALUES ARE IN OHMS, 1/16W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
3. THE ORIGINATION SOURCE OF A VOLTAGE IS REPRESENTED BY (VCC ▲), AND ALL REFERENCES TO THAT VOLTAGE ARE REPRESENTED BY (VCC ┬).
4. R27, R33, & BT1 NOT NORMALLY STUFFED.
5. COMPONENT VALUES SHOWN WITH AN ASTERISK (*) FOLLOWING THE VALUE, MAY HAVE DIFFERENT VALUES, OR MAY NOT BE STUFFED DEPENDING ON MODEL. SEE STUFFING CHART FOR CLARIFICATION.

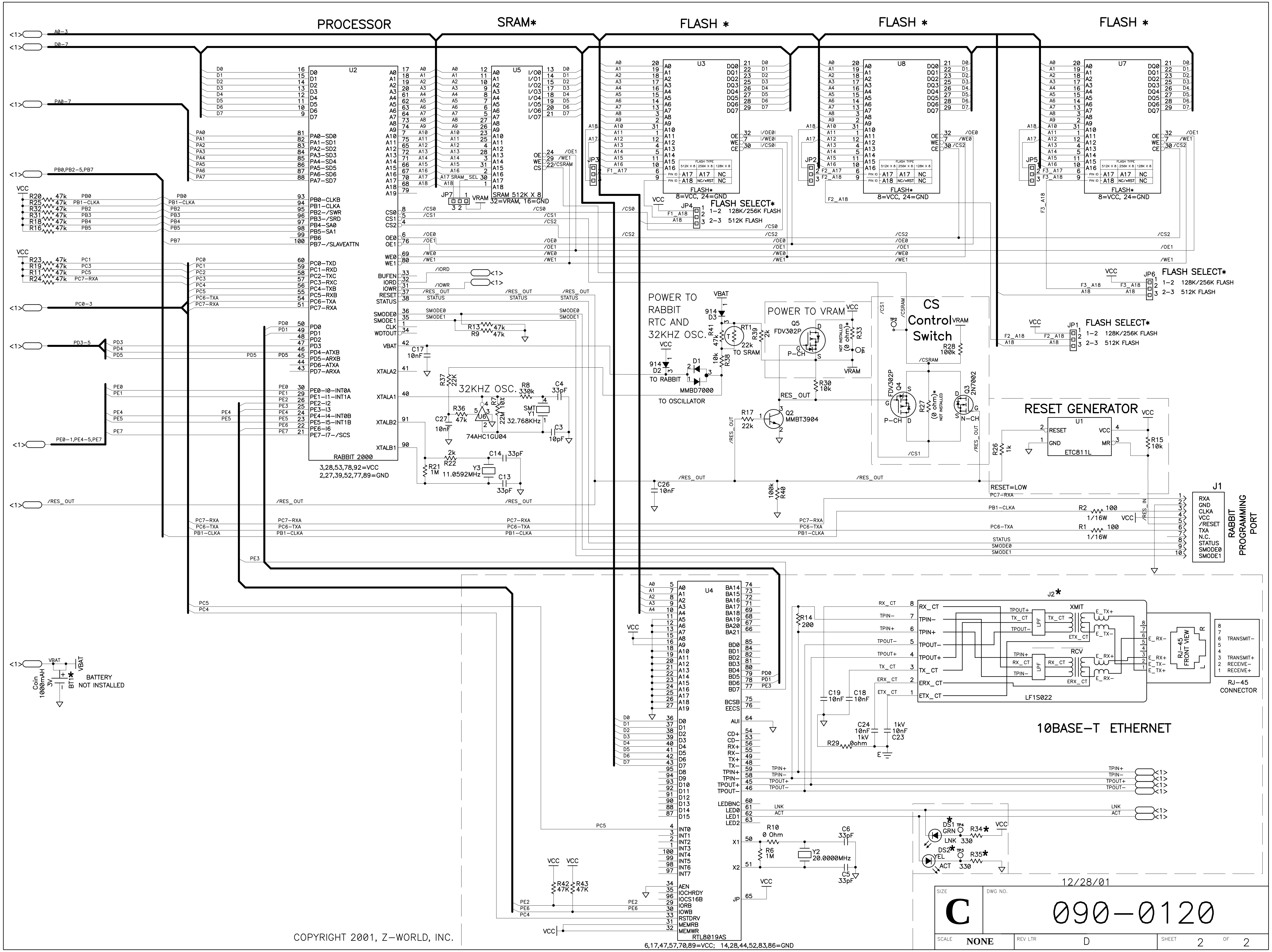
APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:	DRAWING CONTENT:	
	DRAWN BY: (INITIAL RELEASE) RJH	3/15/01
	REVISED BY: K.SCHALLER	12/28/01
	APPROVALS: INITIAL RELEASE	
	PROJECT ENGINEER: RICHARD HESS	3/22/01
	ENGINEERING MANAGER: R.MATTHEWS	3/22/01
	SIGNATURES	DATE

TITLE
SCHEMATIC DIAGRAM MICRO ETHERNET RABBITCORES RCM2200 SERIES

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757-4616

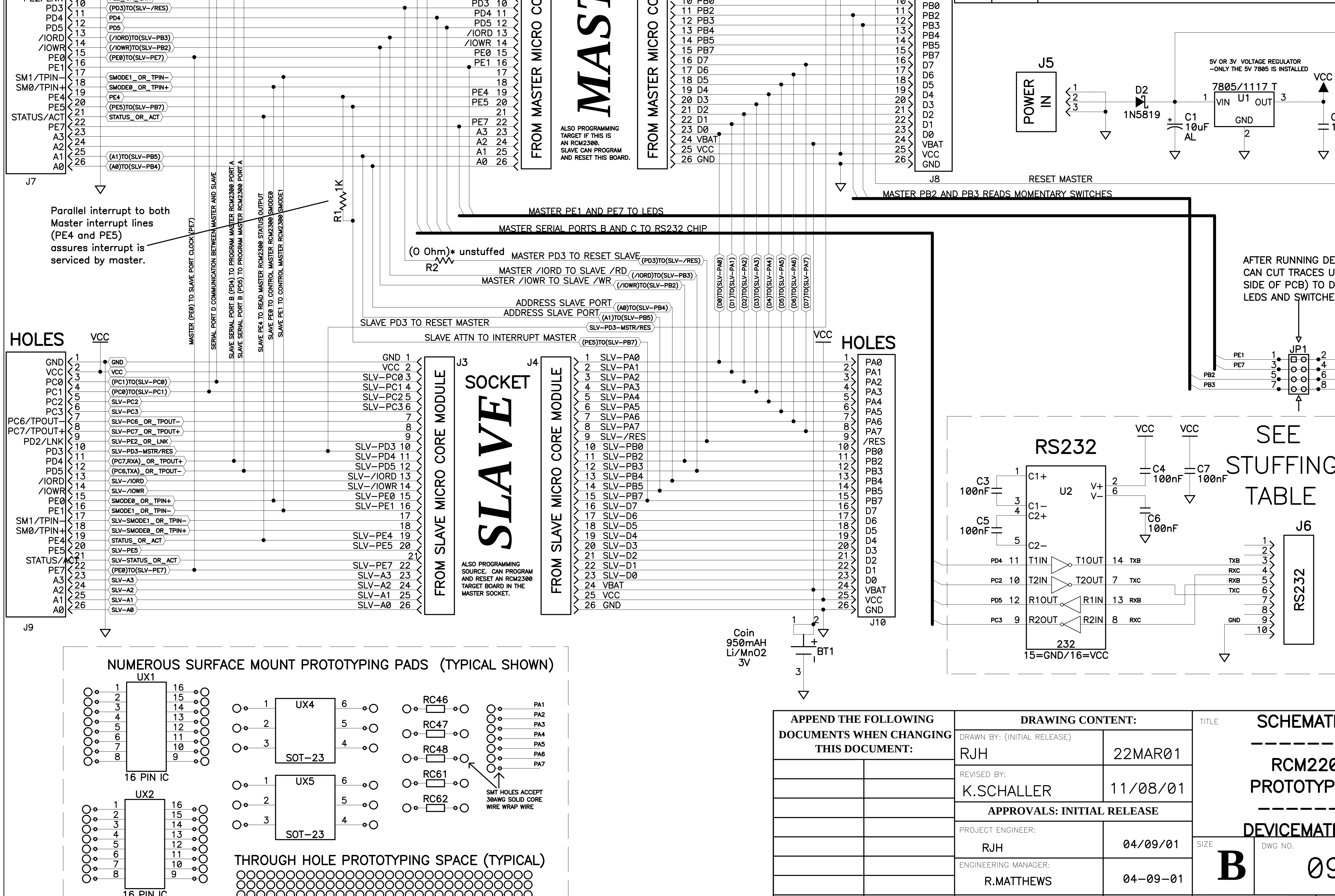
SIZE	DWG NO.
C	090–0120

SCALE NONE | RELEASE DATE | SHEET 1 OF 2



PROCESSOR
SRAM*
FLASH *
FLASH *
FLASH *
RABBIT 2000
3,28,53,78,92=VCC
2,27,39,52,77,89=GND
SRAM 512K X 8
32=VRAM, 16=GND
8=VCC, 24=GND
FLASH SELECT*
1-2 128K/256K FLASH
2-3 512K FLASH
POWER TO RABBIT RTC AND 32KHZ OSC.
POWER TO VRAM
CS Control Switch
32KHZ OSC.
74AHC1GU04
32.768KHz
11.0592MHz
MMBD7000
TO OSCILLATOR
TO RABBIT
TO SRAM
RESET GENERATOR
ETC811L
RESET=LOW
RABBIT PROGRAMMING PORT
BATTERY NOT INSTALLED
RTL8019AS
6,17,47,57,70,89=VCC; 14,28,44,52,83,86=GND
20.0000MHz
LF1S022
10BASE-T ETHERNET
RJ-45 CONNECTOR
COPYRIGHT 2001, Z-WORLD, INC.
12/28/01
SIZE C
DWG NO. 090-0120
SCALE NONE
REV LTR D
SHEET 2 OF 2

REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
B	E11520	ADD RCM2300 CONNECTIONS	RJH	04/11/01	KIS	05/10/01
C	E11669	MAKE PROVISION FOR NEW DEMO BOARD	RJH	9/18/01	KIS	9/17/01
D	E11724	ADD 'DEVICEMATE' NAME TO NEW DEMO BOARD REFERENCES				



STUFFING TABLE

PART	RCM2200/2300 PROTOTYPING BOARD	DEVICEMATE DEMO BOARD
U2	NOT INSTALLED	INSTALLED
J6	NOT INSTALLED	INSTALLED
C3 –C7	NOT INSTALLED	INSTALLED

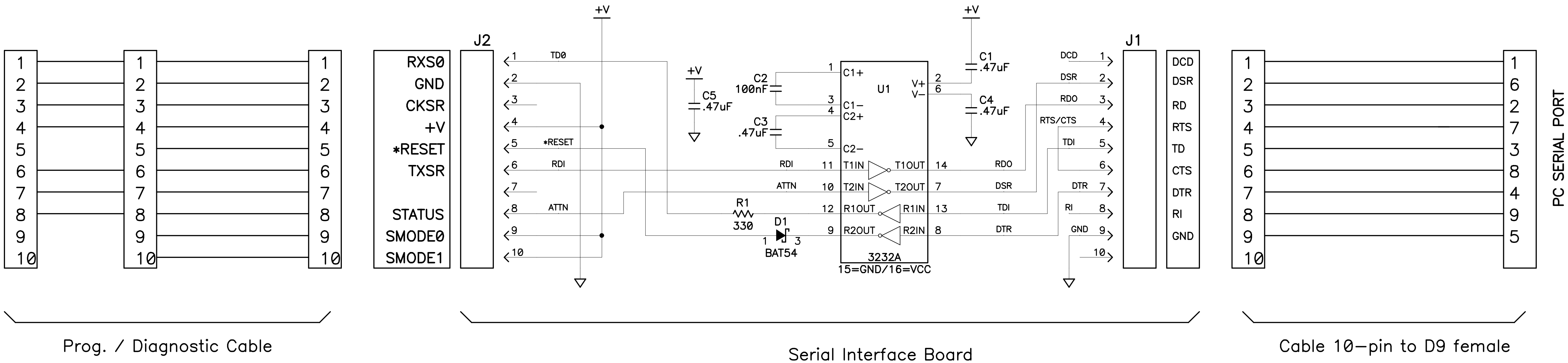
APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:	DRAWING CONTENT:	
	DRAWN BY: (INITIAL RELEASE) RJH	22MAR01
	REVISED BY: K.SCHALLER	11/08/01
	APPROVALS: INITIAL RELEASE	
	PROJECT ENGINEER: RJH	04/09/01
	ENGINEERING MANAGER: R.MATTHEWS	04-09-01
	SIGNATURES	DATE

TITLE: SCHEMATIC DIAGRAM — RCM2200/2300 PROTOTYPING BOARD — DEVICEMATE DEMO BOARD

SIZE: B | DWG NO. 090-0122 | SCALE: NONE | RELEASE DATE | SHEET 1 OF 1

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
A	E11523	INITIAL RELEASE OF SCHEMATIC	EP	5/14/01	KIS	5/14/01
B	E11691	CORRECT DE9 PINOUT	EP	10/5/01	KIS	10/4/01
C	E11816	ADD 3.3V CAPABILITY AND RED TUBING				



NOTES: UNLESS OTHERWISE SPECIFIED;

1. ALL RESISTOR VALUES ARE IN OHMS, 1/10W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
3. THE ORIGINATION SOURCE OF A VOLTAGE IS REPRESENTED BY (VCC), AND ALL REFERENCES TO THAT VOLTAGE ARE REPRESENTED BY (VCC).

APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:	DRAWING CONTENT:	
	DRAWN BY: (INITIAL RELEASE) E. PEAK	14MAY01
	REVISED BY: D MUSGROVE	01/21/02
	APPROVALS: INITIAL RELEASE	
	PROJECT ENGINEER: ERIC PEAK	5/14/01
	ENGINEERING MANAGER: R MATTHEWS	5/14/01
	SIGNATURES	DATE

TITLE
SCHEMATIC DIAGRAM RABBIT PROG. CABLE 3.3V − 5.0V

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

SIZE **B** DWG NO. 090−0128

SCALE **NONE** RELEASE DATE SHEET 1 OF 1