SF1000

Serial Flash Expansion Card

User's Manual

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SF1000 User's Manual

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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.

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.
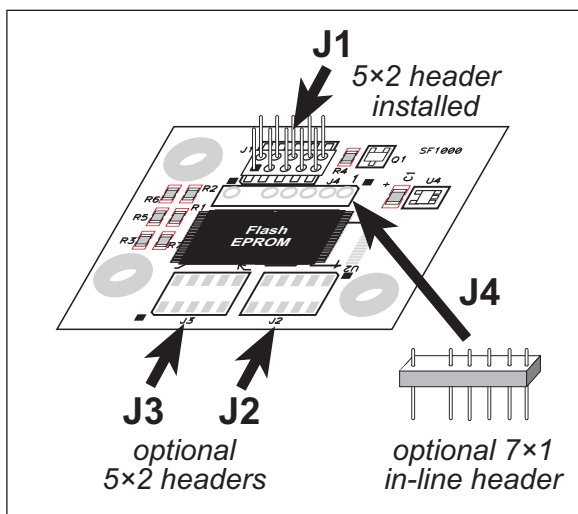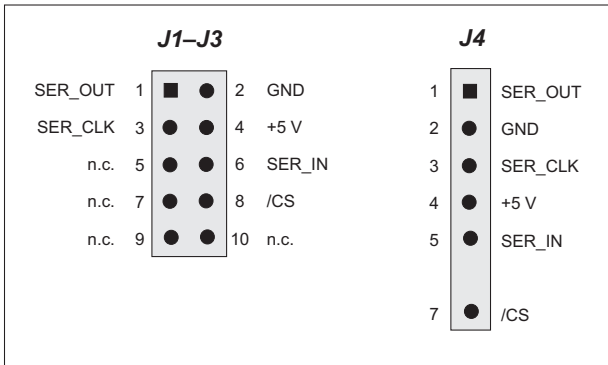

Figure 1. User Connection Points to SF1000

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.

J1–J3					J4		
SER_OUT	1 ■	● 2	GND		1 ■	SER_OUT	
SER_CLK	3 ●	● 4	+5 V		2 ●	GND	
n.c.	5 ●	● 6	SER_IN		3 ●	SER_CLK	
n.c.	7 ●	● 8	/CS		4 ●	+5 V	
n.c.	9 ●	● 10	n.c.		5 ●	SER_IN	
					7 ●	/CS	

Figure 2. SF1000 Pinout

Connections

Rabbit 2000 Boards

Serial Port B on all the Rabbit-based boards 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

SF1000 Signal	Rabbit-Based Board	
+5 V	**+5 V**	
GND	**GND**	
SER_OUT	**PC5 (RXB)**	
SER_IN	**PC4 (TXB)**	Serial Port B
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.

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.
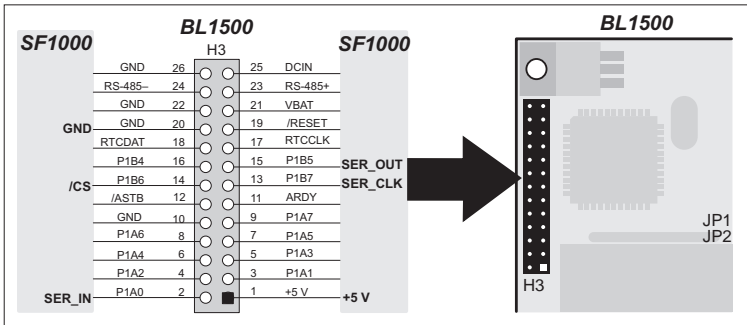
Z180 Boards

The following Z180-based boards are currently supported:

- BL1100
- BL1500
- BL1700
- LP3100
- PK2200

Figure 3 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**).
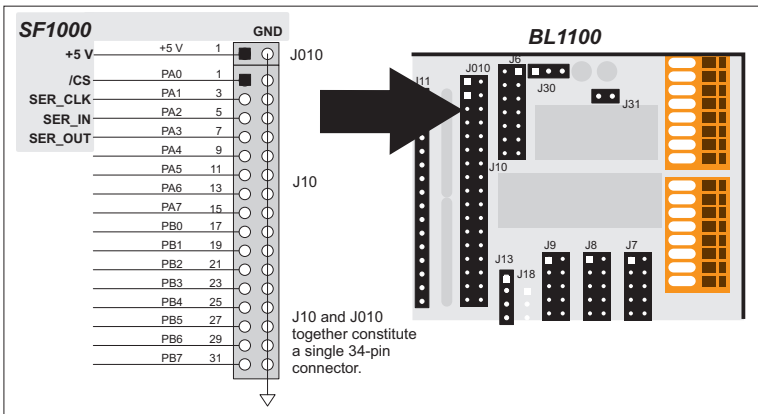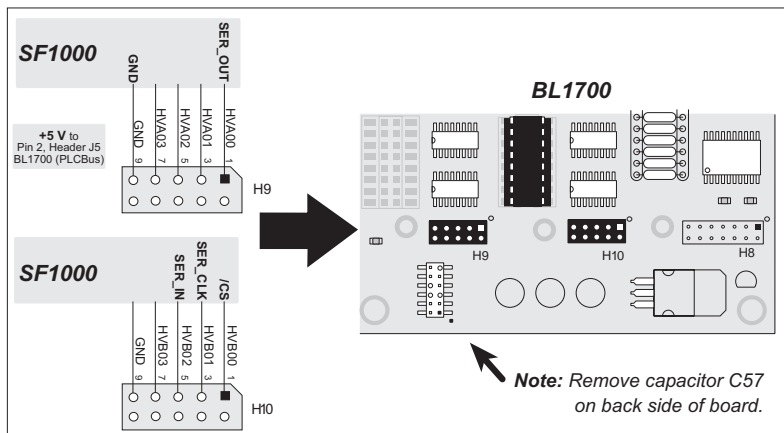

(a) BL1100 Connections

(b) BL1500 Connections

Figure 3. SF1000 Connections to Z180-Based Boards

(c) Bl1700 Connections

Note that a capacitor must be removed on the BL1700 as indicated in Figure 3(c) to keep the **SER_IN** signal from getting slowed down too much by the capacitor.

(d) LP3100 Connections

Figure 3. SF1000 Connections to Z180-Based Boards

(e) PK2200 Connections

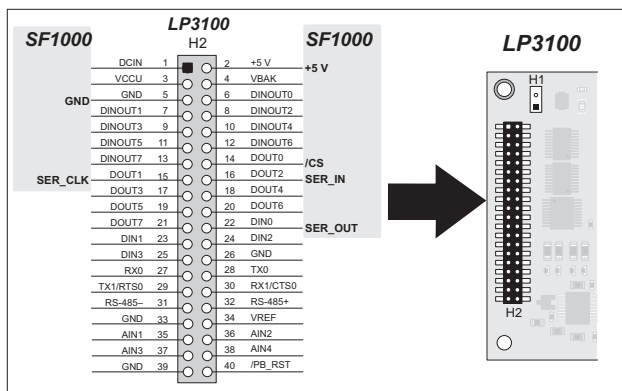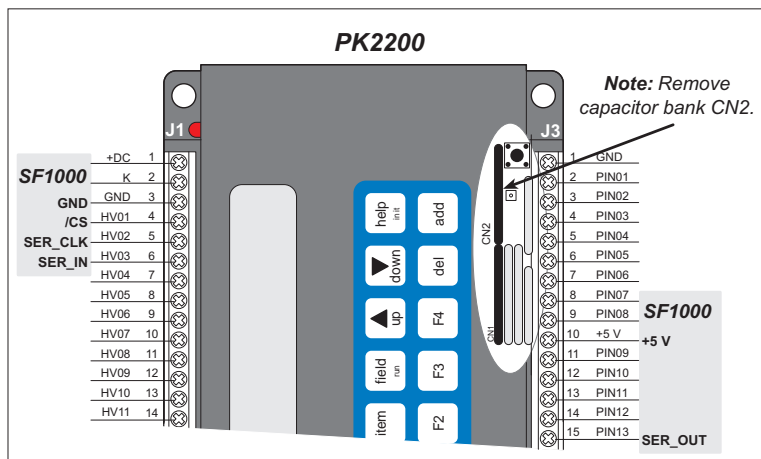**Figure 3. SF1000 Connections to Z180-Based Boards**

✎ Note that a capacitor must be removed on the PK2200 as
indicated in Figure 3(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**)

   SF1000_SER_A   use Serial Port A

   SF1000_SER_B   use Serial Port B

   SF1000_PARALLEL   use a parallel I/O port

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

   SF1000_SPI_BIT_RATE

   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

   SF1000_TX_REG   register for clock and Tx data (default is PDDR)

   SF1000_TXD_BIT   bit number for Tx data (default is bit 1)

   SF1000_CLK_BIT   bit number for clock (default is bit 0)

   SF1000_RX_REG   register for Rx data (default is PDDR)

   SF1000_RXD_MASK   mask for Rx bit (default is 8, bit 3)

   The default values will be used if **SF1000_TX_REG** is not defined. If **SF1000_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!

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	$1.51'' \times 1.75'' \times 0.25''$ (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

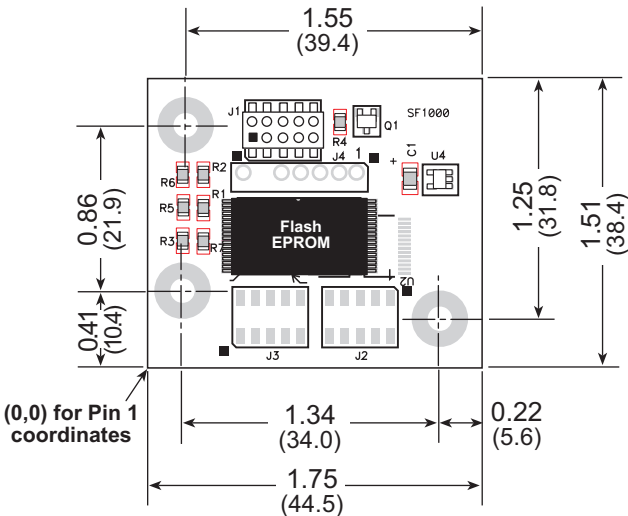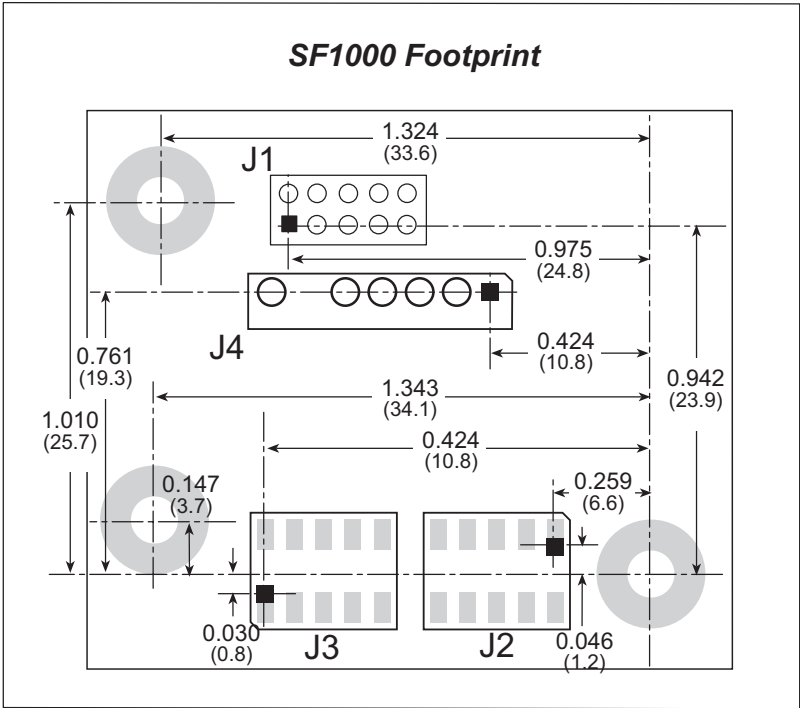Figure A-1 shows the mechanical dimensions of an SF1000.

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.

SF1000 Footprint

Figure A-2. User Board Footprint for SF1000

SCHEMATICS

J3
/CS
SER-IN
+5V
SER_CLK
GND
SER_OUT

J2
/CS
SER-IN
+5V
SER_CLK
GND
SER_OUT

J1
/CS
SER-IN
+5V
SER_CLK
GND
SER_OUT

J4
/CS
SER-IN
+5V
SER_CLK
GND
SER_OUT

U2 LP2940
Vin
On/Off
Vout
NC
GND
V_OUT

Q1 FDV303N

R7 1K 1/16W
R1 1K 1/16W
R2 100 OHMS 1/16W
R3 1K 1/16W
R4 3.3K* 1/16W
R5 3.3K* 1/16W
R6 3.3K* 1/16W

C2 1uF 16V TANT

U3 AT45DB321 — 4 MB
R/B /RESET /WP /CS SCK SI SO VCC=7 GND=8

U1 AT45DB642 — 8 MB
R/B /RESET /WP /CS SCK SI SO VCC=9 GND=10

TABLE A

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

STUFFING TABLE

CIRCUIT	PART	MODEL	
		8 MByte	4 MByte
		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:
ENGINEERING MANAGER:
SIGNATURES   DATE

TITLE
SCHEMATIC DIAGRAM
SF1000 SERIES

ZWORLD
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DAVIS, CA 95616
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SIZE B
DWG NO. 090−0123
SCALE NONE
RELEASE DATE
SHEET 1 OF 1