Digi - 101-0488 Datasheet

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Understanding Embedded - Microcontroller, Microprocessor, FPGA Modules

Embedded - Microcontroller, Microprocessor, and FPGA Modules are fundamental components in modern electronic systems, offering a wide range of functionalities and capabilities. Microcontrollers are compact integrated circuits designed to execute specific control tasks within an embedded system. They typically include a processor, memory, and input/output peripherals on a single chip. Microprocessors, on the other hand, are more powerful processing units used in complex computing tasks, often requiring external memory and peripherals. FPGAs (Field Programmable Gate Arrays) are highly flexible devices that can be configured by the user to perform specific logic functions, making them invaluable in applications requiring customization and adaptability.

Applications of Embedded - Microcontroller,

Details	
Product Status	Obsolete
Module/Board Type	MPU Core
Core Processor	Rabbit 2000
Co-Processor	-
Speed	22.1MHz
Flash Size	512KB
RAM Size	512KB
Connector Type	2 IDC Headers 2x13
Size / Dimension	1.6" x 2.3" (41mm x 58mm)
Operating Temperature	-40°C ~ 70°C
Purchase URL	https://www.e-xfl.com/product-detail/digi-international/101-0488

TABLE OF CONTENTS

- Provision for customer-supplied backup battery via connections on header J5
- 10/100-compatible RJ-45 Ethernet port with 10Base-T interface (Ethernet jack not installed on all models)
- 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.

2.1.3 Connect Power

When all other connections have been made, you can connect power to the RCM2200 Prototyping Board.

First, prepare the AC adapter for the country where it will be used by selecting the plug. The RCM2200 Development Kit presently includes Canada/Japan/U.S., Australia/N.Z., U.K., and European style plugs. Snap in the top of the plug assembly into the slot at the top of the AC adapter as shown in Figure 3, then press down on the spring-loaded clip below the plug assembly to allow the plug assembly to click into place.

Connect the AC adapter to 3-pin header J5 on the Prototyping Board as shown in Figure 3 below. The connector may be attached either way as long as it is not offset to one side.

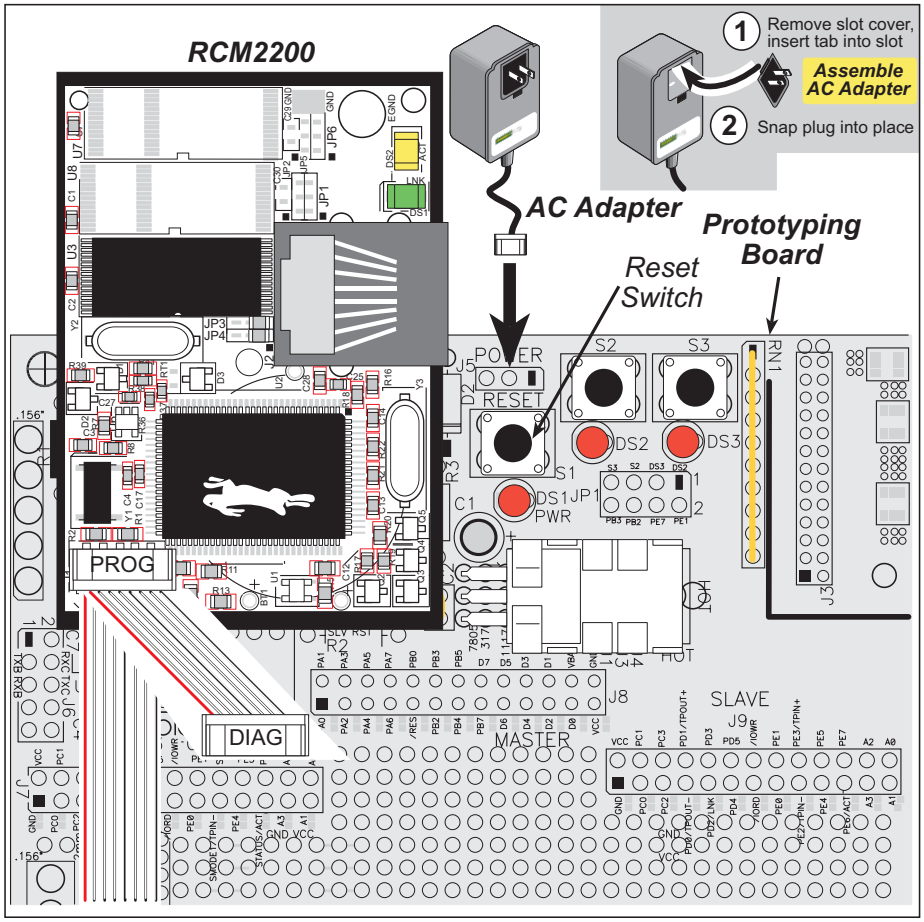


Figure 3. Power Supply Connections

Plug in the AC adapter. The power LED on the Prototyping Board should light up. The RCM2200 and the Prototyping Board are now ready to be used.

NOTE: A **RESET** button is provided on the Prototyping Board to allow hardware reset without disconnecting power.

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

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

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

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

2.3 Where Do I Go From Here?

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

1. Run all of the sample programs described in Chapter 3 to get a basic familiarity with Dynamic C and the RCM2200 module's capabilities.
2. For further development, refer to the ***RabbitCore RCM2200 User's Manual*** for details of the module's hardware and software components.

   A documentation icon should have been installed on your workstation's desktop; click on it to reach the documentation menu. You can create a new desktop icon that points to **default.htm** in the **docs** folder in the Dynamic C installation folder.
3. For advanced development topics, refer to the ***Dynamic C User's Manual*** and the ***Dynamic C TCP/IP User's Manual***, also in the online documentation set.

2.3.1 Technical Support

NOTE: If you purchased your RCM2200 through a distributor or through a Rabbit partner, contact the distributor or partner first for technical support.

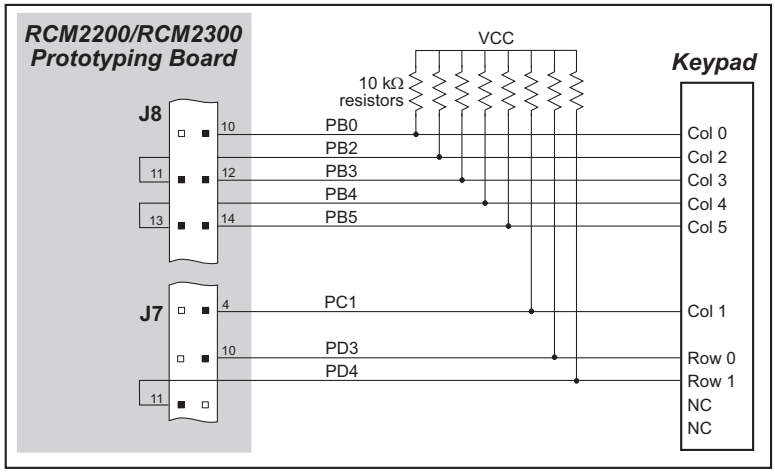
If there are any problems at this point:

- Use the Dynamic C **Help** menu to get further assistance with Dynamic C.
- Check the Rabbit Technical Bulletin Board and forums at www.rabbit.com/support/bb/ and at www.rabbit.com/forums/.
- Use the Technical Support e-mail form at www.rabbit.com/support/.

- **KEYLCD.C**—demonstrates a simple setup for a 2 × 6 keypad and a 2 × 20 LCD.

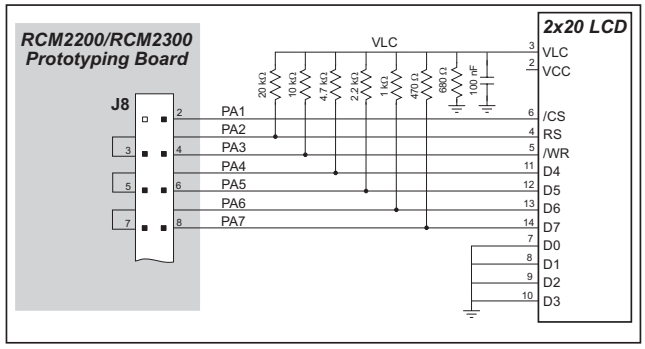
  Connect the keypad to Parallel Ports B, C, and D.

  PB0—Keypad Col 0
  PC1—Keypad Col 1
  PB2—Keypad Col 2
  PB3—Keypad Col 3
  PB4—Keypad Col 4
  PB5—Keypad Col 5
  PD3—Keypad Row 0
  PD4—Keypad Row 1



  Connect the LCD to Parallel Port A.

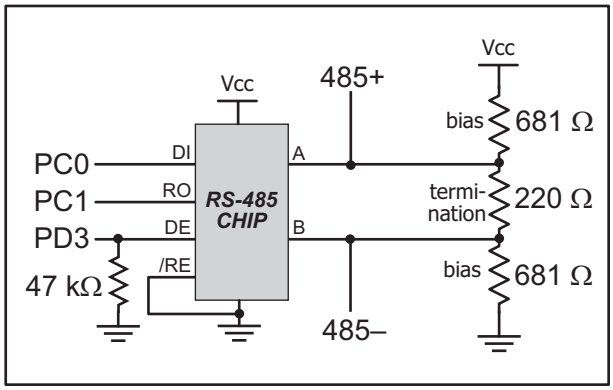
  PA0—backlight (if connected)
  PA1—LCD /CS
  PA2—LCD RS (High = Control, Low = Data) / LCD Contrast 0
  PA3—LCD /WR/ LCD Contrast 1
  PA4—LCD D4 / LCD Contrast 2
  PA5—LCD D5 / LCD Contrast 3
  PA6—LCD D6 / LCD Contrast 4
  PA7—LCD D7 / LCD Contrast 5



  Once the connections have been made and the sample program is running, the LCD will display two rows of 6 dots, each dot representing the corresponding key. When a key is pressed, the corresponding dot will become an asterisk.

Two sample programs, **MASTER.C** and **SLAVE.C**, are available to illustrate RS-485 master/slave communication. To run these sample programs, you will need a second Rabbit-based system with RS-485, and you will also have to add an RS-485 transceiver such as the SP483E and bias resistors to the Prototyping Board.

The diagram shows the connections. You will have to connect PC0 and PC1 (Serial Port D) on the Prototyping Board to the RS-485 transceiver, and you will connect PD3 to the RS-485 transceiver to enable or disable the RS-485 transmitter.



The RS-485 connections between the slave and master devices are as follows.

- RS485+ to RS485+
- RS485– to RS485–
- GND to GND

- **MASTER.C**—This program demonstrates a simple RS-485 transmission of lower case letters to a slave RCM2200. The slave will send back converted upper case letters back to the master RCM2200 and display them in the **STDIO** window. Use **SLAVE.C** to program the slave RCM2200—reset the slave before you run **MASTER.C** on the master.
- **SLAVE.C**—This program demonstrates a simple RS-485 transmission of lower case letters to a master RCM2200. The slave will send back converted upper case letters back to the master RCM2200 and display them in the **STDIO** window. Compile and run this program on the slave before you use **MASTER.C** to program the master.

3.1.3 Other Sample Programs

Section 6.2 covers how to run the TCP/IP sample programs, which are then described in detail.

tion of how Dynamic C handles multitasking with costatements and cofunctions, see Chapter 5, "Multitasking with Dynamic C," and Chapter 6, "The Virtual Driver," in the ***Dynamic C User's Manual***.

3.1.4.3 TOGGLELED.C

One of Dynamic C's unique and powerful aspects is its ability to efficiently multitask using *cofunctions* and *costatements*. This simple application demonstrates how these program elements work.

This sample program uses two costatements to set up and manage the two tasks. Costatements must be contained in a loop that will "tap" each of them at regular intervals. This program:

1. Initializes the pins of Port A as outputs.
2. Sets all the pins of Port A high, turning off the attached LEDs.
3. Sets the toggled LED status variable **`vswitch`** to 0 (LED off).
4. Starts an endless loop using a **`while(1)`** expression, and within that loop:
    - Executes a costatement that flashes LED DS3;
    - Executes a costatement that checks the state of switch S2 and toggles the state of **`vswitch`** if it is pressed;
    - Turns LED DS2 on or off, according to the state of **`vswitch`**.

    These steps repeat as long as the program is allowed to run.

The first costatement is a compressed version of **`FLASHLED.c`**, with slightly different flash timing. It also uses the library function **`DelayMs()`** to deliver more accurate timing than the simple delay loops of the previous program.

The second costatement does more than check the status of S2. Switch contacts often "bounce" open and closed several times when the switch is actuated, and each bounce can be interpreted by fast digital logic as an independent press. To clean up this input, the code in the second costatement "debounces" the switch signal by waiting 50 milliseconds and checking the state of the switch again. If it is detected as being closed both times, the program considers it a valid switch press and toggles **`vswitch`**.

Unlike most C statements, the two costatements are not executed in their entirety on each iteration of the **`while(1)`** loop. Instead, the list of statements within each costatement is initiated on the first loop, and then executed one "slice" at a time on each successive interation. This mode of operation is known as a *state machine*, a powerful concept that permits a single processor to efficiently handle a number of independent tasks.

The ability of Dynamic C to manage state machine programs enables you to create very powerful and efficient embedded systems with much greater ease than other programming methods.

More Information

See the entries for the **`DelayMs()`** function, as well as Section 5, "Multitasking with Dynamic C," in the ***Dynamic C User's Manual***.

4.3.2 Standalone Operation of the RCM2200

The RCM2200 must be programmed via the RCM2200/RCM2300 Prototyping Board or via a similar arrangement on a customer-supplied board. Once the RCM2200 has been programmed successfully, remove the programming cable from the programming connector and reset the RCM2200. The RCM2200 may be reset by cycling the power off/on or by pressing the **RESET** button on the Prototyping Board. The RCM2200 module may now be removed from the Prototyping Board for end-use installation.

CAUTION: Power to the Prototyping Board or other boards should be disconnected when removing or installing your RCM2200 module to protect against inadvertent shorts across the pins or damage to the RCM2200 if the pins are not plugged in correctly. Do not reapply power until you have verified that the RCM2200 module is plugged in correctly.

4.4 Memory

4.4.1 SRAM

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

4.4.2 Flash EPROM

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

> **NOTE:** Rabbit 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 downloaded 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.

4.4.3 Dynamic C BIOS Source Files

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

The following options require more care in address selection and testing actions, as conflicts with other users, servers and systems can occur:

- **LAN —** Connect the RCM2200's Ethernet port to an existing LAN, preferably one to which the development PC is already connected. You will need to obtain IP addressing information from your network administrator.
- **WAN —** The RCM2200 is capable of direct connection to the Internet and other Wide Area Networks, but exceptional care should be used with IP address settings and all network-related programming and development. We recommend that development and debugging be done on a local network before connecting a RabbitCore system to the Internet.

  TIP: Checking and debugging the initial setup on a micro-LAN is recommended before connecting the system to a LAN or WAN.

The PC running Dynamic C through the serial port on the RCM2200 does not need to be the PC with the Ethernet card.

3. Apply Power

   Plug in the AC adapter. The RCM2200 is now ready to be used.

6.3 IP Addresses Explained

IP (Internet Protocol) addresses are expressed as 4 decimal numbers separated by periods, for example:

216.103.126.155

10.1.1.6

Each decimal number must be between 0 and 255. The total IP address is a 32-bit number consisting of the 4 bytes expressed as shown above. A local network uses a group of adjacent IP addresses. There are always 2^N IP addresses in a local network. The netmask (also called subnet mask) determines how many IP addresses belong to the local network. The netmask is also a 32-bit address expressed in the same form as the IP address. An example netmask is:

255.255.255.0

This netmask has 8 zero bits in the least significant portion, and this means that 2^8 addresses are a part of the local network. Applied to the IP address above (216.103.126.155), this netmask would indicate that the following IP addresses belong to the local network:

216.103.126.0

216.103.126.1

216.103.126.2

etc.

216.103.126.254

216.103.126.255

The lowest and highest address are reserved for special purposes. The lowest address (216.103.126.0) is used to identify the local network. The highest address (216.103.126.255) is used as a broadcast address. Usually one other address is used for the address of the gateway out of the network. This leaves 256 - 3 = 253 available IP addresses for the example given.

6.7 How to Set IP Addresses in the Sample Programs

We have provided a number of sample programs demonstrating various uses of TCP/IP for networking embedded systems. These programs require that you connect your PC and the Coyote together on the same network. This network can be a local private network (preferred for initial experimentation and debugging), or a connection via the Internet.

With the introduction of Dynamic C 7.30 we have taken steps to make it easier to run many of our sample programs. You will see a **TCPCONFIG** macro. This macro tells Dynamic C to select your configuration from a list of default configurations. You will have three choices when you encounter a sample program with the **TCPCONFIG** macro.

1. You can replace the **TCPCONFIG** macro with individual **MY_IP_ADDRESS**, **MY_NETMASK**, **MY_GATEWAY**, and **MY_NAMESERVER** macros in each program.
2. You can leave **TCPCONFIG** at the usual default of 1, which will set the IP configurations to **10.10.6.100**, the netmask to **255.255.255.0**, and the nameserver and gateway to **10.10.6.1**. If you would like to change the default values, for example, to use an IP address of **10.1.1.2** for the Coyote board, and **10.1.1.1** for your PC, you can edit the values in the section that directly follows the "General Configuration" comment in the **TCP_CONFIG.LIB** library. You will find this library in the **LIB\TCPIP** directory.
3. You can create a **CUSTOM_CONFIG.LIB** library and use a **TCPCONFIG** value greater than 100. Instructions for doing this are at the beginning of the **TCP_CONFIG.LIB** library in the **LIB\TCPIP** directory.

There are some other "standard" configurations for **TCPCONFIG** that let you select different features such as DHCP. Their values are documented at the top of the **TCP_CONFIG.LIB** library in the **LIB\TCPIP** directory. More information is available in the ***Dynamic C TCP/IP User's Manual***.

IP Addresses Before Dynamic C 7.30

Most of the sample programs use macros to define the IP address assigned to the board and the IP address of the gateway, if there is a gateway. Instead of the **TCPCONFIG** macro, you will see a **MY_IP_ADDRESS** macro and other macros.

```
#define MY_IP_ADDRESS "10.10.6.170"
#define MY_NETMASK "255.255.255.0"
#define MY_GATEWAY "10.10.6.1"
#define MY_NAMESERVER "10.10.6.1"
```

In order to do a direct connection, the following IP addresses can be used for the Coyote:

```
#define MY_IP_ADDRESS "10.1.1.2"
#define MY_NETMASK "255.255.255.0"
// #define MY_GATEWAY "10.10.6.1"
// #define MY_NAMESERVER "10.10.6.1"
```

In this case, the gateway and nameserver are not used, and are commented out. The IP address of the board is defined to be **10.1.1.2**. The IP address of your PC can be defined as **10.1.1.1**.

6.8 How to Set Up Your Computer for Direct Connect

Follow these instructions to set up your PC or notebook. Check with your administrator if you are unable to change the settings as described here since you may need administrator privileges. The instructions are specifically for Windows 2000, but the interface is similar for other versions of Windows.

> **TIP:** If you are using a PC that is already on a network, you will disconnect the PC from that network to run these sample programs. Write down the existing settings before changing them to facilitate restoring them when you are finished with the sample programs and reconnect your PC to the network.

1. Go to the control panel (**Start > Settings > Control Panel**), and then double-click the Network icon.
2. Select the network interface card used for the Ethernet interface you intend to use (e.g., **TCP/IP Xircom Credit Card Network Adapter**) and click on the "Properties" button. Depending on which version of Windows your PC is running, you may have to select the "Local Area Connection" first, and then click on the "Properties" button to bring up the Ethernet interface dialog. Then "Configure" your interface card for a "10Base-T Half-Duplex" or an "Auto-Negotiation" connection on the "Advanced" tab.

   NOTE: Your network interface card will likely have a different name.

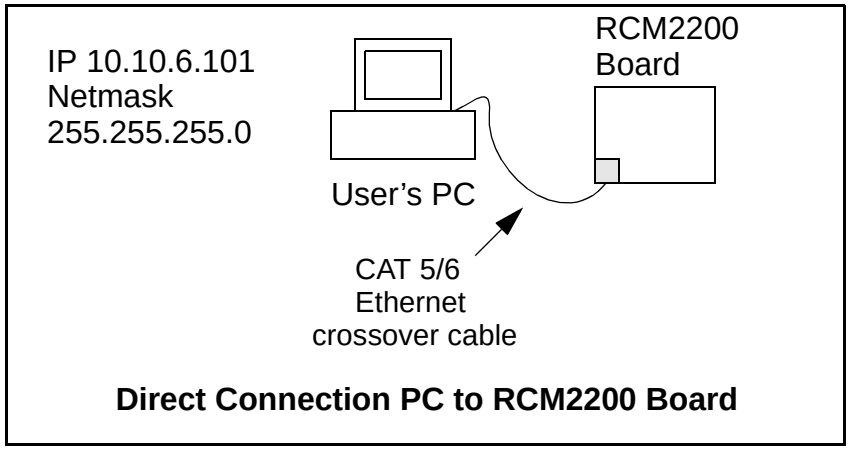
3. Now select the **IP Address** tab, and check **Specify an IP Address**, or select TCP/IP and click on "Properties" to assign an IP address to your computer (this will disable "obtain an IP address automatically"):

   IP Address : 10.10.6.101

   Netmask : 255.255.255.0

   Default gateway : 10.10.6.1

4. Click **<OK>** or **<Close>** to exit the various dialog boxes.



Direct Connection PC to RCM2200 Board

Figure A-4 shows a typical timing diagram for the Rabbit 2000 microprocessor external I/O read and write cycles.

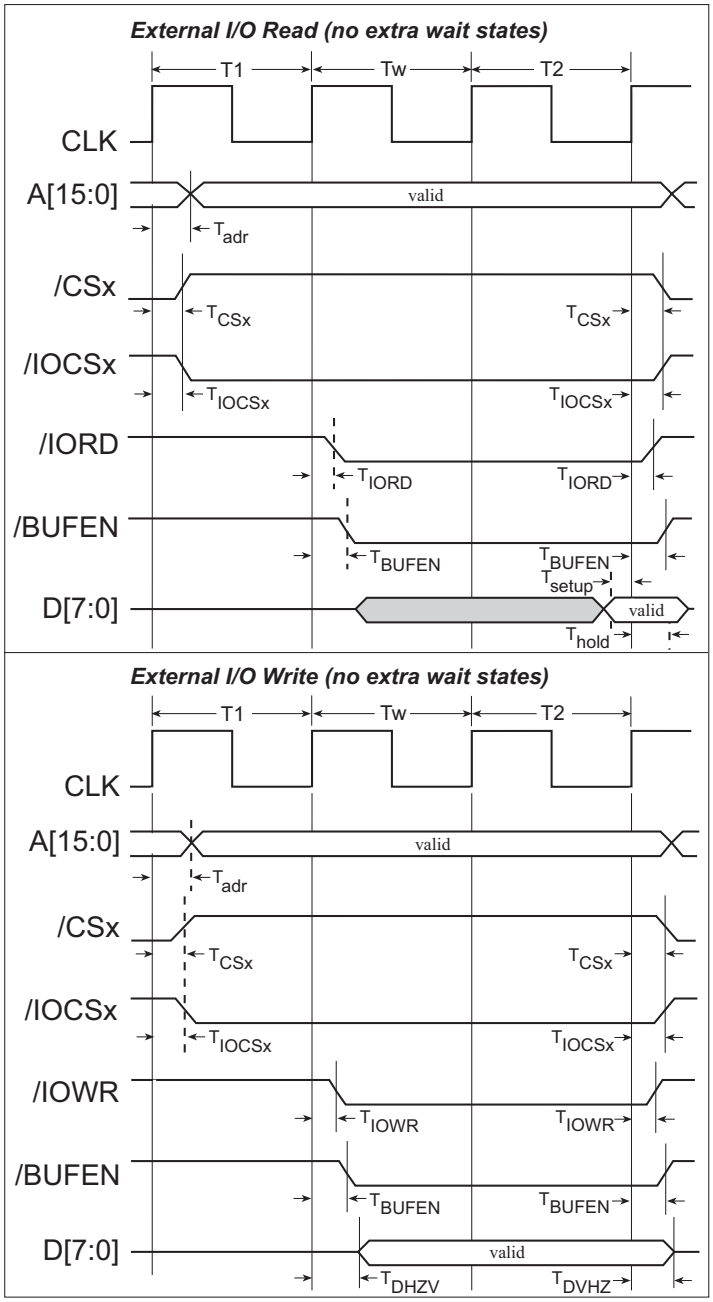


Figure A-4. External I/O Read and Write Cycles—No Extra Wait States

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.

A.5 Jumper Configurations

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

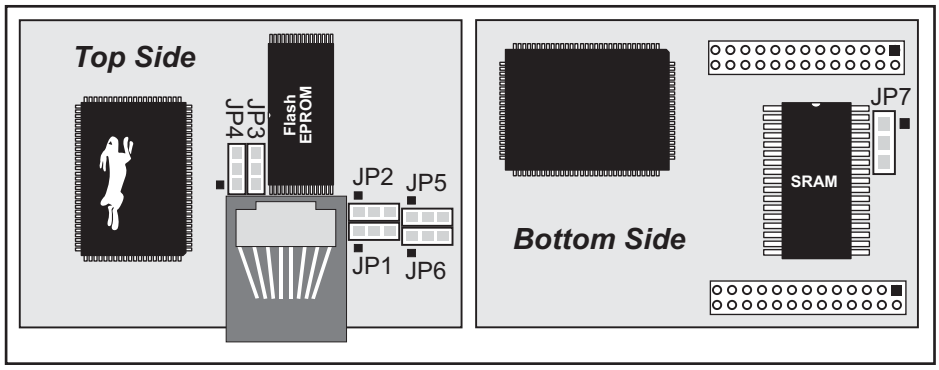


Figure A-5. Location of RCM2200 Configurable Positions

Table A-6 lists the configuration options.

Table A-6. RCM2200 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.

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.

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-5.

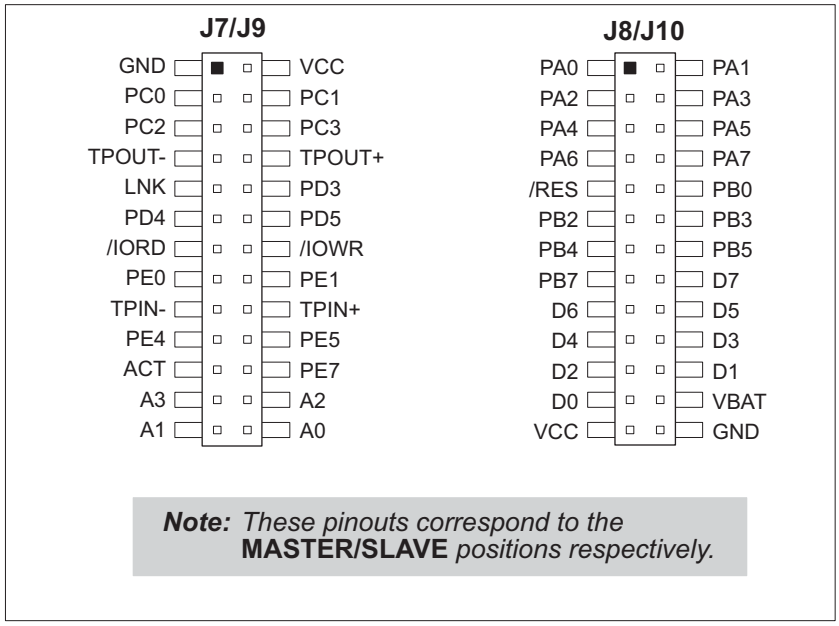


Figure B-5. RCM2200 Prototyping Board Pinout (Top View)

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.

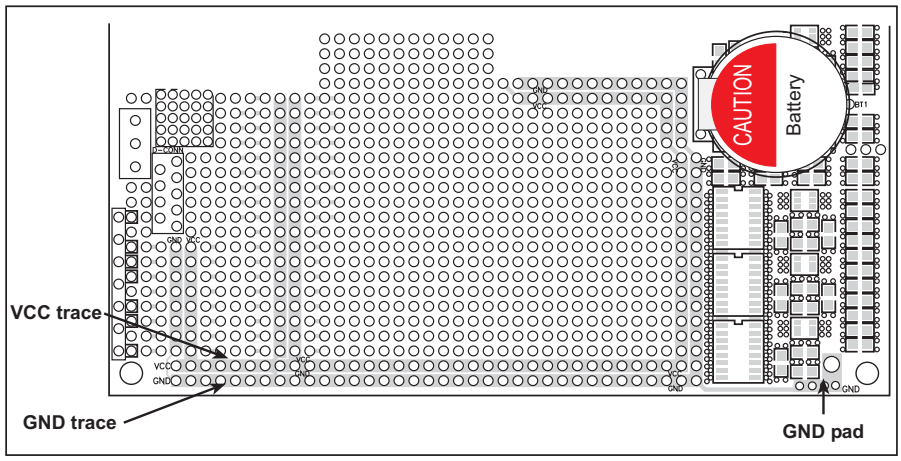


Figure B-6. VCC and GND Traces Along Edge of Prototyping Board

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.

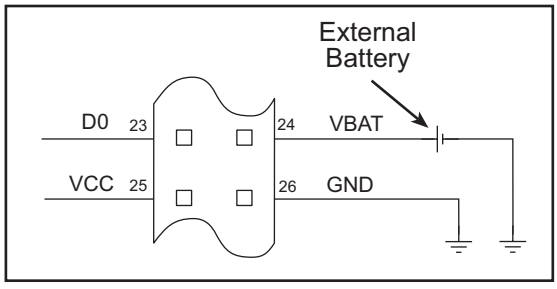


Figure C-1. External Battery Connections at Header J5

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.

D.2 Keypad and LCD Connections

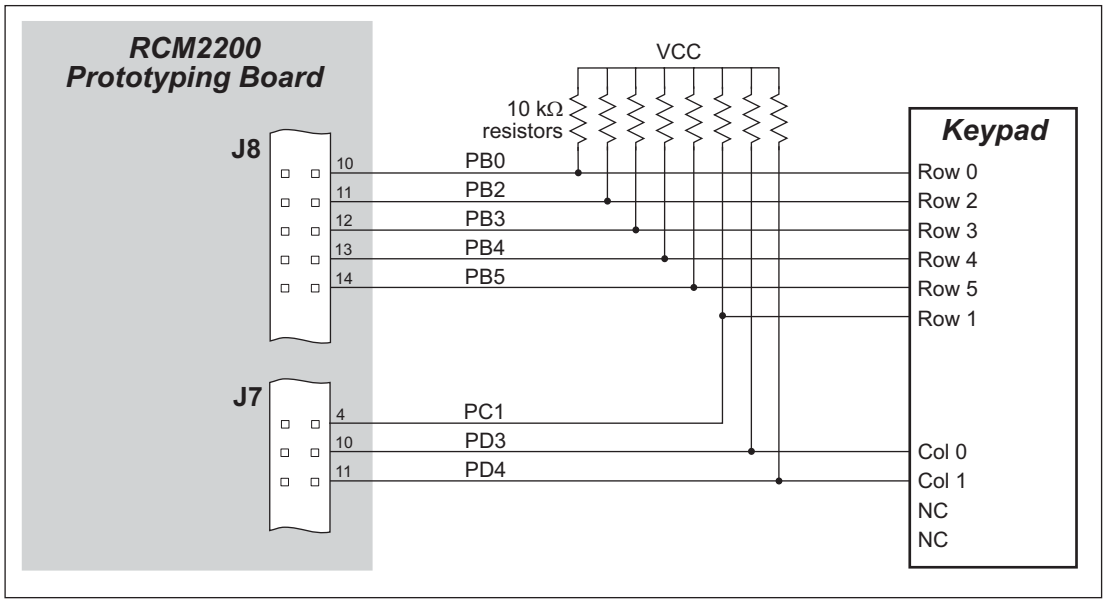


Figure D-2. Sample Keypad Connections

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

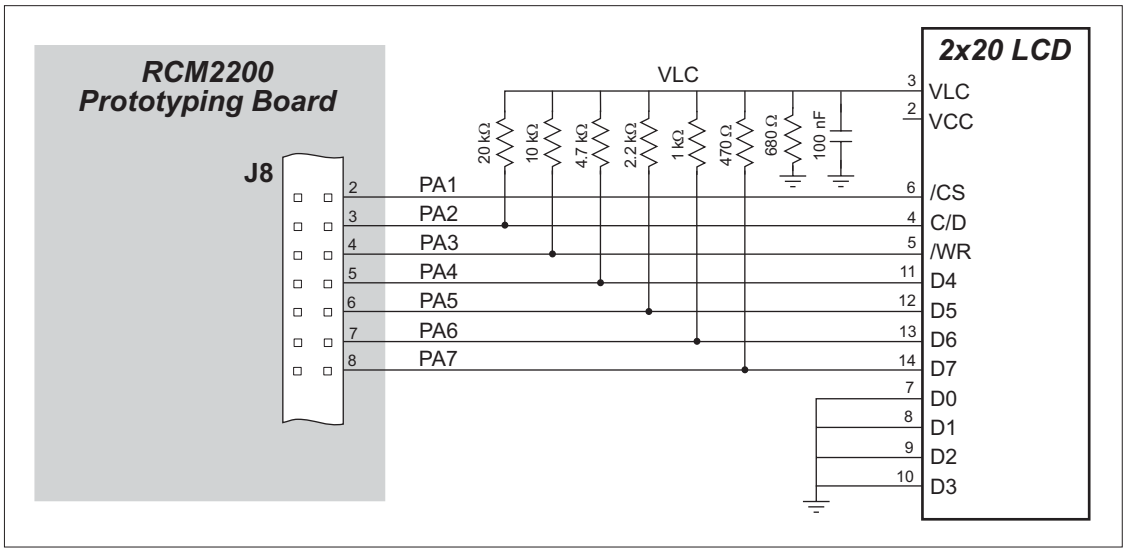


Figure D-3. Sample LCD Connections

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

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