SF1000

Serial Flash Expansion Card

User’s Manual

019–0102 • 011217–C

SF1000 User's Manual

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Z-World, Inc.
2900 Spafford Street
Davis, California 95616-6800
USA

Telephone: (530) 757-3737
Facsimile: (530) 757-3792
Web Site: http://www.zworld.com
E-Mail: zworld@zworld.com

Table of Contents

INTRODUCTION

The SF1000 is a serial-interfaced flash memory card designed to work with Z-World's single-board computers. Single-board computers equipped with the Rabbit 2000 processor can use the SF1000 with either a synchronous serial peripheral interface (SPI) or an emulated SPI via parallel I/O ports. Zilog Z180-based single-board computers must use the emulated SPI method.

Two SF1000 models are presently offered, as shown in Table 1.

Table 1. SF1000 Models

Model	Flash Memory Size
SF1000	8MB
SF1010	4MB

Larger memories will be possible in the future when parts become available.

These serial flash cards are ideal for applications that require the temporary storage of large amounts of data. This data can be retrieved or downloaded to another system via the controlling single-board computer using TCP/IP or serial communication, or the card itself may be removed to facilitate transferring the data to another location.

GETTING STARTED

Headers

The SF1000 comes with a 10-pin, 2 mm, 5×2 header located at J1 as shown in Figure 1. Headers, either plugs or sockets, SMT or through-hole, may also be installed at J2 or J3. The pinouts for these positions are identical, and allow for a connecting cable to be hooked up in different ways. There is also a location at J4 for a 7-pin in-line header or socket with 0.1" spacing. Position 6 at J4 is not used, which allows this connection to be keyed.

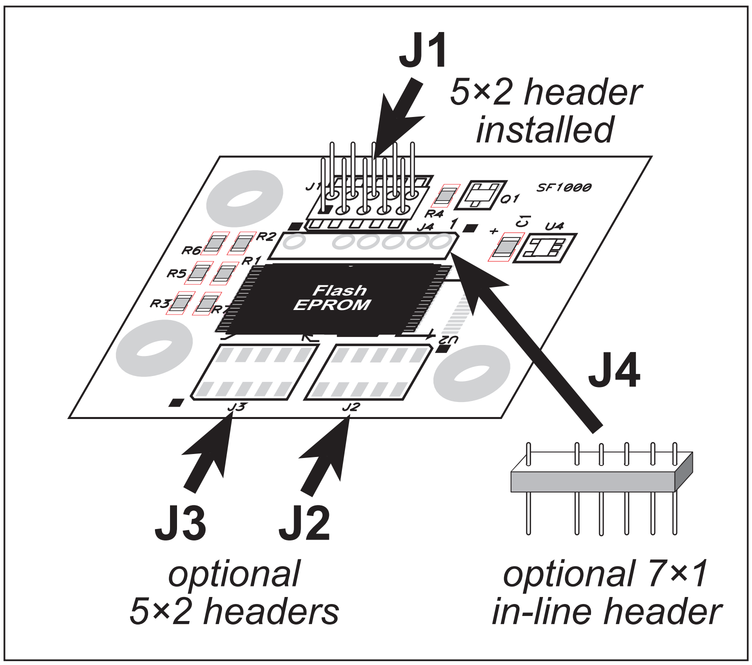


Figure 1. User Connection Points to SF1000

Pinout

Only six connections are required to interface the SF1000 with a Z-World single-board computer:

- +5 V
- Ground
- Chip Select input
- Serial Clock Input
- Serial Data Input
- Serial Data Output. This output is inverted because the serial flash is a 3 V part and the signal is converted to 5 V via an inverting transistor buffer.

Figure 2 shows the pinouts for the SF1000 header locations.

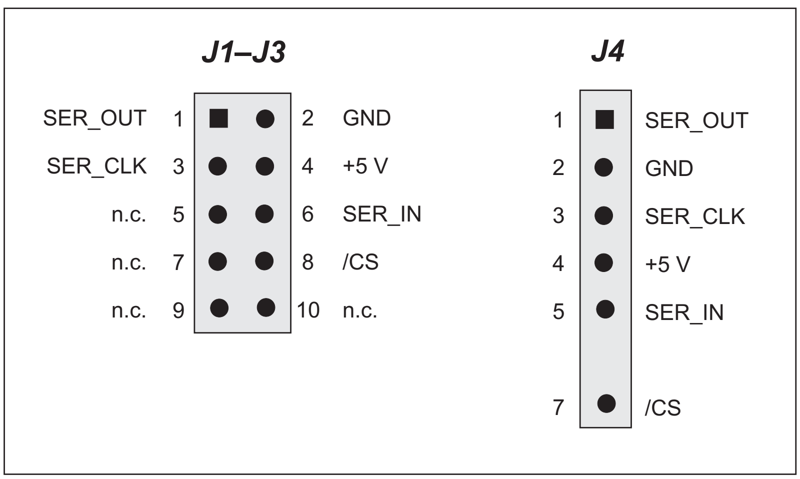


Figure 2. SF1000 Pinout

Connections

Rabbit 2000 Boards

Serial Port B on all the Rabbit-based boards (except the BL2000) is the recommended port to use to connect the SF1000 serial flash card. Table 2 lists the connections.

Table 2. SF1000 Connections to Rabbit-Based Board (except BL2000)

<table>
<tr><th>SF1000 Signal</th><th colspan="2">Rabbit-Based Board</th></tr>
<tr><td>+5 V</td><td colspan="2">+5 V</td></tr>
<tr><td>GND</td><td colspan="2">GND</td></tr>
<tr><td>SER_OUT</td><td>PC5 (RXB)</td><td rowspan="3">Serial Port B</td></tr>
<tr><td>SER_IN</td><td>PC4 (TXB)</td></tr>
<tr><td>SER_CLK</td><td>PB0 (CLKB)</td></tr>
<tr><td>/CS</td><td colspan="2">user-selected output bit
(default is PB7)</td></tr>
</table>

Refer to the user’s manual for you Rabbit-based single-board computer for the locations of these connection pins.

While Serial Port B is the recommended port for connecting the SF1000 serial flash card, the programming port (Serial Port A), which is compatible with the header pinout on header J1 on the SF1000, or a parallel I/O port may also be used. A connector cable is available from Z-World if you wish to connect the SF1000 to the programming port (Serial Port A) on your Rabbit-based board.

Note that the programming port (Serial Port A) will not be available for application development and debugging if it is used to connect the SF1000 serial flash card.

Refer to the “Programming Information” section of the “Software” chapter for details of the software associated with your choice of connections.

A synchronous Serial Port B is not available on the BL2000, and so the following parallel-port connections are recommended instead.

Table 3. SF1000 Connections to BL2000

SF1000 Signal	BL2000 Board	
+5 V	+5 V	
GND	GND	
SER_OUT	IN10 (PB5)	
SER_IN	OUT3 (PA3)	Parallel Port A
SER_CLK	OUT2 (PA2)	
/CS	OUT1 (PA1)	

All three BL2000 outputs need to be pulled up to +5 V with a pull-up resistor of 1 kΩ to 2 kΩ. The following additional modifications need to be made.

- Remove R161 (removes GND from J9/J11 pin 12).
- Install R160 (adds VCC to J9/J11 pin 12).
- Remove C46, C47, and C48 (removes filter capacitors, which slow down the output signals).
- Remove C31 (removes filter capacitor, which slows down the input signals).

Figure 3 shows the locations of these components.

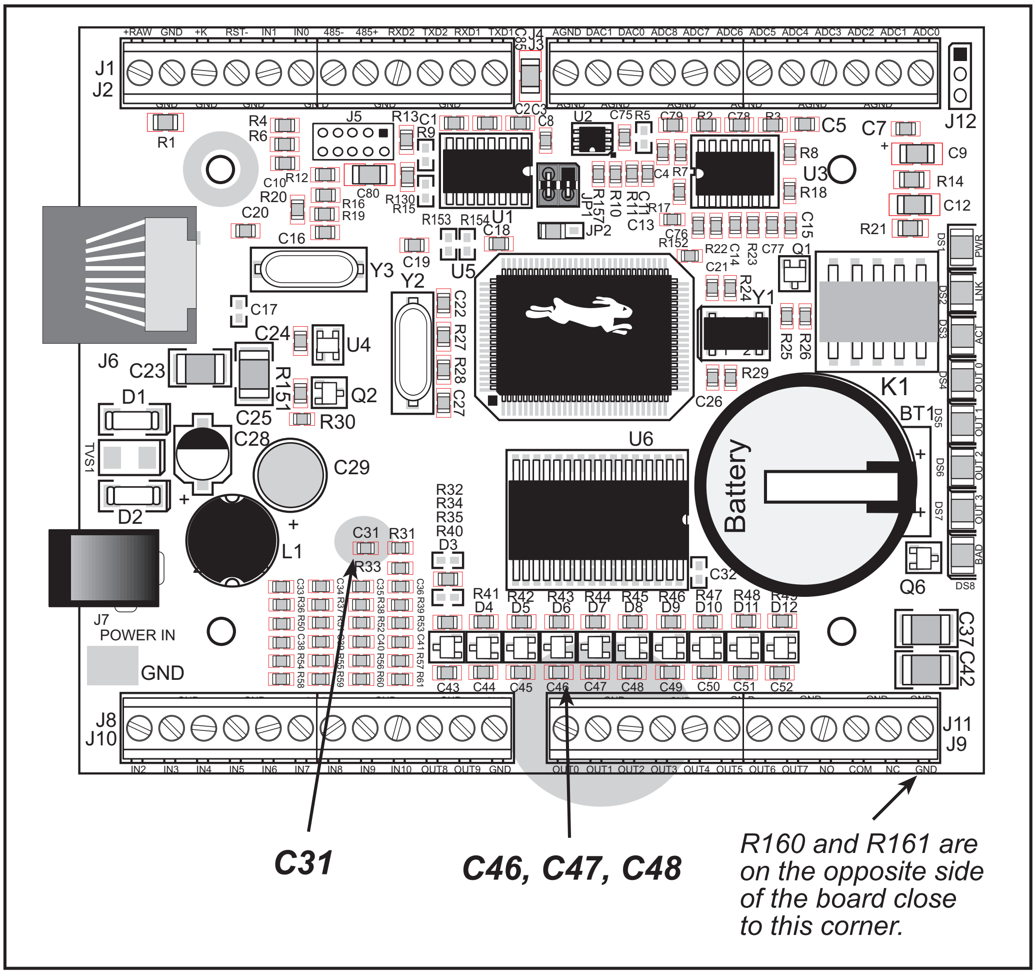


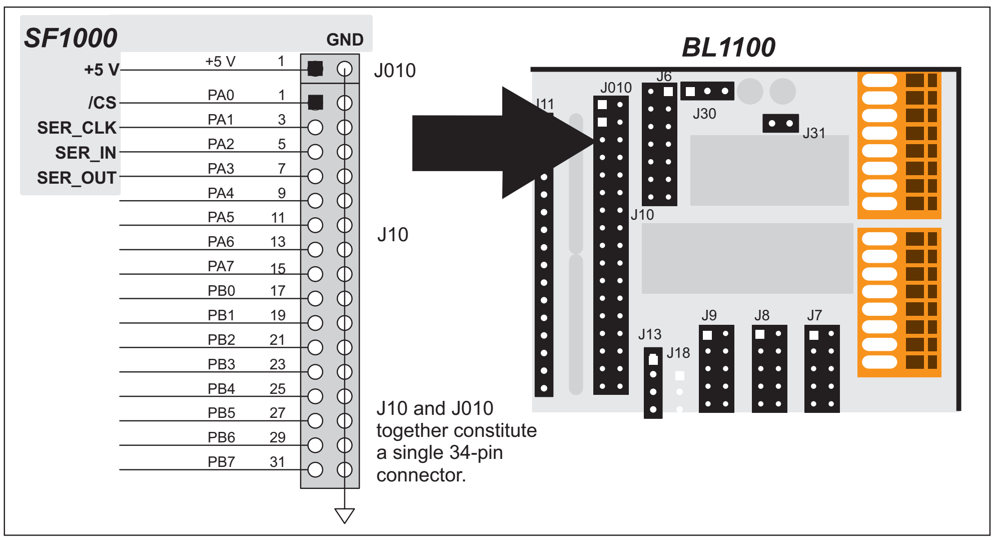
Figure 3. Locations of BL2000 Components to be Added or Removed

Z180 Boards

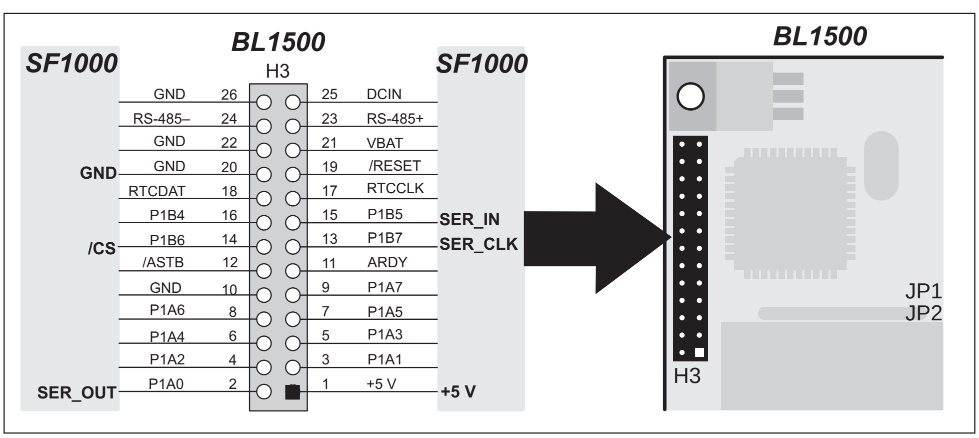
The following Z180-based boards are currently supported:

- BL1100
- BL1500
- BL1700
- LP3100
- PK2200

Figure 4 shows the connections to these boards. These connections may be modified as long as the library functions are also modified accordingly in the library specific to the single-board computer (e.g., **`EZIOBL17.LIB`**).

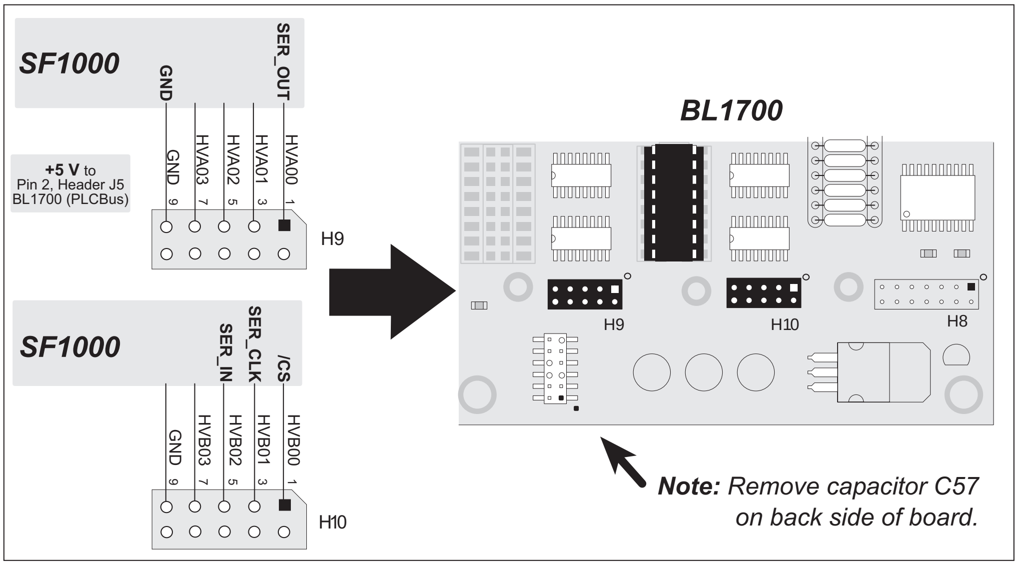


(a) BL1100 Connections



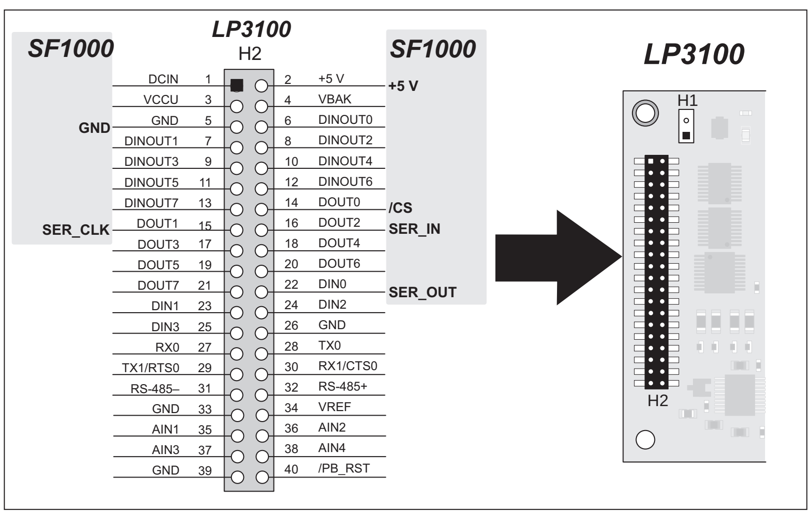
(b) BL1500 Connections

Figure 4. SF1000 Connections to Z180-Based Boards



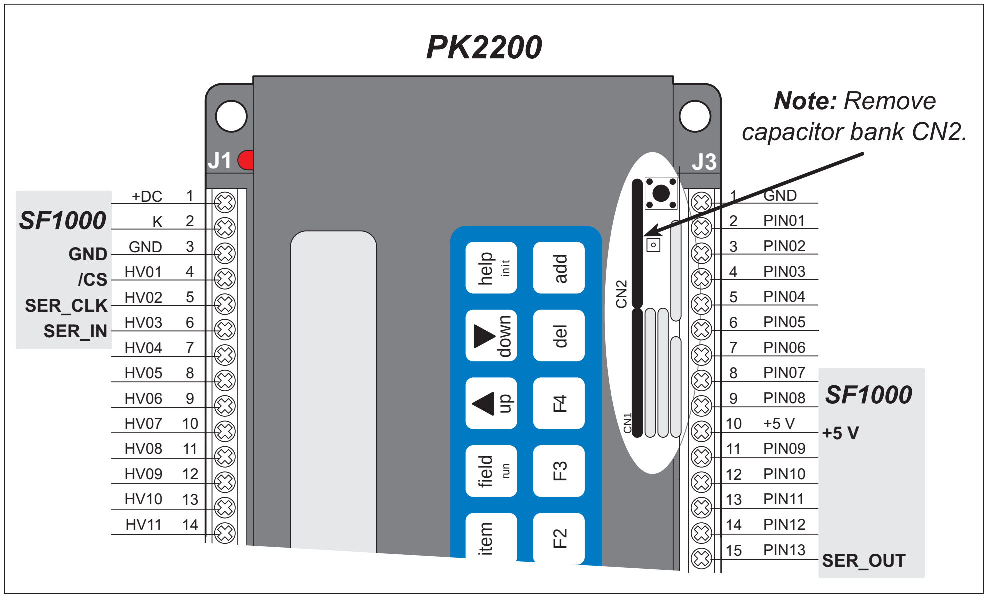
(c) Bl1700 Connections

Note that a capacitor must be removed on the BL1700 as indicated in Figure 4(c) to keep the **SER_IN** signal from getting slowed down too much by the capacitor.



(d) LP3100 Connections

Figure 4. SF1000 Connections to Z180-Based Boards



(e) PK2200 Connections

Figure 4. SF1000 Connections to Z180-Based Boards

Note that a capacitor must be removed on the PK2200 as indicated in Figure 4(e) to keep the **SER_IN** signal from getting slowed down too much by the capacitor.

SOFTWARE

The SF1000 serial flash expansion card implements a flash memory chip with a single, large, linear address space. It is up to the user to maintain appropriate information within the program in order to store and retrieve data in the flash memory.

The flash memory chip consists of a series of "sectors." The size of each sector is the same within a given chip, but can vary from one chip to another. A sector also contains extra bytes that are not made available to the user. Some of these bytes are used by the driver as follows:

- a fixed sync value, indicating that the sector has been written to at least once,
- a version number, and
- a long integer value for the number of times the sector has been written.

The user should keep in mind that a flash memory chip has a limited number of write cycles per sector, and that an entire sector must be written at a time. The chips used in the SF1000 serial flash cards are specified at 50,000 write cycles typical. The most efficient usage dictates that the user "block" all writing to the flash memory so that only full sectors are written.

More than one SF1000 serial flash card may be used in the control system built around the Z-World single-board computer. Users have to write their own **`CS_enable`**/**`CS_disable`** functions to control the chip select signals on the SF1000 serial flash cards. The only restriction is that all the SF1000 serial flash cards have the same size of flash memory chip, i.e., 4M or 8M.

Dynamic C

Z-World's Dynamic C integrated development software is used to add API functions from the **SF1000.LIB** library to your program. The **SF1000.LIB** library is available in Dynamic C Premier for Rabbit-based boards and in DC 32 for selected Z180-based boards.

SF1000.LIB *Library Functions*

The following API functions are available in the Dynamic C **SF1000.LIB** library. These functions are blocking functions, but do not disable interrupts. The functions are not re-entrant.

- **int SF1000Init (void);**

  Minimum setup needed to verify correct flash operation.

  PARAMETERS: None.

  RETURN VALUES:

  0 = success
  -1 = invalid density value read
  -2 = unknown response
  -3 = maybe no SF1000?

  GLOBALS DEFINED:

  ```
  int SF1000_Density_Value
  int SF1000_Sector_size
  int SF1000_Block_size
  int SF1000_Nbr_of_Blocks
  ```

- **int SF1000Write (long FlashAddrDest, void* Data, int ByteCount);**

  Write a block of data to the flash.

  PARAMETERS:

  1 = (**long**) address of destination
  2 = (**void***) source RAM starting address
  3 = (**int**) number of bytes to write

  RETURN VALUES:

  0 = success
  -1 = illegal byte count
  -2 = illegal flash address

- **`int SF1000Read ( long FlashAddrSource, void* Data, int ByteCount );`**

  Read a block of data from the flash.

  PARAMETERS:

  1 = (**`long`**) address of source
  2 = (**`void*`**) destination RAM starting address
  3 = (**`int`**) number of bytes to write

  RETURN VALUES:

  0 = success
  -1 = illegal byte count
  -2 = illegal flash address

- **`long SF1000CheckWrites ( int Block );`**

  Read the number of times that a block has been written.

  PARAMETER: (**`int`**) block number (0 relative)

  RETURN VALUE: the number of times the block has been written.

Programming Information

Rabbit 2000 Boards

Define the following values ***before*** the **`#use SF1000.LIB`** statement.

1. Interface (default is **`SF1000_SER_B`**)

`SPI_SER_A`	use Serial Port A
`SPI_SER_B`	use Serial Port B
`SPI_PARALLEL`	use a parallel I/O port

2. SPI bit rate (if using a serial port—default is 5)

   `SPI_CLK_DIVISOR`

   This is the divisor for the appropriate Timer A register.

3. I/O bit to be used for Chip Select (default is PB7)

   `SF1000_CS_PORT`

   `SF1000_CS_PORTSHADOW`

   `SF1000_CS_BIT`

4. I/O bits for parallel interface

`SPI_TX_REG`	register for clock and Tx data (default is PDDR)
`SPI_TXD_BIT`	bit number for Tx data (default is bit 1)
`SPI_CLK_BIT`	bit number for clock (default is bit 0)
`SPI_RX_REG`	register for Rx data (default is PDDR)
`SPI_RXD_MASK`	mask for Rx bit (default is 8, bit 3)

   The default values will be used if **`SPI_TX_REG`** is not defined. If **`SPI_TX_REG`** is defined, then all the values must be defined.

The I/O port ***must*** be initialized for proper operation of the input and output!

If you are using the alternate Serial Port B I/O pins, you need to define **`SERB_USEPORTD`**.

BL2000

These are the required setup definitions when the BL2000 connections are made using Parallel Port A as described in this manual.

```
#define SPI_MODE_PARALLEL 1 // show using parallel I/O
#define SF1000_CS_PORT PADR
#define SF1000_CS_PORTSHADOW PADRShadow
#define SF1000_CS_BIT 1
#define SPI_TX_REG PADR
#define SPI_TXD_BIT 3
#define SPI_CLK_BIT 2
#define SPI_RX_REG PBDR
#define SPI_RXD_MASK 0x20
#define SPI_INVERT_CLOCK

// define the chip select macro

#define CS_ENABLE BitWrPortI ( SF1000_CS_PORT,
  &SF1000_CS_PORTSHADOW, 1, SF1000_CS_BIT );
#define CS_DISABLE BitWrPortI ( SF1000_CS_PORT,
  &SF1000_CS_PORTSHADOW, 0, SF1000_CS_BIT );
#define PROC_RABBIT
```

These are the initialization statements.

```
brdInit();     // initialize the I/O of the BL2000
SPIxor = 0xFF; // invert the received bits due to
               // inverter on SF1000
SPITXxor = 0xFF; // invert the transmitted bits
                 // due to BL2000 output
```

Z180 Boards

The following Z180-based boards are currently supported.

- BL1100
- BL1500
- BL1700
- LP3100
- PK2200

Figure 3 in the "Getting Started" chapter shows the connections to these boards. These connections may be modified as long as the library functions are also modified accordingly in the library specific to the single-board computer (e.g., **`EZIOBL17.LIB`**).

APPENDIX. SPECIFICATIONS

General Specifications

Table A-1 lists the electrical, mechanical, and environmental specifications for an SF1000 serial flash card.

Table A-1. SF1000 General Specifications

Parameter	Specification	
Board Size	1.51″ × 1.75″ × 0.25″ (38.4 mm × 44.5 mm × 6.4 mm)	
Operating Temperature	–40°C to 70°C	
Humidity	5% to 95%, noncondensing	
Input Voltage and Current	4.75 V to 5.25 V DC, 60 mA maximum	
Flash Memory	8M (SF1000) 4M (SF1010)	
Serial Data Rate* Block size SF1000: 1024 bytes SF1010: 512 bytes	BL1700 @ 18.4 MHz (SF1010)	Read 70 ms/block Write 88 ms/block
	RCM2000 @ 25.8 MHz (SF1000)	Read 14.0 ms/block Write 27.5 ms/block
	RCM2000 @ 25.8 MHz (SF1010)	Read 7.3 ms/block Write 23.5 ms/block

* The BL1700 measurements were made using a "bit-banged" parallel I/O port to simulate an SPI; the RCM2000 measurements were made using a synchronous serial interface (SPI).

Mechanical Specifications

Figure A-1 shows the mechanical dimensions of an SF1000.

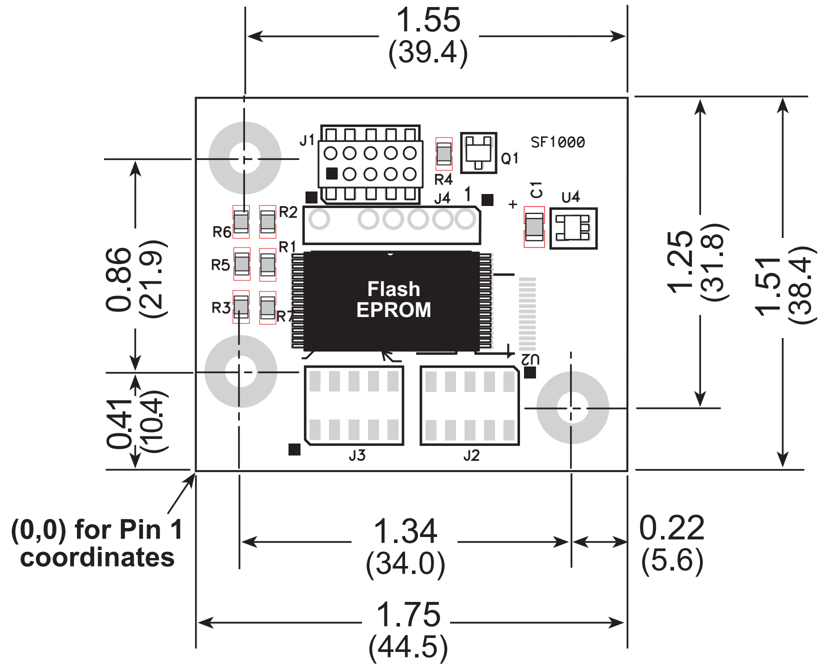


Figure A-1. SF1000 Dimensions

Table A-2 lists the pin 1 locations.

Table A-2. SF1000 Pin 1 Locations (in inches)

Header		Location
J1	installed	0.551, 1.202
J2	not installed	1.267, 0.306
J3	not installed	0.485, 0.230
J4	not installed	1.102, 1.021

Figure A-2 shows the footprint of another board that the SF1000 would be plugged into. These values are relative to the header connectors.

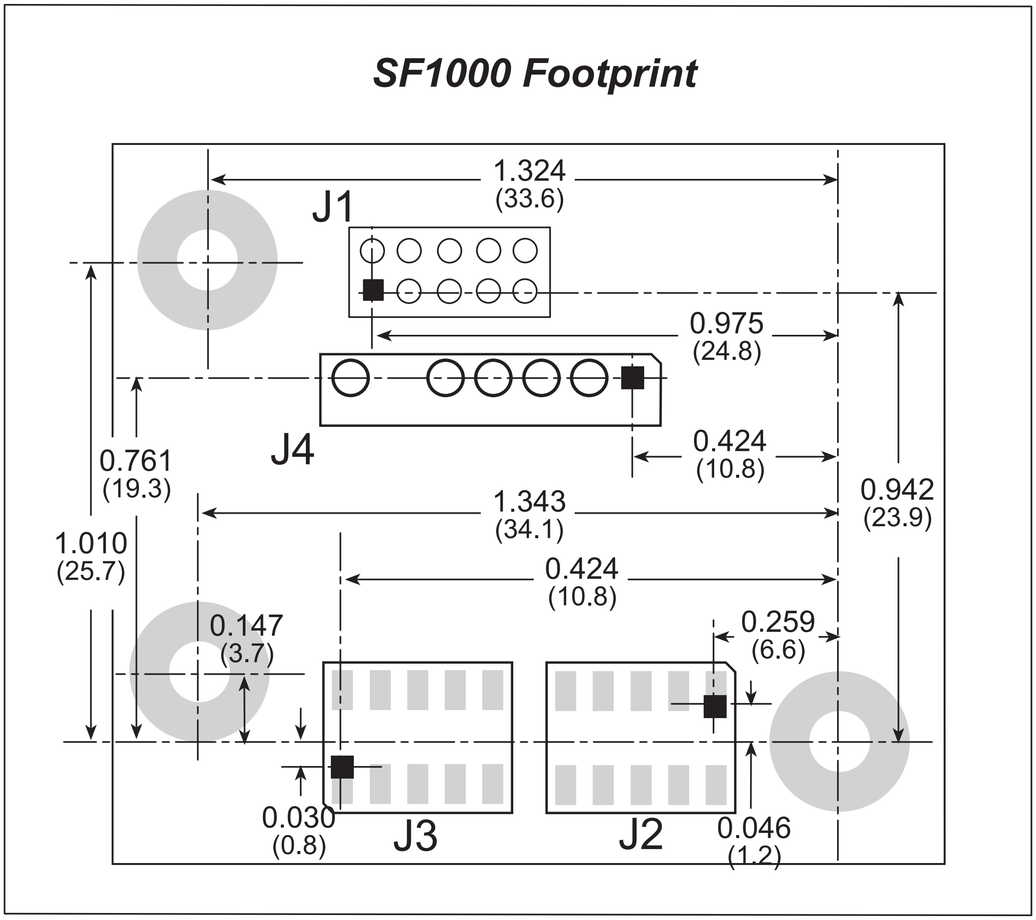


Figure A-2. User Board Footprint for SF1000

SCHEMATICS

REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
A	E11620	INITIAL RELEASE	XT	8/7/01	KIS	8/7/01
B	E11652	CHANGE VALUE OF R2 FROM 1K TO 100 OHMS.				

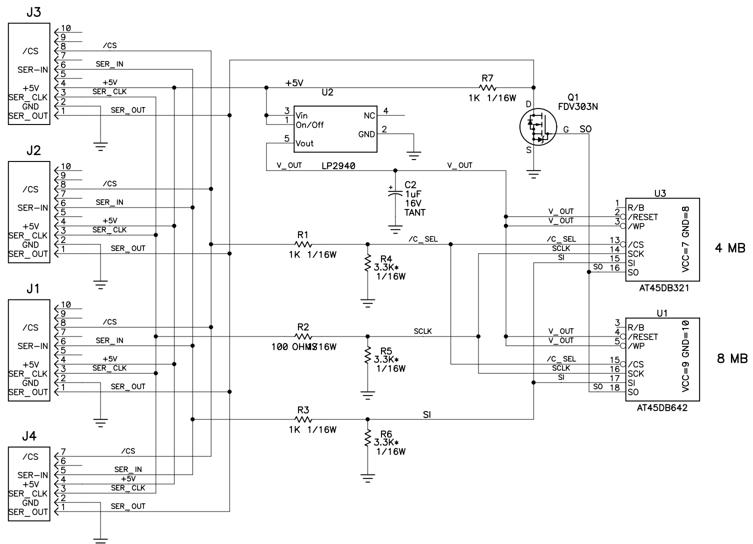


TABLE A

REF DES	DEVICE	DEVICE VOLTAGE INFORMATION	
		GND	VCC
U1	SerFlash 8 MB	10	9
U3	SerFlash 4 MB	8	7

STUFFING TABLE

		MODEL	
		8 MByte	4 MByte
CIRCUIT	PART	SF1000	SF1010
SERIAL FLASH	U1	INSTALLED	NOT INSTALLED
	U3	NOT INSTALLED	INSTALLED
HEADERS	J1	2X5 HEADER	2X5 HEADER
	J2	NOT INSTALLED	NOT INSTALLED
	J3	NOT INSTALLED	NOT INSTALLED
	J4	NOT INSTALLED	NOT INSTALLED

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	REVISED BY: K.SCHALLER	09/05/01	
	APPROVALS: INITIAL RELEASE		
	PROJECT ENGINEER:		SIZE B — DWG NO. 090-0123
	ENGINEERING MANAGER:		
	SIGNATURES	DATE	SCALE NONE — RELEASE DATE — SHEET 1 OF 1

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