

S3F49FAX

FLASH Controllers
for Compact Flash / PC Card / IDE Disk

REFERENCE GUIDE MANUAL

HELP DESK

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ELECTRONICS

Table of Contents

1.1 Overview.....	3
1.2 S3F49FAX Controller Features.....	3
1.2.1 Features.....	3
1.3 Design Guide for Card Assembly.....	4
1.4 Compliance Test of Cards Assembled with Samsung's Controller.....	4
2.1 Overview.....	5
2.2 Schematics and Manual Files	5
2.3 Utility Program Files	6
2.4 Setup I/O Range for System	6
2.5 How to Use Utility Program	9
2.5.1 Batch File Features.....	9
2.5.2 The Details of Commands	10
2.5.3 Command Form.....	11
2.5.4 Drive Information Parameter Definition	12
2.5.5 The Example Code of an Initial Batch File	14
2.5.6 BOM (Bill Of Material).....	16
2.5.7 Vendor Unique Command	17

Table of Tables

1	Memory IC Select Table for Various CF-Card Size.....	12
2	Parts Master List of S3F49FAX CompactFlash Type 1 Card.....	15
3	Vendor Unique Command	16

1 INTRODUCTION

1.1 OVERVIEW

This document describes application information required to assemble PC-ATA, CompactFlash card and True-IDE hard disk with Samsung's "NAND Flash memory" and "NAND Flash controllers". Samsung manufactures both the "NAND Flash memory" and "NAND Flash controllers". Until now, the NAND Flash of density ranging 16MB to 4GB is available. For more detailed features and specifications for NAND Flash memory, please refer to the current data sheets and technical note parts. The NAND Flash controllers support 128Mb, 256Mb, 512Mb and 1Gb, 2Gb, 4Gb NAND Flash memory made by Samsung. S3F49FAX is under mass production. (X means a version number for firmware and hardware revision)

1.2 S3F49FAX CONTROLLER FEATURES

1.2.1 FEATURES

- PC Card-ATA / True IDE / CompactFlash compatible host interface.
- ECC function (Error correction algorithm): 2bit correction
- Interface voltage: 3.0V to 5.5V
- Operating Temperature : -25 to 80 °C
- Efficient and powerful ARM7TDMI CPU core
- Support 128 / 256 / 512Mbit, 1Gbit, 2Gbit, 4Gbit NAND flash memory made by Samsung

NAND Flash Density	Min. / Max. Capacity (number of flash)
128M / 256M / 512M / 1G bit (512Byte/page)	16MB / 1 G Byte (Up to 8EA)
1G / 2G / 4G bit (2048Byte/page)	256MB / 4 G Byte (Up to 8EA)

- Interface Support

Controller Part Nubmer	Host Interface
S3F49FAXZZ	CompactFlash
S3F49FAXZA	USB 1.1

1.3 DESIGN GUIDE FOR CARD ASSEMBLY

The following lists are application information required to assemble cards. Samsung supports items described below in order to help with card assembly.

- Board Schematics and PCB Gerber file: Compact Flash Card, True-IDE Disk
- Data Sheet: S3F49FAX
- Initialization Utility Program
- Vendor Unique Command Description & CIS/IDI Information
- Compatibility Test Results (Digital Still Camera, Desk-Top/Handheld PC, Card Reader etc.)

1.4 COMPLIANCE TEST OF CARDS ASSEMBLED WITH SAMSUNG'S CONTROLLER

TESTMETRIX has been selected as the official provider of Certification Compliance Testers for the Compact Flash Association. CFA Members can either purchase the compliance tester, or receive an upgrade for an existing tester if already purchased. Samsung's ATA / Compact Flash Production Test Library has been already completed by TESTMETRIX. Manufacturers have to purchase the Production Test Library at TESTMETRIX. (<http://www.testmetrix.com>)

A general compliance test program is offered for registered customer by TESTMETRIX. If customer has no user name and password, please contact with us. Customer has to use the latest compliance test program updated by TESTMETRIX.

2

CARD UTILITY PROGRAM

2.1 OVERVIEW

This utility program is the Flash initialization program provided by Samsung. In order to process the initialization program, manufacturer should use batch file of each density made by Samsung. The batch file consists of ATA and Vendor Unique Command. Samsung provides the following files to manufacturer.

NOTE

If customer wants to test assembled card, please test it under Native-DOS with SMARTDRV.

2.2 SCHEMATICS AND MANUAL FILES

- S3F49FA_CFCARD_XX.PDF: CF card schematic
(X means that version number for CompactFlash card)
- S3F49FA_IDE_XX. PDF: IDE disk schematic
(X means that version number for IDE interface like HDD)
- S3F49FA_SPECIFICATION_XX. PDF: Data sheet for S3F49FAX
(X means that version number for firmware revision)

2.3 UTILITY PROGRAM FILES

Users should create a new directory and copy all the files to this new directory.

vcinit.c	: vcinit source file
firebat.c	: firebat source file
Setcmd.c	: Setcmd source file
Longsec.c	: Longsec source file
getopt.c	: getopt source file
loaddr.h	: Input/Output address header file
firebat.h	: firebat header file
getopt.h	: getopt header file
rwtest.c	: rwtest source file
chs.dat	: It contains CHS value that user defined.
vendor.dat	: It contains vendor / serial information that user defined.

2.4 SETUP I/O RANGE FOR SYSTEM

First of all, customer should search I/O range used on customer system. In case of using the cardsoft program made by SystemSoft co., customer can check I/O range using "cardinfo" command under DOS environment.

If customer finds your system I/O range, for example, 0x380-0x38F, change header file as follows:

(in loaddr.h)

```
#define      COMMAND_PORT      0x387
#define      FEATURE_PORT      0x381
#define      SECTOR_COUNT_PORT 0x382
#define      SECTOR_NUM_PORT   0x383
#define      CYLINDER_LOW_PORT 0x384
#define      CYLINDER_HIGH_PORT 0x385
#define      DRIVE_HEAD_PORT   0x386
#define      ERROR_PORT        0x381
#define      STATUS_PORT       0x387
#define      DATA_PORT        0x380
```

3. Recompile the source file each by each by using Turbo-c or Borland-c compiler. And then customer will get setcmd.exe, and longsec.exe.

To distinguish used I/O range address in the batch file, rename execution files as follows:

setcmd.exe	====>	set380.exe
longsec.exe	====>	long380.exe
vcinit.exe	====>	vc380.exe
firebat.exe	====>	fire380.exe

If I/O range was 0x270, customer can rename the execution files as follows:

setcmd.exe	====>	set270.exe
longsec.exe	====>	long270.exe
vcinit.exe	====>	vc270.exe
firebat.exe	====>	fire270.exe

- setcmd function: setcmd execution file performs the ATA commands and vendor unique commands.
- longsec function: longsec execution file performs the same functions of setcmd file except long byte(528bytes) access.
- vcinit function: vcinit execution file performs that It initialize the CF card and write cis data.
- firebat function: firebat execution file performs that It update the firmware of controller

4. Now, customer can use these commands as shown in the following format:

(setcmd, longsec)

Command <Feature><Sec Cnt><Sec Num><Cyl Low>
<Cyl High><C/D/H><Command>[definition file]

- * Command ~ setcmd or longsec
- * [definition file] ~ This is Option.

- Ex) Case1: To read sector
C:> set380 00 01 01 00 00 E0 20
Sector's data is displayed to the screen
- Case2: To execute Initial Drive Parameter command
C:> set380 00 20 00 00 00 02 91
- Case3: To write Sector as all "FF"
C:> set380 00 01 01 00 00 E0 30 FF
- Case4: To read physical sector from 3rd chip, 0 block, 1 page
C:> long380 f0 c0 02 01 00 00 ef

5. vcinit has one option parameter.

```
Vcinit /c <check mode>
```

/c : It is necessary to executing this operation

initial mode :

- 0 – no more check
- 1 – Erase Check
- 2 – Blank Check
- 3 – Pattern Check

6. Firebat program has one option parameter.

```
Firebat /f <image file>
```

/f : It is necessary to execute this operation
image file: file name of firmware image

7. Rwttest program does not have the option parameter.

2.5 HOW TO USE UTILITY PROGRAM

2.5.1 BATCH FILE FEATURES

The Compact Flash card and IDE disk need initialization before they are used for the first time. This process requires the several special information. Customer should set the appropriate parameters in the batch file for different density and the number of chips

For example, the initialization of the Compact Flash card consists of following process.

- 1) Flash Memory Initialization and CIS/IDI Information Amendment
- 2) Write/Read/Verify the Sector in CF card
- 3) MBR/PBR Write
- 4) Logical Formatting

For example, the initialization of the IDE disk consists of following process.

- 1) Flash Memory Initialization and CIS/IDI Information Amendment
- 2) Write/Read/Verify the Sector in CF card
- 3) After rebooting on your PC, try to execute FDISK
- 4) Logical Formatting

A batch file is used for the consecutive execution of the above process. This batch file consists of several command according to the above 1) ~ 5) sequences. The main commands used in a batch file, are 'VCINIT', 'RWTEST', 'ATAINIT' and 'FORMAT'.

'VCINIT', 'RWTEST' programs are the utility commands which supported by SAMSUNG Electronics. When customer wants to use these commands, the modifications of the command arguments and the definition file are required.

'ATAINIT' is the special command that is given by PC card reader (PCMCIA type) maker.

'FORMAT' is DOS command.

2.5.2 THE DETAILS OF COMMANDS

The main commands need to parameters input. The **vcinit** commands require 2 parameters input.

Following source files are the batch files to initialize the CF card automatically

vcinit /c 2	← 1) Flash Memory Initialization CIS/IDI Information Amendment
Rwtest.exe	← 2) Test the logical sector in the CF card
atainit.exe d: /v	← 3) Write the MBR/PBR
format d:	← 4) Logical DOS format

CAUTION

To initialize an IDE disk based on these platforms, customer should remove two lines ("**atainit.exe d: /v**" and "**format d:**") from the batch file of compact Flash card above. That is, customer should not use CardSoft program made by SystemSoft co.. An initialization method for IDE disk is as follows.

1. Setting of hardware:
 - Connect to primary master or slave
 - Use DOS diskette for IDE drive system booting
 - Try to store source, execution and batch files into DOS diskette
2. Execute power-off or software reset (ctrl+alt+delete)
3. Execute an appropriate batch file according to the disk capacity
4. After rebooting on PC, try to execute FDISK and logical DOS Format

2.5.3 COMMAND FORM

[FORM] SETCMD <feature> <sec_cnt> <sec_num> <cyl_low> <cyl_high> <C/D/H> <command>

[FORM] LONGSEC <feature> <sec_cnt> <sec_num> <cyl_low> <cyl_high> <C/D/H> <command>

<feature>	Feature register set value. Used when the host sets a particular function to the card. Available only for writing data and not for reading.
<sec_cnt>	Sector count register set value. The host sets the number of sectors to transfer in this register. The default setting is "01H" . The number of sectors are 256 when "00H" is set.
<sec_num>	Sector number register set value. Sets the number of the sector where transfer start.
<cyl_low>	Cylinder low register set value. Sets the lower 8bits of the number of the cylinder where the sector transfer starts.
<cyl_high>	Cylinder high register set value. Sets the upper 8bits of the number of the cylinder where the sector transfer starts.
<C/D/H>	Drive head register set value. Sets the LBA,DRV and head number . When LBA=0,the cylinder head sector(CHS) mode is selected. The DRV bit is used for selecting the master or slave configuration. The card can be accessed when the DRV# bit of the socket and copy register is equal to this bit. Bit3 to bit0 are used to set the number of the head where sector transfer starts.
<command>	Command register set value.

2.5.4 DRIVE INFORMATION PARAMETER DEFINITION

You can change the CHS value by editing 'chs.dat' file. This is standard values of cylinder, head, sector in S3F49FAX's Card.

[Chs.dat]

Vendor defined CHS values

#SIZE	CYL	HEAD	SECTOR
16MB	227	4	32
32MB	473	4	32
64MB	243	16	32
128MB	490	16	32
256MB	985	16	32
512MB	999	16	63
1024MB	1999	16	63
2048MB	3998	16	63
4096MB	7996	16	63

Table 1. Memory IC Select Table for Various CF-Card Size

Card Size	Number of Flash memory					
	K9F2808	K9F5608	K9F1208	K9K1G08	K9K2G08	K9F4G08
				K9F1G08	K9F2G08	–
16MB	1	–	–	–	–	–
32MB	2	1	–	–	–	–
64MB	4	2	1	–	–	–
128MB	8	4	2	1	–	–
256MB	–	8	4	2	1	–
512MB	–	–	8	4	2	1
1GB	–	–	–	8	4	2
2GB	–	–	–	–	–	4
4GB	–	–	–	–	–	8

NOTE: – : we don't support.

2.5.5 THE EXAMPLE CODE OF AN INITIAL BATCH FILE

For your understanding, the example codes of the initial batch file and the definition file, are shown in [EXAMPLE 1] and [EXAMPLE 2] and [EXAMPLE 3]. When you have difficulty in modifying file, refer to following code.

[EXAMPLE 1] contents of the Initializing batch file <INIT.BAT>

```
REM -----  
REM initialize CF card (erase check)  
REM -----  
vcinit.exe /c 2  
  
:RWTEST  
REM -----  
REM Write/Read/Verify the CF card  
REM -----  
rwtest.exe  
  
:MAKEMBR  
REM -----  
REM make MBR/PBR in the CF card  
REM -----  
atainit d: /v  
  
REM -----  
REM format CF card  
REM -----  
format d:
```

[EXAMPLE 2] Contents of the CHS data file <chs.dat>

16MB	227	4	32
32MB	473	4	32
64MB	243	16	32
128MB	490	16	32
256MB	985	16	32
512MB	999	16	63
1024MB	1999	16	63
2048MB	3998	16	63
4096MB	7996	16	63

[EXAMPLE 3] Contents of the vendor data file <vendor.dat>

CIS_MANUFACTURE	SAMSUNG
CIS_PRODUCT_NAME	Vancouver
IDI_SERIAL_NUM	97419812
IDI_MODEL_NUM	SAMSUNG C/F(MBY2)
IDI_VERSION	Rev 5.0

2.5.6 BOM (BILL OF MATERIAL)

This section lists the bill of material for the S3F49FAX controller. The BOM for CompactFlash cards will vary depending on the number of Flash memory used. Please refer to the CF card schematic recommended.

Table 2. Parts Master List of S3F49FAX CompactFlash Type 1 Card

Item	Reference Designator	Quantity	Description
1	J1	1	50-Pin connector
2	U6	1	Voltage Resulator - Part Number : AME8801AEEV - Maker : AME - Output : 300mA, 3.3V
3	U5	1	S3F49FAX Controller, 100TQFP
4	U1, U2, U3, U4	4	Flash Memory
5	R1, R3	2	Resistor 10K
6	R4	1	Resistor 1.5M
7	R7	1	Resistor 3.9M
8	C6, C8, C12, C13, C14, C15, C17, C18, C21, C24, C25	12	Capacitor 0.1uF
9	C7, C26	2	Capacitor 10uF
10	C16	1	Capacitor 0.47uF

2.5.7 VENDOR UNIQUE COMMAND

S3F49FAX supports the eight vendor unique commands with standard ATA commands. Table 3 summarizes Vendor Unique Command set.

Table 3. Vendor Unique Command

Command Name	Command Code	Description
Physical Read	C0	Read from physical page in Flash memory
Physical Write	C1	Write data to physical page in Flash memory
Physical Block Erase	C2	Erase physical block in Flash memory
Flash Initialize	C3	Execute to initialize the Flash memory
Get Flash Chip information	C4	Get flash information in card (number of block / chips)
Get Firmware version	C5	Get internal firmware version
Get Bad block information	C6	Get bad block number in card
Read Flash ID	C8	Get Flash ID information
Update firmware	C9	Update the firmware in S3F49FAX

[The form of vendor command]

- Feature register : always '0xf0', result value
- Sector count register : Command input, result value
- Sector number register : input parameter, result value
- Cylinder low register : input parameter, result value
- Cylinder high register : input parameter, result value
- Drive head register : input parameter, result value
- Command register : always '0xef' (set feature command)

(1) Read physical page

Command	0xC0
Input Parameter	- Physical Block Address = (drive_head << 16) + (cylinder_high << 8) + cylinder_low - Physical Page Address in 512B Page = sector_number - Physical Page Address in 2KB Page = sector_number / 4
Result Value	- Error Code = setor_number
Command Flow	- write read command - wait DRQ - receive 528 Bytes - wait READY - check error code
Caution	If error code isn't 0x00, this command fail.

(2) Write physical page

Command	0xC1
Input Parameter	- Physical Block Address = (drive_head << 16) + (cylinder_high << 8) + cylinder_low - Physical Page Address in 512B Page = sector_number - Physical Page Address in 2KB Page = sector_number / 4
Result Value	- Error Code = setor_number
Command Flow	- write write command - wait DRQ - send 528 Bytes - wait READY - check error code
Caution	If error code isn't 0x00, this command fail.

(3) Erase Physical block

Command	0xC2
Input Parameter	- Physical Block Address = (drive_head << 16) + (cylinder_high << 8) + cylinder_low
Result Value	- Error Code = setor_number
Command Flow	- write erase command - wait READY - check error code
Caution	If error code isn't 0x00, this command fail.

(4) Initialize the Card

Command	0xC3
Input Parameter	NONE
Result Value	- The Number of Bad blocks = (cylinder_high << 8) + cylinder_low - Error Code = setor_number
Command Flow	- write erase command - wait DRQ - send initial parameter (512 Bytes) - wait DRQ - send CIS DATA (512 Bytes) - wait DRQ - send IDI DATA (512 Bytes) - wait READY - check Error Code
Caution	If error code isn't 0x00, this command fail.

(5) Get the information of NAND FLASH Memory

Command	0xC4
Input Parameter	NONE
Result Value	- page number per block = sector_num - block number per chip = (cylinder_high << 8) + cylinder_low - chip number of the card = sector_count
Command Flow	- write command - wait ready - check the result value
Caution	NONE

(6) Get the firmware version of controller

Command	0xC5
Input Parameter	NONE
Result Value	- firmware major version : cylinder_high - firmware minor version : cylinder_low
Command Flow	- write command - wait ready - check the result value
Caution	NONE

(7) Gat bad block information in card

Command	0xC6
Input Parameter	NONE
Result Value	the Number of Bad blocks = (cylinder_high << 8) + cylinder_low
Command Flow	- write command - wait ready - check the result value
Caution	NONE

(8) Read the Id data of NAND Flash memory

Command	0xC8
Input Parameter	NONE
Result Value	- maker code = cylinder_high - device code = cylinder_low - is multi plane supported = drive_head - number of chips = sector_number - firmware major version = sector_count - firmware minor version = feature
Command Flow	- write command - wait ready - check the result value
Caution	NONE

(9) Update the firmware in controller.

Command	0xC9
Input Parameter	the sector number of firmware = cylinder_low
Result Value	Error Code = setor_number
Command Flow	- write command - wait DRQ - send the data of firmware (loop) - wait ready - check the error code
Caution	If error code isn't 0x00, this command fail.

NOTES

- 2003/12/22 Modify the explanation of vendor command (physical read/write/erase command)
- 2003/01/27 Adjust CHS(Cylinder, Head, Sector) values and correct misprints.
- 2004/02/16 Record host interface support per controller part number.