R-420SP USER'S GUIDE

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RIGEL CORPORATION

PO Box 90040, Gainesville, Florida 32607

(352) 384-3766,

www.rigelcorp.com,

techsupport@rigelcorp.com

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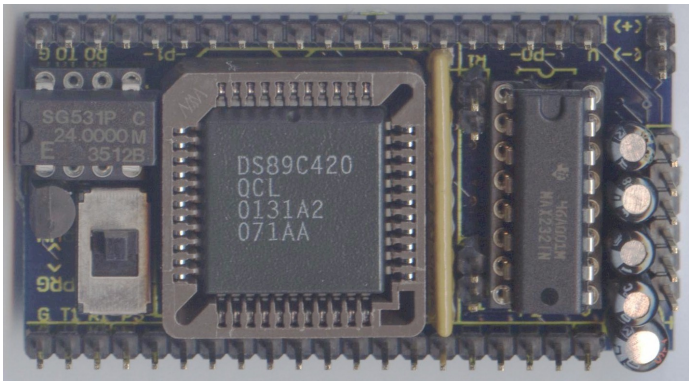
1 OVERVIEW

The R-420SP is very low-cost programmer and chip carrier for the DS89C4X0 microcontroller in the 44-pin PLCC package. It contains a clock oscillator, a reset chip, and an RS-232 level converter. These support chips allow the microcontroller to be programmed and run in the single-chip mode. That is, the board will run code from internal ROM, using the on-chip RAM. The R-420SP complements the line of MCS-51 single-chip mode products from Rigel Corporation. This line includes the R-51SP, R-51SD, the programming and prototyping board R-51PB and Reads51, Rigel's Integrated Development Environment, with a C compiler, and assembler, and a linker. Reads51, build 448, now supports code generation for the single-chip mode and on-board programming of the DS89C4X0 using the R-420SP board.



The R-420SP is intended to be embedded into the end product. Connections to the R-420SP may be made through sockets, headers, or straight soldering into the ports. All integrated circuits except the reset chip are socketed. This makes the R-420SP disposable, as the expensive components may be removed and used over again. Moreover, the clock frequency is determined by a socketed oscillator chip. This way, the clock frequency may be changed simply be replacing this chip.

2 SOFTWARE DEVELOPMENT AND PROGRAMMING THE ROM

Code may be downloaded into the ROM of the microcontroller while it is on-board the R-420SP. The Reads51 integrated development environment (IDE) may be used for code development and programming the R-420SP. Rigel Corporation also offers a programmer board, the R-51PB, specifically designed to program the ROM on 8051-family microcontrollers to be used for debugging code.

2.1 System Requirements

All of Rigel's software is designed to work with an IBM PC or compatible, Pentium 120MHz or better, running Windows 95, 98, 2000, ME, NT, or Windows XP. The newest versions of our software are always available to download off our web site, www.rigelcorp.com. We encourage you to check our web site often to keep up-to-date.

2.2 Software Installation

If you receive a CD from Rigel, follow these steps:
Place the CD-ROM in your drive.
Go to the **Rigel Products | 8051 Software** and click on the .exe file you wish to install. The program will then install in your system. Follow the standard install directions.

If you download Rigel software from the web, (www.rigelcorp.com), follow these steps:
Click on the.exe file you downloaded.
The program will then install in your system. Follow the standard install directions.

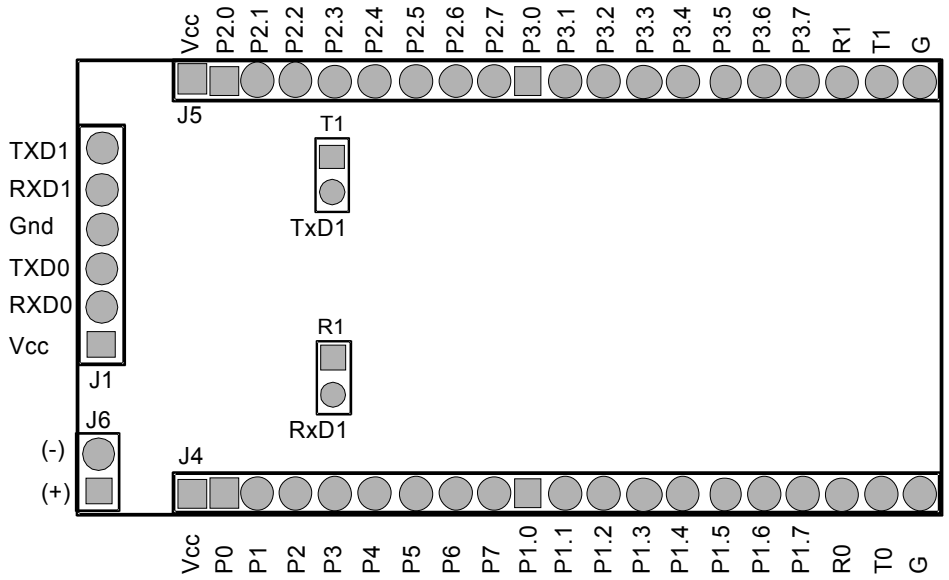
2.3 Reads51

Reads51 is an integrated development environment (IDE) that has a source code editor, an assembler, a Small-C compatible compiler, and an OMF-51 linker. Reads51 (build 448) allows you to download directly to the R-420SP from the TTY window. Refer to the R-420SP user's manual for details.

3 BOARD CONNECTIONS

The connections to the R-420SP board are made through the terminals placed along the peripheral of the boards. These terminals may be left as open holes and the application signals may be directly soldered to the terminals. Alternatively, the terminals may be populated by headers or sockets, and the application signals may be applied through mating connectors. The headers or sockets may be connected from the top or the bottom of the boards. These options are intentionally left open to provide the maximum level of flexibility in the physical assembly of the final product.

The connections to the boards may be classified into three categories: power connections, serial communications signals, and port connections. These categories are presented below. There are several alternate ways to connect the R-420SP board to the application. Refer to the board when considering these options. Only power and serial communications connections are needed to program and run the board. See Diagram.



3.1 Power Connections

The R-420SP board requires a well-regulated 5Volt DC supply. There are several VCC (+5V) and GND (ground) terminals available on the board. The ones on the lower left corner, header J6, marked "(-)" and "(+)" are perhaps the most convenient place to supply the power. In addition, the port terminals placed along the two longer sides of the board terminate with power posts. This is convenient if a single harness for power and port signals is to be used. Similarly, the serial communications signals at the dedicated terminal J1 terminate with power posts. Again, a single harness carrying power and the serial communications signals may be used. For mobile applications, you may use four 1.5V batteries in series to generate a 6V DC supply. Then use one or two diodes in series to drop the voltage.

3.2 Serial Communications Signals

There are two serial ports on the board. Each serial port uses three lines: receive (RxD), transmit (TxD), and ground (GND or G). R0 and T0 are connected to serial port 0 of the DS89C4X0 microcontroller. R1 and T1 are used with serial port 1 of the microcontroller. Two headers, marked R1 and T1 on the board must, be populated to use serial port 1. When these jumpers are removed, the port pins P1.2 and P1.3 may be used as general-purpose ports.

Serial port signals are available on headers J4 and J5 on the extreme right-top and right-bottom of the board as two triplets: "R0-T0-G" and "R1-T1-G." Serial port signals are also available on the six-position terminal (J1), placed on the left edge. A square pad marks pin 1 of J1. The terminal signals are given below:

Position	Signal	Remark
1	VCC (+5 VDC)	Square pad
2	RxD0	Serial port 0
3	TxD0	
4	GND (Ground)	
5	RxD1	Serial port 1
6	TxD1	

3.3 Input/Output Ports

The R-420SP input/output ports are directly connected to the ports of the microcontroller. The MCS-51 ports are quasi-bi-directional ports. They use pull-up resistors to be at logic level high. When used as inputs, the external signal must ground the port for the microcontroller to read a logic level low. Refer to the 8051 data books for more information. Several examples are also provided in the textbooks by Rigel Press (see references).

The four ports of the 89C4X0 are available on the top and bottom edges of the board. There are eight terminals for each of the ports P0 to P3. A square pad indicates Port bit 0 for each port. In addition to the port bits, each side has an additional terminal for VCC (marked 'V') and serial port signals, including the ground (marked 'G') signal.

4 PROGRAMMING

4.1 Reset

The R-420SP board uses a dedicated reset chip, the DS1812. The board is reset upon power up. Cycle the power (turn the power off and then on again) to induce a reset.

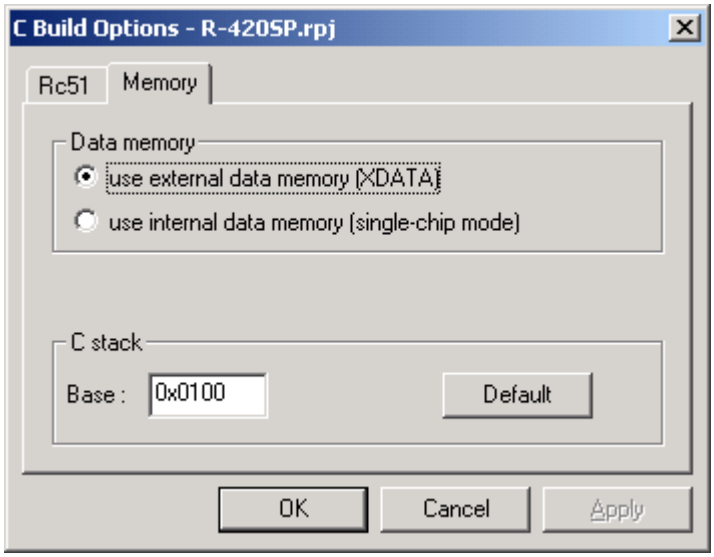
4.2 Programming the DS89C4X0

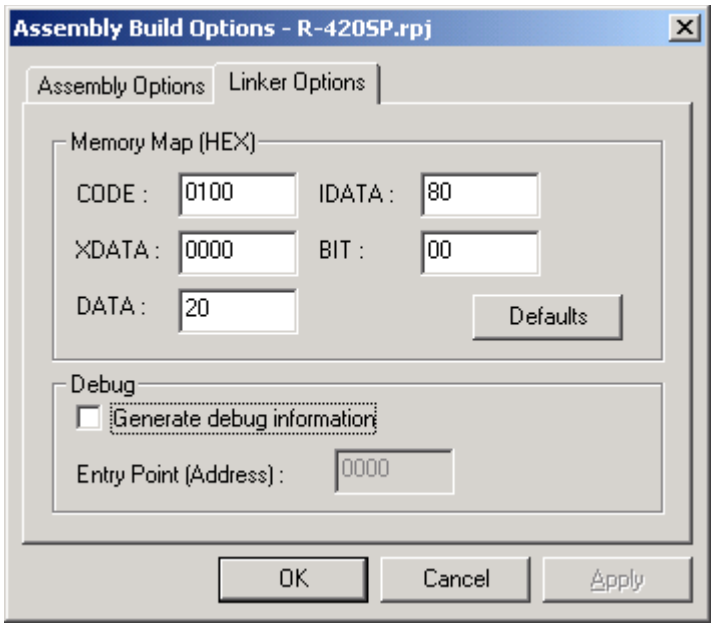
The board is placed in the program mode by moving the slide switch (S1) to the upper position marked "<PRG>." Once the board is programmed the switch should be moved to the operating position marked "<RUN>" and the power cycled.

Refer to the C-language examples in Reads51 to see how the internal XDATA RAM of the DS89C4X0 is enabled. Once you develop your code, you may download it to the board using the Reads51 TTY window. Place the board in the program (PGM) mode and press the "enter" key. The DS89C4X0 internal "ROM LOADER" monitor program answers with a prompt. Note that the DS89C4X0 monitor extracts the Baud rate from the received character. Refer to the DS89C4X0 data sheet to see what Baud rate – crystal frequency combinations are supported. In general, an 11.0592MHz crystal frequency supports almost all Baud rates.

Once the internal monitor program answers with the prompt, use the monitor command 'K' to erase internal memory. That is, press 'K' and enter. Refer to the DS89C4X0 data sheet for a complete set of monitor commands. Then enter the load command 'L' (and enter). This places the monitor in the download state. It expects code in the Intel Hex format. Use the Reads51 "Tools -> Download ASCII file" command to download your program to the board. Note that the "Options->TTY Options" dialog has three fields related to the ASCII downloads. You may specify a delay after each character and each line of ASCII text. (The hex file is ASCII text.) You may also instruct the Reads51 down-loader to wait for an acknowledgement character before sending the next line of text. The DS89C4X0 monitor returns a 'G' (for good record) when it is ready for the next line. It is recommended that you set the character delay to 0 (no delay).

Use the Reads51 to communicate with the board. Note that the 89C4X0 internal XDATA RAM is only 1K. The settings below reserve the first 256 bytes (0x100) for global variables, and the remaining 768 bytes (0x300) for the C-stack. That is, the C-stack starts at 0x100.





Include a start-up module in your project. This module must be named “c0.src.” Enable the internal XDATA RAM in the start-up code. That is, set the PMR (0xC4) to 1. The project R-420SP shows the compiler and linker settings. It also includes the start-up code.

4.3 Downloading HEX Code to the DS89C4xx Microcontrollers

The menu item "Download ASCII File" in the "Tools" menu can be used to send generated HEX code to the DS89C4xx microcntrollers.

These microcontrollers have a built-in monitor program called the "ROM Loader." The microcntroller must be placed in the so-called "ROM Loader Mode" by selecting the appropriate hardware signals. The Rigel boards usually have a slide switch that allows you to toggle between the modes. On the Rigel boards, the two modes are referred to as the "Program (or Pgm)" and "Run" modes.

Once the microcntroller is in the PGM mode, it communicates through its serial port (SP0). The on-chip monitor detects the communications Baud rate from the characters it receives. In Reads51, open the TTY window and select a suitable Baud rate. The on-chip monitor (ROM Loader) expects a carrige return character. Press the "Enter" key. If the monitor can match the Baud rate, it responds with a prompt message. Note that although a broad range of Baud rates are supported, some Baud rates may not work at certain crystal frequencies. Usually, trying a different Baud rate solves the problem. Refer to the data sheet for more information on exactly which Baud rates are detected at different crystal frequencies.

Once the monitor (ROM Loader) is invoked, the remaining operations are carried out by a series of commands. Again refer to the data sheet for a complete set of commands. Below, we summarize the most important three commands.

4.3.1 Clear FLASH

At the monitor prompt, press 'K' and "Enter" to clear the internal FLASH. The FLASH should be erased before loading a new Hex file. Clearing the FLASH also clears the security bits (Lock Bits or LB).

4.3.2 Download HEX File

At the monitor prompt, press 'L' and "Enter" to initialize a download session. The monitor expects to receive Intel Hex records. At this point, use the "Download ASCII File" menu to specify a HEX file. The menu item is under the "Tools" menu. Once you specify a HEX file, the transmission starts.

The monitor acknowledges the reception and successful programming of a record by a 'G' character. You may use the TTY options dialog (from the "Options" menu, select "TTY Options") to specify 'G' as the

"Line ACK char." This improves transmission speed. If you use another TTY program such as the WIndows HyperTerminal, make sure you insert enough delays after each line to allow for FLASH programming time.

At the end of the transmission, the monitor will once again display its prompt.

4.3.3 Setting the Security Bits

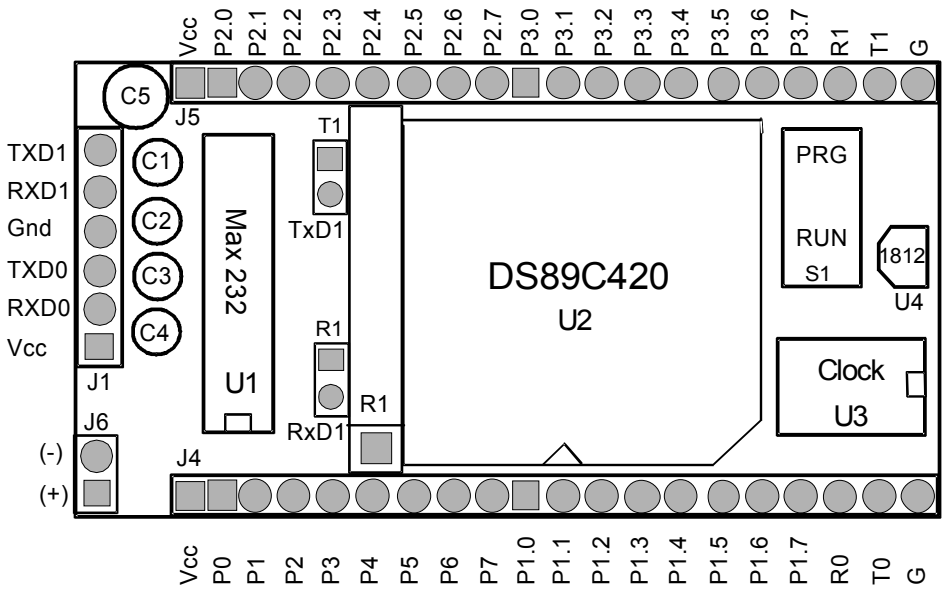
Use the 'W' command to set the security bits LB1, LB1+LB2, or LB1+LB2+LB3. These bits provide increasing levels of security, as explained in the data sheet. The "Lock Bits" LB are bit mapped. LB1 is the least significant bit, while LB3 is the most significant. A value of 3, for instances, sets LB1 and LB2. The following are permissible combinations:

Command : "W LB 1 <enter>"
Command : "W LB 3 <enter>"
Command : "W LB 7 <enter>"

5 Parts List

Quantity	Part	Mouser Part Number	Designator
3	**10nF**	**PCC103BCT-ND**	**C6, C7, C8**
4	1uF	140-MLRL50V1.0	C1-C4
1	47uF	140-MLRL50V1.0	C5
1	10K gang	266-10K	R1
2	**1N4001 / 1N4148**	**583-SM4001 / 621-MMBD4148**	**D1, D2**
3	1X2 Header	100mil	T1/J2, R1/J3, J6
1	1X6 Header	100mil	J1
2	1X20 Header	100mil	J4, J5
1	16 Pin Dip Socket	575-199316	U1
1	44 Pin PLCC	575-442494	U2
1	8 Pin Dip Socket	575-199308	U3
1	MAX232	MAX232CPE	U1
1	DS89C4X0	DS89C4X0MNG	U2
1	Clock	11.0592 / 12 / 24 MHz	U3
1	DS1812	DS1812-10	U4
Part #'s in Bold are Surface Mount Parts populated on the bottom of the board			

6 Top Overlay



Bottom Overlay