



# ***FM4428***

## ***8KBits Memory Card Chip***

**Specification**

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**Oct. 2007**

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# Product Overview

## Description

FM4428 is the memory card chip developed by Shanghai FM Co, Ltd.. This chip uses 0.6μm CMOS EEPROM process, has 1K × 8Bit EEPROM with write protect function and programmable security code, its contact configuration is in accordance to ISO standard 7816 (Synchronous Transmission), FM4428 can be widely used in different types of IC memory cards.

## Features

- ◆ 1024×8 bit EEPROM organization
- ◆ Byte-wise addressing
- ◆ Irreversible byte-wise write protection
- ◆ 1024×1 bit protection memory organization
- ◆ Serial three wire bus
- ◆ Minimum of 100,000 write/erase cycles
- ◆ Data retention for at least 10 years
- ◆ Contact configuration and serial interface in accordance to ISO standard 7816 (synchronous Transmission)
- ◆ Only after entry of the correct 2Byte programmable security code (PSC) data can be changed
- ◆ Compatible with SLE4428

## Pin Configurations

$V_{CC}$	C1		C8	GND
RST	C2		C7	NC
CLK	C3		C6	I/O
NC	C4		C5	NC

## Pin Functions

PIN	Symbol	Function
C1	$V_{CC}$	Operation voltage 5V
C2	RST	Reset control
C3	CLK	Clock
C4	N.C.	Not connected
C5	GND	Ground
C6	N.C.	Not connected
C7	I/O	Data line (pen drain)
C8	N.C.	Not connected

## Block Diagram

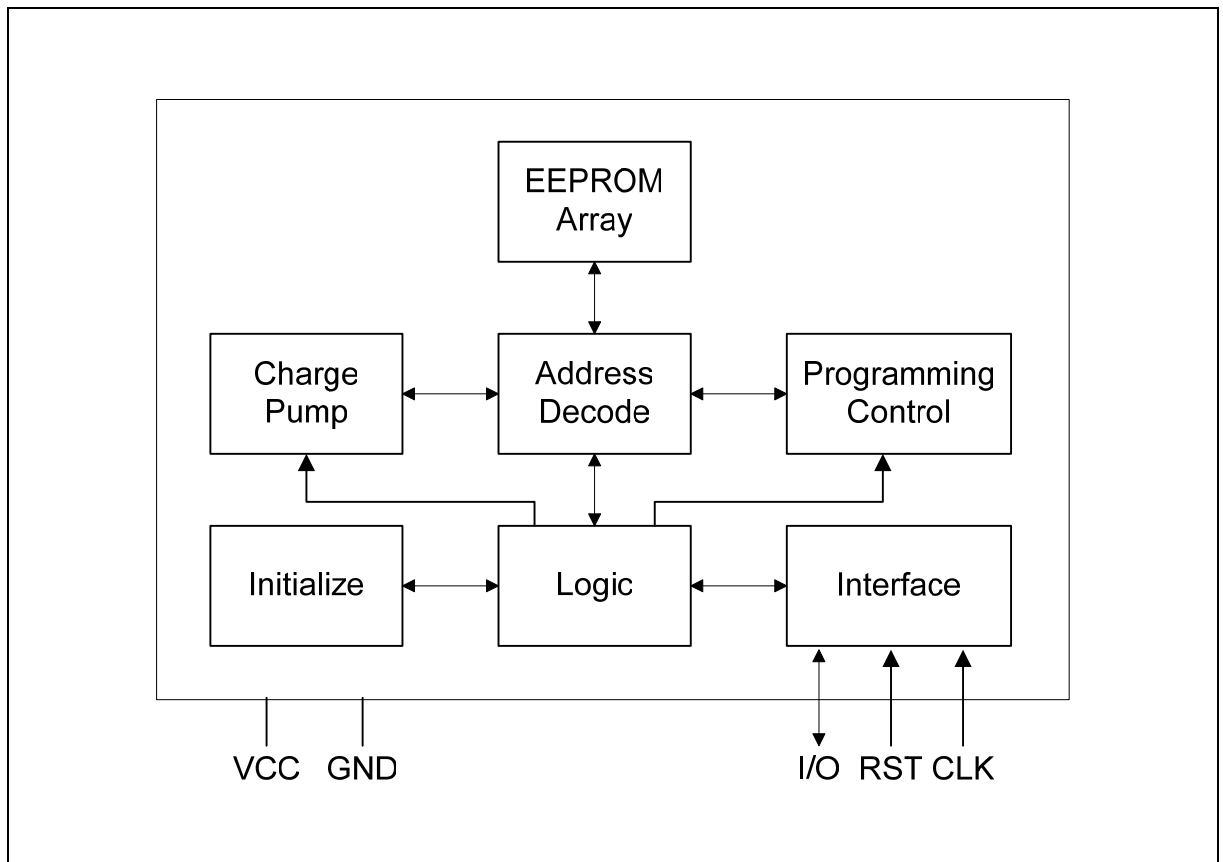


Figure 1-1 FM4428 Block Diagram

# Function Description

## Command Format

The chip receives input and gives output through I/O; the state of RST defines the data direction on I/O:

RST=1, I/O is for command entry

RST=0, I/O is for data output

Command takes the following format:

b1	B2	b3	b4	b5	b6	b7	b8	b1	B2	b3	b4	b5	b6	b7	b8	b1	b2	b3	b4	b5	b6	b7	b8
S0	S1	S2	S3	S4	S5	A8	A9	A0	A1	A2	A3	A4	A5	A6	A7	D0	D1	D2	D3	D4	D5	D6	D7

Command is 24bit in length, organized in 3 Byte:

S0~S5 in byte 1 is control word for the command. The remaining 2 bits in byte 1 and the whole byte 2 add up 10 bits, they are address bit A0~A9. The last byte is for data bits D0~D7, in commands carrying out reading operations, this byte is of no effect.

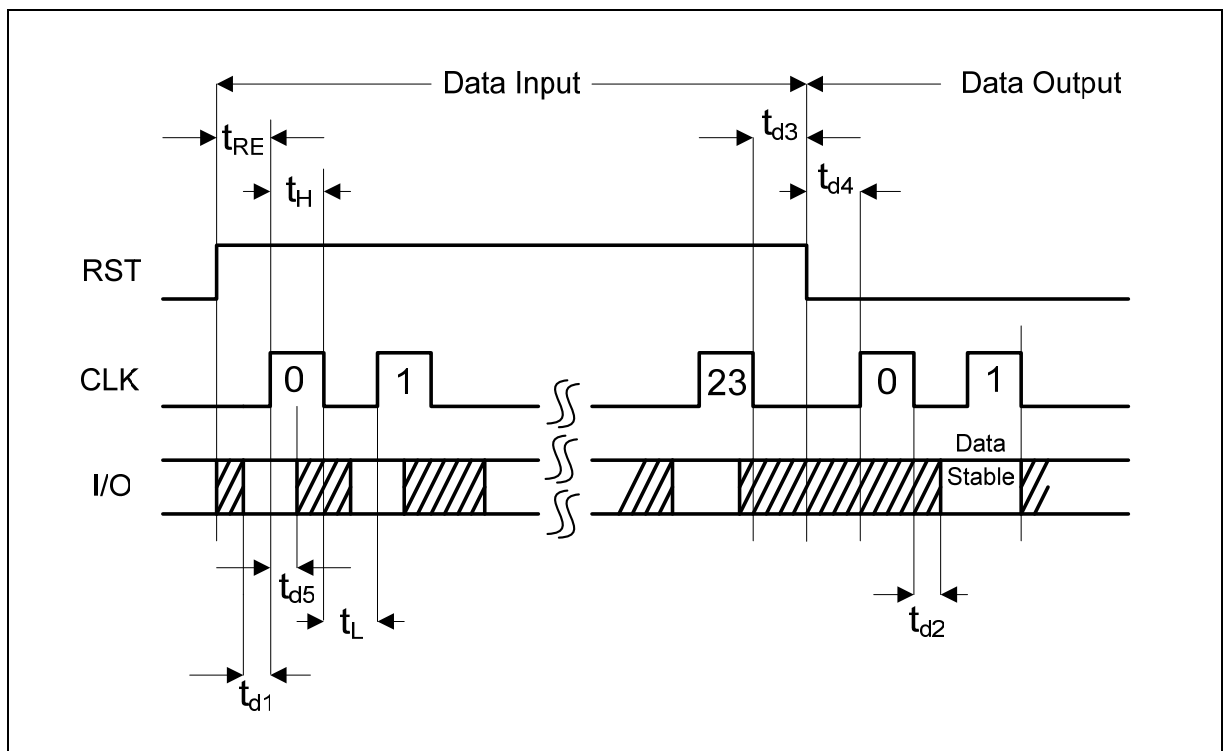


Figure 2-1 FM4428 General Timing Relationship

## Command Introduction

### (1) Erase/Write Data Byte with Protect Bit

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
1	0	0	0	1	1	Address bit 8 and 9		Address bit 0 and 7	Input data

The protect bit is enabled when data are written, memory area is set read only.

### (2) Erase/Write Data Byte without Protect Bit

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
1	1	0	0	1	1	Address bit 8 and 9		Address bit 0 and 7	Input data

The protect bit is not enabled when data are written; memory area is still writable/erasable.

### (3) Write Protect Bit with Date Comparison

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
0	0	0	0	1	1	Address bit 8 and 9		Address bit 0 and 7	Comparison data

When this command is carried out, the comparison data is compared with the contents in destination memory unit. If they are identical, then the corresponding protect bit is written as "0", otherwise, no change.

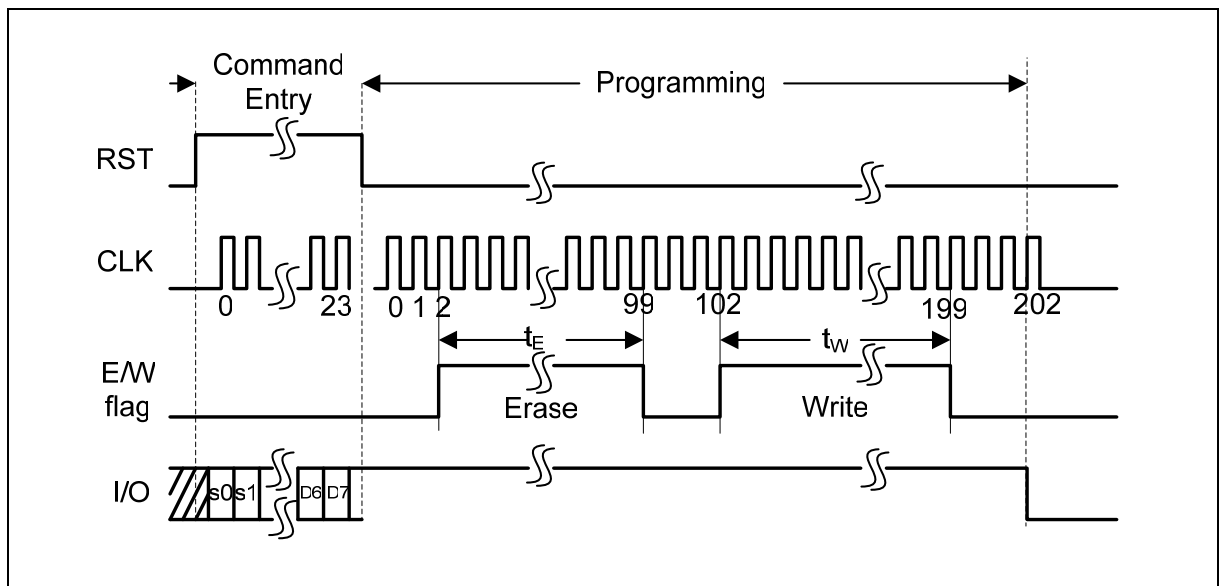


Figure 2-2 FM4428 Erase and Write

(If the operation is erase only, there is no WRITE part shown in the figure, hence lasting 102 CLK)

**(4) Read Data Byte with Protect Bit**

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
0	0	1	1	0	0	Address bit 8 and 9		Address bit 0 and 7	No effect

This command reads out 8 data bits in destination address and the corresponding protect bit, adding up to 9 bit.

**(5) Read Data Byte without Protect Bit**

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
0	1	1	1	0	0	Address bit 8 and 9		Address bit 0 and 7	No effect

This command reads out 8 data bits in destination address.

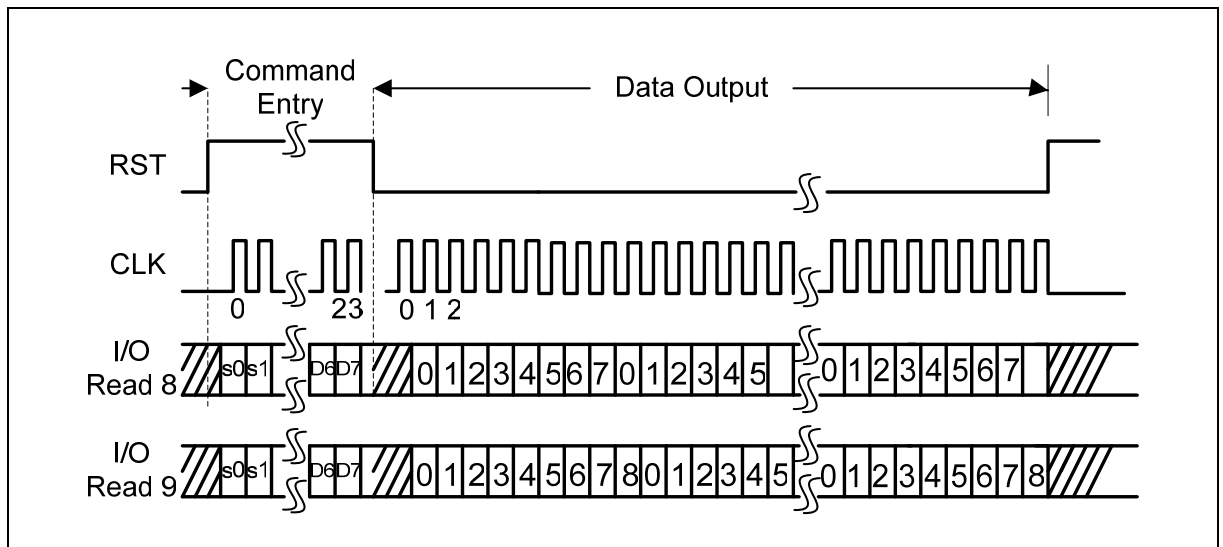


Figure 2-3 FM4428 Read Data Byte (with and without protect bit)

**(6) Modify Error Counter**

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
0	1	0	0	1	1	1	1	253	Bit mask

According to the entry mask word, change one bit "1" in the error counter to "0"

**(7) Compare PSC Byte**

s0	s1	s2	s3	s4	s5	A8	A9	A0—A7	D0—D7
1	0	1	1	0	0	1	1	254 / 255	PSC Byte 1/Byte 2

This command compares the entry PSC with contents stored in PSC memory area. After verification of comparison, erase operation can be carded out.

## PSC Verification

The chip has a 2byte programmable security code (PSC). If failed to pass PSC verification, only reading is possible, while the contents of the PSC addresses cannot be read out. If failed to pass PSC verification, apart from writing to error counter bits, no other erase/write operation is allowed.

The verification procedure of the chip must be performed in the following steps:

- ◆ write one not written error-counter bit, address “1021”;
- ◆ enter first PSC-code byte, address “1022”;
- ◆ enter second PSC-code byte, address “1023”;
- ◆ after correct input the error counter can be erased;

Whether PSC verification is passed can be judged from I/O state:

- 1). On the rising side of the 3<sup>rd</sup> lock after entry of the erase error counter command, if I/O state changes from “1” to “0”, it means that PSC verification fails; error counter is unable to be erased.
- 2). On the rising side of the 103<sup>rd</sup> clock after entry of the erase error counter command, if I/O state changes from “1” to “0”, it means PSC verification passes, error counter has been written all “1”.

Entry of PSC must start with the least-significant PSC byte with the least significant bit, and then the most –significant one. If PSC verification passes, all the memory is enabled for erasing and writing as long as operating voltage is applied, except those whose protect bit is “0”. At this time, the error counter should be erased as all “1” in order to reactivate the next 8 attempts, The PSC may be altered as wished, if the corresponding protect bits are not effective.



# Electrical Characteristics

## Absolute Maximum Ratings

Symbol	Parameter	Limit Values			Unit
		Min	Typ	Max	
$V_{CC}$	Supply voltage	-0.3	-	6	V
$V_i$	Input voltage	-0.3	-	6	V
$T_{sto}$	Storage temperature	-40	-	+125	°C
$P_{tot}$	Power dissipation	-	-	60	mW

## DC Characteristics

Symbol	Parameter	Limit Values			unit
		Min	Typ	Max	
$V_{CC}$	Supply voltage	4.5	5	5.5	V
$I_{CC}$	Supply current	-	3	10	mA
$V_{ih}$	H input voltage (I/O, CLK, RST)	3.5	-	$V_{CC}$	V
$V_{il}$	L input voltage (I/O, CLK, RST)	0	-	0.8	V
$I_h$	H input current (I/O, CLK, RST)	-	3.9	10	μA
$I_{ol}$	L input current ( $V_I=0.4V$ , open drain)	0.5	-	-	mA
$I_{oh}$	H leakage current ( $V_I=V_{CC}$ , open drain)	-	-	10	μA
$C_i$	Input capacitance	-	-	10	pF
F	Clock frequency	-	20	-	kHz
T	Test pin	Open or on GND			

## AC Characteristics

Symbol	Parameter	Limit Values			unit
		Min	Typ	Max	
$t_{RE}$	Reset time	9	-	-	μs
$t_H$	CLK (count, H level)	10	-	-	μs
$t_L$	CLK (count, L level)	10	-	-	μs
$t_W$	Write time	5	-	-	ms
$t_E$	Erase time	5	-	-	ms
$t_{d1}$	Setup time (D/CLK)	4	-	-	μs
$t_{d3}$	Setup time (CLK/RST)	4	-	-	μs
$t_{d4}$	Setup time (RST/CLK)	4	-	-	μs
$t_{d5}$	Hold time (D/CLK)	4	-	-	μs
$t_{d2}$	Delay time (CLK/D)	6	-	-	μs
$t_R$	Rise time (I/O, CLK, RST)	-	-	1	μs
$t_F$	Fall time (I/O, CLK, RST)	-	-	1	μs



# Revision History

Version	Publication date	Pages	Paragraph or Illustration	Revise Description
1.0	Jun. 2001	6		Initial Release
2.0	Oct. 2007	11		Updated Format

# Sales and Service

## Shanghai Fudan Microelectronics Co., Ltd.

Address: Bldg No. 4, 127 Guotai Rd,  
Shanghai City China.

Postcode: 200433

Tel: (86-21) 6565 5050

Fax: (86-21) 6565 9115

## Shanghai Fudan Microelectronics (HK) Co., Ltd.

Address: Flat 12, 7/F, East Ocean Centre, 98 Granville Rd,  
Tsimshatsui East, Kowloon, Hong Kong.

Tel: (852) 2116 3288 2116 3338

Fax: (852) 2116 0882

## Beijing Office

Address: Room.1208, Bldg C,  
Zhongguancun Science and Technology Development Edifice,  
34 zhongguancun Street (South)

Haidian District, Beijing City, China.

Tel: (86-10) 6212 0682 6213 9558

Fax: (86-10) 6212 0681

## Shenzhen Office

Address: Room.1301, Century Bldg, Shengtingyuan Hotel,  
Huaqiang Rd (North)

Tel: (86-755) 8335 1011 8335 0911

Fax: (86-755) 8335 9011

**Web Site:** <http://www.fmsk.com/>