



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts,Customers Priority,Honest Operation,and Considerate Service",our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





# **MiniCom (OP6800)**

C-Programmable Operator Interface

## **User's Manual**

019-0106 • 090529-G

## **MiniCom (OP6800) User's Manual**

Part Number 019-0106 • 090529-G • Printed in U.S.A.

©2002–2009 Digi International Inc. • All rights reserved.

No part of the contents of this manual may be reproduced or transmitted in any form or by any means without the express written permission of Digi International.

Permission is granted to make one or more copies as long as the copyright page contained therein is included. These copies of the manuals may not be let or sold for any reason without the express written permission of Digi International.

Digi International reserves the right to make changes and improvements to its products without providing notice.

### **Trademarks**

Rabbit and Dynamic C are registered trademarks of Digi International Inc.

Rabbit 2000 and RabbitCore are trademarks of Digi International Inc.

The latest revision of this manual is available on the Rabbit Web site, [www.rabbit.com](http://www.rabbit.com), for free, unregistered download.

**Digi International Inc.**

[www.rabbit.com](http://www.rabbit.com)

# TABLE OF CONTENTS

<b>Chapter 1. Introduction</b>	<b>1</b>
1.1 Description .....	1
1.2 Features .....	1
1.3 Development and Evaluation Tools .....	2
1.3.1 Tool Kit .....	2
1.3.2 Software .....	3
1.4 CE Compliance .....	4
1.4.1 Design Guidelines .....	5
1.4.2 Interfacing the OP6800 to Other Devices .....	5
<b>Chapter 2. Getting Started</b>	<b>7</b>
2.1 Connections .....	7
2.2 Demonstration Program on Power-Up .....	10
2.3 Display Contrast Adjustment .....	10
2.4 Programming Cable Connections .....	11
2.5 Installing Dynamic C .....	12
2.6 Starting Dynamic C .....	12
2.7 PONG.C .....	13
2.8 Where Do I Go From Here? .....	13
<b>Chapter 3. Subsystems</b>	<b>15</b>
3.1 Pinouts .....	16
3.2 Digital I/O .....	17
3.2.1 Digital Inputs .....	17
3.2.2 Digital Outputs .....	18
3.3 Serial Communication .....	19
3.3.1 RS-232 .....	19
3.3.2 RS-485 .....	19
3.3.3 Programming Port .....	21
3.3.4 Ethernet Port (OP6800 models only) .....	22
3.4 Programming Cable .....	23
3.4.1 Changing Between Program Mode and Run Mode .....	23
3.5 Other Hardware .....	24
3.5.1 Clock Doubler .....	24
3.5.2 Spectrum Spreader .....	25
3.6 Memory .....	26
3.6.1 SRAM .....	26
3.6.2 Flash Memory .....	26
3.7 Keypad Labeling .....	27
<b>Chapter 4. Software</b>	<b>29</b>
4.1 Upgrading Dynamic C .....	31
4.1.1 Patches and Bug Fixes .....	31
4.1.2 Upgrades .....	31
4.2 Font and Bitmap Converter .....	32

4.3	Sample Programs.....	33
4.3.1	Board ID.....	33
4.3.2	Demonstration Board.....	33
4.3.3	Digital I/O.....	34
4.3.4	Serial Communication.....	34
4.3.5	LCD/Keypad Module Sample Programs.....	34
4.3.6	TCP/IP Sample Programs.....	35
4.4	OP6800 Libraries.....	36
<b>Chapter 5. Using the TCP/IP Features</b>		<b>37</b>
5.1	TCP/IP Connections.....	37
5.2	TCP/IP Sample Programs.....	39
5.2.1	How to Set IP Addresses in the Sample Programs.....	39
5.2.2	How to Set Up Your Computer for Direct Connect.....	40
5.2.3	Run the PINGME.C Demo.....	41
5.2.4	Running More Demo Programs With a Direct Connection.....	41
5.2.5	LCD/Keypad Sample Programs Showing TCP/IP Features.....	42
5.3	Where Do I Go From Here?.....	43
<b>Chapter 6. Installation and Mounting Guidelines</b>		<b>45</b>
6.1	Installation Guidelines.....	45
6.2	Mounting Instructions.....	46
6.2.1	Bezel-Mount Installation.....	46
<b>Appendix A. Specifications</b>		<b>49</b>
A.1	Electrical and Mechanical Specifications.....	50
A.2	Conformal Coating.....	53
A.3	Jumper Configurations.....	54
A.4	Use of Rabbit 2000 Parallel Ports.....	55
A.5	I/O Address Assignments.....	57
<b>Appendix B. Power Supply</b>		<b>59</b>
B.1	Power Supplies.....	59
B.2	Batteries and External Battery Connections.....	60
B.2.1	Battery-Backup Circuit.....	60
B.2.2	Power to VRAM Switch.....	61
B.2.3	Reset Generator.....	61
B.3	Chip Select Circuit.....	62
<b>Appendix C. Demonstration Board</b>		<b>63</b>
C.1	Mechanical Dimensions and Layout.....	64
C.2	Power Supply.....	65
C.3	Using the Demonstration Board.....	67
<b>Appendix D. OP6800 Function Calls</b>		<b>71</b>
D.1	Board Initialization (OP68xx.LIB).....	72
D.2	Digital I/O (OP68xx.LIB).....	73
D.3	Serial Communication (OP68xx.LIB).....	74
D.4	LEDs (OP68xx.LIB).....	76
D.5	LCD Display.....	77
D.5.1	Keypad.....	97
<b>Index</b>		<b>101</b>
<b>Schematics</b>		<b>105</b>



# 1. INTRODUCTION

The OP6800 intelligent terminal interface is a small, high-performance, C-programmable terminal interface that offers built-in I/O and Ethernet connectivity. A Rabbit® 2000 micro-processor operating at 22.1 MHz provides fast data processing.

## 1.1 Description

The OP6800 intelligent terminal interface incorporates the powerful Rabbit 2000 micro-processor, flash memory, static RAM, digital I/O ports, RS-232/RS-485 serial ports, and a 10Base-T Ethernet port.

## 1.2 Features

- 122 × 32 graphic display.
- 7-key keypad.
- 7 LEDs.
- 24 digital I/O: 13 filtered digital inputs, and 11 sinking high-current outputs (7 outputs with LED indicators, and 4 high-current digital outputs with transient protection to drive inductive loads).
- Rabbit 2000 microprocessor operating at 22.1 MHz.
- 128K static RAM and 256K flash memory standard, may be increased to 512K SRAM and 512K flash memory.
- One RJ-45 Ethernet port compliant with IEEE 802.3 standard for 10Base-T Ethernet protocol (OP6800 only).
- Four serial ports (2 RS-232 or 1 RS-232 with RTS/CTS, 1 RS-485, and 1 CMOS-compatible programming port).
- Battery-backable real-time clock, connection point for external battery included.
- Watchdog.
- Reset generator.
- Meets NEMA 4 watertightness specifications when front-panel mounted.
- Remote program downloading and debugging capability via RabbitLink.

Two OP6800 models are available. Their standard features are summarized in Table 1.

**Table 1. OP6800 Models**

Feature	OP6800	OP6810
Microprocessor	Rabbit 2000 running at 22.1 MHz	
Static RAM	128K	
Flash Memory	256K	
RJ-45 Ethernet Connector and Filter Capacitors	Yes	No
RabbitCore Module Used	RCM2200	RCM2300

One additional 512K flash/512K SRAM memory option is available for custom orders, and involves nominal lead times. Contact your Rabbit sales representative or authorized distributor for more information.

Throughout this manual, the term OP6800 refers to the complete series of OP6800 operator interfaces unless other production models are referred to specifically.

Appendix A provides detailed specifications.

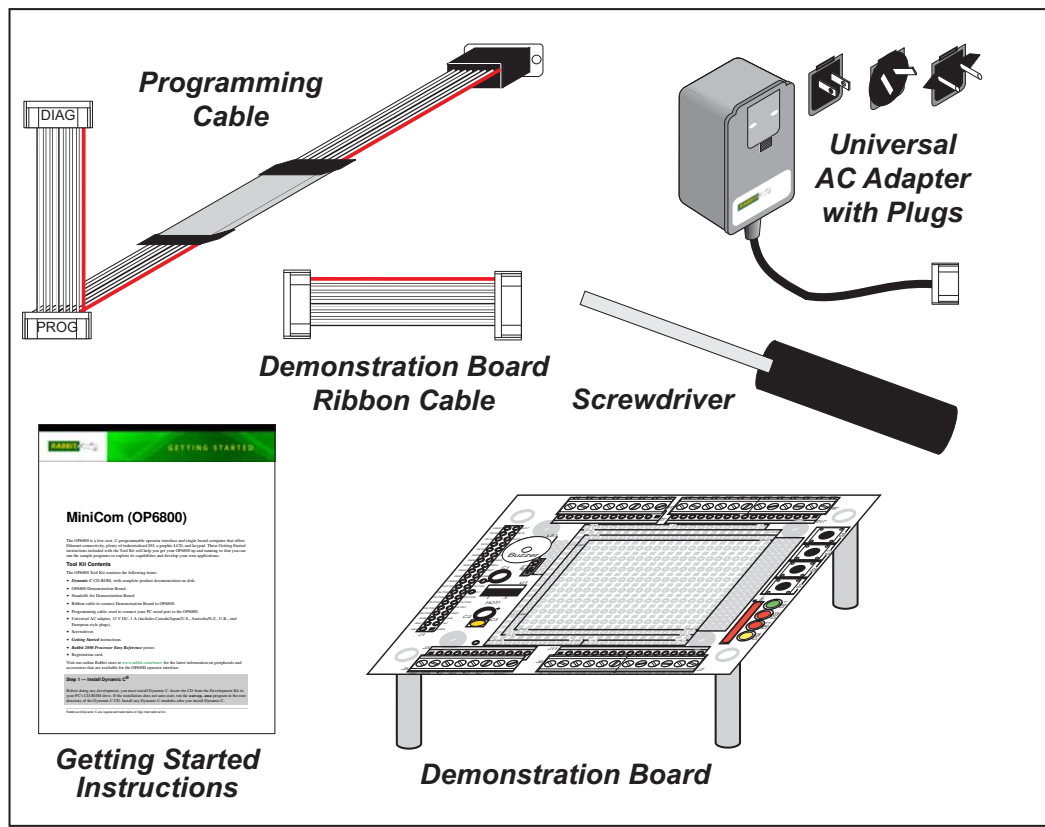
Visit our [Web site](#) for up-to-date information about additional add-ons and features as they become available. The Web site also has the latest revision of this user's manual.

## 1.3 Development and Evaluation Tools

### 1.3.1 Tool Kit

A Tool Kit contains the hardware essentials you will need to use your OP6800. The items in the Tool Kit and their use are as follows.

- **Dynamic C** CD-ROM, with complete product documentation on disk.
- **OP6800 Getting Started** instructions.
- Programming cable, used to connect your PC serial port to the OP6800.
- Universal AC adapter, 12 V DC, 1 A (includes Canada/Japan/U.S., Australia/N.Z., U.K., and European style plugs).
- Demonstration Board with prototyping area, pushbutton switches, and LEDs. The Demonstration Board can be hooked up to the OP6800 to demonstrate the I/O, and the prototyping area can be used for custom circuits.
- Ribbon cable to connect Demonstration Board to OP6800.
- Screwdriver.
- **Rabbit 2000 Processor Easy Reference** poster.
- Registration card.



**Figure 1. OP6800 Tool Kit**

### 1.3.2 Software

The OP6800 is programmed using version 7.06 or later of Rabbit's Dynamic C. A compatible version is included on the Tool Kit CD-ROM. Library functions provide an easy-to-use interface for the OP6800. Software drivers for the display and keypad, TCP/IP, I/O, and serial communication are included with Dynamic C.

Dynamic C v. 9.60 includes the popular  $\mu$ C/OS-II real-time operating system, point-to-point protocol (PPP), FAT file system, RabbitWeb, and other select libraries that were previously sold as individual Dynamic C modules.

Rabbit also offers for purchase the Rabbit Embedded Security Pack featuring the Secure Sockets Layer (SSL) and a specific Advanced Encryption Standard (AES) library. In addition to the Web-based technical support included at no extra charge, a one-year telephone-based technical support subscription is also available for purchase. Visit our Web site at [www.rabbit.com](http://www.rabbit.com) for further information and complete documentation, or contact your Rabbit sales representative or authorized distributor.



## 1.4 CE Compliance

Equipment is generally divided into two classes.

CLASS A	CLASS B
Digital equipment meant for light industrial use	Digital equipment meant for home use
Less restrictive emissions requirement: less than 40 dB $\mu$ V/m at 10 m (40 dB relative to 1 $\mu$ V/m) or 300 $\mu$ V/m	More restrictive emissions requirement: 30 dB $\mu$ V/m at 10 m or 100 $\mu$ V/m

These limits apply over the range of 30–230 MHz. The limits are 7 dB higher for frequencies above 230 MHz. Although the test range goes to 1 GHz, the emissions from Rabbit-based systems at frequencies above 300 MHz are generally well below background noise levels.

The OP6800 has been tested and was found to be in conformity with the following applicable immunity and emission standards. The OP6810 is also CE qualified as it is a sub-version of the OP6800. Boards that are CE-compliant have the CE mark.



**NOTE:** Earlier versions of the OP6800 sold before 2003 that do not have the CE mark are *not* CE-complaint.

### Immunity

The OP6800 operator interfaces meet the following EN55024/1998 immunity standards.

- EN61000-4-2 (ESD)
- EN61000-4-3 (Radiated Immunity)
- EN61000-4-4 (EFT)
- EN61000-4-6 (Conducted Immunity)

Additional shielding or filtering may be required for a heavy industrial environment.

### Emissions

The OP6800 operator interfaces meet the following emission standards with the Rabbit 2000 spectrum spreader turned on and set to the normal mode. The spectrum spreader is only available with Rev. C or higher of the Rabbit 2000 microprocessor. This microprocessor is used on the OP6800 operator control panels that carry the CE mark.

- EN55022:1998 Class B
- FCC Part 15 Class B

Your results may vary, depending on your application, so additional shielding or filtering may be needed to maintain the Class B emission qualification.

### 1.4.1 Design Guidelines

Note the following requirements for incorporating the OP6800 operator interfaces into your application to comply with CE requirements.

#### General

- The power supply provided with the Tool Kit is for development purposes only. It is the customer's responsibility to provide a CE-compliant power supply for the end-product application.
- When connecting the OP6800 to outdoor cables, the customer is responsible for providing CE-approved surge/lightning protection.
- Rabbit recommends placing digital I/O or analog cables that are 3 m or longer in a metal conduit to assist in maintaining CE compliance and to conform to good cable design practices. Rabbit also recommends using properly shielded I/O cables in noisy electromagnetic environments.
- While the OP6800 meets the EN61000-4-2 (ESD) requirements in that it can withstand contact discharges of  $\pm 4$  kV and air discharges of  $\pm 8$  kV, it is the responsibility of the end-user to use proper ESD precautions to prevent ESD damage when installing or servicing the OP6800.

#### Safety

- For personal safety, all inputs and outputs to and from the OP6800 must not be connected to voltages exceeding SELV levels (42.4 V AC peak, or 60 V DC). Damage to the Rabbit 2000 microprocessor may result if voltages outside the design range of 0 V to 40 V DC are applied directly to any of its digital inputs.
- The lithium backup battery circuit on the OP6800 has been designed to protect the battery from hazardous conditions such as reverse charging and excessive current flows. Do not disable the safety features of the design.

### 1.4.2 Interfacing the OP6800 to Other Devices

Since the OP6800 operator control panels are designed to be connected to other devices, good EMC practices should be followed to ensure compliance. CE compliance is ultimately the responsibility of the integrator. Additional information, tips, and technical assistance are available from your authorized Rabbit distributor, and are also available on our Web site at [www.rabbit.com](http://www.rabbit.com).

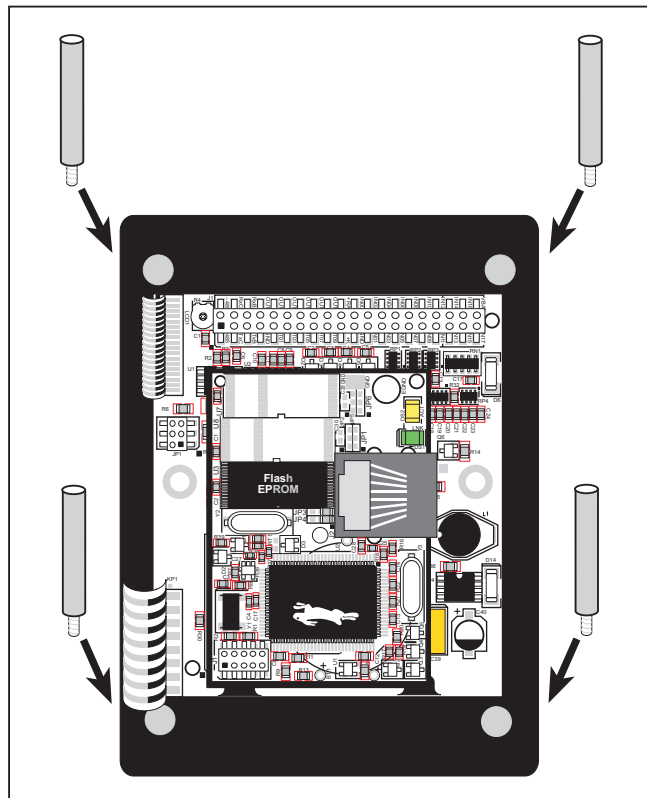


## 2. GETTING STARTED

Chapter 2 explains how to connect the programming cable and power supply to the OP6800. Once you run a sample program to demonstrate that you have connected everything correctly, you will be ready to go on and finish developing your system.

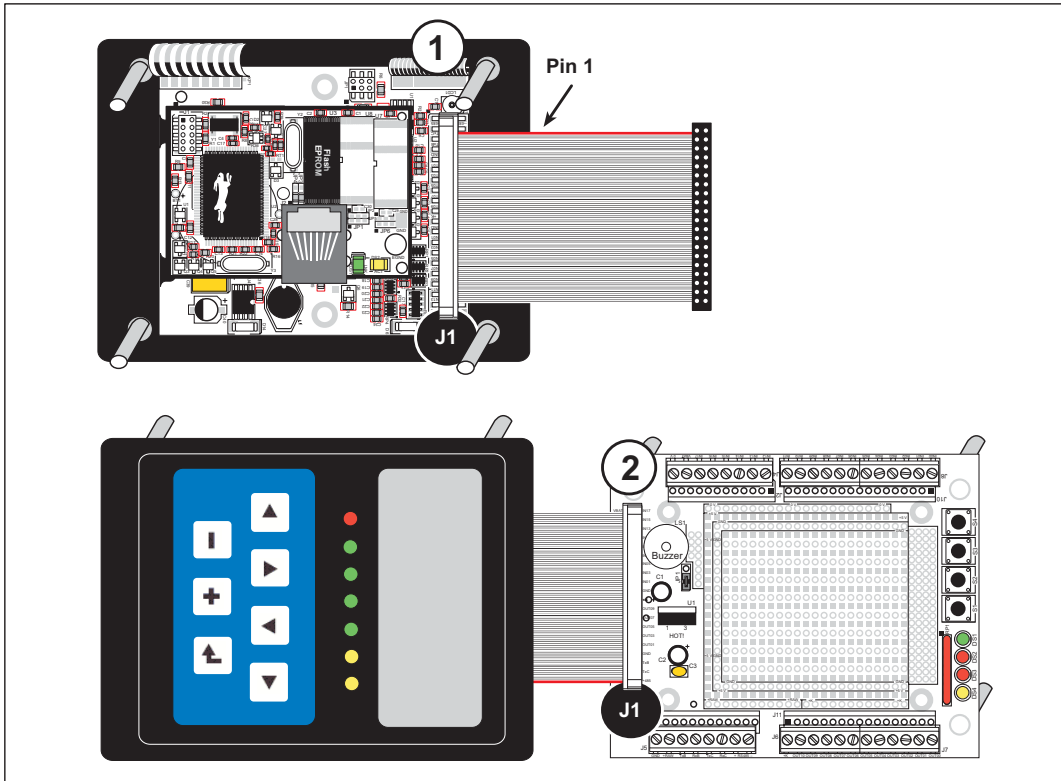
### 2.1 Connections

1. Screw in the four standoffs included with the Tool Kit into the four mounting threads on the OP6800 as shown in Figure 2.



*Figure 2. Screw In Standoffs Into OP6800 Mounting Threads*

2. Connect the OP6800 to the Demonstration Board from the Tool Kit using the ribbon cable connector as shown in Figure 3. First, connect the ribbon cable to header J1 on the OP6800, then turn the OP6800 over and connect the other end of the ribbon cable to header J1 on the Demonstration Board. By connecting the boards this way, you have the option of placing the Demonstration Board behind your OP6800 in your final installation as explained in Appendix C.

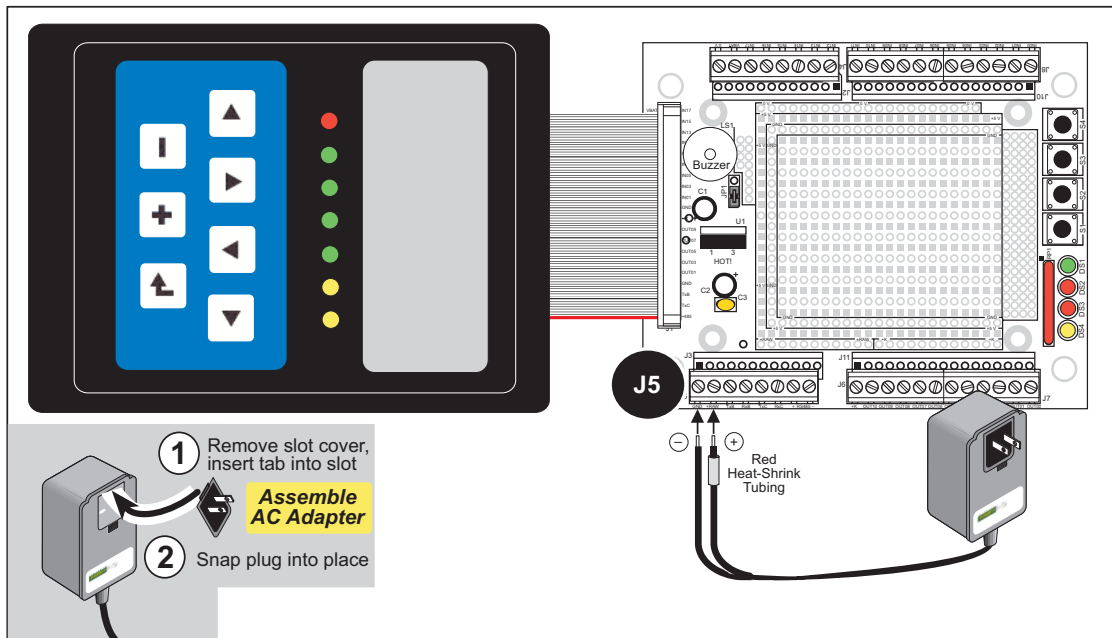


**Figure 3. Connect the OP6800 to the Demonstration Board**

### 3. Connect the power supply.

First, prepare the AC adapter for the country where it will be used by selecting the plug. The OP6800 Tool 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 4, then press down on the spring-loaded clip below the plug assembly to allow the plug assembly to click into place.

Connect the bare ends of the power supply to the **+RAW** and **GND** positions on screw terminal header J5 of the Demonstration Board as shown in Figure 4.



**Figure 4. Power Supply Connections**

**NOTE:** The OP6800 itself has reverse polarity protection, but the Demonstration Board does not. Be careful to connect the positive and negative leads as shown to avoid damaging the Demonstration Board.

**NOTE:** If you are using your own power supply, Rabbit recommends using a 9 V to 25 V DC power supply. The linear regulator on the Demonstration Board can handle up to 35 V, but can get extremely hot.

### 4. Apply power.

Plug in the AC adapter.

**CAUTION:** Unplug the power supply while you make or otherwise work with the connections to the headers. This will protect your OP6800 from inadvertent shorts or power spikes.

**NOTE:** A hardware RESET is done by unplugging the AC adapter, then plugging it back in.



## 2.2 Demonstration Program on Power-Up

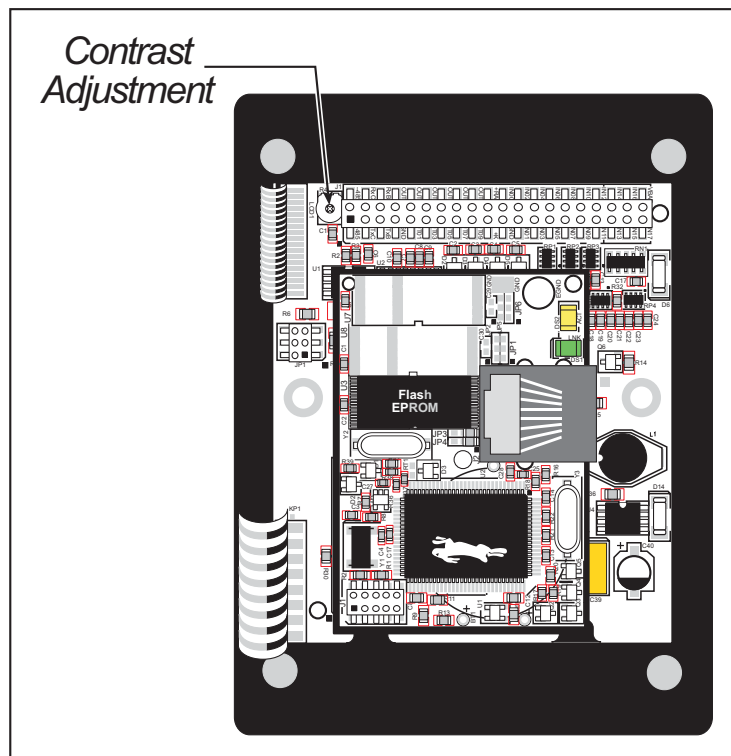
A repeating sequence of graphics and messages in various languages will be displayed on the LCD, and the LEDs will flash on and off in sequence when power is first applied to the OP6800. Try pressing the buttons on the keypad. The LED immediately above that button will light up, and if you pressed one of the keys in the top row of the keypad, the corresponding LED on the Demonstration Board will light up. Similarly, if you press one of the switches on the Demonstration Board, the corresponding LED on the Demonstration Board and on the OP6800 will light up.

Note that the programming cable does *not* have to be connected for this demonstration.

This demonstration will be replaced by a new program when the programming cable is attached and the new program is compiled and run. The demonstration is available for future reference in the Dynamic C `SAMPLES\LCD_KEYPAD\122x32_1x7` directory as `FUN.C`.

## 2.3 Display Contrast Adjustment

The LCD contrast is preset at the factory. If you need to adjust the contrast for optimum display of graphics and messages, you may adjust the potentiometer at R4 located as shown in Figure 5. Note that OP6800 units sold before 2004 did not have any provision to adjust the contrast.



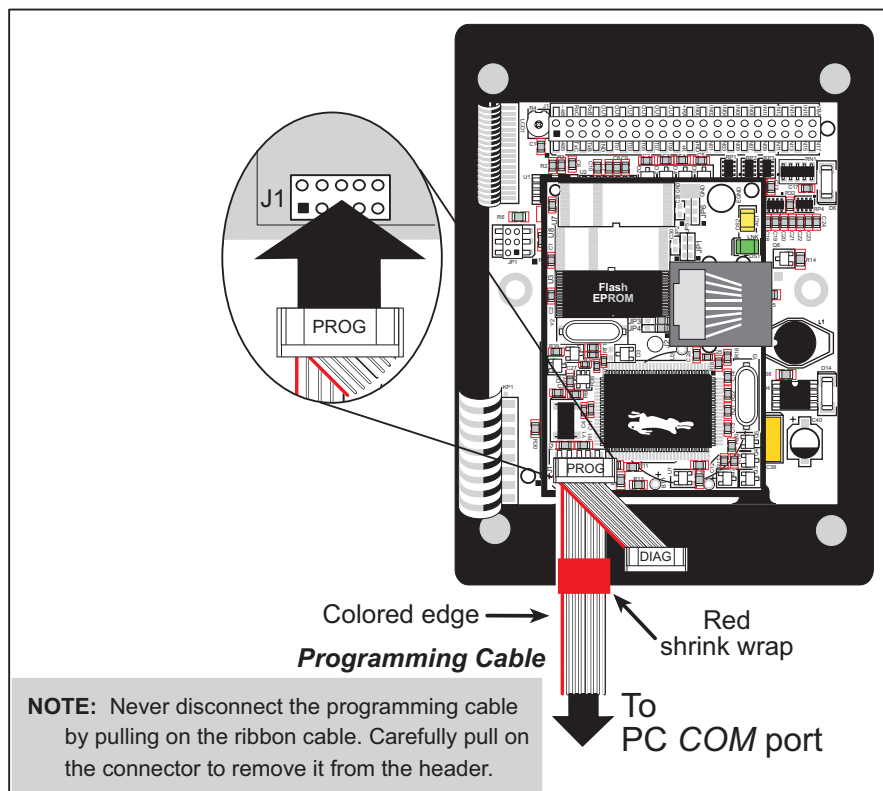
**Figure 5. LCD Contrast Adjustment**

## 2.4 Programming Cable Connections

1. Connect the programming cable to download programs from your PC and to program and debug the OP6800.

Connect the 10-pin **PROG** connector of the programming cable to header J1 on the OP6800 RabbitCore module. Ensure that the colored edge lines up with pin 1 as shown. (Do not use the **DIAG** connector, which is used for a nonprogramming serial connection.) 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 will need to have this parameter configured. Note that COM1 on the PC is the default COM 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. 20-151-0178) with the programming cable supplied with the OP6800 Tool Kit. Note that not all RS-232/USB converters work with Dynamic C.



**Figure 6. Programming Cable Connections**

**NOTE:** Be sure to use the programming cable (Part No. 101-0513) supplied with the OP6800 Tool Kit—the programming cable has red shrink wrap around the RS-232 converter section located in the middle of the cable. Programming cables from other Rabbit kits are not designed to work with the OP6800.

2. Reset the OP6800 by unplugging the AC adapter, then plugging it back in. The OP6800 is now ready to be used.

## 2.5 Installing Dynamic C

If you have not yet installed Dynamic C version 7.06P2 (or a later version), do so now by inserting the Dynamic C CD in your PC's CD-ROM drive. The CD will auto-install unless you have disabled auto-install on your PC.

If the CD does not auto-install, click **Start > Run** from the Windows **Start** button and browse for the Dynamic C **setup.exe** file on your CD drive. Click **OK** to begin the installation once you have selected the **setup.exe** file.

The *Dynamic C User's Manual* provides detailed instructions for the installation of Dynamic C and any future upgrades.

**NOTE:** If you have an earlier version of Dynamic C already installed, the default installation of the later version will be in a different folder, and a separate icon will appear on your desktop.

## 2.6 Starting Dynamic C

Once the OP6800 is connected to your PC and to a power source, start Dynamic C by double-clicking on the Dynamic C icon on your desktop or in your **Start** menu.

If you are using a USB port to connect your computer to the OP6800, choose **Options > Project Options** and select "Use USB to Serial Converter." Click **OK**.

Dynamic C assumes, by default, that you are using serial port COM1 on your PC. If you *are* using COM1, then Dynamic C should detect the OP6800 and go through a sequence of steps to cold-boot the OP6800 and to compile the BIOS. If the error message "Rabbit Processor Not Detected" appears, you have probably connected to a different PC serial port such as COM2, COM3, or COM4. You can change the serial port used by Dynamic C with the **OPTIONS** menu, then try to get Dynamic C to recognize the OP6800 by selecting **Reset Target/Compile BIOS** on the **Compile** menu. Try the different COM ports in the **OPTIONS** menu until you find the one you are connected to. If you still can't get Dynamic C to recognize the target on any port, then the hookup may be wrong or the COM port might not be working on your PC.

If you receive the "BIOS successfully compiled ..." message after pressing **<Ctrl-Y>** or starting Dynamic C, and this message is followed by a communications error message, it is possible that your PC cannot handle the 115,200 bps baud rate. Try changing the baud rate to 57,600 bps as follows.

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

## 2.7 PONG.C

You are now ready to test your programming connections by running a sample program.

Find the file **PONG.C**, which is in the Dynamic C **SAMPLES** folder. To run the 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 **STDIO** window will open and will display a small square bouncing around in a box.

This program shows that the CPU is working. The sample program described in Section 5.2.3, “Run the PINGME.C Demo,” tests the TCP/IP portion of the board (if you have the OP6800 model—the OP6810 does not have an Ethernet capability).

## 2.8 Where Do I Go From Here?

**NOTE:** If you purchased your OP6800 through a distributor or 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/](http://www.rabbit.com/support/bb/) and at [www.rabbit.com/forums/](http://www.rabbit.com/forums/).
- Use the Technical Support e-mail form at [www.rabbit.com/support/](http://www.rabbit.com/support/).

If the sample program ran fine, you are now ready to go on to explore other OP6800 features and develop your own applications.

The following sample programs illustrate the features and operation of the OP6800.

<b>OP6800</b> (SAMPLES\LCD_KEYPAD\122x32_1x7)	<b>Demonstration Board</b> (SAMPLES\OP6800\DEMO_BD)
<b>KEYBASIC.C</b> <b>KEYMENU.C</b> <b>SCROLLING.C</b> <b>TEXT.C</b>	<b>KEYPAD.C</b> <b>SWITCHES.C</b>

These sample programs can be used as templates for applications you may wish to develop.

Chapter 3, “Subsystems,” provides a description of the OP6800’s features, Chapter 4, “Software,” describes the Dynamic C software libraries and describes the sample programs, and Chapter 5, “Using the TCP/IP Features,” explains the TCP/IP features and describes some sample programs.



## 3. SUBSYSTEMS

Chapter 3 describes the principal subsystems for the OP6800.

- Digital I/O
- Serial Communication
- Memory

Figure 7 shows these Rabbit-based subsystems designed into the OP6800.

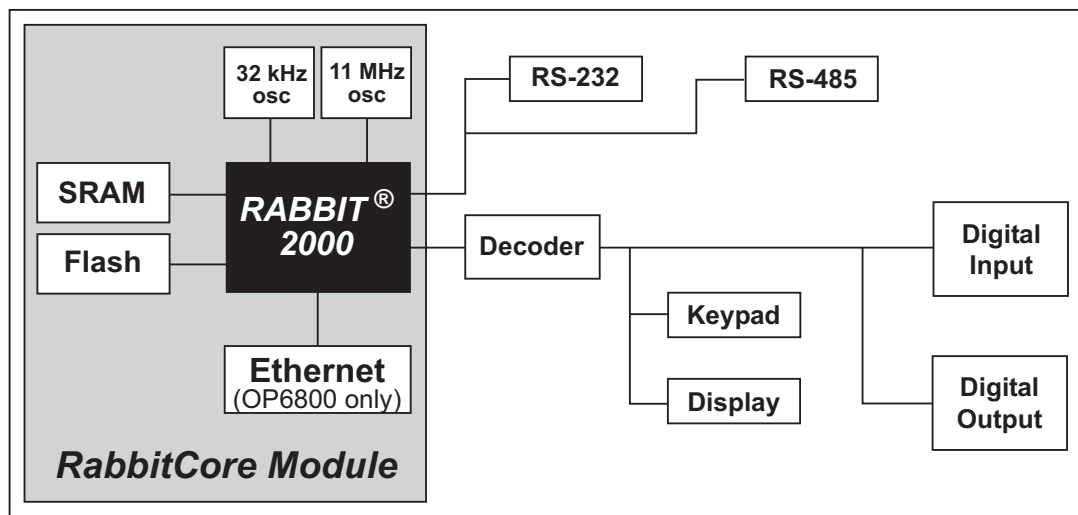
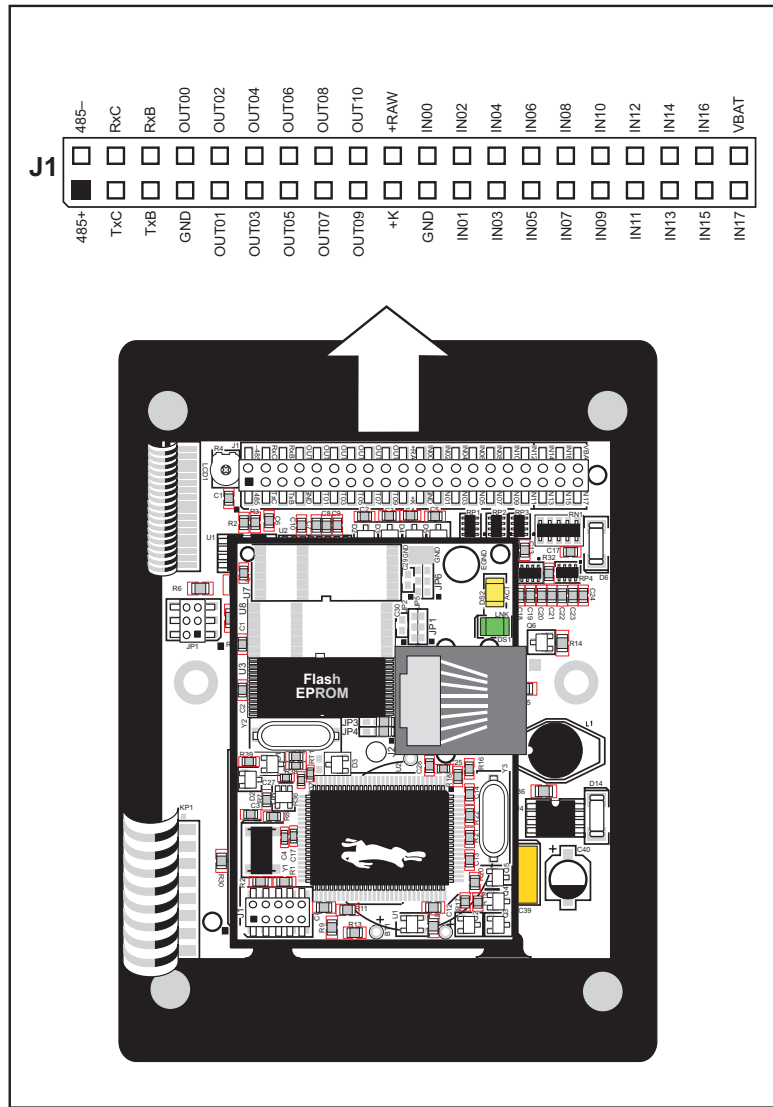


Figure 7. OP6800 Subsystems



### 3.1 Pinouts

Figure 8 shows the OP6800 pinouts.



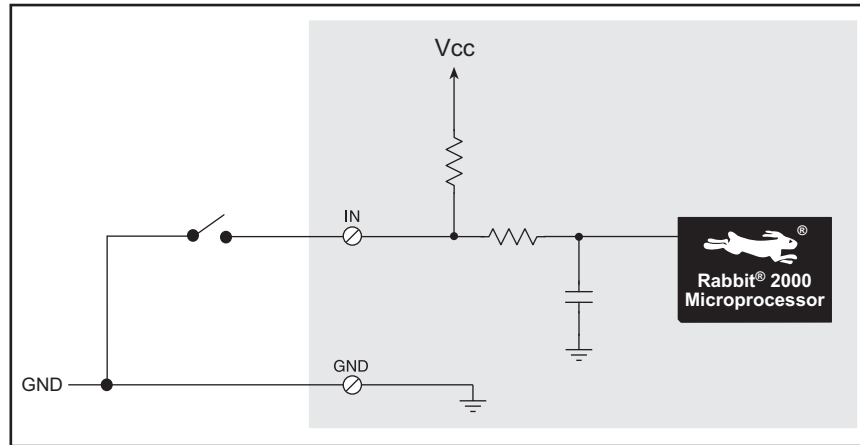
**Figure 8. OP6800 Pinouts**

Header J1 is a standard 2 × 20 header with a nominal 0.1" pitch. The OP6800 also has an RJ-45 Ethernet jack on the RabbitCore module.

## 3.2 Digital I/O

### 3.2.1 Digital Inputs

The OP6800 has eight digital inputs, IN00–IN07, each with a current-limiting resistor of 27 k $\Omega$ , and protected over a range of –36 V to +36 V. The inputs are all pulled up to +5 V as shown in Figure 9.



**Figure 9. OP6800 Digital Inputs**

The OP6800 also has five digital inputs, IN08–IN12, each with a current-limiting resistor of 12 k $\Omega$ , protected over a range of –25 V to +25 V, and pulled up to +5 V.

The actual switching threshold for IN00–IN12 is approximately 2.40 V. Anything below this value is a logic 0, and anything above is a logic 1.

IN13–IN17 are connected in parallel with five of the keypad buttons. These inputs are normally pulled up, but pulling one of these inputs down is the equivalent of pressing the corresponding keypad key remotely.

**Table 2. Remote Keypad Operation**

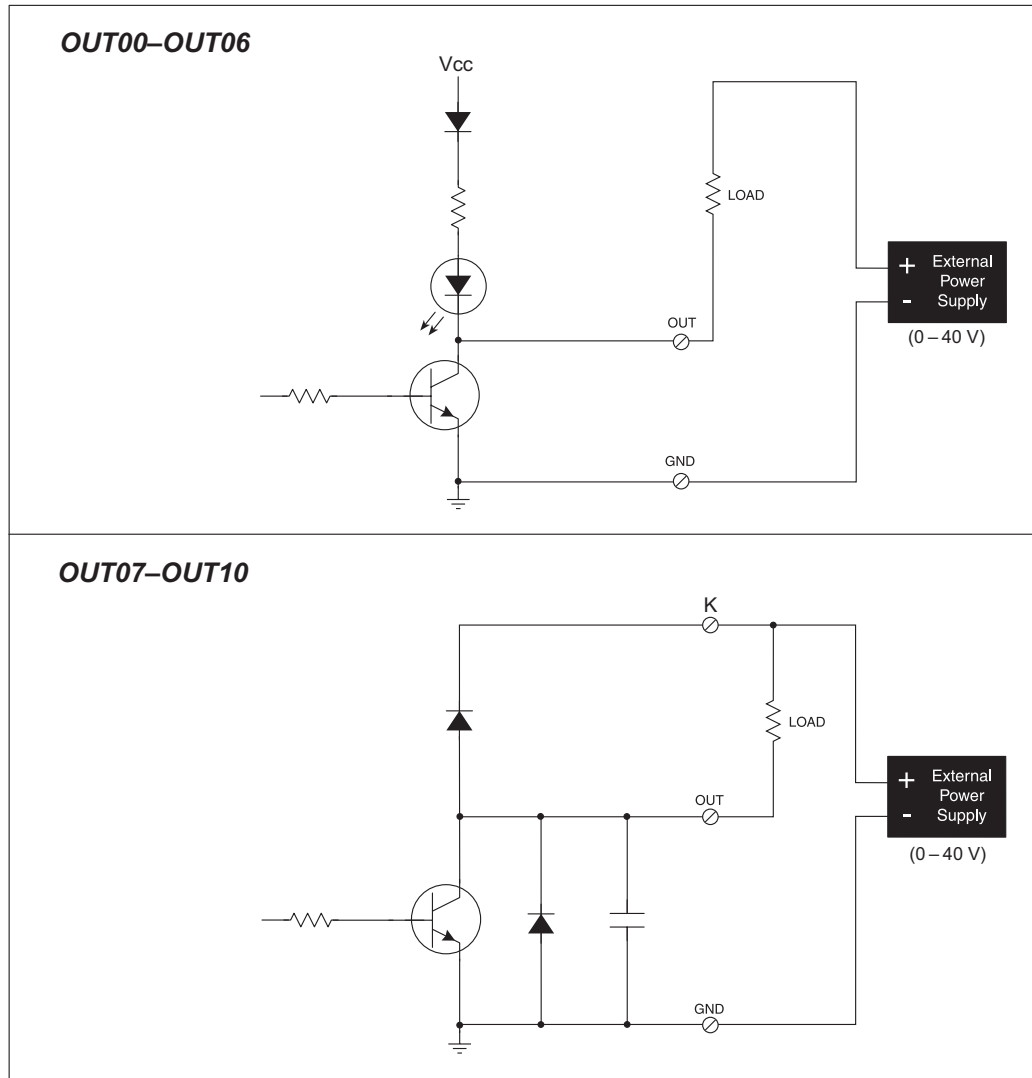
Keypad Key	Remote Keypad Signal Inputs
0 (◀)	IN13
1 (▲)	IN14
2 (▼)	IN15
3 (▶)	IN16
6 (↙)	IN17

**NOTE:** Remote keypad signal inputs IN13–IN17 are *not* protected, and can only handle a voltage range from 0 to +5 V. These inputs were designed solely to facilitate a remote keypad, and should not be used for other purposes.

### 3.2.2 Digital Outputs

The OP6800 has 11 digital outputs, OUT00–OUT10, which can each sink up to 200 mA. Figure 10 shows a wiring diagram for using the digital outputs.

OUT00–OUT06 can switch up to 40 V and the corresponding LEDs when the outputs are on. OUT07–OUT10 offer protection for inductive loads when K is connected to an external power supply; OUT07–OUT10 are not connected to the LEDs.



**Figure 10. OP6800 Digital Outputs**

It is possible to use an external open-collector driver to control the LEDs associated with OUT00–OUT06. Connect the external driver to the output corresponding to the LED you wish to control, but keep the internal driver turned off. The external driver will then control the LED.

### 3.3 Serial Communication

The OP6800 has two RS-232 serial ports, which can be configured as one RS-232 serial channel (with RTS/CTS) or as two RS-232 (3-wire) channels using the `serMode` software function call. Table 3 summarizes the options.

**Table 3. Serial Communication Configurations**

Mode	Serial Port		
	B	C	D
0	RS-232, 3-wire	RS-232, 3-wire	RS-485
1	RS-232, 5-wire	CTS/RTS	RS-485

The OP6800 also has one RS-485 serial channel and one CMOS serial channel. The CMOS serial channel serves as the programming port.

All four serial ports operate in an asynchronous mode. 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 Port A, the CMOS programming port, can be operated alternately 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. The OP6800 boards typically use all four ports in the asynchronous serial mode. Serial Ports B and C are used for RS-232 communication, and Serial Port D is used for RS-485 communication. The OP6800 uses an 11.0592 MHz crystal, which is doubled to 22.1184 MHz. At this frequency, the OP6800 supports standard asynchronous baud rates up to a maximum of 230,400 bps.

#### 3.3.1 RS-232

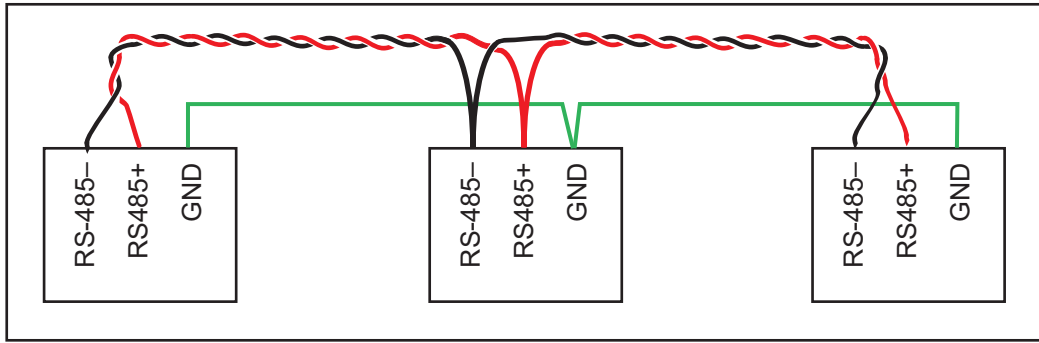
The OP6800 RS-232 serial communication is supported by an RS-232 transceiver. This transceiver provides the voltage output, slew rate, and input voltage immunity required to meet the RS-232 serial communication protocol. Basically, the chip translates the Rabbit 2000's CMOS/TTL signals to RS-232 signal levels. Note that the polarity is reversed by an RS-232 circuit so that a +5 V input becomes approximately -10 V and 0 V is output as +10 V. The RS-232 transceiver also provides the proper line loading for reliable communication.

RS-232 can be used effectively at the OP6800's maximum baud rate for distances of up to 15 m.

#### 3.3.2 RS-485

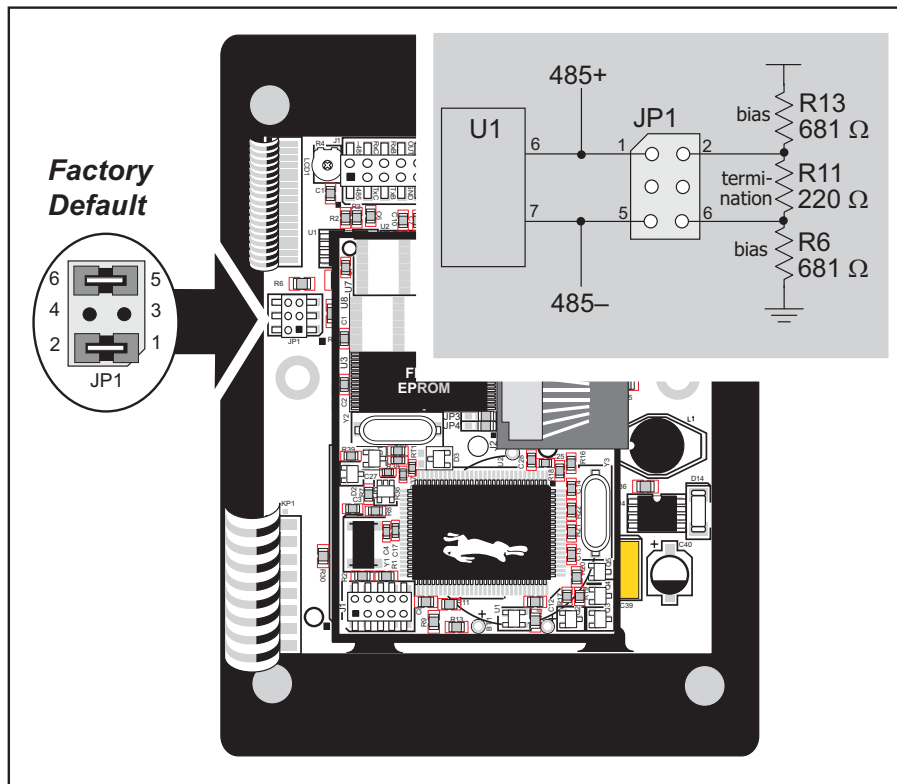
The OP6800 has one RS-485 serial channel, which is connected to the Rabbit 2000 Serial Port D through an RS-485 transceiver. The half-duplex communication uses the Rabbit 2000's PB6 pin to control the transmit enable on the communication line.

The OP6800 can be used in an RS-485 multidrop network. Connect the 485+ to 485+ and 485- to 485- using single twisted-pair wires (nonstranded, tinned) as shown in Figure 11. Note that a common ground is recommended.



**Figure 11. OP6800 Multidrop Network**

The OP6800 comes with a 220  $\Omega$  termination resistor and two 681  $\Omega$  bias resistors installed and enabled with jumpers across pins 1–2 and 5–6 on header JP1, as shown in Figure 12.



**Figure 12. RS-485 Termination and Bias Resistors**

For best performance, the bias and termination resistors in a multidrop network should only be enabled on both end nodes of the network. Disable the termination and bias resistors on any intervening OP6800 units in the network by removing both jumpers from header JP1.

**TIP:** Save the jumpers for possible future use by “parking” them across pins 1–3 and 4–6 of header JP1. Pins 3 and 4 are not otherwise connected to the OP6800.

### 3.3.3 Programming Port

The OP6800 programming port is accessed using header J1 on the OP6800's RabbitCore module or through the Ethernet jack. The programming port uses the Rabbit 2000's Serial Port A for communication. Dynamic C uses the programming port to download and debug programs.

The programming port is also used for the following operations.

- Cold-boot the Rabbit 2000 on the OP6800 after a reset.
- Remotely download and debug a program over an Ethernet connection using the RabbitLink EG2110.
- Fast copy designated portions of flash memory from one Rabbit-based board (the master) to another (the slave) using the Rabbit Cloning Board.

#### Alternate Uses of the Programming Port

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

The programming port may also be used as a serial port via the **DIAG** connector on the programming cable.

In addition to Serial Port A, the Rabbit 2000 startup-mode (SMODE0, SMODE1), status, and reset pins are available on the programming port header.

The two startup mode pins determine what happens after a reset—the Rabbit 2000 is either cold-booted or the program begins executing at address 0x0000.

The status pin is used by Dynamic C to determine whether a Rabbit microprocessor is present. The status output has three different programmable functions:

1. It can be driven low on the first op code fetch cycle.
2. It can be driven low during an interrupt acknowledge cycle.
3. It can also serve as a general-purpose output.

The /RESET\_IN pin is an external input that is used to reset the Rabbit 2000 and the OP6800 onboard peripheral circuits.

Refer to the *Rabbit 2000 Microprocessor User's Manual* for more information.