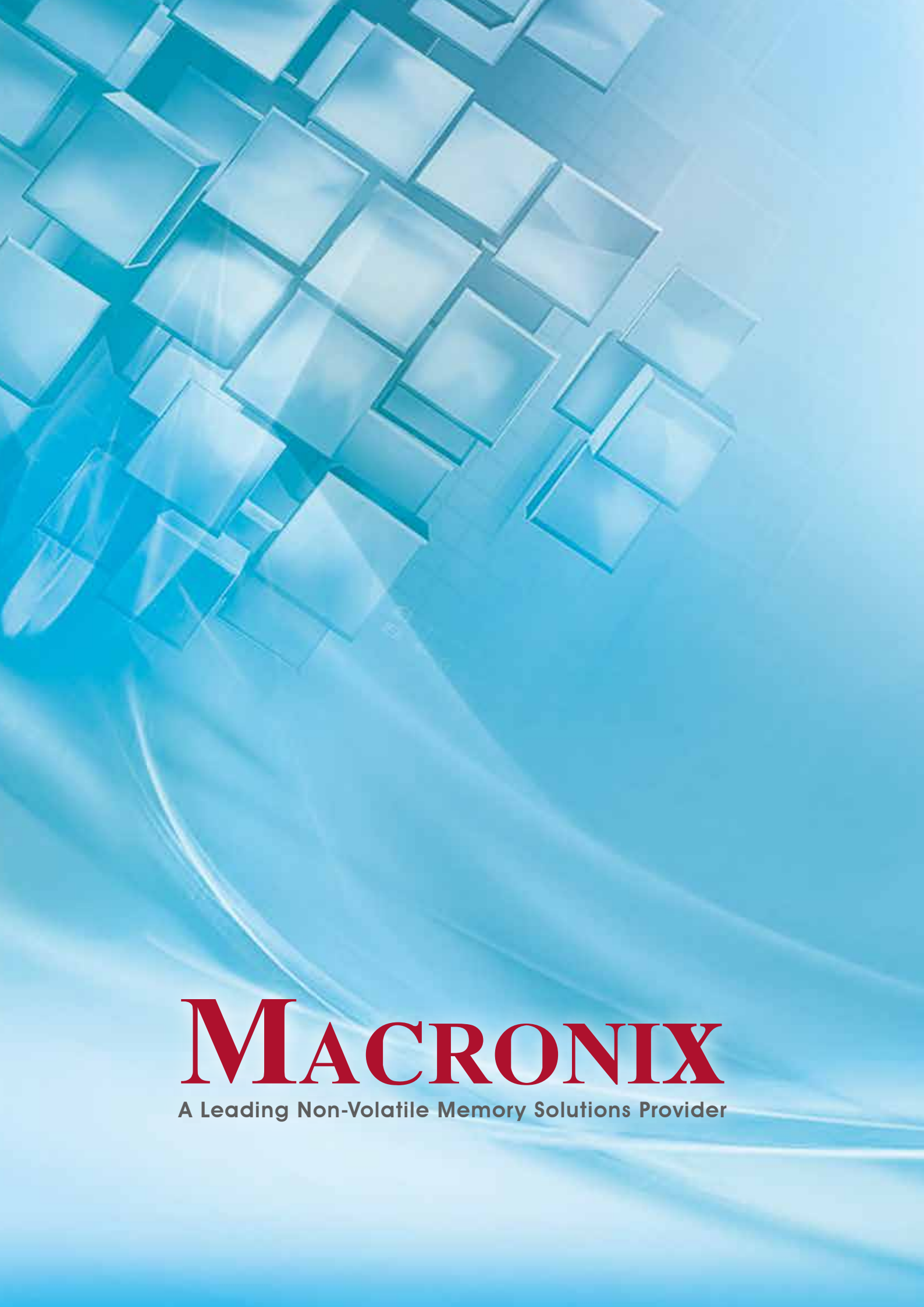
MACRONIX

PRODUCT SELECTION GUIDE

June, 2021


MACRONIX
A Leading Non-Volatile Memory Solutions Provider

MACRONIX Your Trustworthy & Reliable Partner

Macronix, the leading provider of NVM (Non-Volatile Memory) semiconductor solutions, produces an expansive range of NOR Flash, NAND Flash, and ROM products. Macronix continues to deliver high quality, innovative and performance driven products, ideal for diverse applications from computing, consumer, networking, and industrial, to mobile, embedded, automotive, and Internet of Things (IoT).

Macronix is one of the few IDM (Integrated Device Manufacturer) companies worldwide with complete Design, Manufacturing, and Marketing capabilities under its own Brand. Macronix dedicates itself to developing superior homegrown technologies and consistently improving its manufacturing processes in order to offer its customers quality products and services.

Broad Product Portfolio

Designers can select from a broad array of Serial NOR and Parallel NOR Flash memory solutions, spanning 3V, 1.8V and 1.2V products from 512 Kb to 2Gb and NAND Flash memory solutions from 512Mb to 8Gb. Packaging configurations include single-die packaged, Known Good Die (KGD), wafer, and multi-chip package (MCP) configurations.

Technology Innovator

Macronix believes that Innovation and Differentiation are key factors in creating a better, more valuable future for our customers and partners. Macronix has been dedicating more than 20% of its annual revenue to Research and Development. We have strong technology portfolio with over 8000 patents.

Long-term Commitment and Support

Macronix has over 30 years of IDM experience with excellent in-house design and manufacturing capabilities, which facilitate continuous improvement in all aspects of the development and production cycle. Macronix is committed to providing reliable and efficient support to satisfy customers' expectations for long-lasting partnerships.

Reliable Quality Standard

Macronix's stringent quality standards, based on the ISO 9001 philosophy, have resulted in TS 16949 certification. Our Green Product Management system is highly regarded in the industry. Macronix has been granted green partnerships with Canon, LG, Nintendo, Sony and Samsung.

Serial NOR Flash

Macronix designs and manufactures 1.8V, 2.5V and 3V Serial NOR Flash products from 512Kb to 2Gb. We also offer backward-compatible, high-performance Serial NOR Flash, MXSMIO® (Multi-I/O) family and MXSMIO® Duplex (DTR) family.

Density	Mode	Organization	I/O Bus	Speed (MHz)	Package	Voltage	Temperature Range
MX25/66L 3V Serial NOR Flash							
2Gb	MXSMIO®, DTR	4KB/32KB/64KB	x1,x2,x4	STR:166 DTR:100	24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C
1Gb	MXSMIO®, DTR, Dual Quad	4KB/32KB/64KB	x1,x2,x4	STR:166 DTR:100	16-SOP, 24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
512Mb	MXSMIO®, DTR, Dual Quad, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR:166 DTR:100	8-WSON,16-SOP, 24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
256Mb	MXSMIO®, DTR, Dual Quad, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR:133 DTR:100	8-SOP/WSON,16-SOP, 24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
128Mb	MXSMIO®, DTR, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR:133 DTR:100	8-SOP/WSON,16-SOP, 24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C
64Mb	MXSMIO®, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	133	8-SOP/WSON, 16-SOP, 24-TFBGA	2.65-3.6V 2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
32Mb	MXSMIO®, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	133	8-SOP/WSON/USON, 16-SOP,24-TFBGA	2.65-3.6V 2.7-3.6V	-40°C to +85°C -40°C to +105°C
16Mb	MXSMIO®, Quad I/O Permanent Enabled	4KB/64KB	x1,x2,x4	133	8-SOP,24-TFBGA	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
8Mb	MXSMIO®	4KB/64KB	x1,x2,x4	133	8-SOP/WSON/USON	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
4Mb	Default Lock Protection	4KB/64KB	x1,x2	86	8-SOP/WSON/USON	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
2Mb	Default Lock Protection	4KB/64KB	x1,x2	86	8-SOP	2.7-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
1Mb	Default Lock Protection	4KB/64KB	x1,x2	104	8-SOP	2.7-3.6V	0°C to +70°C -40°C to +85°C
512Kb	Standard Interface	4KB/64KB	x1,x2	104	8-SOP/TSSOP/USON	2.7-3.6V	0°C to +70°C -40°C to +85°C

Density	Mode	Organization	I/O Bus	Speed (MHz)	Package	Voltage	Temperature Range
MX25V 2.5-3V Serial NOR Flash							
16Mb	Multi I/O	4KB/32KB/64KB	x1,x2	104	8-SOP/WSON	2.3-3.6V	-40°C to +85°C -40°C to +125°C
8Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	108	8-SOP/WSON/USON	2.3-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
4Mb	Multi I/O	4KB/32KB/64KB	x1,x2	104	8-SOP/VSOP/TSSOP/WSON	2.3-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
2Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	80	8-SOP/USON	2.3-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
1Mb	Multi I/O	4KB/32KB/64KB	x1,x2	80	8-SOP/TSSOP/USON	2.3-3.6V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
512Kb	Multi I/O	4KB/32KB/64KB	x1,x2	80	8-SOP/TSSOP/USON	2.3-3.6V	-40°C to +85°C

Density	Mode	Organization	I/O Bus	Speed (MHz)	Package	Voltage	Temperature Range
MX25/66U 1.8V Serial NOR Flash							
2Gb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR: 166 DTR:100	24-TFBGA	1.65-2.0V	-40°C to +85°C -40°C to +105°C
1Gb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR: 166 DTR:100	16-SOP, 24-TFBGA	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
512Mb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR: 166 DTR:100	8-WSON,16-SOP,24-TFBGA, WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
256Mb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR: 166 DTR:100	8-WSON/8-WLGA,16-SOP, 24-TFBGA, WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
128Mb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	STR: 166 DTR:100	8-SOP/WSON,16-SOP, 24-TFBGA, WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
64Mb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	133	8-SOP/WSON/VSOP/XSON/USON, WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
32Mb	Multi I/O, Quad I/O Permanent Enabled	4KB/32KB/64KB	x1,x2,x4	133	8-SOP/WSON/USON,WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
16Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	133	8-SOP/USON,WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +105°C -40°C to +125°C
8Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	108	8-SOP/WSON/USON,WLCSP	1.65-2.0V	-40°C to +85°C
4Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	108	8-SOP/VSOP/USON,WLCSP	1.65-2.0V	-40°C to +85°C -40°C to +125°C
2Mb	Multi I/O	4KB/32KB/64KB	x1,x2,x4	108	8-SOP/VSOP/WSON/USON,WLCSP	1.65-2.0V	-40°C to +85°C
1Mb	Multi I/O	4KB/64KB	x1,x2,x4	70	8-SOP/TSSOP/USON	1.65-2.0V	-40°C to +85°C
512Kb	Multi I/O	4KB/64KB	x1,x2,x4	70	8-SOP/TSSOP/USON	1.65-2.0V	-40°C to +85°C

MX25xxx06 - Standard Serial Interface Series

The MX25xxx06 series provides Standard Serial Interface x1 or x2 I/O [Single I/O or Dual I/O] at a single 3V or 2.5V power-supply voltage. The MX25xxx06E products are offered with 4KB sectors and 64KB blocks.

MX25xxx26 - Default Lock Protection Series

The default lock protection series is optimized for Parameter Protection applications. These products utilize the BP volatile protection bits to protect selected boot areas of memory against misuse of programs, and to erase instructions in the protected area.

MX25/66xxx32/33/35/36/37/39 - MXSMIO®(Multi-I/O) Series

The MXSMIO® Family provides two kinds of Multi-I/O interfaces: the MX25xxx32/35/33/37/39 series, which offers a Multi-in / Multi-out interface, and the MX25xxx36 series, which offers a Single-in / Multi-out interface. Both series are available on Quad I/O operation, which quadruples the read performance of systems for high-end consumer applications.

MX25/66xxx43/45/59/83/85/89 - MXSMIO®(Multi-I/O) Duplex (DTR) Series

The MX25xxx43/45/59 series offer Quad I/O interface with DTR (Double Transfer Rate) mode operation, featuring the industry's fastest data transfer rate of up to 800MHz. To extend MXSMIO® Duplex family I/O selection, we also provide Dual Quad I/O interface with DTR (Double Transfer Rate) mode operation, MX66xxx85 series, featuring data transfer rate of up to 1600MHz, and MX66xxx83/89 series, featuring 2 CS# and 2 SCLK pins. The MXSMIO® Duplex family offers independent block lock protection on the boot sector.

MX25xxx72/73 - MXSMIO® Series (Quad I/O Permanent Enabled)

The MX25xxx72/73 series provide Multi-I/O default enable solution. The Multi-I/O interface is available without any setting in Flash side, and it provides user more convenient way to experience the Multi-I/O performance.

MX25/66xxx50/55/56 - Permanent Lock

The MX25/66xxx50/55/56 series with permanent lock feature provide extreme write protection mechanism. This security feature could permanently set block or sector of a flash to be read only. Our flash memory is available to protect system operation from intentional tampering.

Serial NOR Flash Example

MX 25U 256 45 G M I 0* 0*

DEVICE:
- 25L/66L : 3V,Serial NOR Flash
- 25U/66U : 1.8V,Serial NOR Flash
- 25V : 2.5-3V, Serial NOR Flash
- 25LR : 3V, RWW Serial NOR Flash
- 25UR : 1.8V, RWW Serial NOR Flash
- 77L : 3V, Security RPMC NOR Flash
- 77U : 1.8V, Security RPMC NOR Flash

DENSITY:
- 512/5126 : 512Kb
- 10 : 1Mb
- 20 : 2Mb
- 40 : 4Mb
- 80 : 8Mb
- 16 : 16Mb
- 32 : 32Mb
- 64 : 64Mb
- 128 : 128Mb
- 256/257 : 256Mb
- 512 : 512Mb
- 1G : 1Gb
- 2G : 2Gb

MODE:
- 06 : Single-in,Dual-out
- 08 : Unique ID
- 26 : Default Lock Protection
- 32/33/35/29 /30/39/65 : MXSMIO®-Multi-in, Multi-out
- 36 : MXSMIO®-Single-in,Multi-out
- 37 : MXSMIO®-Multi-in, Multi-out, Supports I/O voltage, VIO =1.65V to 3.6V
- 43/45 : MXSMIO® Duplex(DTR)-Multi-in, Multi-out
- 50 : MXSMIO®-Security RPMC type
- 55/59 : MXSMIO®-Security type
- 71 : MXSMIO®-Multi I/O, Quad I/O Permanent Enabled, ASP default unprotection(default DPB=0)
- 72/73 : MXSMIO®-Multi I/O, Quad I/O Permanent Enabled
- 83/89 : MXSMIO®-Multi I/O,Dual Quad (2 CS# and 2 SCLK pins)
- 85 : MXSMIO®-Multi I/O,Dual Quad

GENERATION

PACKAGE TYPE:
- BA/BB/BC/BD/BE/BF/BH/BJ/BK : WLCSP
- M/M1/M2 : SOP
- MB/MD : VSOP
- G : WLGA
- O : 8-TSSOP
- P : PDIP
- X : BGA
- ZN/Z2/Z4 : WSON
- ZA/ZB/ZU : USON
- ZC : XSON

TEMPERATURE RANGE:
- E : Industrial (-55°C to 125°C)
- I : Industrial (-40°C to 85°C)
- J : Industrial (-40°C to 105°C)
- K : Industrial (-40°C to 125°C)
- Q : Automotive Grade 1 (-40°C to 125°C)
- R : Automotive Grade 2 (-40°C to 105°C)
- S : Automotive Grade 3 (-40°C to 85°C)

FEATURE CODE 1:
- 0: 1 CS#, Default Standard I/O, Default Standard Dummy Cycle
- 1: 1 CS#, Default Standard I/O, Default Maximum Dummy Cycle
- 4: 1 CS#, Permanent Multi I/O Mode, Default Standard Dummy Cycle
- 5: 1 CS#, Permanent Multi I/O Mode, Default Maximum Dummy Cycle

***SPEED code for Macronix Legacy products:**
- 08 : 133MHz
- 09 : 120MHz
- 10 : 104MHz/108MHz
- 12 : 80MHz/86MHz
- 13 : 75MHz
- 14 : 70MHz
- 20 : 45MHz

*Special Functions : Factory Mode for 3V G Generation
08: Support Factory Mode

FEATURE CODE 2:
- 0/2: RESET#, Default 3 Byte
- 1/3: HOLD#, Default 3 Byte
- 4/6: RESET#, Permanent 4 Byte
- 5/7: HOLD#, Permanent 4 Byte

***OPTION code for Macronix Legacy products:**
- G : RoHS Compliant

Ultra Low Power
Wide Range Vcc Flash

Macronix MX25R Serial NOR Flash is a family of ultra low power/wide range Vcc memory products, suitable for use in a wide variety of the IoT and other energy conscious applications, such as wearable devices, and mobile devices. The MX25R product family features ultra low power consumption, 60% lower than that of traditional products, and wide range Vcc (1.65-3.6V), enabling extended battery life.

The MX25R Serial NOR Flash family with densities ranging from 512Kb to 64Mb supports the standard Serial NOR Flash memory interface, and provides ultra small product packages such as USON, WLCSP, and KGD (Known Good Die) products for SiP (System in Package) solutions.

Density	Organization	I/O Bus	Speed (MHz)	Voltage	Mode	Package
MX25R Serial NOR Flash						
64Mb	4KB/32KB/64KB	x1, x2, x4	80	1.65-3.6V	Multi I/O	8-SOP/WSON/USON,WLCSP
32Mb	4KB/32KB/64KB	x1, x2, x4	80	1.65-3.6V	Multi I/O	8-SOP/WSON/USON,WLCSP
16Mb	4KB/32KB/64KB	x1, x2, x4	80	1.65-3.6V	Multi I/O	8-SOP/WSON/USON,WLCSP
8Mb	4KB/32KB/64KB	x1, x2, x4	108	1.65-3.6V	Multi I/O	8-SOP/USON, WLCSP
4Mb	4KB/32KB/64KB	x1, x2, x4	108	1.65-3.6V	Multi I/O	8-SOP/WSON/USON,WLCSP
2Mb	4KB/32KB/64KB	x1, x2, x4	108	1.65-3.6V	Multi I/O	8-SOP/TSSOP/USON,WLCSP
1Mb	4KB/32KB/64KB	x1, x2, x4	108	1.65-3.6V	Multi I/O	8-SOP/TSSOP/USON,WLCSP
512Kb	4KB/32KB/64KB	x1, x2, x4	108	1.65-3.6V	Multi I/O	8-SOP/TSSOP/USON,WLCSP

Ultra Low Power Serial NOR Flash Example

MX 25R 64 35 F M2 I L 0

DEVICE:
25R : Serial NOR Flash (Ultra Low Power/1.65-3.6V)

DENSITY:
512 : 512kb
10 : 1Mb
20 : 2Mb
40 : 4Mb
80 : 8Mb
16 : 16Mb
32 : 32Mb
64 : 64Mb

MODE:
33/35: MXSMIO®-Multi-in, Multi-out
73 : MXSMIO®-Multi I/O,
Quad I/O Permanent Enabled

GENERATION

PACKAGE TYPE:
BD/BE/BF/BH : WLCSP
M1/M2 : SOP
O : 8-TSSOP
ZA/ZB/ZU : USON
ZN/Z2/Z3/Z4 : WSON

TEMPERATURE RANGE:
I : Industrial (-40°C to 85°C)
Q : Automotive Grade 1 (-40°C to 125°C)
R : Automotive Grade 2 (-40°C to 105°C)
S : Automotive Grade 3 (-40°C to 85°C)

FEATURE CODE 1:
Mode: (MX25R)
L : Ultra Low Power Mode (Default)
H : High Performance Mode (Default)

FEATURE CODE 2:
0/2: RESET#
1/3: HOLD#

1.2V Serial NOR Flash (1.14-1.6 V)

With the demand of low power applications, such as health monitoring, Bluetooth connection, IoT, wearables and mobile Internet devices, system engineers will need memory with reduced supply voltage to simplify their design.

The MX25S Series meets these needs by featuring 1.2V (1.14V-1.6V) and ultra-low power consumption (1.65mA ICC_active, 0.05uA ICC_dpd), capable of more than 80% power saving compared to the existing Serial NOR Flash. The MX25S will also effectively extend the battery life.

The MX25S series of products is a Serial NOR Flash memory interface, offered from 8Mb to 64Mb densities, and in small form factor packages, such as USON and WLCSP, or KGD (Known Good Die) that can be used with SiP solution.

Density	Organization	I/O Bus	Speed (MHz)	Vcc	Mode	Packages
MX25S Serial NOR Flash						
8Mb	4KB/32KB/64KB	x1, x2, x4	120	1.14V-1.6V	Multi I/O	8-SOP/USON
16Mb	4KB/32KB/64KB	x1, x2, x4	120	1.14V-1.6V	Multi I/O	8-SOP
64Mb	4KB/32KB/64KB	x1, x2, x4	120	1.14V-1.6V	Multi I/O	8-SOP/XSON, WLCSP

1.2V Serial NOR Flash Example

MX 25S 64 33 F M2 I L 0

DEVICE:
25S : Serial NOR Flash
(Ultra low power/1.14-16V)

DENSITY:
80 : 8Mb
16 : 16Mb
64 : 64Mb

MODE:
33/35: MXSMIO®-Multi-in, Multi-out

GENERATION

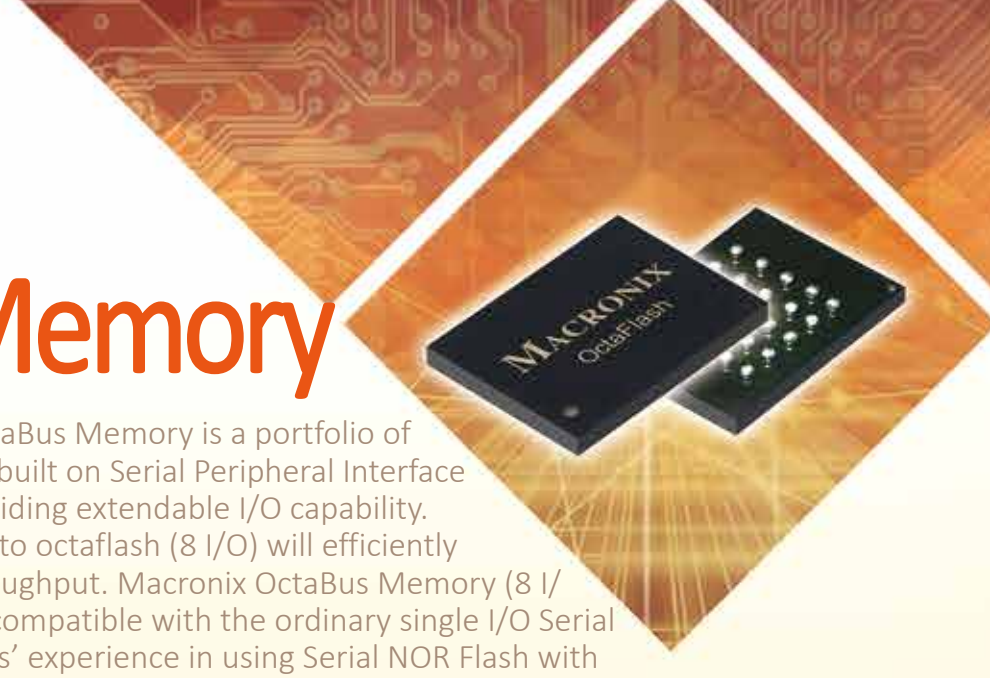
PACKAGE TYPE:
BB : WLCSP
M1/M2 : SOP
ZA/ZB/ZU : USON
ZC : XSON
ZN/Z2/Z3/Z4 : WSON

TEMPERATURE RANGE:
I : Industrial (-40°C to 85°C)
Q : Automotive Grade 1 (-40°C to 125°C)
R : Automotive Grade 2 (-40°C to 105°C)
S : Automotive Grade 3 (-40°C to 85°C)

FEATURE CODE 1:
0: 1 CS#, Default Standard I/O,
Default Standard Dummy Cycle
4: 1 CS#, Permanent Multi I/O Mode,
Default Standard Dummy Cycle

FEATURE CODE 2:
2: RESET#
3: HOLD#

OctaBus™ Memory



The new-generation Macronix OctaBus Memory is a portfolio of extreme speed memory products built on Serial Peripheral Interface (SPI) and command protocol, providing extendable I/O capability. Expanding from current Quad I/O to octaflash (8 I/O) will efficiently broaden our Serial NOR Flash throughput. Macronix OctaBus Memory (8 I/O) also retains the user interface compatible with the ordinary single I/O Serial NOR Flash, which can sustain users' experience in using Serial NOR Flash with minimum efforts.

The LW/UW series is a multiple bank architecture solution based on ultra-high performance OctaBus interface, which provide simultaneous Read-While-Write capability that allows read access from one memory bank while writing to another memory bank.

The LM/UM series is a solution based on the ultra-high performance Macronix OctaBus interface, which dedicates to raising the product performance with the fastest 250MHz frequency, combining with the brand-new Data Transfer Rate (DTR) feature. The data transfer rate has therefore been increased from existing 100MB/s of Quad I/O Serial NOR Flash to 500MB/s, while the read latency has also been lowered immensely. The improved performance will help system in running eXecute In Place (XIP) on octaflash with more efficiency and shorten the access time in high density, which accelerates overall system performance.

It is an ideal solution for Over-The-Air (OTA) update applications which are becoming more prevalent within Automotive Cockpit solutions.

Key Features

- Support 3V/1.8V operation voltage
- Backward compatible with x1 I/O SPI interface
- Both STR & DTR (Double Transfer Rate) mode support
- New DTR feature for Read, Program and Erase operation

LM/UM Series

- Upto 250MHz clock frequency with both DTR/STR operation

LW/UW Series

- Multiple bank architecture
- Support Simultaneous Read while Write operations

Density	Organization	I/O Bus	Speed (MHz)	Mode	Package
MX25/66LM 3V OctaBus Memory					
2Gb	4KB / 64KB	x1, x8	133	Octa I/O, DTR	24-BGA (5x5 ball array)
1Gb	4KB / 64KB	x1, x8	133	Octa I/O, DTR	16-SOP, 24-BGA (5x5 ball array)
512Mb	4KB / 64KB	x1, x8	133	Octa I/O, DTR	16-SOP, 24-BGA (5x5 ball array)
256Mb	4KB / 64KB	x1, x8	133	Octa I/O, DTR	16-SOP, 24-BGA (5x5 ball array)
MX25/66UM 1.8V OctaBus Memory					
2Gb	4KB / 64KB	x1, x8	200	Octa I/O, DTR	24-BGA (5x5 ball array)
1Gb	4KB / 64KB	x1, x8	200	Octa I/O, DTR	24-BGA (5x5 ball array)
512Mb	4KB / 64KB	x1, x8	250	Octa I/O, DTR	16-SOP, 24-BGA (5x5 ball array), WLCSP
256Mb	4KB / 64KB	x1, x8	200	Octa I/O, DTR	16-SOP, 24-BGA (5x5 ball array), WLCSP
128Mb	4KB/8KB	x1, x8	200	Octa I/O, DTR	16-SOP, 24-BGA(5x5 ball array)

Density	Organization	I/O Bus	Speed (MHz)	Mode	Package
MX25/66LW 3V Read-While-Write OctaBus Memory					
2Gb	4KB/64KB	x1,x8	133	Octa I/O, DTR, Multiple Bank, RWW	24-BGA (5x5 ball array)
1Gb	4KB/64KB	x1,x8	133	Octa I/O, DTR, Multiple Bank, RWW	24-BGA (5x5 ball array)
512Mb	4KB/64KB	x1,x8	133	Octa I/O, DTR, Multiple Bank, RWW	16-SOP, 24-BGA (5x5 ball array)
256Mb	4KB/64KB	x1,x8	133	Octa I/O, DTR, Multiple Bank, RWW	6x8mm 24-TFBGA (5x5)
MX25/66UW 3V Read-While-Write OctaBus Memory					
2Gb	4KB/64KB	x1,x8	200	Octa I/O, DTR, Multiple Bank, RWW	24-BGA (5x5 ball array)
1Gb	4KB/64KB	x1,x8	200	Octa I/O, DTR, Multiple Bank, RWW	24-BGA (5x5 ball array)
512Mb	4KB/64KB	x1,x8	200	Octa I/O, DTR, Multiple Bank, RWW	16-SOP, 24-BGA (5x5 ball array)
256Mb	4KB/64KB	X1,X8	200	Octa I/O, DTR, Multiple Bank, RWW	24-BGA (5x5 ball array)
128Mb	4KB/64KB	x1,x8	200	Octa I/O, DTR, Multiple Bank, RWW	16-SOP, 24-BGA (5x5 ball array), WLCSP
64Mb	4KB/64KB	x1,x8	200	Octa I/O, DTR, Multiple Bank, RWW	16-SOP, 24-BGA (5x5 ball array), WLCSP

OctaBus™ Memory Example

MX 25UM 256 45 G M I 00

DEVICE:
25UM/66UM :
1.8V,8 I/O,Serial NOR Flash
25LM/66LM :
3V, 8 I/O, Serial NOR Flash
25UW/66UW :
1.8V, 8 I/O, Read-while-Write Serial NOR Flash
25LW/66LW :
3V, 8 I/O, Read-while-Write Serial NOR Flash

DENSITY:
64 : 64Mb
128/123/12A* : 128Mb
256/253* : 256Mb
512/513* : 512Mb
1G : 1Gb
2G : 2Gb

3 : Byte Mode data output sequence.
A : with 90 Degree shifted SCLK2.

* Density & Mode:
12A45: 128Mb with 90 Degree shifted SCLK2
63/123/253/513/1G3/2G3 : Byte Mode data

MODE:
45 : MXSMIO®Duplex(DTR)-Multi-in, Multi-out
50 : MXSMIO®-Security RPMC type

GENERATION

PACKAGE TYPE:
M/M2: SOP
XD/XR: BGA
ZN/Z2/Z4 : WSON

FEATURE CODE 1:
0: 1 CS#, Default Standard I/O, Default Standard Dummy Cycle
1: 1 CS#, Default Standard I/O, Default Maximum Dummy Cycle
4: 1 CS#, Multi I/O Mode Permanent Enabled, Default Standard Dummy Cycle
5: 1 CS#, Multi I/O Mode Permanent Enabled, Default Maximum Dummy Cycle
X: 1 CS#, Default Standard I/O, Default 8 Dummy Cycles

FEATURE CODE 2:
0/2: RESET#, Default 3 Byte
1/3: HOLD#, Default 3 Byte
4/6: RESET#, Permanent 4 Byte
5/7: HOLD#, Permanent 4 Byte

TEMPERATURE RANGE:
I : Industrial (-40°C to 85°C)
Q : Automotive Grade 1 (-40°C to 125°C)
R : Automotive Grade 2 (-40°C to 105°C)
S : Automotive Grade 3 (-40°C to 85°C)
U : Automotive Extended Grade 1 (-40°C to 135°C)

NAND Flash

Macronix's broad NAND product portfolio covers a wide range of customer requirements, including both single-level cell(SLC) NAND and Serial NAND designed for a variety of demanding applications.

SLC NAND Flash

Macronix SLC NAND complements its world-leading Serial and Parallel NOR Flash offerings. Our rigorous quality management system ensures that Macronix SLC NAND is one of the most robust and reliable NAND devices in the market.

Macronix focuses on the low density NAND market with industry-standard packages and features. The SLC NAND product portfolio includes: MX30LF/MX60LF family of 3V parallel SLC NAND ranging in densities from 1Gb to 8Gb; MX30UF family of 1.8V SLC NAND, offered in densities from 1Gb to 8Gb.

Density	ONFI	Cell Type	Bus Width	ECC Requirement	Speed (ns)	Voltage	Package	Automotive Grade
MX30/60LF 3V SLC NAND Flash								
8Gb	ONFI1.0	SLC	x8	4-bit, 8-bit ECC	20	2.7-3.6V	48-TSOP, 63-VFBGA	-40°C to 85°C -40°C to 105°C
4Gb	ONFI1.0	SLC	x8	4-bit, 8-bit ECC	20	2.7-3.6V	48-TSOP, 63-VFBGA	-40°C to 85°C -40°C to 105°C
2Gb	ONFI1.0	SLC	x8	4-bit, 8-bit ECC	20	2.7-3.6V	48-TSOP, 63-VFBGA	-40°C to 85°C -40°C to 105°C
1Gb	ONFI1.0	SLC	x8	ECC-free, 4-bit ECC, 8-bit ECC	20	2.7-3.6V	48-TSOP/VFBGA, 63-VFBGA	-40°C to 105°C
MX30/60UF 1.8V SLC NAND Flash								
8Gb	ONFI1.0	SLC	x8	4-bit, 8-bit ECC	25	1.7V-1.95V	48-TSOP, 63-VFBGA	-40°C to 105°C
4Gb	ONFI1.0	SLC	x8,x16	4-bit, 8-bit ECC	25	1.7V-1.95V	48-TSOP, 63-VFBGA	-40°C to 105°C
2Gb	ONFI1.0	SLC	x8,x16	4-bit, 8-bit ECC	25	1.7V-1.95V	48-TSOP/VFBGA, 63-VFBGA	-40°C to 105°C
1Gb	ONFI1.0	SLC	x8,x16	4-bit, 8-bit ECC	25	1.7V-1.95V	48-TSOP/VFBGA, 63-VFBGA	-40°C to 105°C

Note: For more NAND related information, please contact Macronix sales.

Serial NAND Flash

As embedded systems evolve, there are many applications with a Serial Peripheral Interface (SPI) that require higher-density memory solutions to store large image files. Recognizing such application needs, Macronix, as a global leader in Serial Flash memory, offers a new MX35 Serial NAND family for a NAND-based storage solution.

The MX35 family provides storage capacity from 1Gb to 4Gb densities with a low cost-per-megabit, and as such, Macronix Serial NAND is ideal for embedded applications such as digital TVs, set-top boxes, and AP routers as these applications now contain more sophisticated operating systems for managing multimedia, photos and other data intensive content.

Macronix Serial NAND is compatible with the industry standard Serial Peripheral Interface (SPI) command set, allowing designers to easily and cost-effectively expand their application storage capacity without having to perform a complete system redesign and hence achieve short time-to-market, realizing the benefits of using Macronix Serial NAND.

Density	Interface	Cell Type	Bus Width	ECC Requirement	Speed (ns)	Voltage	Package	Temperature Range
MX35LF 3V Serial NAND Flash								
4Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	120	2.7V-3.6V	8-WSON	Industrial Grade (I) -40°C to +85°C Automotive Grade (R) -40°C to +105°C
	SPI Quad Output	SLC	x1, x2, x4	ECC-free	104	2.7-3.6V	8-WSON	
2Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	120	2.7-3.6V	8-WSON	Industrial Grade (I) -40°C to +85°C Automotive Grade (R) -40°C to +105°C
	SPI Quad Output	SLC	x1, x2, x4	4-bit ECC, ECC-free	104	2.7-3.6V	8-WSON, 16-SOP	
1Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	120	2.7-3.6V	8-WSON	Industrial Grade (I) -40°C to +85°C Automotive Grade (R) -40°C to +105°C
	SPI Quad Output	SLC	x1, x2, x4	ECC-free	104	2.7-3.6V	8-WSON	
MX35UF 1.8V Serial NAND Flash								
4Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	166	1.7V-1.95V	8-WSON	Industrial Grade (I) -40°C to +85°C
	SPI Quad Output	SLC	x1, x2, x4	ECC-free	133	1.7V-1.95V	8-WSON	
2Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	166	1.7V-1.95V	8-WSON	Industrial Grade (I) -40°C to +85°C
	SPI Quad Output	SLC	x1, x2, x4	ECC-free	133	1.7V-1.95V	8-WSON	
	SPI Quad Output	SLC	x1, x2, x4	4-bit ECC, ECC-free	104	1.7V-1.95V	8-WSON, 24-BGA (5x5 ball array)	
1Gb	SPI Quad Output	SLC	x1, x2, x4	8-bit ECC	166	1.7V-1.95V	8-WSON	Industrial Grade (I) -40°C to +85°C
	SPI Quad Output	SLC	x1, x2, x4	ECC-free	133	1.7V-1.95V	8-WSON	
	SPI Quad Output	SLC	x1, x2, x4	4-bit ECC, ECC-free	104	1.7V-1.95V	8-WSON, 24-BGA (5x5 ball array)	

NAND Flash Example

MX 30 L F 1G 0 8 A D - XK I X

TYPE:
30 : SLC NAND Flash
60 : SLC NAND Flash (stacked die)
35 : SLC Serial NAND Flash

VOLTAGE:
L: 2.7V-3.6V
U: 1.7V-1.95V

CLASSIFICATION:
F : SLC+Large Block

DENSITY :
12 : 512Mb
1G : 1Gb
2G : 2Gb
4G : 4Gb
8G : 8Gb

ECC :
0 : 1bit (2bit in Automotive Grade)
1 : 4bit
2 : 8bit
E : ECC-free

Bus Width :
4 : x4
8 : x8
6 : x16

MODE :
A : Feature A
S : Security feature supported

GENERATION

PACKAGE TYPE :
M : 16-SOP (300mil)
T : 48-TSOP (12x20mm)
XD : 24-BGA (6x8mm, 5x5 ball array)
XK : 63-VFBGA (9x11mm)
XQ : 48-VFBGA (6x8mm)
Z4 : 8-WSON (8x6mm)

OPERATING TEMPERATURE :
I : Industrial (-40°C to 85°C)
J : Industrial (-40°C to 105°C)
R : Automotive Grade 2 (-40°C to 105°C)
S : Automotive Grade 3 (-40°C to 85°C)

RESERVED

e.MMC™ Memory

As a leader in the non-volatile memory market, Macronix has launched a family of e.MMC™ memory to meet the needs of high capacity storage and high reliability applications. This memory offering from Macronix is made possible by combining years of experience in the design and management of Flash memory with its advanced in-house NAND Flash fabrication technologies.

With profound experience in embedded solutions, Macronix is able to develop the optimized management firmware to provide a longer product lifespan with robust data integrity. This managed Flash solution optimizes memory mapping, bad block management, wear-leveling, and error correction techniques to fulfill the higher reliability demands required by developers. To face the challenges of demanding application environments, Macronix's e.MMC™ memory can help developers increase system availability and reduce maintenance efforts.

Macronix integrates its MLC NAND Flash and controller in a BGA package with a standard interface to the host system. The e.MMC™ memory is ideal for various applications, such as digital TV, set-top boxes, infotainment, industrial and networking applications. It is also available in the 11x10mm BGA package for wearable applications.

Density	Voltage (VCC)	Cell Type	*e*.MMC Version	Bus Width	Max. Bandwidth (MB/s)	Package	Temperature Range
MX52L *e*.MMC™ Flash Memory							
8GB	2.7V-3.6V	MLC	5.1	x1, x4, x8	400	11.5x13mm 153-FBGA 11x10mm 153-FBGA	-40°C to +85°C
4GB	2.7V-3.6V	MLC	5.1	x1, x4, x8	400	11.5x13mm 153-FBGA 11x10mm 153-FBGA	-40°C to +85°C
2GB	2.7V-3.6V	MLC	5.1	x1, x4, x8	400	11x10mm 153-FBGA	-40°C to +85°C

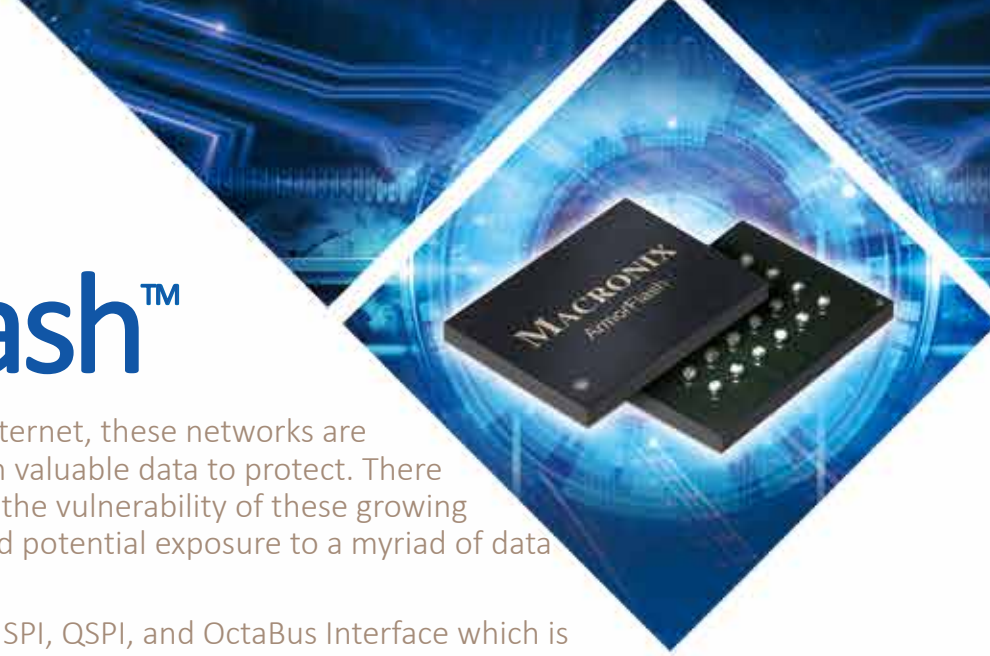
Note: *e*.MMC™ is the trademark of JEDEC/MMCA.

e.MMC™ Example

MX 52 L M 04 A 1 1 XS I XXX

- RESERVED
- Operating Temperature：
  I：Industrial
- Package Type
  XS=153-BGA(11.5x13x0.8mm)
  XV=153-BGA(11.5x13x1.0mm)
  XU=153-BGA(11x10x0.8mm)
  XW=153-BGA (11x10x1.0mm)
- Configuration
  1=Standard Type
- Controller Rev.：
  1=CTR#1
- GENERATION：A
- DENSITY：
  04=4G-byte
  02=2G-byte
  08=8G-byte
- CLASSIFICATION：
  M=MLC
- VOLTAGE：
  L=2.7V to 3.6V
- TYPE：
  52=*e*.MMC™ Series

ArmorFlash™



As more devices connect to the Internet, these networks are becoming more sophisticated with valuable data to protect. There are increasing concerns regarding the vulnerability of these growing networks to outside influences and potential exposure to a myriad of data that needs to be secure.

ArmorFlash™ supports a standard SPI, QSPI, and OctaBus Interface which is based on highly configurable security technologies providing a secure ID, authentication, and an encrypted link for NOR, SLC NAND, or e.MMC™ Flash.

The data encrypted by ArmorFlash™ uses a security protocol that provides unique transfers even when repeatedly reading the same address of the ArmorFlash™ secure memory region. ArmorFlash™ offers high levels of data confidentiality, integrity and availability to prevent data from being compromised. This storage is also offered in a number of densities to meet your application's needs.

ArmorFlash™ offers secure technologies like a Physical Unclonable Function (PUF) that makes use of a semiconductor's biometrics, which are characteristics derived from fabrication that can be used for encoding or identification. This highly unique fingerprint cannot be predicted, duplicated, or cloned and so provides a reliable unique ID with very high levels of entropy.

ArmorFlash™ is an ideal security solution for a wide range of identification, authentication and encryption requirements for IoT, automotive, computing, industrial, healthcare, wearables, smart home, and smart cities.

Key Features

- Standard SPI/QSPI/OctaBus Interface
- Non-volatile Monotonic Counters
- True Random Number Generator (TRNG)
- Physical Unclonable Functions (PUF) Support
- Hardware Crypto Engines
- Symmetric and Asymmetric Key Provision and Management
- Secure Areas for Authentication/Encryption/Decryption
- Standard Areas for Authentication

Automotive Grade

- AEC-Q100 Grade-1/2/3 Compliant

Security Certifications

- NIST CAVP Validated

Serial NOR Flash

Density	Status	Voltage (VCC)	Security Features	Frequency, MHz (Bus Width)	Package	Temperature Range
MX75L25690F						
256Mb	Production	2.7V-3.6V	Standard Serial NOR Interface PUF Secured OTP Unique ID AES Engine TRNG Monotonic Counter	120(x1, x2) 104(x4)	300mil 16-SOP	Industrial Grade -40°C to +85°C
MX75U25690F						
256Mb	Production	1.65V-2.0V	Standard Serial NOR Interface PUF Secured OTP Unique ID AES Engine TRNG Monotonic Counter	120(x1, x2) 104(x4)	6x8mm 24-TFBGA(5x5)	Industrial Grade -40°C to +85°C Automotive Grade -40°C to +105°C

Serial NOR Flash

Density	Status	Voltage (VCC)	Security Features	Frequency, MHz (Bus Width)	Package	Temperature Range
MX78L64A00F						
64Mb	Under Development	2.7V-3.6V	Standard Serial NOR Interface AES/ECC/SHA Hardware Engine TRNG Unique ID PUF Monotonic Counter	133(x1) 120(x2) 104(x4)	6x8mm 24-TFBGA(5x5)	Automotive Grade -40°C to +105°C
MX78U64A00F						
64Mb	Sampling	1.65V-2.0V	Standard Serial NOR Interface AES/ECC/SHA Hardware Engine TRNG Unique ID PUF Monotonic Counter	133(x1) 120(x2) 104(x4)	6x8mm 24-TFBGA(5x5)	Automotive Grade -40°C to +105°C
MX76U3233F						
32Mb	Production	1.65V-2.0V	Standard Serial NOR Interface PUF Secured OTP Unique ID	80 (x1, x2, x4)	200mil 8-SOP	Industrial Grade -40°C to +85°C

Note: *e*•MMC™ is the trademark of JEDEC/MMCA.

ArmorFlash™ Example

MX 75U 256 90 F XD R 0 2

DEVICE:
75L/75U : 3V/1.8V, ArmorFlash™ Secure NOR Flash
76U : 1.8V, ArmorFlash™ Secure NOR Flash
78L/78U : 3V/1.8V, ArmorFlash™ Secure NOR Flash (ECC/SHA Hardware Engine)

DENSITY:
256 : 256Mb
64A : 64Mb
32 : 32Mb

MODE:
90/91/00 : MXSMIO®-Multi-in, Multi-out; with Security Features
33 : MXSMIO®-Multi-in, Multi-out

GENERATION

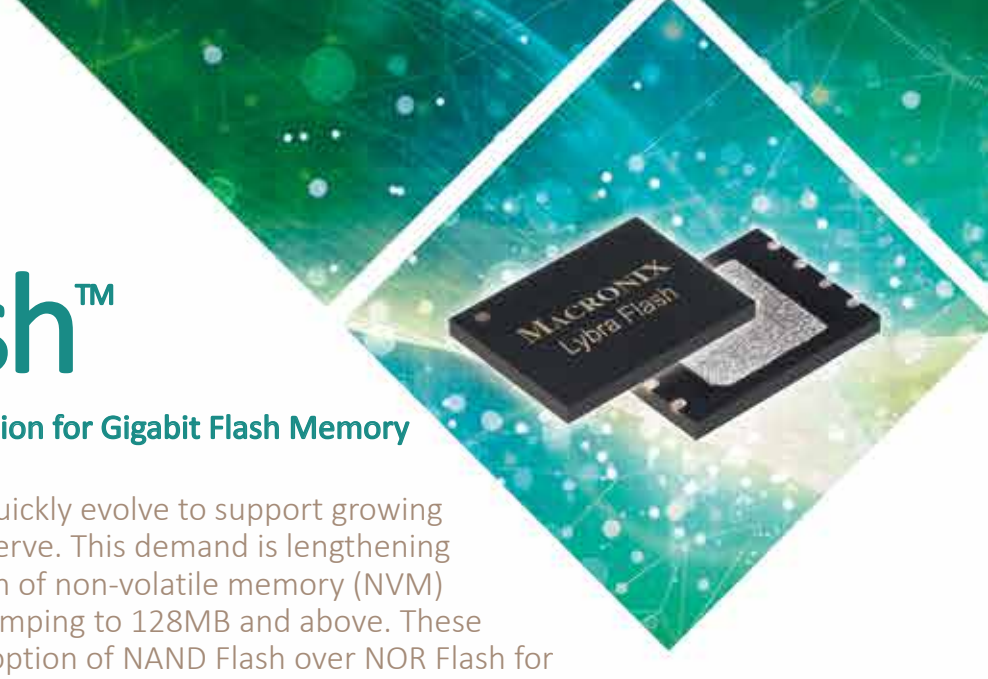
PACKAGE TYPE
M/M2 : SOP
X : BGA

TEMPERATURE RANGE:
I : Industrial (-40°C to 85°C)
J : Industrial (-40°C to 105°C)
Q : Automotive Grade 1 (-40°C to 125°C)
R : Automotive Grade 2 (-40°C to 105°C)

FEATURE CODE 1:
0: 1 CS#, Default Standard I/O, Default Standard Dummy Cycle

FEATURE CODE 2:
0/2: RESET#, Default 3 Byte

LybraFlash™



LybraFlash™ : The Optimum Solution for Gigabit Flash Memory

Today's applications continue to quickly evolve to support growing demands from the markets they serve. This demand is lengthening feature lists and driving the growth of non-volatile memory (NVM) capacities, previously 32-64MB, jumping to 128MB and above. These trends are also compelling the adoption of NAND Flash over NOR Flash for the cost advantage, when the density range of NOR can be matched by NAND. However, it can be an initial undertaking to work with NAND if the system designer lacks experience in doing so or if the application hardware doesn't support it.

Please contact Macronix sales for more details.

With that challenge in mind, Macronix has developed LybraFlash™ as an ideal choice for most automotive systems. LybraFlash™ delivers a user experience comparable to NOR flash, with no need to change the system's hardware design and only small modifications to system software to achieve this.

LybraFlash™ implements an embedded ECC engine to deliver high integrity data. This feature paves the way for most MCU platforms lacking either support of ECC hardware or computing power based on software ECC calculations. In order to achieve the highest data integrity possible, LybraFlash™ also provides other enhanced reliability features that provide impressive data reliability performance.

LybraFlash™ Memory is a great fit for code storage use, accomplished by high performance continuous read operation, fast write (program/erase) performance, strong data integrity, and respectable endurance.

For those that want fast write performance, similar read performance compared to standard SPI NOR Flash, and cost effective high capacity Flash memory, LybraFlash™ could be the right solution for that next project.

Key Features

- Solution Coverage of the MX31 Series:
  - VCC: 3V family (MX31LFxGE4BC) & 1.8V family (MX31UFxGE4BC)
  - Density: 1Gb and 2Gb
- Interface: SPI Single, Dual, Quad I/O(1-1-1, 1-1-2, 1-1-4, 1-2-2, 1-4-4)
- High Performance
  - Read throughput: ~50MB/s (Quad I/O, w/ continuous read mode)
  - SPI clock rate: 104MHz Quad I/O
- Special Features for NOR-like Boot Applications: Please contact Macronix for details
- High Reliability Features: (please contact Macronix for details)
- Package: 8-WSON, 24-BGA, 16-SOP

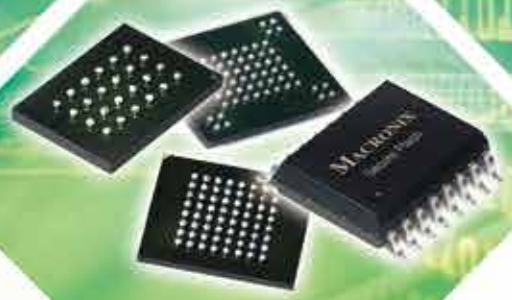
Density	Voltage	Read Speed (MHz)	Page Size	Enhanced Reliability Features	NOR-like booting	P/E Cycles	Package	Temperature Range
MX31LF 3V LybraFlash R-Grade (-40°C to 105°C)								
1GB	2.7V-3.6V	104	2KB	•	•	100K	8-WSON, 24-BGA, 16-SOP	I-Grade (-40°C to 85°C) R-Grade (-40°C to 105°C)
2GB	2.7V-3.6V	104	2KB	•	•	100K	8-WSON, 24-BGA, 16-SOP	R-Grade (-40°C to 85°C)
MX31UF 1.8V LybraFlash R-Grade (-40°C to 105°C)								
1GB	1.7V-1.95V	104	2KB	•	•	100K	8-WSON, 24-BGA, 16-SOP	R-Grade (-40°C to 85°C)
2GB	1.7V-1.95V	104	2KB	•	•	100K	8-WSON, 24-BGA, 16-SOP	R-Grade (-40°C to 85°C)

LybraFlash™ Example

MX 31 LF 1G E 4 B C XD I X

- **TYPE :** 31 : LybraFlash
- **VOLTAGE :** LF : 2.7V-3.6V; LH : 2.7V-3.6V High Speed; UF : 1.7V-1.95V; UH : 1.7V-1.95V High Speed
- **DENSITY :** 1G : 1Gb; 2G : 2Gb
- **ECC :** E : ECC-free
- **Bus Width :** 4 : x4; 8 : x8
- **Series :** B : B series family; C : C series family
- **Combination :** C : Combination C
- **PACKAGE TYPE :** M : 16-SOP (300mil); XD : 24-FBGA (6x8mm); Z4 : 8-WSON (8x6mm)
- **Operating Temperature :** I : Industrial (-40°C to 85°C); Q : Automotive Grade 1 (-40°C to 125°C); R : Automotive Grade 2 (-40°C to 105°C); S : Automotive Grade 3 (-40°C to 85°C)
- **RESERVED**

Secure Flash



Nowadays, security is at the forefront of many applications. Several Flash memory products are now equipped with various security features. Macronix provides an expansive product portfolio of security solutions, which enable customers to protect confidential/sensitive and private data stored in Flash memory from malicious overwrites and attacks.

The Macronix Secure Flash portfolio includes a broad offering of NOR memories: Parallel NOR available in densities from 16Mb to 1Gb, Serial NOR 16Mb to 1Gb. Macronix Secure NAND Flash, the MX30LFxxS series, provides the advanced PBL (Permanently Block Lock) security feature implemented in the NAND device. This security feature could permanently set block or sector of a flash to be read only, which protects the confidential code from intentional tampering and attacks. The products are available in densities from 1Gb to 4Gb and support ONFI 1.0 NAND interface.

Secure Flash is primarily used for the applications that require data and code security, such as the Set-Top Box, Digital TV, etc.

Serial Secure NOR Flash

Density	Organization	I/O Bus	Speed (MHz)	Voltage	Mode	Package
MX25/66L 3V Serial NOR Flash						
1Gb	4KB/32KB/64KB	x1,x2,x4	166	2.7-3.6V	Multi I/O	16-SOP, 24-TFBGA
512Mb	4KB/32KB/64KB	x1,x2,x4	166	2.7-3.6V	Multi I/O	16-SOP, 24-TFBGA
256Mb	4KB/32KB/64KB	x1,x2,x4	133	2.7-3.6V	Multi I/O	16-SOP, 24-TFBGA
128Mb	4KB/32KB/64KB	x1,x2,x4	133	2.7-3.6V	Multi I/O	16-SOP, 24-TFBGA
	4KB/32KB/64KB	x1,x2,x4	84	2.7-3.6V	Multi I/O, RPMC Mode	8-PDIP/SOP/WSON
64Mb	4KB/32KB/64KB	x1,x2,x4	120	2.7-3.6V	Multi I/O	8-SOP, 16-SOP, 24-TFBGA
	4KB/32KB/64KB	x1,x2,x4	84	2.7-3.6V	Multi I/O, RPMC Mode	8-PDIP/SOP/WSON
32Mb	4KB/32KB/64KB	x1,x2,x4	104	2.7-3.6V	Multi I/O	8-SOP, 24-TFBGA
16Mb	4KB/64KB	x1,x2,x4	104	2.7-3.6V	Multi I/O	8-SOP, 24-TFBGA

Parallel Secure NOR Flash

Density	Bus Width	Speed (ns)	Voltage	Feature	Package
MX29LA 3V Parallel NOR Flash					
64Mb	x8, x16	70	2.7-3.6V	Uniform Sector	64-FBGA
32Mb	x8, x16	70	2.7-3.6V	Uniform Sector	64-FBGA
MX29/68GA 3V Parallel NOR Flash					
1Gb	x8, x16	110	2.7-3.6V	Page Mode, Uniform Sector	64-FBGA
512Mb	x8, x16	100	2.7-3.6V	Page Mode, Uniform Sector	64-LFBGA
256Mb	x8, x16	90	2.7-3.6V	Page Mode, Uniform Sector	64-FBGA / LFBGA
128Mb	x8, x16	90	2.7-3.6V	Page Mode, Uniform Sector	64-FBGA / LFBGA
64Mb	x8, x16	90	2.7-3.6V	Page Mode, Uniform Sector	64-FBGA / LFBGA
32Mb	x8, x16	70	2.7-3.6V	Page Mode, Uniform Sector	64-FBGA / LFBGA

Secure SLC NAND Flash

Density	Cell Type	Bus Width	ECC Requirement	Speed (ns)	Voltage	Feature	Package
MX30LF 3V SLC NAND Flash							
4Gb	SLC	x8	4-bit ECC	20	2.7-3.6V	PBL (Permanently Block-Locked)	63-VFBGA
2Gb	SLC	x8	4-bit ECC, 8-bit ECC	20	2.7-3.6V	PBL (Permanently Block-Locked)	63-VFBGA
1Gb	SLC	x8	4-bit ECC, 8-bit ECC	20	2.7-3.6V	PBL (Permanently Block-Locked)	63-VFBGA

MCP (Multichip Packages)

Macronix is especially leading the 1.8V/3V Flash memory specification for power saving and space constraint needs. Made by state-of-art manufacturing capability and quality controls, our MCP solution portfolio provides flexible choices and fast time-to-market advantages for both embedded and wireless application usage. With a small footprint and backward compatible pinout, customers can choose different densities to meet their cost effective solutions.

NOR-Based MCP

NOR Density	NOR Product Type	NOR Bus Width	OctaRAM Density	pSRAM Bus Width	Voltage	Package Type	Temperature Range
MX65L 3V MCP NOR Flash							
512Mb	octaflash	x1, x8	64Mb	x1, x8	3V	24-BGA	-40°C to +85°C -40°C to +105°C

NOR Density	NOR Product Type	NOR Bus Width	pSRAM Density	pSRAM Bus Width	Voltage	Package Type	Temperature Range
MX69GL 3V Parallel NOR-Based MCP							
64Mb	De-Mux	x16	32Mb	x16	3V	56-TFBGA	-40°C to +85°C
MX69V 1.8V Parallel NOR-Based MCP							
128Mb	AD-Mux	x16	64Mb	x16	1.8V	56-TFBGA	-25°C to +85°C
MX69N 1.8V Parallel NOR-Based MCP							
64Mb	AD-Mux	x16	32Mb	x16	1.8V	52-TFBGA, 56-TFBGA	-25°C to +85°C -40°C to +85°C

NOR Density	NAND Product Type	NAND Bus Width	LPDDR Density	LPDDR Product Type	LPDDR Bus Width	Voltage	ECC Requirement	Package Type	Temperature Range
MX63U 1.8V NAND-Based MCP									
4Gb	ONFI	x8	2Gb	LPDDR2	x16, x32	1.8V	4-bit, 8-bit ECC	162-TFBGA	-30°C to +85°C -40°C to +85°C
2Gb	ONFI	x8,x16	2Gb,1Gb	LPDDR2	x16, x32	1.8V	4-bit, 8-bit ECC	162-TFBGA	-30°C to +85°C -40°C to +85°C
1Gb	ONFI	x8,x16	1Gb, 512Mb	LPDDR2	x16, x32	1.8V	4-bit ECC	162-TFBGA	-30°C to +85°C -40°C to +85°C

NAND-Based MCP Example

MX63 U 4G A 2G B A XM I 00

Product Family
MX63U : NAND + LPDRAM MCP

NAND Voltage : 1.8V

NAND Density
512M = 12 8G = 8G
1G = 1G 16G = AG
2G = 2G 32G = BG
4G = 4G 64G = CG

NAND Configuration

Type	Bus	Number of ECC-bit	Generation
A	x8	8	1st
B	x16	8	1st
C	x8	4	1st
D	x16	4	1st
E	x8	4	2nd

LPDDR Density :
256M = 56 2G = 2G
512M = 12 4G = 4G
1G = 1G 8G = 8G

LPDDR Configuration :

Type		Bus	Vcc	Generation	Speed
A	DDR2	x16	1.7-1.95V	3	533MHz
B	DDR2	x32	1.7-1.95V	2	533MHz
C	DDR2	x32	1.7-1.95V	3	533MHz
E	DDR	x16	1.7-1.95V	5	200MHz
F	DDR	x32	1.7-1.95V	5	200MHz
J	DDR	x16	1.7-1.95V	5	200MHz
K	DDR	x32	1.7-1.95V	5	200MHz
G	DDR2	x16	1.7-1.95V	6	533MHz
H	DDR2	x32	1.7-1.95V	6	533MHz

Option Code
00 : -30°C to +85°C
01 : -40°C to +85°C

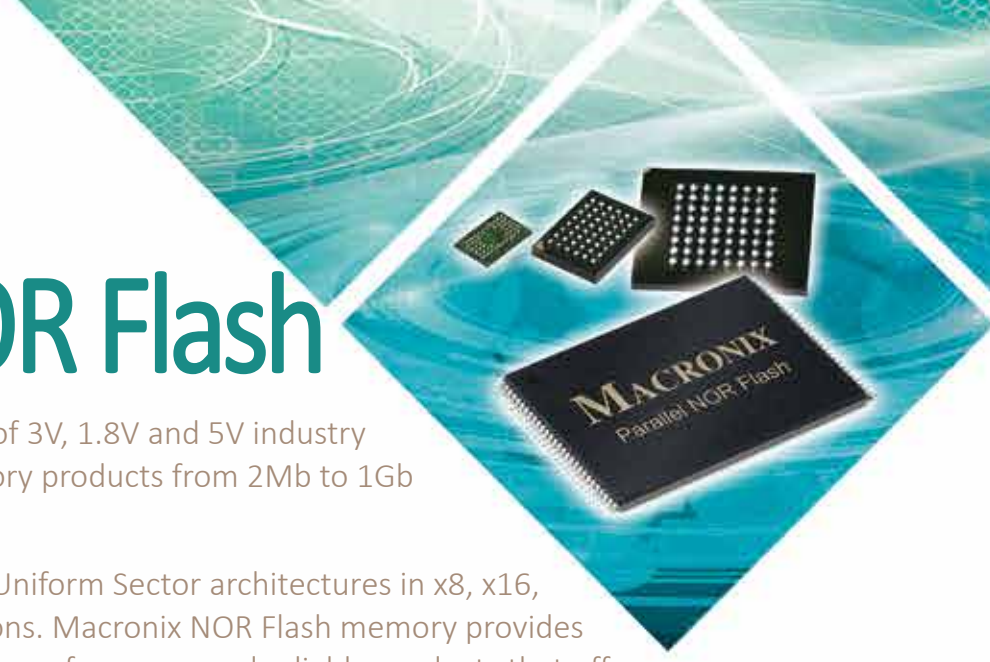
Product Grade
I : Industrial

Package
XM : 162-Ball FBGA

MCP Combinations

Type	CE#	Combination
A	1,1	1 NAND; 1 LPDDR

Parallel NOR Flash



Macronix offers an extensive line of 3V, 1.8V and 5V industry standard Parallel NOR Flash memory products from 2Mb to 1Gb densities.

These products feature Boot and Uniform Sector architectures in x8, x16, and x8/x16 selectable configurations. Macronix NOR Flash memory provides customers with cost-effective, high performance and reliable products that offer low-power consumption, high endurance and reliability.

Standard Read Access

Density	Bus Width	Speed (ns)	Package	Feature	Voltage	Automotive Grade
MX29F 5V Parallel NOR Flash						
8Mb	x8, x16	70	44-SOP, 48-TSOP/LFBGA	Boot Sector	4.5-5.5V	
4Mb	x8, x16	70	32-PLCC/TSOP, 44-SOP, 48-TSOP	Uniform Sector, Boot Sector	4.5-5.5V	-40°C to +105°C
2Mb	x8, x16	70	44-SOP, 48-TSOP	Boot Sector	4.5-5.5V	
MX29LV 3V Parallel NOR Flash						
64Mb	x8, x16	70	48-TSOP/LFBGA	Boot Sector	2.7-3.6V	-40°C to +105°C
32Mb	x8, x16	70	44-SOP, 48-TSOP/TFBGA/LFBGA	Boot Sector, V I/O=1.8V	2.7-3.6V	-40°C to +105°C
16Mb	x8, x16	70	48-TSOP/WFBGA/TFBGA/LFBGA/ XFLGA	Boot Sector, V I/O=1.8V	2.7-3.6V	-40°C to +85°C
8Mb	x8, x16	70	44-SOP, 48-TSOP/WFBGA/TFBGA/ LFBGA/XFLGA	Boot Sector	2.7-3.6V	-40°C to +105°C
4Mb	x8, x16	70	32-PLCC/TSOP, 44-SOP, 48-TSOP/ WFBGA/TFBGA/LFBGA/XFLGA	Uniform Sector, Boot Sector	2.7-3.6V	
MX29SL 1.8V Parallel NOR Flash						
8Mb	x8, x16	90	48-TSOP/WFBGA/TFBGA/LFBGA/ XFLGA	Boot Sector	1.65-2.2V	
4Mb	x8, x16	90	48-TSOP/WFBGA/TFBGA/LFBGA/ XFLGA	Boot Sector	1.65-2.2V	

Page Mode Read Access

The GL family offers enhanced performance products with faster effective programming and read time, which makes GL family ideal for applications demanding for higher density, better performance and lower power consumption.

Density	Bus Width	Speed (ns)	Package	Feature	Voltage	Automotive Grade
MX29/68GL 3V Paralle NOR Flash						
1Gb	x8, x16	100	56-TSOP, 64-LFBGA	V I/O, Uniform Sector	2.7-3.6V	-40°C to +105°C
512Mb	x8, x16	100	56-TSOP/FBGA, 64-LFBGA	V I/O, Uniform Sector	2.7-3.6V	-40°C to +105°C

Density	Bus Width	Speed (ns)	Package	Feature	Voltage	Automotive Grade
MX29/68GL 3V Paralle NOR Flash						
256Mb	x8, x16	90	56-TSOP/FBGA, 64-FBGA/LFBGA, 70-SSOP	V I/O, Uniform Sector	2.7-3.6V	-40°C to +105°C
128Mb	x8, x16	70	56-TSOP/FBGA, 64-FBGA/LFBGA, 70-SSOP	V I/O, Uniform Sector	2.7-3.6V	-40°C to +105°C
64Mb	x8, x16	70	48-TSOP/LFBGA/TFBGA, 56-TSOP, 64-LFBGA	Uniform Sector, Boot Sector	2.7-3.6V	-40°C to +105°C
32Mb	x8, x16	70	48-TSOP/LFBGA/TFBGA, 56-TSOP, 64-LFBGA	Uniform Sector, Boot Sector	2.7-3.6V	-40°C to +105°C

Note: V I/O: Versatile power supply for Input/Output

Burst Mode Read Access

The product families offer leading edge performance with 1.8V, Burst mode and Address-Data Multiplexing (AD-Mux). The MX29NS is a single-bank product, while the MX29VS offers multi-bank architecture for simultaneous read-write capability. With 1.8V operation, faster effective programming and burst read time, the families are ideal for applications demanding high performance and low power consumption.

Density	Bus Width	Speed (ns)	Package	Feature	Voltage	Automotive Grade
MX29VS 1.8V Parallel NOR Flash						
128Mb	x16	80	56-TFBGA	AD-Mux; Burst Mode Read While Write	1.7-1.95V	
MX29NS 1.8V Parallel NOR Flash						
64Mb	x16	80	56-TFBGA	AD-Mux; Burst Mode	1.7-1.95V	
32Mb	x16	80	56-TFBGA	AD-Mux; Burst Mode	1.7-1.95V	

Parallel NOR Flash Example

MX 29GL 512 F H XF I - 90 G

DEVICE :
29F : 5V
29LV/29GL/68GL : 3V
29NS/29VS/29SL : 1.8V
29LA/29GA/68GA : Security type

DENSITY :
20x : 2Mb
40x/040 : 4Mb
80x : 8Mb
16x : 16Mb
32x : 32Mb
64x : 64Mb
12x : 128Mb
25x : 256Mb
51x : 512Mb
1Gx : 1Gb

GENERATION

BLOCK TYPE :
T : Top Boot
B : Bottom Boot
H : Uniform Sector, Highest Address Sector Protected
L : Uniform Sector, Lowest Address Sector Protected
U : VI/O=1.65 to VCC, VCC=2.7 to 3.6V, Highest Address Sector Protected
D : VI/O=1.65 to VCC, VCC=2.7 to 3.6V, Lowest Address Sector Protected

PACKAGE TYPE :
M : SOP
T : TSOP
Q : PLCC
X : BGA

TEMPERATURE RANGE :
C : Commercial (0°C to 70°C)
I : Industrial (-40°C to 85°C)
J : Industrial (-40°C to 105°C)
S : Automotive Grade 3 (-40°C to 85°C)
R : Automotive Grade 2 (-40°C to 105°C)

SPEED :
55 : 55ns
70 : 70ns
80 : 80ns
90 : 90ns
10 : 100ns
11 : 110ns
12 : 120ns

OPTION :
G : RoHS Compliant
Q : Restricted Vcc (3.0V-3.6V), RoHS Compliant

KGD (Known Good Die)

Macronix provides Known Good Die products for custom System in Package (SiP) solutions requiring small form factor Flash memory.

Our KGD products are ideal for diverse applications, such as portable consumer electronics, set top box, DSC, mobile phones, IoT/wearable devices, automotive devices, GPS, tablets, industrial, networking….etc.

Macronix is will apply its stringent process for qualification, testing, extended temperature support and packaging to its line of KGD products, and committed to delivering:

• Stringent quality management to meet the requirements of most demanding applications, even the automotive segment.

• Professional service offered by our dedicated technical support team to support various customer needs.

• Effective production control & planning to ensure longevity supply and support

• Complete testing for function, data retention, endurance, etc.

	Voltage	512Kb	1Mb	2Mb	4Mb	8Mb	16Mb	32Mb	64Mb	128Mb	256Mb	512Mb	1Gb	2Gb	4Gb
Serial NOR Flash															
MX25L	3V	●	●	●	●	●	●	●	●	●	●	●			
MX25V	2.5V	●	●	●	●	●	●	●*	●*						
MX25U	1.8V	●	●	●	●	●	●	●	●	●	●*	●			
MX25R	Ultra Low Power(1)	●	●	●	●	●	●	●	●*						
Parallel NOR Flash															
MX29LV	3V				●	●	●	●	●						
MX29GL	3V							●	●	●	●				
MX29SL	1.8V				●	●									
MX29NS	1.8V							●	●	●					
MX29VS	1.8V									●					
SLC NAND Flash															
MX30LF	3V											●	●	●	●
MX30UF	1.8V												●	●*	

* Advance Information
Note: (1) Ultra Low Power/Wide Range Vcc. (1.65-3.6V)

ROM (Read-Only Memory)

As the NO.1 ROM provider in the industry, we continue to offer the cutting-edge ROM products to our valued customers.

Migrating from Mask ROM to XtraROM® with significant resources investment, Macronix has made ROM products more flexible in production and delivery, while preserving high quality and cost advantages.

ASIC XtraROM®

Macronix excels at customized XtraROM® from IC design to content programming to quick delivery. We can build your DRM (Digital Right Management) scheme in the circuit of XtraROM® to protect your content from being pirated. Our designs are used in handheld gaming consoles around the world.

Packages

Serial NOR Flash

WLCSP
(Wafer Level Chip Scale Package)
The result package is subject to various die sizes. The smallest chip so far is 1.24x1.29mm.

8-USON
3x2x0.6mm, Pitch 0.5mm

8-USON
4x3x0.6mm, Pitch 0.8mm

8-USON
4x4x0.6mm, Pitch 0.8mm

8-WSON / 8-WLGA
6x5x0.8mm, Pitch 1.27mm

8-WSON
8x6x0.8mm, Pitch 1.27mm

24-BGA
(Ball Dia. 0.4)
8x6x1.2mm, Pitch 1.0mm

8-SOP (150mil)
6x5x1.75mm, Pitch 1.27mm

8-SOP (200mil)
7.9x5.23x2.16mm, Pitch 1.27mm

16-SOP (300mil)
10.3x10.3x2.65mm, Pitch 1.27mm

Multichip Packages

52-TFBGA
(Ball Dia. 0.3)
6x6x1.2mm, Pitch 0.5mm

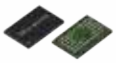
56-TFBGA
(Ball Dia. 0.3)
7.7x6.2x1.2mm, Pitch 0.5mm

130 TFBGA
(Ball Dia.0.3)
8x9x1.0mm, Pitch 0.65mm

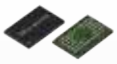
162 TFBGA
(Ball Dia.0.3)
8x10.5x1.0mm, Pitch 0.5mm

Parallel NOR Flash

48-XFLGA
6x4x0.5mm, Pitch 0.5mm



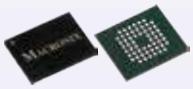
48-WFBGA
(Ball Dia. 0.3)
6x4x0.75mm, Pitch 0.5mm



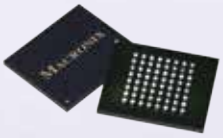
48-LFBGA
(Ball Dia. 0.4)
8x6x1.3mm, Pitch 0.8mm

48-TFBGA
(Ball Dia. 0.3)
8x6x1.2mm, Pitch 0.8mm

56-FBGA
(Ball Dia. 0.4)
9x7x1.2mm, Pitch 0.8mm



64-FBGA
(Ball Dia. 0.4)
13x10x1.2mm, Pitch 1.0mm



44-SOP (500mil)
28.5x16.03x3mm, Pitch 1.27mm

48-TSOP
20x12x1.2mm, Pitch 0.5mm

56-TSOP
20x14x1.2mm, Pitch 0.5mm

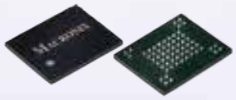
70-SSOP
28.5x16.03x3.05mm,Pitch 0.8mm

NAND Flash

48-TSOP
12x20x1.2mm, Pitch 0.5mm

48-VFBGA
(Ball Dia. 0.4)
6x8x1.0mm, Pitch 0.8mm

63-VFBGA
(Ball Dia.0.45)
9x11x1.0mm, Pitch 0.8mm

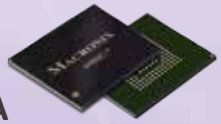


8-WSON
8x6x0.8mm, Pitch 1.27mm

16-SOP (300mil)
10.3x10.3x2.65mm, Pitch 1.27mm

e.MMC™

153-LFBGA
11.5 x 13 x 0.8mm, Pitch: 0.5mm
11.5 x 13 x 1.0mm, Pitch: 0.5mm

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