



SF1000

Serial Flash Expansion Card

User's Manual

019-0102 • 070716-F

SF1000 User's Manual

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INTRODUCTION

The SF1000 is a serial-interfaced flash memory card designed to work with Rabbit Semiconductor's single-board computers and RabbitCore modules. All Rabbit-based boards 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
SF1008 (formerly SF1000)	8MB
SF1004 (formerly SF1010)	4MB

Larger memories may be possible in the future when parts become available. Throughout this manual, the term SF1000 refers to all the models shown in Table 1; specific models are identified according to their name in Table 1.

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.

The Dynamic C implementation of the FAT file system can be used with the SF1000 serial flash cards to store and access the data via a directory structure that can be accessed through Unix or DOS style paths. The standard directory structure allows for monitoring, logging, Web browsing, and FTP updates of the files.

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.

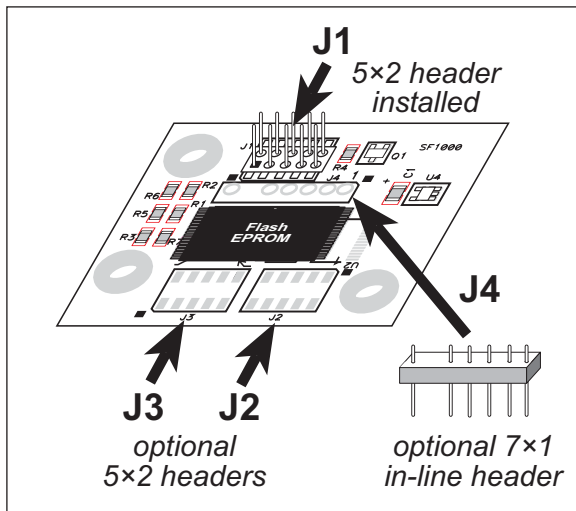


Figure 1. User Connection Points to SF1000

Pinout

Only six connections are required to interface the SF1000 with a Rabbit Semiconductor board:

- +5V
- 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.

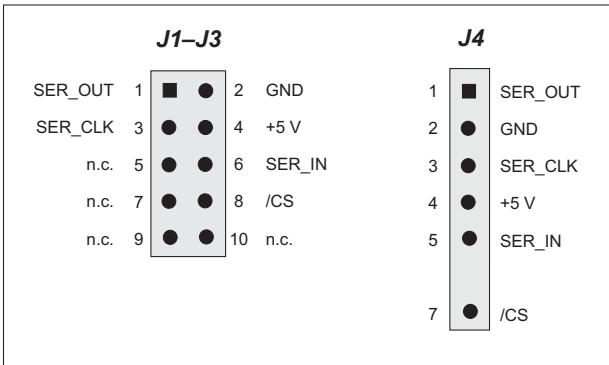


Figure 2. SF1000 Pinout

Connections

Rabbit 2000 and Rabbit 3000 Boards

Serial Port B on all the Rabbit-based boards (except the BL2000 and the BL2500) 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 and BL2500)

SF1000 Signal	Rabbit-Based Board	
+5 V	+5 V	
GND	GND	
SER_OUT	PC5 (RXB)	Serial Port B
SER_IN	PC4 (TXB)	
SER_CLK	PB0 (CLKB)	
/CS	user-selected output bit (default is PB7)	



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 Rabbit Semiconductor 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.

The RCM3300 Prototyping Board, which can be used with RCM3000, RCM3100, RCM3200, RCM3300/RCM3310, and RCM3360/RCM3370 RabbitCore modules, has a built-in header socket at J11 that allows an SF1000 serial flash card to be plugged in directly to the Prototyping Board to interface with Serial Port B on the RabbitCore module.

BL2000

Asynchronous 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 k Ω to 2 k Ω . 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 signal).

Figure 3 shows the locations of these components.

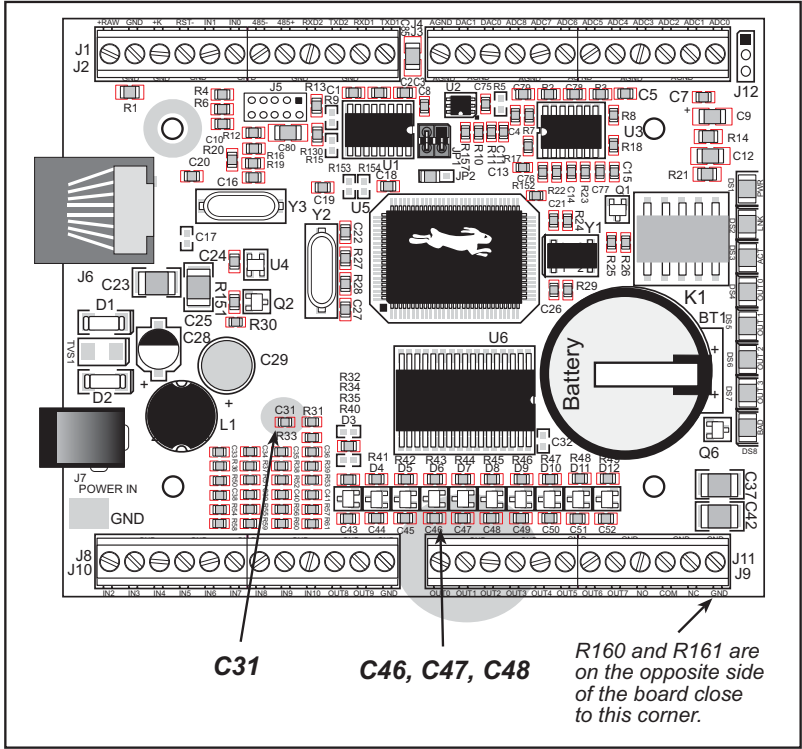


Figure 3. Locations of BL2000 Components to be Added or Removed

BL2500

Serial Port B is used for the RabbitNet ports on the BL2500, and so the following parallel-port connections are recommended instead.

Table 4. SF1000 Connections to BL2500

SF1000 Signal	BL2500 Board
+5 V	+5 V
GND	GND
SER_OUT	PC3-RXC
SER_IN	PC2-TXC
SER_CLK	PF1-CLKC
/CS	OUT1 (PA1)

You must short out resistors R26 and R28 on the BL2500 to avoid problems with **SER_OUT** and **SER_CLK** when using the SF1000 with the BL2500. Figure 4 shows the locations of these components under the RabbitCore module.

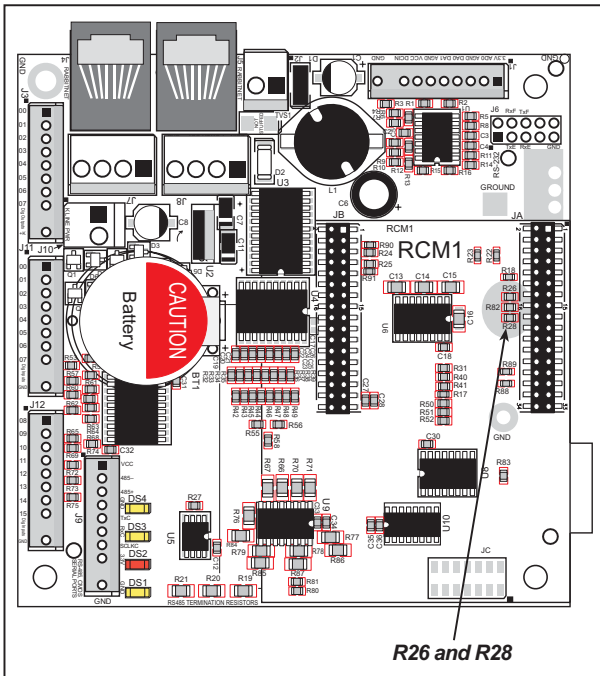


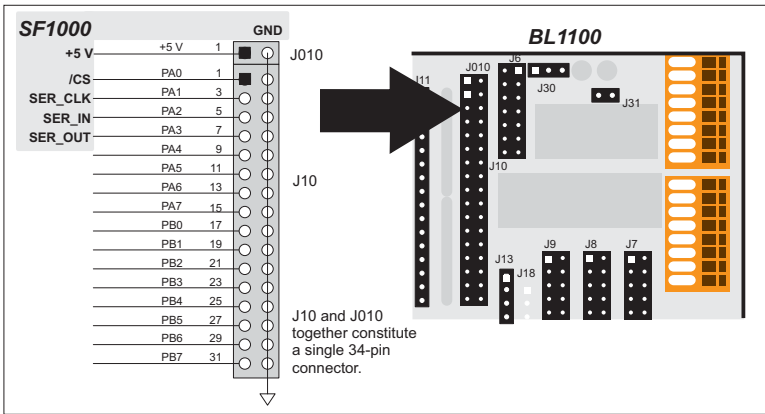
Figure 4. Locations of BL2500 Components to be Shorted When Using SF1000

Z180 Boards

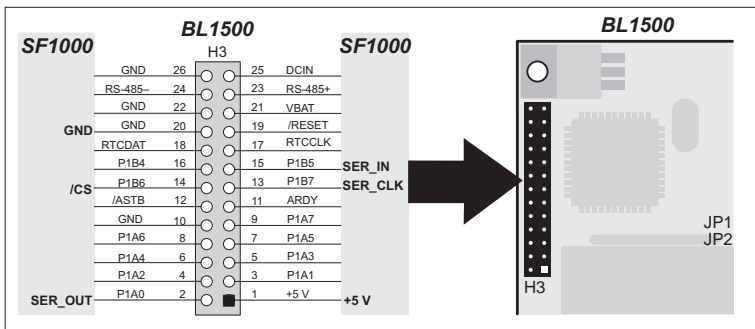
The following Z180-based boards are currently supported:

- BL1100
- BL1500
- BL1600
- BL1700
- LP3100
- PK2200

Figure 5 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`).

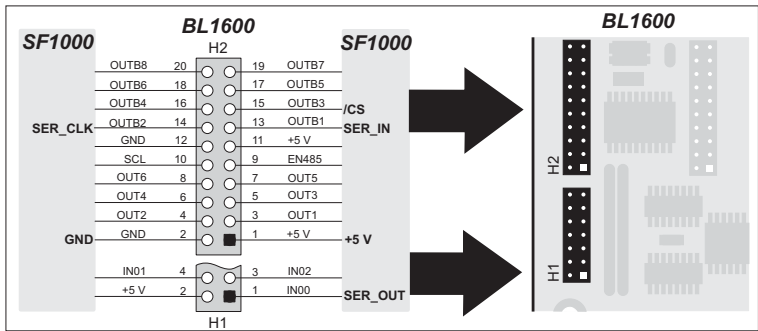


(a) BL1100 Connections

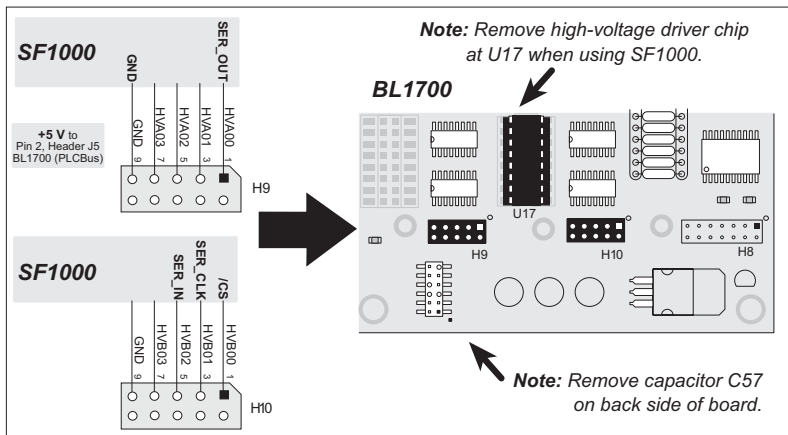


(b) BL1500 Connections

Figure 5. SF1000 Connections to Z180-Based Boards



(c) BL1600 Connections



(d) BL1700 Connections



Only standard factory BL1700 models with digital inputs on Bank A can be connected as shown since the **SER_OUT** signal from the SF1000 must be connected to a digital input.

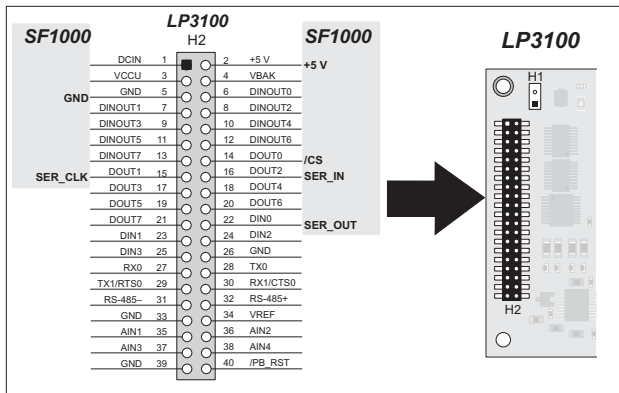


Note that a capacitor must be removed on the BL1700 as indicated in Figure 5(d) to keep the **SER_OUT** signal from getting slowed down too much by the capacitor.

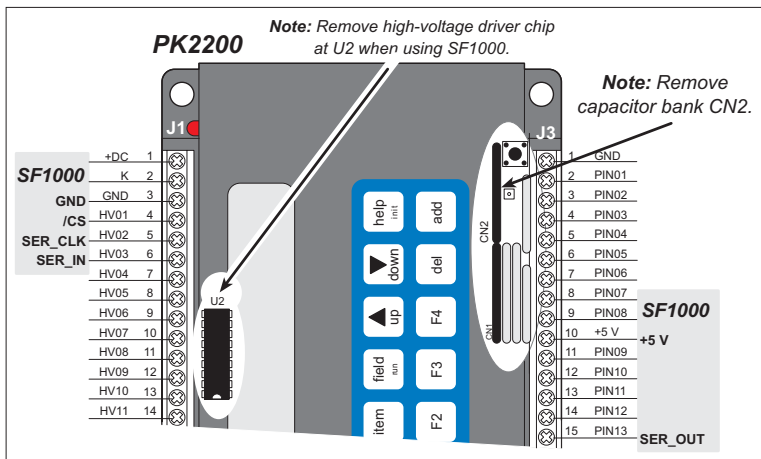


Remove the high-voltage driver chip at U17 when using the BL1700 with an SF1000. After you remove the chip, connect jumper wires between pins 1–18, 2–17, and 3–16 of the socket the high-voltage driver chip was plugged in to. This makes the digital outputs TTL/CMOS compatible.

Figure 5. SF1000 Connections to Z180-Based Boards (continued)



(e) LP3100 Connections



(f) PK2200 Connections



Note that a capacitor must be removed on the PK2200 as indicated in Figure 5(f) to keep the **SER_OUT** signal from getting slowed down too much by the capacitor.



Remove the high-voltage driver chip at U2 when using the PK2200 with an SF1000. After you remove the chip, connect jumper wires between pins 1–18, 2–17, and 3–16 of the socket the high-voltage driver chip was plugged in to. This makes the digital outputs TTL/CMOS compatible.

Figure 5. SF1000 Connections to Z180-Based Boards (concluded)

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 Rabbit Semiconductor 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

Rabbit Semiconductor's Dynamic C integrated development software is used to add function calls from the `SF1000.LIB` or the `SF1000_Z.LIB` library to your program. The `SF1000.LIB` library is available in Dynamic C for Rabbit-based boards and the `SF1000_Z.LIB` library is available in DC 32 for selected Z180-based boards.

SF1000.LIB and SF1000_Z.LIB Library Functions

The following function calls are available in the Dynamic C `SF1000.LIB` and in the `SF1000_Z.LIB` libraries. 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 = device not found

GLOBALS DEFINED:

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

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

Write a block of data to the flash.

PARAMETERS:

`FlashAddrDest` is the data block's initial address in the flash
`SrcAddr` is a pointer to the block's source in root memory RAM
`ByteCount` is the number of bytes to write

RETURN VALUES:

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

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

Read a block of data from the flash.

PARAMETERS:

FlashAddrSource is the data block's initial address in the flash

DestAddr is a pointer to the block's destination in root memory RAM

ByteCount is the number of bytes to read

RETURN VALUES:

0 = success

-1 = illegal byte count

-2 = illegal flash address

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

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

PARAMETER:

Block is the number of the flash block relative to 0 to check

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

- **int SF1000EraseBlock (int Block);**

Erases a single block, including the sector prefix area, sync byte, library software version number and sector writes count. The flash block's previous prefix area information is lost permanently.

PARAMETER:

Block is the number of the flash block relative to 0 to check

RETURN VALUES:

0 = success

-1 = error reading device status

-2 = error erasing the block

Programming Information

Rabbit 2000 and Rabbit 3000 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 transmit data and clock bits must be in the same register.



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`.

Dynamic C FAT File System

Invoke the following macro when using the SF1000 with the Dynamic C FAT file system.

```
# define SF_SPI_INVERT_RX
```

The Dynamic C FAT file system was written for serial flash devices mounted directly on a single-board computer or a RabbitCore module. The SF1000 boards are used externally to the single-board computer or RabbitCore module, and have a transistor buffer on their output. This buffer inverts the signal going back to the Rabbit microprocessor. The `SF_SPI_INVERT_RX` macro “re-inverts” the signal.

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
- BL1600
- 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`).

All applications involving the SF1000 with a Z180-based board must have the following two `#use` lines.

```
#use SF1000_Z.LIB
#use VDRIVER.LIB
```

When you are using a BL1700 or a PK2200 with an SF1000, you will have removed the high-voltage output driver chip to make the digital outputs TTL/CMOS-compatible. Regardless of whether your high-voltage output chip was sinking or sourcing, add the following `#define` line to your application before the `#use SF1000_Z.LIB` line.

```
#define NO_SINKING_DRIVER
```

For the BL1700, add the following `#use` line to your application before the `#use SF1000_Z.LIB` line.

```
#use EZIOBL17.LIB
```

For the LP3100, add the following `#use` line to your application before the `#use SF1000_Z.LIB` line.

```
#use EZIOLP31.LIB
```

APPENDIX. SPECIFICATIONS

General Specifications

Table A-1 lists the electrical, mechanical, and environmental specifications for an SF1000 serial flash card. Read/write data for the SF1016 will be added once they are available.

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	16M (SF1016) 8M (SF1008, formerly SF1000) 4M (SF1004, formerly SF1010)		
Serial Data Rate Block size SF1016: 1024 bytes SF1008: 1024 bytes SF1004: 512 bytes	BL1500 @ 9 MHz	SF1004	Read 128 ms/block Write 177 ms/block
		SF1008	Read 249 ms/block Write 318 ms/block
	BL1600 @ 9 MHz	SF1004	Read 112 ms/block Write 133 ms/block
		SF1008	Read 219 ms/block Write 233 ms/block
	BL1700 @ 18.4 MHz	SF1004	Read 70 ms/block Write 90 ms/block
		SF1008	Read 137 ms/block Write 153 ms/block

...continued

Table A-1. SF1000 General Specifications (concluded)

Parameter	Specification		
Serial Data Rate Block size SF1016: 1024 bytes SF1008: 1024 bytes SF1004: 512 bytes	LP3100 @ 6 MHz	SF1004	Read 232 ms/block Write 336 ms/block
		SF1008	Read 453 ms/block Write 624 ms/block
	PK2200 @ 18 MHz	SF1004	Read 51 ms/block Write 70 ms/block
		SF1008	Read 100 ms/block Write 114 ms/block
	RCM2000 @ 25.8 MHz	SF1004	Read 7.3 ms/block Write 23.5 ms/block
		SF1008	Read 14.0 ms/block Write 27.5 ms/block

Mechanical Specifications

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

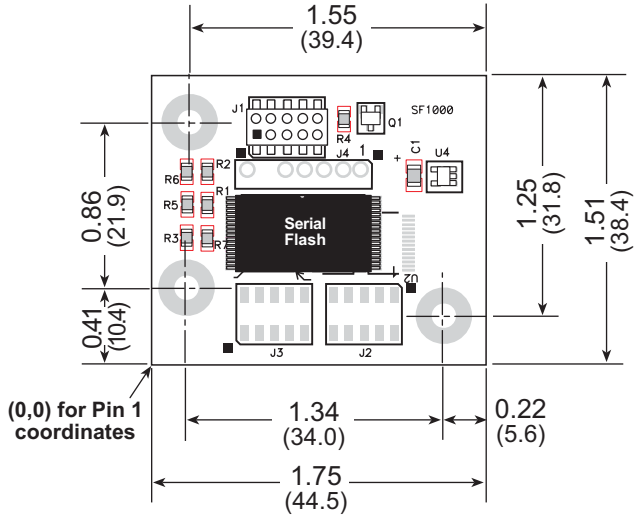


Figure A-1. SF1000 Dimensions

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.

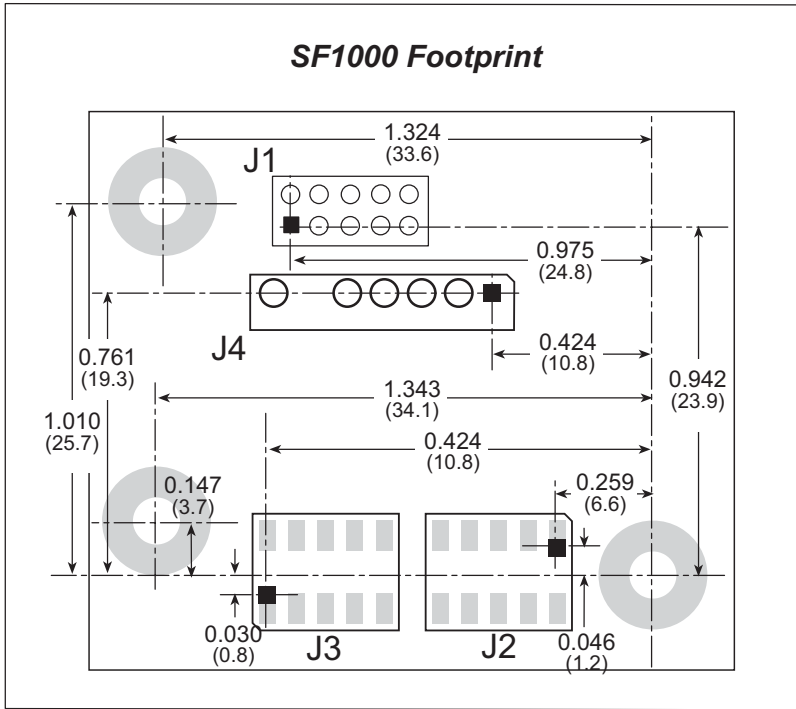


Figure A-2. User Board Footprint for SF1000



SCHEMATICS

090-0123 SF1000 Schematic

www.rabbit.com/documentation/schemat/090-0123.pdf

You may use the URL information provided above to access the latest schematics directly.

