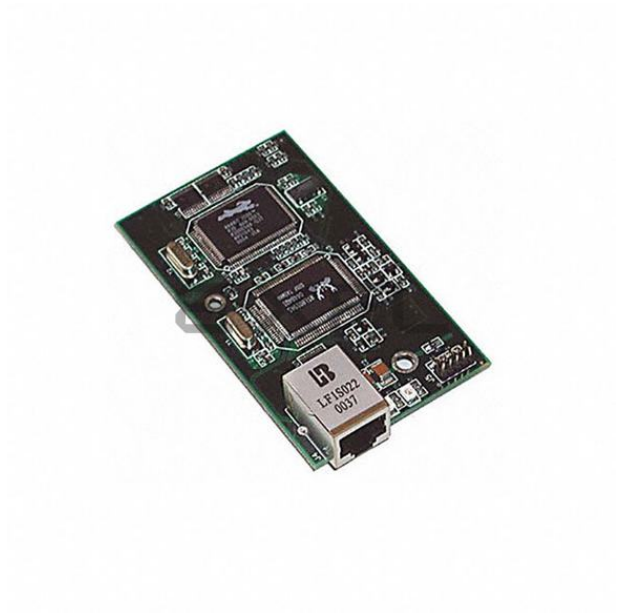

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Applications of Embedded - Microcontroller,

Details	
Product Status	Not For New Designs
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 2x20
Size / Dimension	2" x 3.5" (51mm x 89mm)
Operating Temperature	0°C ~ 70°C
Purchase URL	https://www.e-xfl.com/product-detail/digi-international/20-101-0434

1.1 RCM2100 Features

- Small size: 2.0" × 3.5" × 0.80"
  (51 mm × 89 mm × 20 mm)
- Microprocessor: Rabbit 2000 running at 22.1 MHz
- 34 CMOS-compatible parallel I/O lines grouped in five 8-bit ports (shared with serial ports)
- 8 data lines (BD0–BD7)
- 13 address lines (BA0–BA12)
- I/0 read, write, buffer enable
- Status, watchdog and clock outputs
- Two startup mode inputs for booting and master/slave configuration
- External reset input
- Reset output
- Five 8-bit timers, two 10-bit timers; five timers are cascadable in pairs
- 2 × 256K flash memory, 512K SRAM
- Real-time clock
- Watchdog supervisor
- Provision for customer-supplied backup battery via connections on header J2
- Four CMOS-compatible serial ports: maximum asynchronous baud rate of 690,625 bps, maximum synchronous baud rate of 5.52 Mbps. Two ports are configurable as clocked ports.

Appendix A, “RabbitCore RCM2100 Specifications,” provides detailed specifications for the RabbitCore RCM2100 modules.

Four versions of the RabbitCore RCM2100 are available. Their standard features are summarized in Table 1.

Table 1. RCM2100 Production Models

Model	Features
RCM2100	Full-featured module including 10/100-compatible Ethernet port with 10Base-T interface
RCM2110	RCM2100 with 128K SRAM, 256K flash memory
RCM2120	RCM2100 without Ethernet
RCM2130	RCM2110 without Ethernet

2.1.2 Connect Programming Cable

The programming cable connects the RCM2100 module to the PC running Dynamic C, to download programs and to monitor the RCM2100 for debugging.

Connect the 10-pin connector of the programming cable labeled **PROG** to header J5 on the RCM2100 module as shown in Figure 3 below. Be sure to orient the red edge of the cable towards pin 1 of the connector. (Do not use the **DIAG** connector, which is used for a normal serial connection.)

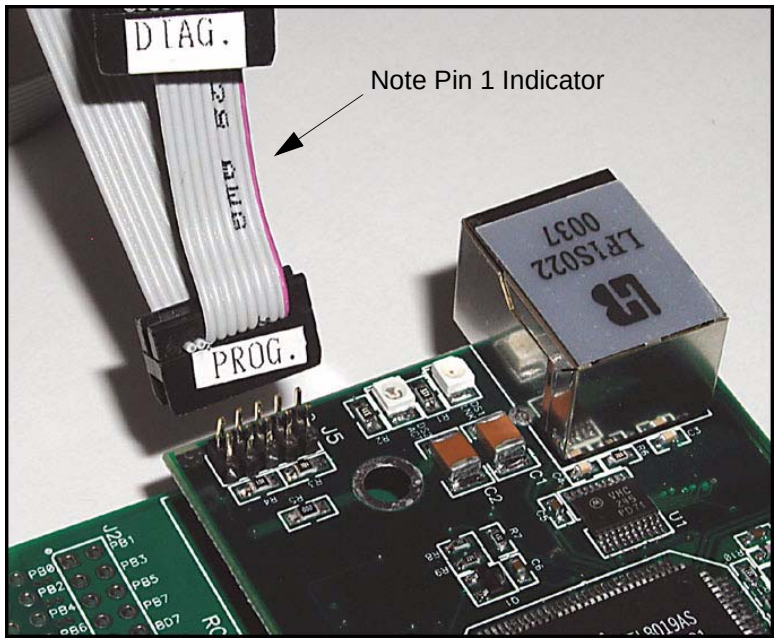


Figure 3. Attaching Programming Cable to the RCM2100

NOTE: The stripe on the cable is towards pin 1 of the header J5.

Connect the other end of the programming cable to a COM port on your PC. Make a note of the port to which you connect the cable, as Dynamic C needs to have this parameter configured when it is installed.

NOTE: COM 1 is the default port used by Dynamic C.

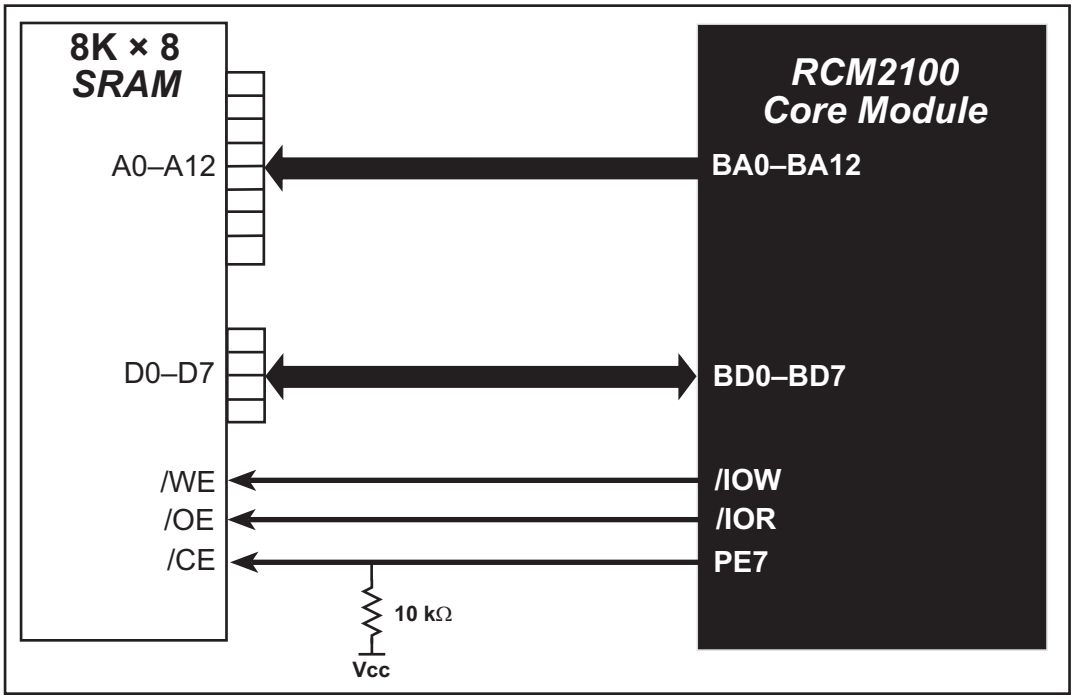
NOTE: Some PCs now come equipped only with a USB port. It may be possible to use an RS-232/USB converter (Part No. 540-0070) with the programming cable supplied with the RCM2100 Development Kit. Note that not all RS-232/USB converters work with Dynamic C.

3.1.1 Getting to Know the RCM2100

The following sample programs can be found in the **SAMPLES\RCM2100** folder.

- **EXTSRAM.C**—demonstrates the setup and simple addressing to an external SRAM. This program first maps the external SRAM to the I/O Bank 7 register with a maximum of 15 wait states, chip select strobe (PE7), and allows writes. The first 256 bytes of SRAM are cleared and read back. Values are then written to the same area and are read back. The Dynamic C **STDIO** window will indicate if writes and reads did not occur

  Connect an external SRAM as shown below before you run this sample program.



- **FLASHLED.C**—repeatedly flashes LED DS3 on the Prototyping Board on and off. LED DS3 is controlled by Parallel Port A bit 1 (PA1).
- **FLASHLED2.C**—repeatedly flashes LED DS3 on the Prototyping Board on and off. LED DS3 is controlled by Parallel Port A bit 1 (PA1).

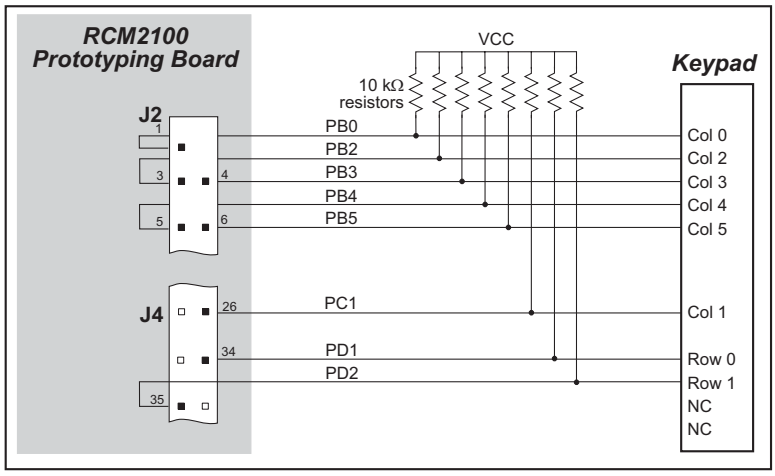
  This sample program also shows the use of the **runwatch()** function to allow Dynamic C to update watch expressions while running. The following steps explain how to do this.

  1. Add a watch expression for "k" in the **Inspect > Add Watch** dialog box.
  2. Click "Add" or "Add to top" so that it will be in the watch list permanently.
  3. Click **OK** to close the dialog box.
  4. Press **<Ctrl+U>** while the program is running. This will update the watch window.

- **FLASHLEDS.C**—demonstrates the use of coding with assembly instructions, cofunctions, and costatements to flash LEDs DS2 and DS3 on the Prototyping Board on and off. LEDs DS2 and DS3 are controlled by Parallel Port A bit 0 (PA0) and Parallel Port A bit 1 (PA1).Once you have compile this program and it is running, LEDs DS2 and DS3 will flash on/off at different rates.
- **FLASHLEDS2.C**—demonstrates the use of cofunctions and costatements to flash LEDs DS2 and DS3 on the Prototyping Board on and off. LEDs DS2 and DS3 are controlled by Parallel Port A bit 0 (PA0) and Parallel Port A bit 1 (PA1).Once you have compile this program and it is running, LEDs DS2 and DS3 will flash on/off at different rates.
- **KEYLCD2.C**—demonstrates a simple setup for a 2 × 6 keypad and a 2 × 20 LCD.

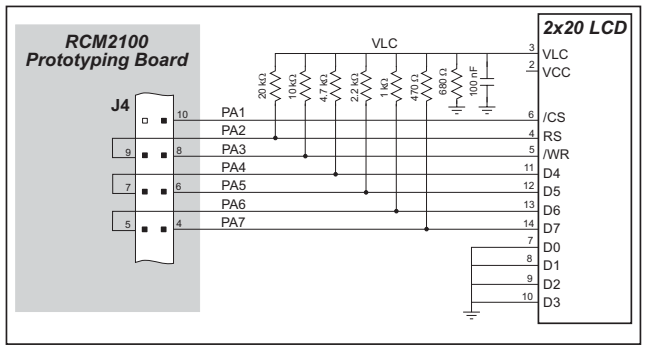
  Connect the keypad to Parallel Ports B, C, and D.

PB0—Keypad Col 0
PC1—Keypad Col 1
PB2—Keypad Col 2
PB3—Keypad Col 3
PB4—Keypad Col 4
PB5—Keypad Col 5
PD1—Keypad Row 0
PD2—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 isrunning, 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.

3.1.4 Sample Program Descriptions

3.1.4.1 FLASHLED.C

This program is about as simple as a Dynamic C application can get—the equivalent of the traditional "Hello, world!" program found in most basic programming tutorials. If you are familiar with ANSI C, you should have no trouble reading through the source code and understanding it.

The only new element in this sample application should be Dynamic C's handling of the Rabbit microprocessor's parallel ports. The program:

4. Initializes the pins of Port A as outputs.
5. Sets all of the pins of Port A high, turning off the attached LEDs.
6. Starts an endless loop with a **`for(;;)`** expression, and within that loop:
    - Writes a bit to turn bit 1 off, lighting LED DS3;
    - Waits through a delay loop;
    - Writes a bit to turn bit 1 on, turning off the LED;
    - Waits through a second delay loop;

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

You can change the flash rate of the LED by adjusting the loop values in the two **`for`** expressions. The first loop controls the LED's "off" time; the second loop controls its "on" time.

> **NOTE:** Since the variable **`j`** is defined as type **`int`**, the range for **`j`** must be between 0 and 32767. To permit larger values and thus longer delays, change the declaration of **`j`** to **`unsigned int`** or **`long`**.

More Information

See the section on primitive data types, and the entries for the library functions **`WrPortI( )`** and **`BitWrPortI( )`** in the ***Dynamic C User's Manual***.

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***.

The RCM2100 has 40 parallel I/O lines grouped in five 8-bit ports available on headers J1 and J2. The 24 bidirectional I/O lines are located on pins PA0–PA7, PD0–PD7, and PE0–PE7. The pinouts for headers J1 and J2 are shown in Figure 6.

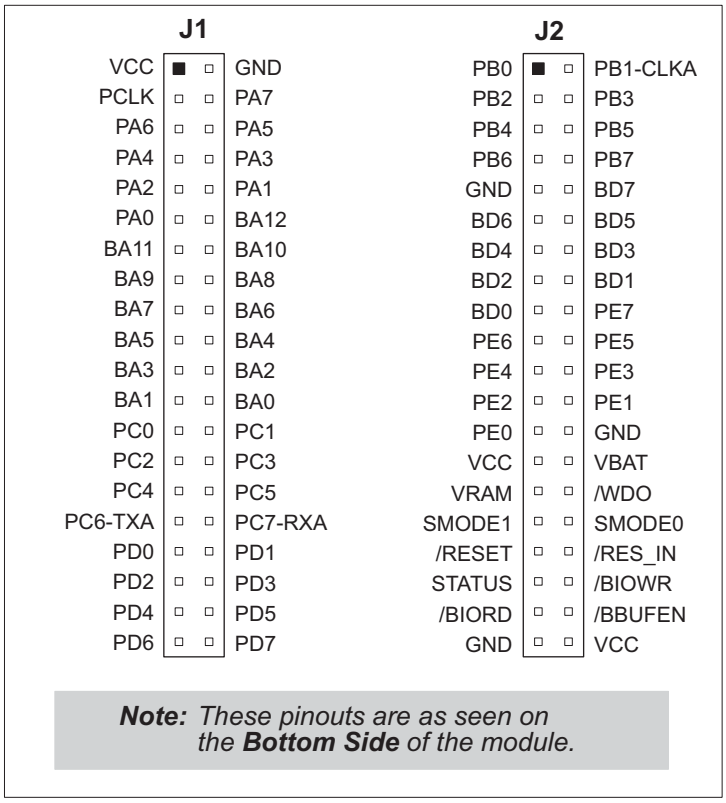


Figure 6. RCM2100 I/O Pinouts

The ports on the Rabbit 2000 microprocessor used in the RCM2100 are configurable, and so the factory defaults can be reconfigured. Table 2 lists the Rabbit 2000 factory defaults and the alternate configurations.

As shown in Table 2, pins PA0–PA7 can be used to allow the Rabbit 2000 to be a slave to another processor. PE0, PE1, PE4, and PE5 can be used as external interrupts INT0A, INT1A, INT0B, and INT1B. Pins PB0 and PB1 can be used to access the clock on Serial Port B and Serial Port A of the Rabbit microprocessor. Pins PD4 and PD6 can be programmed to be optional serial outputs for Serial Ports B and A. PD5 and PD7 can be used as alternate serial inputs by Serial Ports B and A.

The Ethernet-enabled versions of the RCM2100 do not have 0 Ω resistors (jumpers) installed at R21, R24, and R35–R38, which allows PE6, PE2, and PD4–PD7 to connect to the RealTek Ethernet chip that is stuffed on those versions.

Table 2. RCM2100 Pinout Configurations

Pin		Pin Name	Default Use	Alternate Use	Notes
Header J1	1	VCC			
	2	GND			
	3	PCLK	Output (Internal Clock)	Output	Turned off in software
	4–11	PA[7:0]	Parallel I/O	Slave port data bus SD0–SD7	
	12–24	BA[12:0]	Output		Buffered Rabbit 2000 address bus
	25	PC0	Output	TXD	
	26	PC1	Input	RXD	
	27	PC2	Output	TXC	
	28	PC3	Input	RXC	
	29	PC4	Output	TXB	
	30	PC5	Input	RXB	
	31	PC6	Output	TXA	Connected to programming port
	32	PC7	Input	RXA	
	33–36	PD[0:3]	Bitwise or parallel programmable I/O, can be driven or open-drain output		16 mA sourcing and sinking current at full AC switching speed
	37	PD4		ATXB output	Ethernet chip RSTDRV
	38	PD5		ARXB input	Ethernet chip BD5
	39	PD6		ATXA output	Ethernet chip BD6
	40	PD7		ARXA input	Ethernet chip BD7

4.5.2 Spectrum Spreader

RCM2100 modules that have a Rabbit 2000 microprocessor labeled ***IQ4T*** (or higher) are equipped with a Rabbit 2000 microprocessor that has a spectrum spreader, which helps to mitigate EMI problems. By default, the spectrum spreader is on automatically for RCM2100 modules that carry the ***IQ4T*** (or higher) marking when used with Dynamic C 7.30 or later versions, but the spectrum spreader may also be turned off or set to a stronger setting. The means for doing so is through a simple configuration macro as shown below.

1. Select the "Defines" tab from the Dynamic C **Options > Project Options** menu.
2. Normal spreading is the default, and usually no entry is needed. If you need to specify normal spreading, add the line

   ```
   ENABLE_SPREADER=1
   ```

   For strong spreading, add the line

   ```
   ENABLE_SPREADER=2
   ```

   To disable the spectrum spreader, add the line

   ```
   ENABLE_SPREADER=0
   ```

   NOTE: The strong spectrum-spreading setting is usually not necessary for the RCM2100.
3. Click **OK** to save the macro. The spectrum spreader will now remain off whenever you are in the project file where you defined the macro.

There is no spectrum spreader functionality for RCM2100 modules that have a Rabbit 2000 microprocessor labeled ***IQ1T***, ***IQ2T***, or ***IQ3T***, or when using any RCM2100 with a version of Dynamic C prior to 7.30.

6. USING THE TCP/IP FEATURES

6.1 TCP/IP Connections

Programming and development can be done with the RCM2100 RabbitCore modules without connecting the Ethernet port to a network. However, if you will be running the sample programs that use the Ethernet capability or will be doing Ethernet-enabled development, you should connect the RCM2100 module's Ethernet port at this time.

Before proceeding you will need to have the following items.

- If you don't have Ethernet access, you will need at least a 10Base-T Ethernet card (available from your favorite computer supplier) installed in a PC.
- Two RJ-45 straight through Ethernet cables and a hub, or an RJ-45 crossover Ethernet cable.

The Ethernet cables and a 10Base-T Ethernet hub are available from Rabbit Semiconductor in a TCP/IP tool kit. More information is available at www.rabbit.com.

1. Connect the AC adapter and the programming cable as shown in Chapter 2, "Getting Started."
2. Ethernet Connections

   There are four options for connecting the RCM2100 module to a network for development and runtime purposes. The first two options permit total freedom of action in selecting network addresses and use of the "network," as no action can interfere with other users. We recommend one of these options for initial development.

- **No LAN —** The simplest alternative for desktop development. Connect the RCM2100's Ethernet port directly to the PC's network interface card using an RJ-45 *crossover cable*. A crossover cable is a special cable that flips some connections between the two connectors and permits direct connection of two client systems. A standard RJ-45 network cable will not work for this purpose.
- **Micro-LAN —** Another simple alternative for desktop development. Use a small Ethernet 10Base-T hub and connect both the PC's network interface card and the RCM2100's Ethernet port to it, using standard network cables.

6.8.1 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.

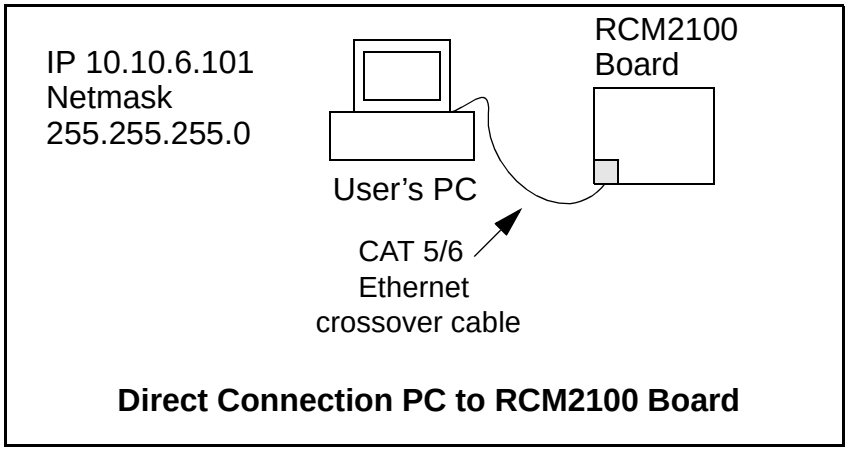
3. Now select the **IP Address** tab, and check **Specify an IP Address**, or select TCP/IP and click on "Properties" to assign an IP address to your computer (this will disable "obtain an IP address automatically"):

   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.



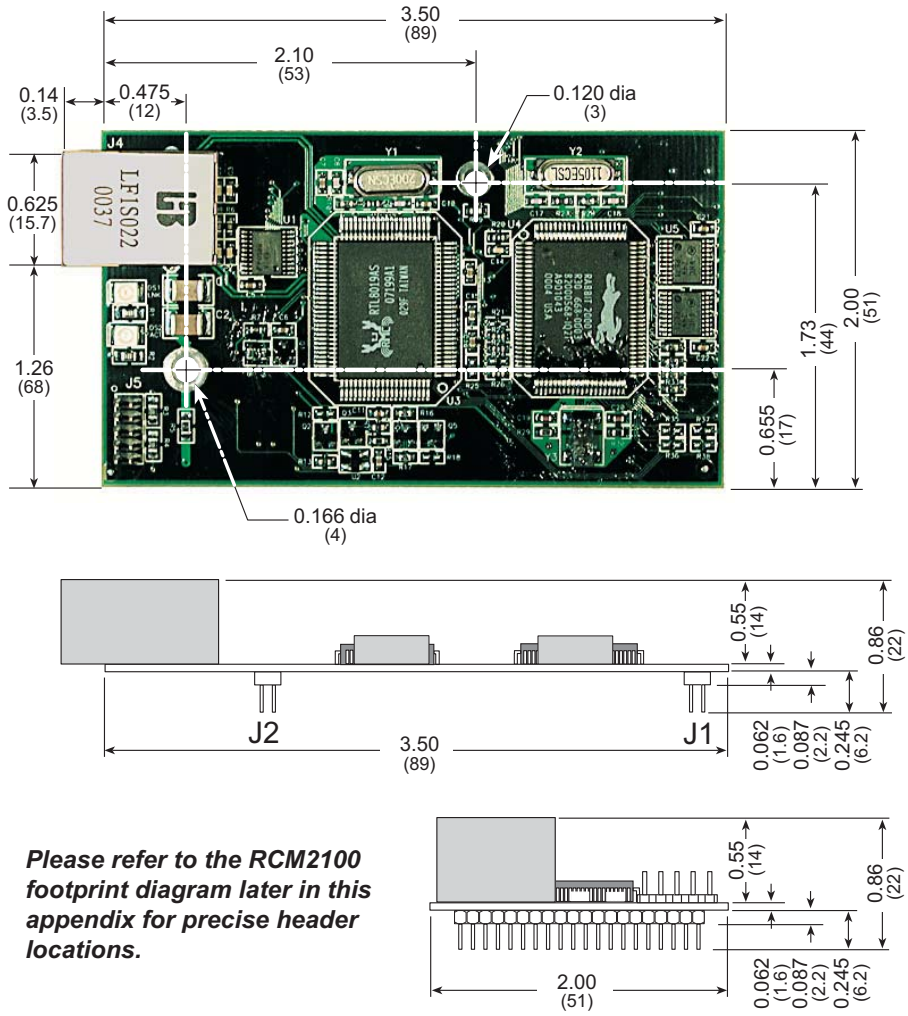
Direct Connection PC to RCM2100 Board

APPENDIX A. RABBITCORE RCM2100 SPECIFICATIONS

Appendix A provides the specifications for the RCM2100, and describes the conformal coating.

A.1 Electrical and Mechanical Characteristics

Figure A-1 shows the mechanical dimensions for the RCM2100.



Please refer to the RCM2100 footprint diagram later in this appendix for precise header locations.

Figure A-1. RCM2100 Dimensions

NOTE: All measurements are in inches followed by millimeters enclosed in parentheses. All dimensions have a manufacturing tolerance of ±0.01" (0.25 mm).

B.2 Mechanical Dimensions and Layout

Figure B-2 shows the mechanical dimensions and layout for the RCM2100 Prototyping Board.

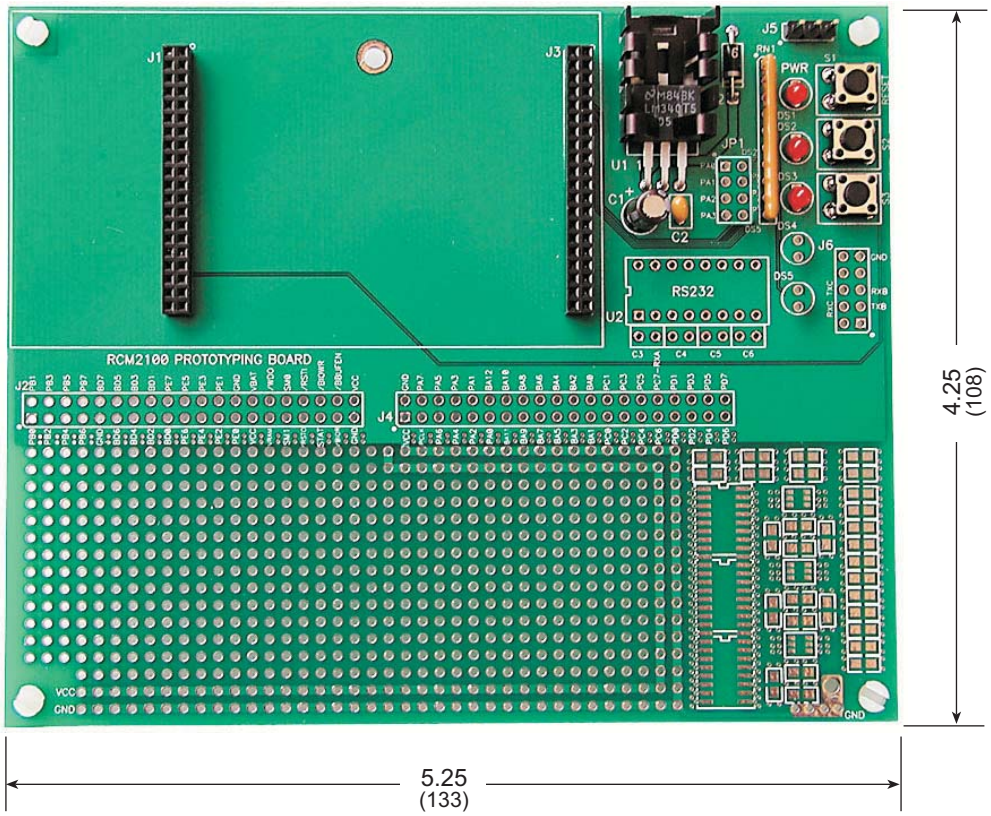


Figure B-2. RCM2100 Prototyping Board Dimensions

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

Table B-1. 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	1.7" × 4" (43 mm × 102 mm) throughhole, 0.1" spacing
Standoffs/Spacers	4, accept 6-32 × 3/8 screws

B.3 Power Supply

The RCM2100 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 LM340-T5 or equivalent. The LM340-T5 is an inexpensive 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-3.

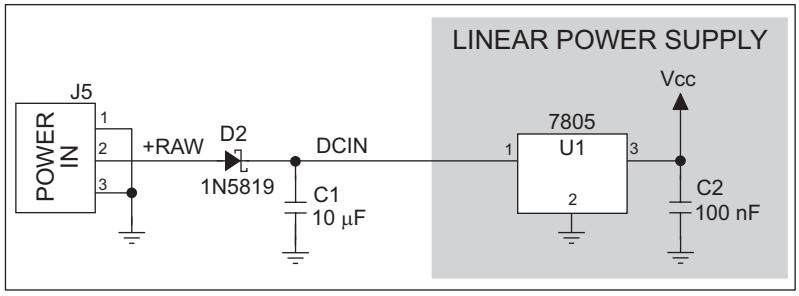


Figure B-3. Prototyping Board Power Supply

Capacitor C1 provides surge current protection for the voltage regulator, and allows the external power supply to be located some distance away.

B.4 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 RCM2100 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 RCM2100. Two LEDs (DS2 and DS3) are connected to PA0 and PA1, 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 RCM2100.

Two more LEDs, driven by PA2 and PA3, may be added to the Prototyping Board for additional outputs.

B.4.1 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–C6 as shown in Figure B-7.

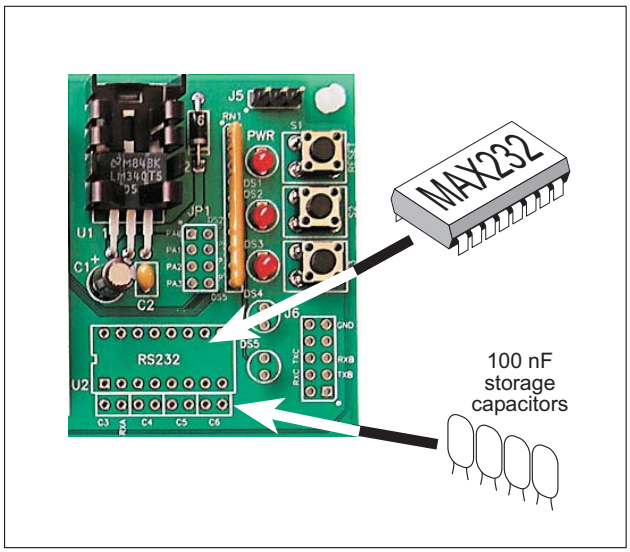


Figure B-7. Location for User-Supplied RS-232 Transceiver and Charge Storage Capacitors

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.