Comparison of MX25L6433F/73F/36F and MX25L64xxE

1. Introduction

This application note compares Macronix 75nm 64Mb Serial NOR Flash MX25L6433F/73F/36F with Macronix MX25L64xxE 110nm Serial flash. Generally, the MX25L6433F/73F/36F is backward compatible with the MX25L64xxE as it is pin and command compatible with the basic Read/Program/Erase commands. There may be some differences if special features are used such as DTR mode, Write Protection, or CP mode programming.

The document does not provide detailed information on the individual devices, but highlights the major similarities and differences between them. The comparison covers the general features, performance, command codes and other differences.

The information in this document is based on datasheets listed in *"9. References"*. Newer versions of the datasheets may override the contents of this document.

2. General Features

Macronix 3V 64Mb Serial NOR Flash families have similar features and functions as shown in *"Table 2-1: Key Features Comparison"*.

Table 2-1: Key Features Comparison

Part Number	MX25L6433F MX25L6473F MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
Technology	75nm	110nm	110nm	110nm	110nm
Operation Temperature	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C
Voltage	2.65 - 3.6V	2.7 - 3.6V	2.7 - 3.6V	2.7 - 3.6V	2.7 - 3.6V
Interface	x1, x2, x4	x1, x2	x1, x2, x4	x1, x2, x4	x1, x2, x4
Page Program Size	256 bytes	256 bytes	256 bytes	256 bytes	256 bytes
Sector Size	4KB	4KB	4KB	4KB	4KB
Block Sizes	64KB and 32KB	64KB	64KB and 32KB	64KB and 32KB	64KB and 32KB
SFDP Mode	Yes	Yes	Yes	Yes	Yes
Hold# Pin	Yes	Yes	Yes	--	--
S/W Reset	Yes	--	Yes	--	--
Deep Power Down	Yes	Yes	Yes	Yes	Yes
P/E Suspend/Resume	Yes	--	MX25L6439E only	--	--
Quad Enable (QE)=1 fixed	MX25L6473F only	--	MX25L6473E only	--	--
QPI mode	--	--	MX25L6439E only	--	--
DTR Mode	--	--	--	Yes	--
Burst Read	Yes	--	MX25L6439E only	--	--
Contin. Pgm (CP) Mode	--	--	Yes	Yes	Yes
Secured OTP Size	8Kbits	512bits	4Kbits	4Kbits	4Kbits
Block Protection	TB, BP3 - BP0	BP3 - BP0	TB, BP3 - BP0	BP3 - BP0	BP3 - BP0
Individual Block Protect	--	--	Yes	Yes	Yes
Advanced Security Mode*	MX25L6436F-08G only	--	--	--	--
Endurance (typ.)	100K cycles	100K cycles	100K cycles	100K cycles	100K cycles
Data Retention (min)	20 years	20 years	20 years	20 years	20 years

***Note:** Advanced Sector Protection commands include E3h, E4h, E2h, E1h, E0h, 7Eh, and 98h.*

3. Electrical Performance

The MX25L6433F/73F/36F is capable of similar or improved performance (*"Table 3-1: Read Performance (Max. Clock Rate)"* and *"Table 3-2: Key Performance Comparison"*).

Table 3-1: Read Performance (Max. Clock Rate)

Part Number	MX25L6433F MX25L6473F MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
Read	50MHz	33MHz	50MHz	50MHz	50MHz
Fast Read (x1 I/O)	133MHz	86MHz	104MHz	104MHz	104MHz
DREAD (1I/2O)	133MHz	80MHz	86MHz	--	70MHz
QREAD (1I/4O)	133MHz	--	86MHz	--	75MHz
2READ (x2 I/O)	133MHz	--	86MHz	70MHz	--
4READ (x4 I/O)	133MHz	--	104MHz	70MHz	--
FASTDTRD	--	--	--	50MHz	--
2DTRD	--	--	--	50MHz	--
4DTRD	--	--	--	50MHz	--
4PP	133MHz	--	104MHz	20MHz	20MHz

Table 3-2: Key Performance Comparison

Part Number		MX25L6433F MX25L6473F MX25L6436F		MX25L6406E		MX25L6435E MX25L6439E MX25L6473E		MX25L6445E		MX25L6436E	
Clock High/ Low Time	tCH (min.)	133MHz: 3.75ns		86MHz: 5.5ns		104MHz: 4.5ns		104MHz: 4.5ns		104MHz: 4.5ns	
		50MHz: 9ns		33MHz: 13ns		50MHz: 9ns		50MHz: 9ns		50MHz: 9ns	
	tCL (min.)	133MHz: 3.75ns		86MHz: 5.5ns		104MHz: 4.5ns		104MHz: 4.5ns		104MHz: 4.5ns	
		50MHz: 9ns		33MHz: 13ns		50MHz: 9ns		50MHz: 9ns		50MHz: 9ns	
Performance		Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.
Program Time	Byte	10us	50us	9us	50us	12us	300us	9us	300us	9us	300us
	Write Status Register	--	40ms	5ms	40ms	--	40ms	40ms	100ms	40ms	100ms
	Page Program (tPP)	0.33ms	1.2ms	0.6ms	3ms	0.7ms	3ms	1.4ms;	5ms	1.4ms	5ms
Erase Time	Sector (tSE)	25ms	200ms	60ms	300ms	60ms	300ms	60ms	300ms	60ms	300ms
	32KB Block (tBE32)	0.14s	0.6s	--	--	0.5s	2s	0.5s	2s	0.5s	2s
	64KB Block (tBE64)	0.25s	1s	0.7s	2s	0.7s	2s	0.7s	2s	0.7s	2s
	Chip	20s	60s	50s	80s	50s	80s	50s	80s	50s	80s
Standby Power	ISB1	10uA	50uA	12uA	50uA	15uA	50uA	--	50uA	--	50uA
Deep Power Down	ISB2	3uA	20uA	2uA	20uA	1uA	25uA	--	20uA	--	20uA
CS# Active Setup/Hold (min)	tSLCH tCHSH	4ns		7ns		4ns		5ns		5ns	
CS# Deselect (min.)	tSHSL	Read=15ns; Write=50ns		Read=15ns; Write=50ns		Read=15ns; Write=50ns		Read=15ns; Write=50ns		Read=15ns; Write=50ns	
Clock to Output Valid	tCLQV (@15pF)	6ns (x1), 6ns (x4)		8ns (x1)		6ns (x1), 6ns (x4)		9ns (x1), 9.5ns (x4)		9ns (x1), 9.5ns (x4)	
Read Current (max)	ICC1	17mA (133MHz, x4)		25mA (86MHz, x1)		35mA (104MHz, x4)		75MHz: 22mA (x4)		75MHz: 22mA (x4)	
		5mA (50MHz, x1)		10mA (33MHz, x1)		25mA (86MHz, x4)		70MHz: 17mA (x2)		70MHz: 17mA (x2)	
						10mA (33MHz, x1)		33MHz: 10mA (x1)		33MHz: 10mA (x1)	
Active Current (max.)	ICC2	15mA		20mA		25mA		25mA		25mA	
	ICC3	15mA		20mA		20mA		20mA		20mA	
	ICC4	15mA		20mA		25mA		25mA		25mA	
	ICC5	15mA		25mA		25mA		20mA		20mA	

4. Command Set

Table 4-1 shows basic Read, Program, and Erase commands are supported by the MX25L6433F. The differences are highlighted in *"Table 4-1: Command Set Table"*.

Table 4-1: Command Set Table

Part Number		MX25L6433F MX25L6473F	MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
WREN	Write Enable	06h	06h	06h	06h	06h	06h
WRDI	Write Disable	04h	04h	04h	04h	04h	04h
WRSR	Write Status/ Configuration Register	01h	01h	01h	01h	01h	01h
RDID	Read Identification	9Fh	9Fh	9Fh	9Fh	9Fh	9Fh
RDSR	Read Status Register	05h	05h	05h	05h	05h	05h
RDCR	Read Configuration Register	15h	15h	--	15h	--	--
READ	Read Data	03h	03h	03h	03h	03h	03h
RDSFDP	Read SFDP data	5Ah	5Ah	5Ah	5Ah	5Ah	5Ah
FAST READ	Fast Read Data	0Bh	0Bh	0Bh	0Bh	0Bh	0Bh
2READ	2 I/O Fast Read	BBh	BBh	--	BBh	BBh	--
4READ	4 I/O Fast Read	EBh	EBh	--	EBh	EBh	--
W4READ	4 I/O Read with 4 Dummy Cycles	--	--	--	E7h	--	--
FASTDTRD	Fast DT Read	--	--	--	--	0Dh	--
2DTRD	Dual I/O DT Read	--	--	--	--	BDh	--
4DTRD	Quad I/O DT Read	--	--	--	--	EDh	--
DREAD	Dual Output Read mode	3Bh	3Bh	3Bh	3Bh	--	38h
QREAD	Quad Output Read mode	6Bh	6Bh		6Bh	--	6Bh
RES	Read Electronic ID	ABh	ABh	ABh	ABh	ABh	ABh
REMS	Read Mfr. ID and Device ID	90h	90h	90h	90h	90h	90h
REMS2	Output ID for 2xI/O Mode	--	--	--	EFh	EFh	EFh
REMS4	Output ID for 4xI/O Mode	--	--	--	DFh	DFh	DFh
REMS4D	Read ID for 4x I/O DT Mode	--	--	--	--	CFh	--

Table 4-1: Command Set Table (Continued)

Part Number		MX25L6433F MX25L6473F	MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
SE	Sector Erase	20h	20h	20h	20h	20h	20h
BE	64KB Block Erase	D8h	D8h	D8h or 52h	D8h	D8h	D8h
BE32K	32KB Block Erase	52h	52h	--	52h	52h	52h
CE	Chip Erase	60h or C7h	60h or C7h	60h or C7h	60h or C7h	60h or C7h	60h or C7h
4PP	Quad Page Program	38h	38h	--	38h	38h	38h
PP	Page Program	02h	02h	02h	02h	02h	02h
CP	Continuously Program Mode			--	ADh	ADh	ADh
RDSCUR	Read Security Register	2Bh	2Bh	2Bh	2Bh	2Bh	2Bh
WRSCUR	Write Security Register	2Fh	2Fh	2Fh	2Fh	2Fh	2Fh
ENSO	Enter Secured OTP	B1h	B1h	B1h	B1h	B1h	B1h
EXSO	Exit Secured OTP	C1h	C1h	C1h	C1h	C1h	C1h
Pgm/Ers Suspend	Program/ Erase Suspend	75h/B0h	75h/B0h	--	75h/B0h	--	--
Pgm/Ers Resume	Program/ Erase Resume	7Ah/30h	7Ah/30h	--	7Ah/30h	--	--
ESRY	Enable SO to Output RY/ BY#	--	--	--	70h	70h	70h
DSRY	Disable SO to Output RY/ BY#	--	--	--	80h	80h	80h
DP	Deep Power Down	B9h	B9h	B9h	B9h	B9h	B9h
RDP	Release from Deep Power Down	ABh	ABh	ABh	ABh	ABh	ABh
RSTEN	Reset Enable	66h	66h	--	66h	--	--
RST	Reset Memory	99h	99h	--	99h	--	--

Table 4-1: Command Set Table (Continued)

Part Number		MX25L6433F MX25L6473F	MX25L6436F*	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
SBL	Set Burst Length	C0h/77h	C0h/77h	--	77h	--	--
SBLK	Single Block Lock	--	--	--	36h	36h	36h
SBULK	Single Block Unlock	--	--	--	39h	39h	39h
GBLK	Gang Block Lock	--	7Eh	--	7Eh	7Eh	7Eh
GBULK	Gang Block Unlock	--	98h	--	98h	98h	98h
CLSR	Clear SR Fail Flags	--	--	--	--	30h	30h
HPM	High Performance Enable Mode	--	--	--	--	A3h	--
RDBLOCK	Block Protect Read	--	--	--	3Ch	3Ch	3Ch
WRSPB	SPB bit program	--	E3h	--	--	--	--
ESSPB	Single Block Unlock	--	E4h	--	--	--	--
RDSPB	read SPB status	--	E2h	--	--	--	--
WRDPB	write DPB register	--	E1h	--	--	--	--
RDDPB	read DPB register	--	E0h	--	--	--	--

**Note: Only MX25L6436F-08G supports the 7Eh, 98h, E3h, E4h, E2h, E1h, and E0h commands.*

5. Register Comparison

The MX25L6433F/73F/36F Status Register bits are backward compatible with the registers of the MX25L64xxE.

Table 5-1: Status Register Bit Comparison

Part Number	MX25L6433F MX25L6473F MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
SR [0]	Write In Progress Bit	Write In Progress Bit	Write In Progress Bit	Write In Progress Bit	Write In Progress Bit
SR [1]	Write Enable Latch	Write Enable Latch	Write Enable Latch	Write Enable Latch	Write Enable Latch
SR [2]	Block Protect : BP0	Block Protect : BP0	Block Protect : BP0	Block Protect : BP0	Block Protect : BP0
SR [3]	Block Protect : BP1	Block Protect : BP1	Block Protect : BP1	Block Protect : BP1	Block Protect : BP1
SR [4]	Block Protect : BP2	Block Protect : BP2	Block Protect : BP2	Block Protect : BP2	Block Protect : BP2
SR [5]	Block Protect : BP3	Block Protect : BP3	Block Protect : BP3	Block Protect : BP3	Block Protect : BP3
SR [6]	Quad Enable	0	Quad Enable	Quad Enable	Quad Enable
SR [7]	Status Register Write Protect	Status Register Write Protect	Status Register Write Protect	Status Register Write Protect	Status Register Write Protect

The MX25L6433F/73F/36F Configuration Register bits are backward compatible with the registers of the MX25L6435E, with the exception bits 6 and which can be used to set the number of dummy cycles when executing a 4Read command. If the default number of dummy cycles is used, then this difference can be ignored.

Table 5-2: Configuration Register Bit Comparison

Part Number	MX25L6433F MX25L6473F MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
Bit0	ODS (Output Driver Strength)	--	Reserved	--	--
Bit1	Reserved	--	Reserved	--	--
Bit2	Reserved	--	Reserved	--	--
Bit3	T/B (Top/Bottom) Protect)	--	T/B (Top/Bottom) Protect)	--	--
Bit4	Reserved	--	Reserved	--	--
Bit5	Reserved	--	Reserved	--	--
Bit6	4READ and 2READ Dummy Cycles	--	Reserved	--	--
Bit7	Reserved	--	4READ Dummy Cycles	--	--

The MX25L6433F/73F/36F Security Register bits are backward compatible with the registers of the MX25L64xxE.

Table 5-3: Security Register Bit Comparison

Part Number	MX25L6433F MX25L6473F MX25L6436F	MX25L6406E	MX25L6435E MX25L6439E MX25L6473E	MX25L6445E	MX25L6436E
Bit0	Secured OTP Indicator Bit	Secured OTP Indicator Bit	Secured OTP Indicator Bit	Secured OTP Indicator Bit	Secured OTP Indicator Bit
Bit1	LDSO (Lock-down Status)	LDSO (Lock-down Status)	LDSO (Lock-down Status)	LDSO (Lock-down Status)	LDSO (Lock-down Status)
Bit2	Program Suspend	Reserved	Reserved	Reserved	Reserved
Bit3	Erase Suspend	Reserved	Reserved	Reserved	Reserved
Bit4	Reserved	Reserved	Continuous Program Mode	Continuous Program Mode	Continuous Program Mode
Bit5	P_FAIL; 1=Program fail	Reserved	P_FAIL; 1=Program fail	P_FAIL; 1=Program fail	P_FAIL; 1=Program fail
Bit6	E_FAIL; 1=Erase fail	Reserved	E_FAIL; 1=Erase fail	E_FAIL; 1=Erase fail	E_FAIL; 1=Erase fail
Bit7	Reserved	Reserved	WPSEL; 1=Individual WP	WPSEL; 1=Individual WP	WPSEL; 1=Individual WP

6. Data Protection

6-1. BP bit Block Protection

All of these 64Mb Macronix flash can use BP bits in the Status Register to select groups of memory areas for write protection. While the MX25L6433F/73F and MX25L6435E/73E/39E have the ability to write protect identical groups of blocks with the same BP bit settings, they have a finer granularity of block protection than the MX25L6406E/36F/45E/36E. Most of the regions protected by the MX25L6406E/36F/45E/36E can be protected by the MX25L6433F (*"Table 6-1: Block Protection (BP) with T/B bit = 0"*).

Table 6-1: Block Protection (BP) with T/B bit = 0

Status Register Bit				Protected Blocks		
BP3	BP2	BP1	BP0	MX25L6433F/73F MX25L6435E/39E/73E	MX25L6406E MX25L6436F	MX25L6445E MX25L6436E
0	0	0	0	None	None	None
0	0	0	1	1 block (#127)	2 blocks (#127-126)	2 blocks (#127-126)
0	0	1	0	2 blocks (#127-126)	4 blocks (#127-124)	4 blocks (#127-124)
0	0	1	1	4 blocks (#127-124)	8 blocks (#127-120)	8 blocks (#127-120)
0	1	0	0	8 blocks (#127-120)	16 blocks (#127-112)	16 blocks (#127-112)
0	1	0	1	16 blocks (#127-112)	32 blocks (#127-96)	32 blocks (#127-96)
0	1	1	0	32 blocks (#127-96)	64 blocks (#127-64)	64 blocks (#127-64)
0	1	1	1	64 blocks (#127-64)	128 blocks (all)	128 blocks (all)
1	0	0	0	128 blocks (all)	128 blocks (all)	128 blocks (all)
1	0	0	1	128 blocks (all)	64 blocks (#0-63)	128 blocks (all)
1	0	1	0	128 blocks (all)	96 blocks (#0-95)	128 blocks (all)
1	0	1	1	128 blocks (all)	112 blocks (#0-111)	128 blocks (all)
1	1	0	0	128 blocks (all)	120 blocks (#0-119)	128 blocks (all)
1	1	0	1	128 blocks (all)	124 blocks (#0-123)	128 blocks (all)
1	1	1	0	128 blocks (all)	126 blocks (#0-125)	128 blocks (all)
1	1	1	1	128 blocks (all)	128 blocks (all)	128 blocks (all)

Notes:

1. The device is ready to accept a Chip Erase instruction if, and only if, all Block Protect (BP3, BP2, BP1, BP0) are 0.

2. The T/B bit = 1 condition is not shown, as MX25L6406E/36F/6445E/6436E do not have T/B bit.

7. Device Identification

The RDID instruction is for reading the 1-byte Manufacturer ID followed by the 2-byte Device ID. The REMS instruction provides both the JEDEC assigned manufacturer ID and the specific Device ID.

Manufacturer and Device IDs have not changed (*"Table 7-1: ID Code Comparison"*).

Table 7-1: ID Code Comparison

Command	MX25L6433F MX25L6473F MX25L6436F			MX25L6406E			MX25L6435E MX25L6473E			MX25L6445E			MX25L6439E			MX25L6436E		
RDID	M ID	Type	Density	M ID	Type	Density	M ID	Type	Density	M ID	Type	Density	M ID	Type	Density	M ID	Type	Density
	C2	20	17	C2	20	17	C2	20	17	C2	20	17	C2	25	37	C2	20	17
RES	Electronic ID			Electronic ID			Electronic ID			Electronic ID			Electronic ID			Electronic ID		
	16			16			16			16			37			16		
REMS	Mfr. ID	Dev.ID		Mfr. ID	Dev.ID		Mfr. ID	Dev.ID		Mfr. ID	Dev.ID		Mfr. ID	Dev.ID		Mfr. ID	Dev.ID	
	C2	16		C2	16		C2	16		C2	16		C2	16		C2	16	

8. Summary

Generally, the MX25L6433F/73F/36F is backward compatible with the MX25L64xxE as it is pin and command compatible with the basic Read/Program/Erase commands. There may be some differences if special features are used such as DTR mode, Write Protection, or CP mode programming.

9. References

"Table 8-1. Datasheet Versions" shows the datasheet versions used for comparison in this application note. For the most current, detailed specification, please refer to the Macronix Website at http://www.macronix.com/ or contact Macronix sales.

Table 8-1. Datasheet Versions

Data sheet	Location	Date Issued	Versions
MX25L6433F	Website	October 2016	Rev. 1.5
MX25L6436F	Website	October 2016	Rev. 1.2
MX25L6473F	Website	October 2016	Rev. 1.2
MX25L6406E	Website	October 2014	Rev. 1.9
MX25L6435E	Website	October 2016	Rev. 1.7
MX25L6473E	Website	June 2015	Rev. 1.4
MX25L6439E	Website	November 2013	Rev. 1.2
MX25L6445E	Website	December 2011	Rev. 1.8
MX25L6436E	Website	August 2012	Rev. 2.0

10. Revision History

Table 10-1. Revision History

Revision No.	Description	Page	Date
Rev. 1	Initial Release	ALL	October 16, 2014
Rev. 2	Modified the document title and datasheet version of MX25L6473F	1, 7	November 03, 2014
Rev. 3	Added MX25L6436F; Modified Data Protection descriptions; Deleted Table "Package Comparison"	ALL	October 18, 2016

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