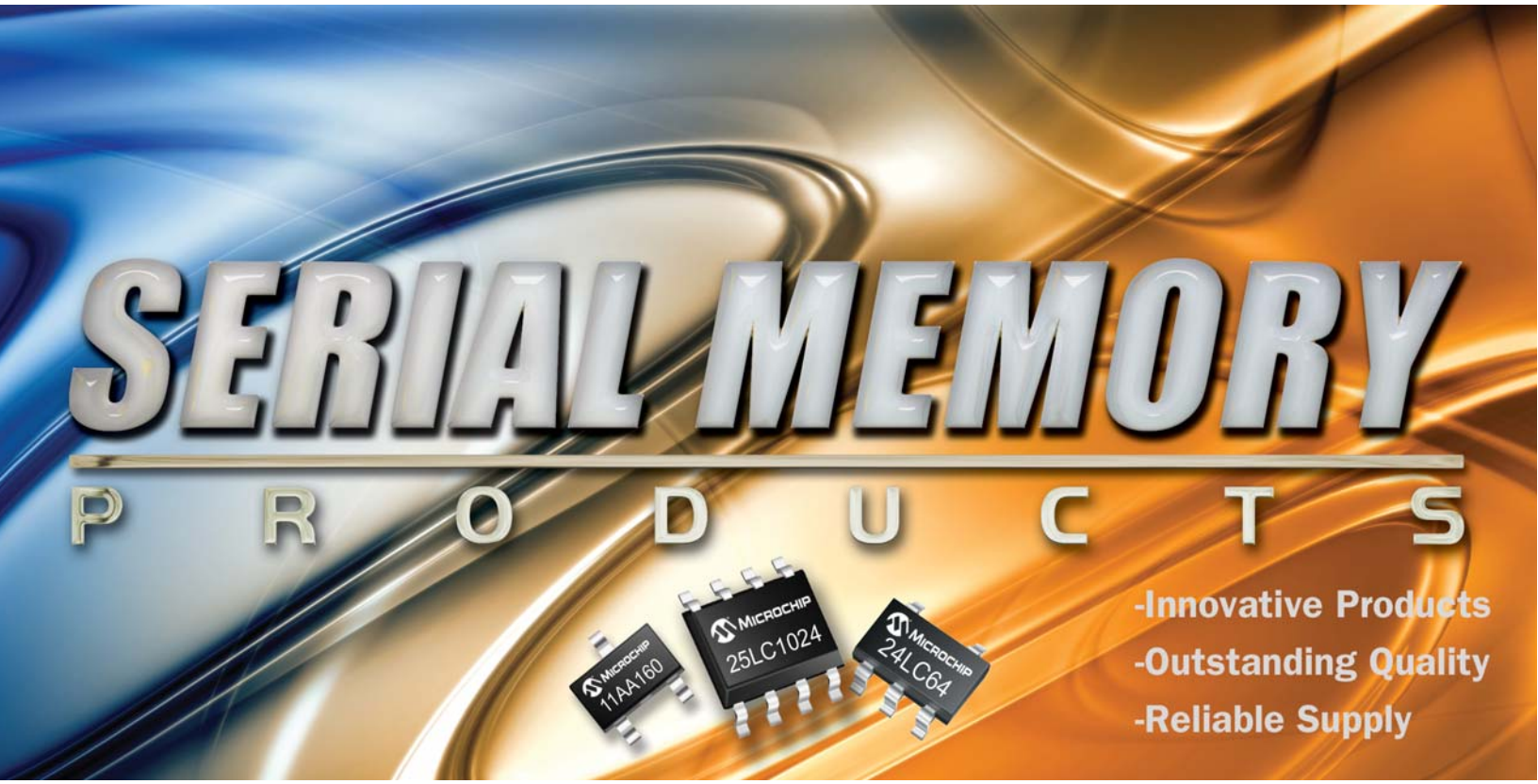
MICROCHIP

# Serial Memory Products

- Serial EEPROM
- Serial SRAM




www.microchip.com/memory

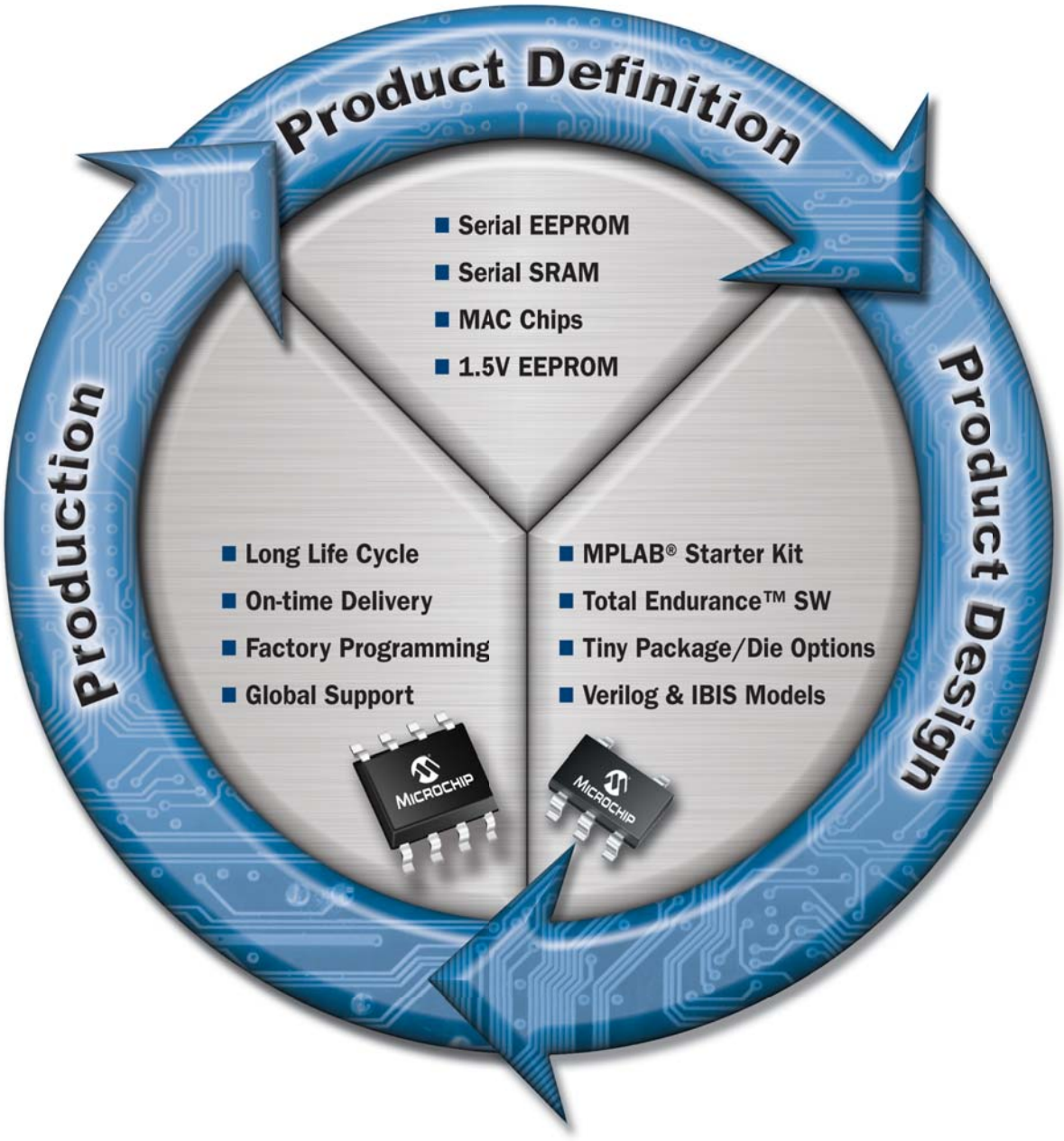
# Serial Memory Products

## *A broad portfolio of high performance, best-in-class Serial Memory Products to meet all your design requirements.*

Microchip offers the broadest range of Serial EEPROM devices (from 128 bits to 1 Mbit) over the widest operating voltage (1.7 to 5.5V) and temperature ranges (up to 150°C). Innovative low-power designs and extensive testing have ensured industry leading endurance and best-in-class quality at low costs.

SPI-compatible Serial SRAM devices are available in 64 and 256 Kbit options and up to 20 MHz. These low power devices provide additional external serial RAM with high-speed performance and are available in standard 8-pin packages.

### Microchip Supports Your Designs Throughout The Product Life Cycle



# Serial Memory Advantages

## Serial Memory Products

**Outstanding Quality**

**Innovative Products**

**Reliable Supply**

### Serial EEPROM

- SPI, I²C™, Microwire, UNI/O® Bus
- Non-Volatile Memory
- 128 bits-1Mbit
- 1.7V-5.5V
- 1M Cycles E/W Endurance
- Fast Read/Write Times
- Low Power Consumption

### Serial SRAM

- SPI Bus, 20 MHz
- Volatile Memory
- 8, 32 Kbytes
- 1.5V-1.95V; 2.7V-3.6V
- Infinite Endurance
- Zero Write Speeds
- Low Power

## Key Features

- Serial architecture – I²C, SPI, UNI/O, Microwire
- Broad range of densities
- Tiny 3, 5, 6 and 8-pin packages, die & wafer
- Innovative, low power designs
- Industry leading endurance
- Wide temperature and voltage range
- Fast read and write times
- Flexible:
  - Byte write capability
  - Package options
  - Custom programming options
  - Application-specific serial memory
- Microchip owned fabs, In-house testing
- Automotive flow on all products

## Key Benefits

- Lower system costs – innovative products, tiny packages, low power consumption, fewer I/O pins, small form factor
- Save I/O pins on the MCU – more compact designs, add additional features
- Secure data with write-protect options
- Highest quality EEPROMs
  - Zero PPM initiatives – Triple-test flow
  - >1M cycles E/W endurance
- Faster time to market
  - Short lead times
  - Complete tools support
- Robust designs – broad operating conditions
- Long product life cycles
- Global sales & engineering support

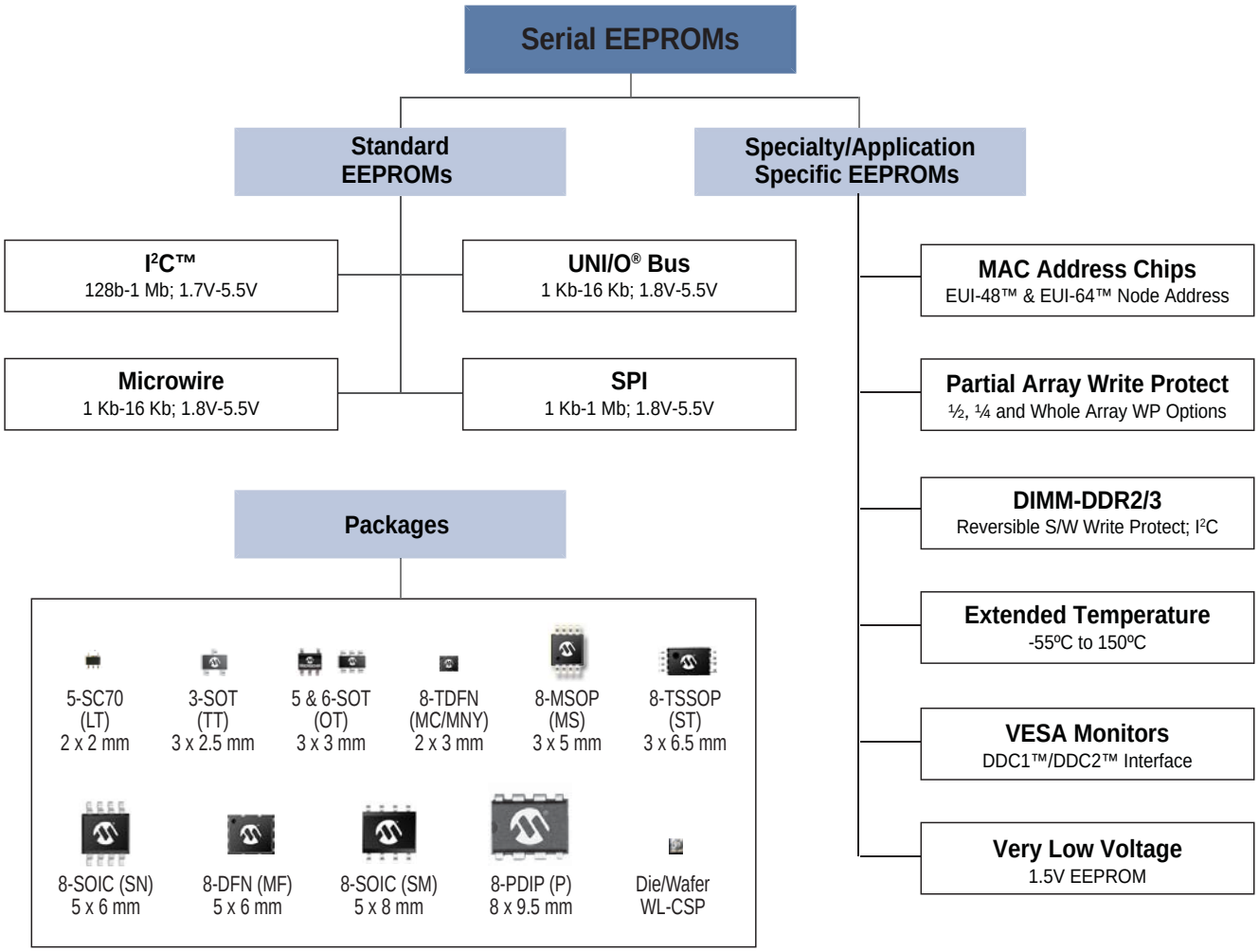
### Serial EEPROM Bus Comparison

| Parameter | I²C | Microwire | UNI/O | SPI |
|---|---|---|---|---|
| Density Range | 128b-1 Mbit | 1 Kb-16 Kb | 1 Kb-16 Kbit | 1Kb-1 Mbit |
| Speed | Up to 1 MHz | Up to 3 MHz | Up to 100 KHz | Up to 20 MHz |
| I/O Pins | 2: Clock, Data | 4: Clock, CS, DI, DO | 1: Clock/Data | 4: SCK, CS, DI, DO |
| Package Options | PDIP, SOIC, SOIJ, TSSOP, MSOP, 2x3 T-DFN, 6x5 DFN, SOT-23, SC70, WLCSP | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN, SOT-23 | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN, SOT-23, TO92, WLCSP | PDIP, SOIC, SOIJ, TSSOP, MSOP, 2x3 T-DFN, 6x5 DFN, SOT-23 |
| Security Options | HW | HW | SW | HW, SW |
| Pricing | Least Expensive | | | Most Expensive |

# Serial EEPROM

***Innovative designs combined with in-house fabrication and outstanding testing methodology has helped create the industry's highest quality Serial EEPROM.***

Microchip offers a broad selection of standard and application specific Serial EEPROM devices that are available in all the standard serial busses – I²C, SPI, Microwire and the new single I/O UNI/O® bus.




## Robust Design

- ESD Protection
  > 4000V Human Body Model (HBM)
  > 400V Machine Model (MM)
  > 1000V Charged Device Model
- Latch-up protection > 200 mA on all pins
- ESD Induced Latch-up > 100V (MM) on $V_{DD}$; >400V on all I/O
  > 1M cycles Endurance and > 200 years data retention
- Up to 150°C Operation (reads and writes)
- Power-On Reset (POR) and Brown-Out Reset (BOR)
  – Effective protection against noisy automotive environments
  – Eliminates false writes
- Schmitt Trigger input filters for noise reduction
- Complete traceability including die location on wafer

## Quality

- Microchip delivers highest quality EEPROMs in the world
- World-class line yields (over 99%)
- ISO/TS16949-compliant
- Industry leader with triple test flow – every cell of every part is tested three times
- Near zero PPM field bit fails
- Statistical process control and continuous improvement procedures in all facilities
- Robustness and reliability designed in
- Automotive grade/flow

# Memory Package Matrix

## *Memory Packages – more memory in less space!*

Serial EEPROM devices from Microchip are available in a wide variety of tiny, innovative packages to help minimize your design – save board space and cost!

- WLCSP – die-sized package – smallest form factor EEPROM package in the world!
- SC70 – smallest 5-lead EEPROM package!
- 5-SOT-23 available up to 64 Kbit; 8-TDFN up to 128 Kbit, 8-SOIC up to 1 Mbit (I²C)

| Density | Max Speed | SOIC SN | SOT-23 OT/TT | TSSOP TS | TDFN MNY/MC | PDIP P | MSOP MS | SOIJ SM | DFN MF | SC70 LT | TO92 TO | Wafer W/S/WF | WLCSP CS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5x6 | 3x3 | 3x6.5 | 2x3 | 8x9.5 | 3x5 | 5x8 | 5x6 | 2x2 | | Die | Die |
| **I²C™ Bus 1.7V-5.5V** | | | | | | | | | | | | | |
| 128bit-2K | 400 KHz | X | 5 | X | X | X | X | | | 5 | | X | |
| 4K-32K | 400 KHz | X | 5 | X | X | X | X | | | | | X | X |
| 64K | 1 MHz | X | 5 | X | X | X | X | X | | | | X | X |
| 128K | 1 MHz | X | | X | X | X | X | X | X | | | X | X |
| 256K | 1 MHz | X | | X | | X | X | X | X | | | X | X |
| 512K | 1 MHz | X | | X | | X | | X | X | | | X | X |
| 1 Mbit | 1 MHz | X | | | | X | | X | | | | | |
| **Microwire Bus 1.8V-5.5V** | | | | | | | | | | | | | |
| 1K-16K | 3 MHz | X | 6 | X | X | X | X | | | | | X | |
| **SPI Bus 1.8V-5.5V** | | | | | | | | | | | | | |
| 1K-4K | 10 MHz | X | 6 | X | X | X | X | | | | | X | |
| 8K-64K | 10 MHz | X | | X | X | X | X | | | | | X | |
| 128K, 256K | 10 MHz | X | | X | | X | | X | X | | | X | |
| 512K | 20 MHz | X | | 14 | | X | | X | X | | | X | |
| 1 Mbit | 20 MHz | | | | | X | | X | X | | | X | |
| **UNI/O® Single-Wire Bus 1.8V-5.5V** | | | | | | | | | | | | | |
| 1K-16K | 100 KHz | X | 3 | | X | X | X | | | | X | X | X |

### Package Sizes



5-SC70 (LT) 2 x 2 mm | 3-SOT (TT) 3 x 2.5 mm | 5 & 6-SOT (OT) 3 x 3 mm | 8-TDFN (MC/MNY) 2 x 3 mm | 8-MSOP (MS) 3 x 5 mm | 8-TSSOP (ST) 3 x 6.5 mm | 8-SOIC (SN) 5 x 6 mm | 8-DFN (MF) 5 x 6 mm | 8-SOIC (SM) 5 x 8 mm | 8-PDIP (P) 8 x 9.5 mm | Die/Wafer WL-CSP

### WLCSP – World's Smallest EEPROM Package

WLCSP from Microchip is bumped die with a redistribution layer to route the bond pads to the bumps.

- True 'die-sized' packages
- Industry's smallest package, form factor
- Lowest profile package
- Available in I²C, UNI/O buses
- Compatible with standard surface mount assembly lines
- Fit a large density into a small space
- Applications: mobile phones, security cameras, sensors, servers, networking, RF, medical, portable electronics

**Wafer Level Chip Scale Packaging**



Actual Size | Enlarged to Show Detail

WLCSP 4 Kbit I²C <1 x 1 mm

# Application-Specific EEPROMs

***Innovative EEPROM options to help you get to market faster and deliver the highest performance at lowest costs.***

**Serial Memory Products – Application Examples**

| | | Microchip Strengths | Applications |
|---|---|---|---|
| Automotive |  | Quality, PPAP, long product life cycles, AEC Q-100 & TSO-16949 compliant, in-house testing, triple-test flow | Transmission, ABS, Power Train, Airbag, Entertainment System, Mirror Controllers, GPS, Steering Control |
| Medical |  | Outstanding quality, and reliability, tiny packages, low power, Microchip owned fabs | Blood Glucose Meters, Hearing Aid, Medical Imaging Devices, XRAY, Oxygen Concentrator, ECG |
| Industrial |  | Robust designs, high endurance, wide operating range, custom part options | Metering, Industrial Control, Security Systems, Alarm Systems, Sensor Networks, Battery Chargers |
| Consumer |  | Short lead times, excellent supply, innovative packages, application specific options, low power | LCD TV, Set Top Box, Printers, Blue Tooth, Wireless, Laptop, Mouse, Networking, DDR2/3, Camera, POS, Appliances |

**Specialty EEPROM Applications**

| Application/Market | Design Challenge | Solution | Products | Benefits |
|---|---|---|---|---|
| Monitors, Projectors, Flat Panel Display | DDC1™ & DDC2™, EDID & E-EDID specification | Vesa products | 24LCS21A, 24LCS22A | Quick, easy plug & play options |
| Networking, Ethernet, Wi-Fi, ZigBee® | EUI-48™/EUI-64™ MAC Address | MAC address chips | 24AA02E48, 11AA02E48, 25AA02E48 | Easy access, Low-cost, Plug & play, Additional EEPROM |
| PCs and Laptops – DRAM DIMM Modules | DDR1/2/3 Specification | DIMM SPD products, Temp sensor with EEPROM | 24LCS52, 34XX02, MCP98242 | Customizable software enabled WP |
| Industrial, Consumer Electronics | Systems that require locked and/or re-writeable memory | Write-protect options | I²C, SPI, UNI/O and Microwire Options available | One lower cost device replace two stand-alone parts |
| HDCP Chipset (TV) | Adding HDCP keys to your chipset | Secure wafer programming service | 4K/8K – I²C, SPI, Microwire | Secure, No code duplication, Lower overall costs, Factory-programmed serialization |
| Industrial | Need devices to operate beyond -40C to +125C | High temp. EEPROMs: up to 150°C<br>Low temp EEPROMs: down to -55°C | 1 Kbit, I²C and 1-256 Kbit SPI | Robust design, Reduce chances of field failures |
| Automotive | Automotive Qualification | Special manufacturing flow | All | Robust design, Hassle-free solution |
| Consumer Electronics, Medical | Need Very Low Voltage | Very Low Voltage EEPROMs | 24VL014, 24VL024, 34VL02 | Low power operation, Reduced system voltage |

# More Speciality EEPROMs

## EUI-48™/EUI-64™ MAC Address Chips




***Need fast, easy and inexpensive access to MAC addresses? Use pre-programmed MAC address chips from Microchip. No serialization needed; unique ID.***

EUI-48 Programmed Serial EEPROMs provide low cost and easy access to IEEE MAC Addresses. These plug-and-play devices allow you to quickly add a MAC address to your networking application eliminating the need for programming and serialization on the MCU – helping you save cost and get to market quicker. For more information visit: **www.microchip.com/MAC**

| 24AA02E48 | 25AA02E48 | 11AA02E48 |
|---|---|---|
| 100 KHz | 10 MHz | 100 KHz |
| I²C | SPI | UNI/O |

### Plug-and-Play Devices

***EUI-48 address embedded in a 2K-bit Serial EEPROM***

- Quick and easy access to IEEE MAC addresses – Read code directly off Serial EEPROM
- Available in SPI, I²C and UNI/O bus
- At least 1.5 Kb of Serial EEPROM memory
- Available in SOIC and SOT-23 packages
- Write-protected codes
- EUI-48 and EUI-64 compatible
  - EUI-48: Networking, Ethernet, Wi-Fi (IEEE 802.11), Bluetooth
  - EUI-64: ZigBee (IEEE802.15.4), MiWi™, FireWire, IPv6
- Can be custom programmed in any memory density. Contact Microchip sales for more information.

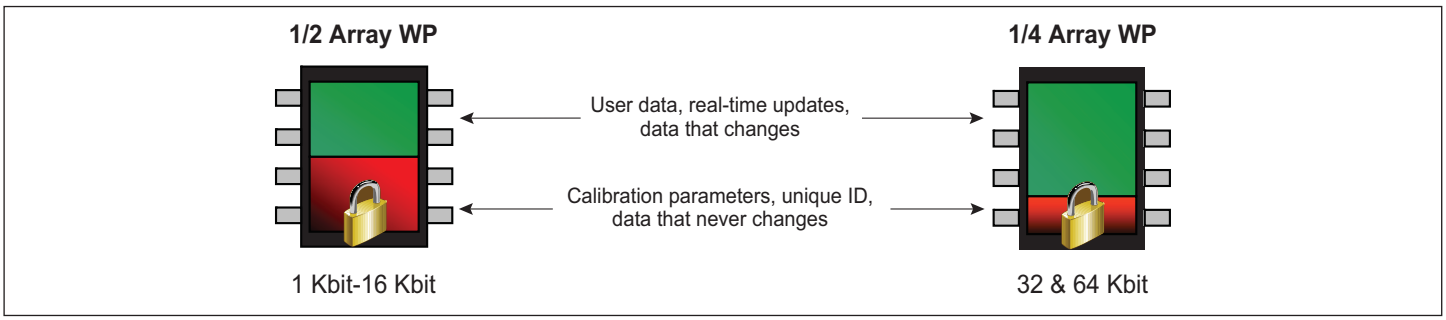
### Flexibility and Low Cost Access

***Quickly add EUI-48 to your networking application and get to market faster***

- Buy code only when needed.
- No added programming and serialization cost – Reduce System Costs
- Come with no volume restrictions.
- Additional EEPROM to store configuration settings
- Unique ID

## Partial Array Write-Protect I²C EEPROMs

Microchip's family of partial array write-protect (WP) EEPROMs offers hardware write-protect capability for only a part of the memory array. These I²C EEPROM devices are available from 1 Kb-64 Kbit.




## I²C and SPI Serial EEPROMs with Optional Range from -55°C to +150°C

- Automotive turbo chargers and exhaust gas recirculation
- Automotive fan motors, air valves, flaps and spark plugs
- Aerospace
- Mining (certifications for use in explosive atmospheres available)



# UNI/O® EEPROM

## *Using UNI/O EEPROM can free up MCU pins for new features.*




Microchip's new UNI/O Serial EEPROM uses only ONE connection to the host microcontroller. This compares to two or three pins for I²C, and three to six pins for Microwire or SPI buses. This new, proprietary bus offers advanced features like a status register and write-protection on demand, along with all I/O and memory array and command functions through a single pin.

| | | | | | |
|---|---|---|---|---|---|
| 2.5-5.5V | 11LC010 | 11LC020 | 11LC040 | 11LC080 | 11LC160 |
| 1.8-5.5V | 11AA010 | 11AA020 | 11AA040 | 11AA080 | 11AA160 |
| | 1 Kb | 2 Kb | 4 Kb | 8 Kb | 16 Kb |

## Single I/O EEPROM

### *One I/O for clock, data & control*

- Single I/O interface
- 1-16 Kbit memory densities
- 1.8-5.5V operating voltage
- 10-100 KHz operating frequency
- Status register, SW write-protect
- 3-pin SOT-23, 8-pin SOIC, MSOP & TDFN
- 1M Erase/Write cycles

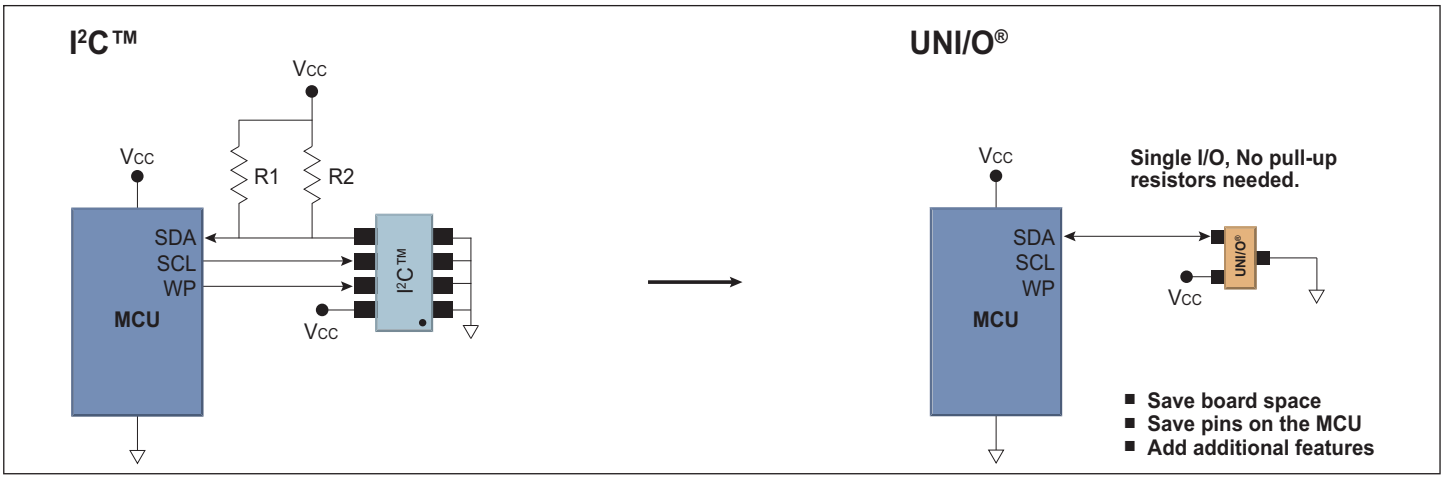


## Save I/O Pins

### *A single I/O EEPROM can simplify your design and reduce system cost*

- Free up pins on the MCU
  - Add new features to your application
  - Move to a smaller MCU – reduce cost
- Free up pins on your connector
  - Smaller connector – lower cost
- Single I/O interface – more compact design

### The UNI/O Advantage




- UNI/O software drivers available for many popular microcontrollers See Ap Note section for more information.
- Convert UNI/O from 3-pins to 2-pins – check out Ap Note AN1213.

**www.microchip.com/unio**

# Serial SRAM




## *Do you need a simple, inexpensive way to add RAM to your application? Microchip offers external RAM where you need it.*

Microchip's new serial SRAM family provides a way to easily and inexpensively add external RAM to almost any application. These serial devices use less power and fewer I/O connections than traditional parallel SRAM. And, they allow designers to use a smaller microcontroller rather than moving to a larger microcontroller just to get more on-board RAM.

| | 1.5V-1.95V | 2.7V-3.6V |
|---|---|---|
| 256 Kb | **23A256** 16 MHz | **23K256** 20 MHz |
| 64 Kb | **23A640** 16 MHz | **23K640** 20 MHz |

- Applications: metering, POS terminals, printers, internet radio, ethernet, Wi-Fi
- Replace parallel RAM
- Any application needing low cost RAM

## Increased Performance

***Quickly and easily add external high-speed SRAM***

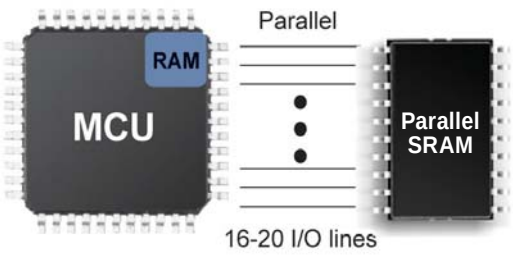
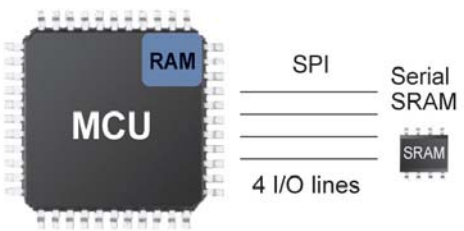
- 8 and 32 Kbyte options
- 20 MHz clock speed
- Low standby and operating currents
- Fast writes with zero latency
- Unlimited endurance
- 8-SOIC, 8-TSSOP, 8-PDIP

## Flexible RAM Expansion

***Add features to your current microcontroller and get to market faster***

- Add functionality to your current design
- No need to buy a large microcontroller just for the RAM
- Familiar 4-pin SPI interface
- Cost reduce your current design
- Scratchpad, buffering, high endurance applications

**The Serial Advantage – Not Just Price**

| Feature | Traditional Parallel SRAM | Microchip Serial SRAM |
|---|---|---|
| I/O Connection to MCU | 16-20 | 4 |
| Standby Current | 3 mA | 1 µA |
| Active Current | 50 mA | 1-10 mA |
| Lowest Operating Voltage | 3.0V | 1.7V |
| Footprint | 100 $mm^2$ | 20 $mm^2$ |
| Smallest Packages | 28-TSSOP, 28-SOIC | 8-TSSOP, 8-SOIC |
|  |  |  |







Stand-alone serial SRAM offering greater design flexibility and the opportunity for RAM expansion

**www.microchip.com/sram**

# Wafer-Level Burn-In

***Microchip's best-in-class field performance is the combined result of world class manufacturing, wafer level burn-in and wafer probe quality screens.***

Microchip's Triple Test Flow is currently the most robust testing procedure for serial EEPROM devices in the industry. It tests each cell of each die three times and also performs extensive endurance and data retention tests to ensure quality and reliability.

Infant mortality of Microchip serial EEPROMs is among the lowest in the industry due to this extensive testing, excellent fabrication and highly reliable memory cell design.

### Traditional Burn-in (Old Technology)

General purpose non-specific testing procedure for random logic cells

- Non-specific and untargeted testing mechanism – Increases failure rates.
- Expensive, time consuming and inefficient.
- Introduces defect modes like bent leads and EOS that sometimes go undetected.

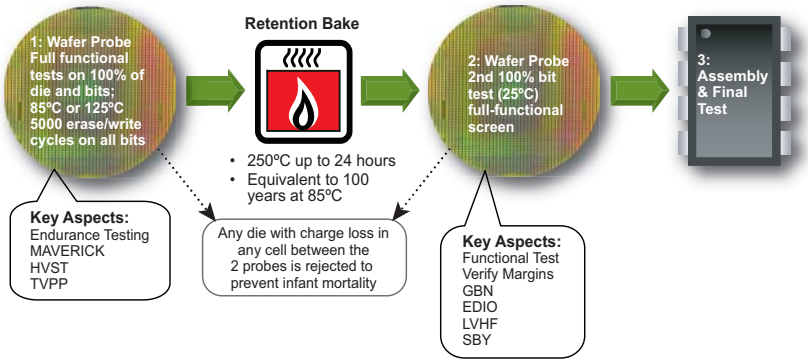
### Microchip's Triple Test and Wafer-level Burn-in Procedure

Moving beyond traditional burn-in to wafer level burn-in with the Triple Test Flow specifically targeted for memory cells has helped create the industry's most reliable memory products.

- Extensive Testing – Every cell in every die is tested three times, including specific endurance and data retention tests to ensure highest quality.
- HVST, LVHF and TVPP tests target specific defects.
- Maverick, SBY and GBN target overall failure patterns and trends.
- Insight into failure modes along with flexible test flow ensures continues improvement.

## Triple Test Flow

Microchip tests every cell in wafer form twice, then performs a final test after assembly.




## Main Goals – Zero Defects

- Full verification of data sheet parameters for functional compliance at die and package level.
- Removal of manufacturing defects to ensure highest quality and reliability.
- Screening out of functional devices that may fail in the future.

## Wafer Probe Quality Screens

Microchip performs additional in-house testing during wafer probe to ensure quality and eliminate any devices that are outside the normal distribution or might possibly fail in the future.

**High Voltage Stress Test (HVST)**

HVST targets weak devices with oxide defects in RAM and logic circuits by stressing the oxides at higher than normal voltages.

**Time at Vpp (TVPP)**

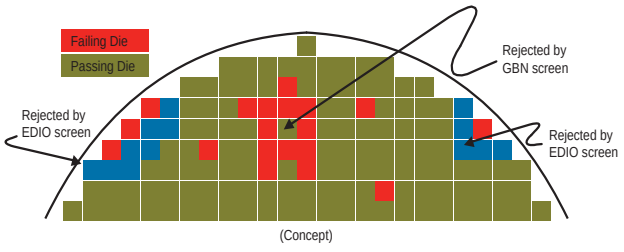
TVPP targets oxide defects in EEPROM cells, charge pumps and other high-voltage circuits. Programming voltages ($V_{PP}$) are applied to the memory array for an extended period of time in order to highlight any weak devices.

**Low Voltage High Frequency (LVHF)**

LVHF targets signal paths that are partially blocked and therefore more resistive than normal. LVHF eliminates these devices by requiring them to operate faster than specified and at voltages lower than specified.

**Good Die in a Bad Neighborhood (GBN) and Edge Die Ink Out (EDIO)**

Special algorithms target devices that function, but are suspect because of their proximity to clusters of failing devices or edge die.




### What Does All of This Mean?

- <<1 PPM Field Failures
- Best-in-class endurance
- Industry-leading data retention

# Consistent, Reliable Supply of the Highest Quality Products

## *Microchip: A leader in non-volatile memory for over 20 years.*

Perfected testing mechanisms along with streamlined in-house fabrication ensures the highest efficiency, shortest lead times and lowest costs.

"Quality Comes First" is at the top of the list of Guiding Values for Microchip Technology. As an ISO/TS-16949 certified supplier since 2003, Microchip's Aggregate System uniquely supports our commitment to exceptional quality. In an environment where enterprise-wide commitment to continuous improvement is demonstrated and every employee is responsible for quality.

- EEPROMs built at Microchip owned fabs (Gresham, OR, Tempe, AZ)
- No obsolescence policy – industry's longest product life cycles
- 100% in-house testing on all of our products
- AECQ100, TS19649 and automotive grade compliant
- Industry's shortest lead times
- Excellent global sales and technical support

With more than 20 years of experience in serving the demanding requirements of customers worldwide, Microchip Technology has a proven track record of success in delivering the total product solution to our valued customers that is cost effective and reliable.



**Corporate Headquarters**
**Chandler, Arizona**




**Fab 2**
**Tempe, Arizona**



**Fab 4**
**Gresham, Oregon**



**Product Assembly/Test**
**Bangkok, Thailand**

**www.microchip.com/quality**

# Resources to Get You Started Quickly

## *Reduce development time and cost with our development tools.*

Competitive market conditions force businesses to examine every aspect of their product life cycle to maximize productivity and minimize expense. Easy-to-learn, low-cost common development tools are one way to reduce risk and get to market quicker.

### MPLAB® Starter Kit for Serial Memory Products (DV243003)

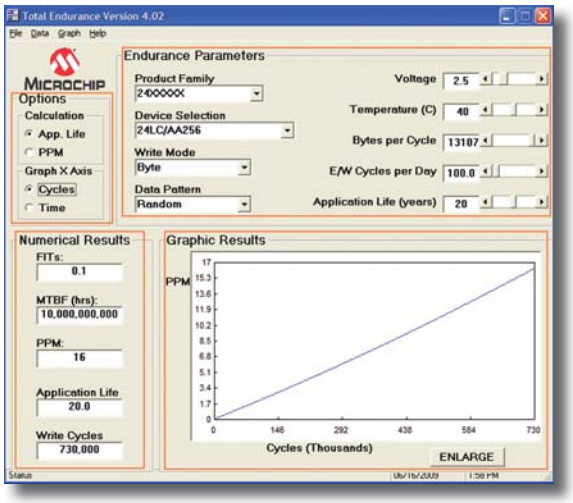



Reduce time to market and create a rock-solid design using the MPLAB Starter Kit for Serial Memory Products. It includes everything necessary to quickly develop a robust and reliable Serial EEPROM design, and greatly reduces the time required for system integration and hardware/software fine-tuning.

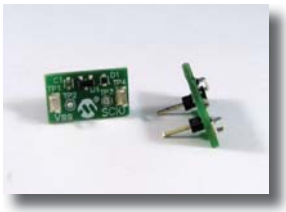
- 3.3V and 5.0V on-board voltage selection
- Supports Microchip UNI/O bus, I²C, SPI and Microwire Serial EEPROMs
- 1.8V to 5.5V external voltage support
- Includes free copy of MPLAB IDE
- USB interconnect

### FREE Total Endurance™ Software

Total Endurance Software provides a comprehensive model that helps estimate the endurance and reliability of Microchip Serial EEPROM devices. By providing operating conditions based on your application, all design trade-offs affecting reliability can be accurately estimated both graphically and numerically in PPM, FIT and MTBF modes, saving time and ensuring a truly robust design.




### UNI/O® Bus Parasitic Power Demo Board (AC243004)



The UNI/O Bus Parasitic Power Demo Board is designed to illustrate how a standard half-wave rectifier and capacitor circuit can be used to parasitically extract power for a UNI/O device from the SCIO signal as described in application note, AN1213 *"Powering a UNI/O® Bus Device Through SCIO"*. This reduces the number of connections necessary for adding a UNI/O device to your application down to two: SCIO and Vss.

### Serial EEPROM PIM PICtail™ Pack (AC243003)



The Serial EEPROM PIM PICtail Modules are a series of boards designed around Microchip Serial EEPROM devices. The boards are designed to interface with the PICtail Plus connector as well as the MPLAB Starter Kit for Serial Memory Products and the PICkit 3, allowing you to get started right out of the box.

- Plug-and-play with PICtail Plus connector and PICkit 3 connector
- Test points for oscilloscope connections for firmware debugging (I²C and UNI/O only)
- Microwire Buses are included for maximum flexibility in developing your application

**www.microchip.com/devtools**

# Reference Code Resources

## *Looking for reference code to interface with our serial memory?*

Select your serial protocol, microcontroller and preferred implementation below.

### Memory Application Notes – PIC® MCUs

| Protocol | Memory Type | Recommended Usage | Implementation | PIC10 | PIC12 | PIC16 | PIC18 | PIC24/ dsPIC33 | PIC32 |
|---|---|---|---|---|---|---|---|---|---|
| UNI/O Bus | EEPROM | AN1194 (General Usage) | Assembly – Firmware Delay | AN1174[1] | AN1174[1] AN1188[2] | AN1174[1] AN1188[2] | AN1183 | | |
| | | AN1213 (Parasitic Power) | Assembly – Hardware Delay | | AN1196[2] | AN1196[2] | AN1187 | | |
| | | | C – Hardware Delay | | AN1251[2] | AN1251[2] | AN1191 | AN1236 | |
| I²C | EEPROM | AN1028 | Assembly – Bit Bang | AN982 | AN982 | AN974 | AN979 | | |
| | | | Assembly – Hardware Port | | | AN976 | AN989 | | |
| | | | C – Bit Bang | | | | AN997 | AN1100 | |
| | | | C – Hardware Port | | | | AN991 | AN1079 | |
| Microwire | EEPROM | AN1029 | Assembly – Bit Bang | | | AN993 | AN999 | | |
| | | | Assembly – Hardware Port | | | AN975 | AN1020 | | |
| | | | C – Bit Bang | | | | AN1004 | | |
| | | | C – Hardware Port | | | | AN1023 | | |
| SPI | EEPROM | AN1040 | Assembly – Bit Bang | | | AN909 | AN1006 | | |
| | | | Assembly – Hardware Port | | | AN966 | AN1000 | | |
| | | | C – Bit Bang | | | | AN1018 | AN1096 | |
| | | | C – Hardware Port | | | | AN1040 | AN1069 | |
| | SRAM | AN1245 | – | | | AN1287 | AN1269 | AN1262 | AN1277 |
| All EEPROMs | | AN1019 | EEPROM Endurance Tutorial | | | | | | |
| | | AN536 | Basic Serial EEPROM Operation | | | | | | |
| | | AN603 | Continuous Improvement | | | | | | |

Note 1: Written for baseline (12-bit program word) cores.
2: Written for mid-range (14-bit program word) cores.

### Memory Application Notes – Third-Party MCUs

| Protocol | Implementation | 8051 | MSP430 |
|---|---|---|---|
| UNI/O Bus | Assembly – Hardware Delay | AN1184 | |
| | C – Hardware Delay | AN1185 | AN1186 |
| I²C | Assembly – Bit Bang | AN1147 | |
| | Assembly – Hardware Port | AN1190 | |
| | C – Bit Bang | AN1195 | |
| | C – Hardware Port | AN1113 | |
| SPI | Assembly – Bit Bang | AN1198 | |
| | Assembly – Hardware Port | AN1197 | |
| | C – Bit Bang | AN1193 | |
| | C – Hardware Port | AN1073 | |

**www.microchip.com/appnotes**

# Product Specifications

## I²C™ Memory Products

| Device | Density (Organization) | Max Clock Frequency | Operating Voltage (AA, LC, C) | Temperature (I, E, H) | Endurance (E/W Cycles) | Data Retention | Write Protect (Hardware) | Packages |
|---|---|---|---|---|---|---|---|---|
| **24XX00** | 128 bits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | No | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN |
| **24XX01/014** | 1 Kbit (x8) | 400 kHz | 1.7V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, SC70 |
| **24XX02/024** | 2 Kbits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, SC70 |
| **24XX04** | 4 Kbits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, WLCSP |
| **24XX08** | 8 Kbits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP |
| **24XX16** | 16 Kbits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, WLCSP |
| **24XX32** | 32 Kbits (x8) | 400 kHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | W, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, WLCSP |
| **24XX64/65** | 64 Kbits (x8) | 1 MHz | 1.7V-5.5V | -40°C to +125°C | 1M/10M | 200 years | W, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, WLCSP |
| **24XX128** | 128 Kbits (x8) | 1 MHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | PDIP, SOIC, TSSOP, 2x3 T-DFN, 6x5 DFN, MSOP, WLCSP |
| **24XX256** | 256 Kbits (x8) | 1 MHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | PDIP, SOIC, TSSOP, 6x5 DFN, MSOP, WLCSP |
| **24XX512** | 512 Kbits (x8) | 1 MHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | PDIP, SOIC, TSSOP, 6x5 DFN, WLCSP |
| **24XX1025** | 1 Mbit (x8) | 1 MHz | 1.7V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | PDIP, SOIC, SOIJ, 6x5 DFN |

## UNI/O® Bus EEPROM Products

| Device | Density (Organization) | Max Clock Frequency | Operating Voltage (AA, LC) | Temperature (I, E) | Endurance (E/W Cycles) | Data Retention | Write Protect (Software) | Packages |
|---|---|---|---|---|---|---|---|---|
| **11XX010** | 1 Kbit (x8) | 100 kHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, TO92, WLCSP |
| **11XX020** | 2 Kbits (x8) | 100 kHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, TO92, WLCSP |
| **11XX040** | 4 Kbits (x8) | 100 kHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, TO92, WLCSP |
| **11XX080** | 8 Kbits (x8) | 100 kHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, TO92, WLCSP |
| **11XX160** | 16 Kbits (x8) | 100 kHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP, TO92, WLCSP |

## Microwire EEPROM Products

| Device | Density (x8 or x16) | Max Clock Frequency | Operating Voltage (AA, LC, C) | Temperature (I, E) | Endurance (E/W Cycles) | Data Retention | Write Protect (Hardware) | Read Current | Packages |
|---|---|---|---|---|---|---|---|---|---|
| **93XX46A/B/C** | 1 Kbit | 3 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | No | 1 mA | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP |
| **93XX56A/B/C** | 2 Kbits | 3 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | No | 1 mA | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP |
| **93XX66A/B/C** | 4 Kbits | 3 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | No | 1 mA | PDIP, SOIC, TSSOP, SOT-23, 2x3 T-DFN, MSOP |
| **93XX76A/B/C** | 8 Kbits | 3 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | 1 mA | PDIP, SOIC, TSSOP, 2x3 T-DFN, MSOP |
| **93XX86A/B/C** | 16 Kbits | 3 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | Yes | 1 mA | PDIP, SOIC, TSSOP, 2x3 T-DFN, MSOP |

A: x8 Organization, B: x16 Organization, C: Selectable x8 or x16 Organization

## SPI EEPROM Products

| Device | Density (Organization) | Max Clock Frequency | Operating Voltage (AA, LC) | Temperature (I, E, H) | Endurance (E/W Cycles) | Data Retention | Write Protect (Software) | Packages |
|---|---|---|---|---|---|---|---|---|
| **25XX010A** | 1 Kbit (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, 2x3 T-DFN, MSOP, SOT-23 |
| **25XX020A** | 2 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, 2x3 T-DFN, MSOP, SOT-23 |
| **25XX040A** | 4 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, 2x3 T-DFN, MSOP, SOT-23 |
| **25XX080C/D** | 8 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN |
| **25XX160C/D** | 16 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN |
| **25XX320A** | 32 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN |
| **25XX640A** | 64 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, MSOP, 2x3 T-DFN |
| **25XX128** | 128 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, 6x5 DFN |
| **25XX256** | 256 Kbits (x8) | 10 MHz | 1.8V-5.5V | -40°C to +150°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, TSSOP, 6x5 DFN |
| **25XX512** | 512 Kbits (x8) | 20 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIC, 6x5 DFN |
| **25XX1024** | 1 Mbit (x8) | 20 MHz | 1.8V-5.5V | -40°C to +125°C | 1M | 200 years | W, ½, ¼ | PDIP, SOIJ, 6x5 DFN |

1. Voltage Range: AA = 1.7- 5.5V; LC = 2.5-5.5V; C = 4.5-5.5V
2. I = -40°C to 85°C; E = -40°C to 125°C; H = -40°C to 150°C
3. Pb-Free, Halogen Free and RoHS Compliant
4. Write Protect: W = Whole Array, ½ = Half Array, ¼ = Quarter Array
5. ESD protection > 4 kV (HBM); > 400V (MM) on all pins
6. H Temp is SOIC only

## Serial SRAM Products

| Device | Density Organization) | Max Clock Frequency | Operating Voltage (A, K) | Temperature (I, E) | Read Current (mA) | Max Standby Current | Packages |
|---|---|---|---|---|---|---|---|
| **23x640** | 8KB (64 Kbits) | 20 MHz | 1.8V, 3V | -40°C to +125°C | 3 mA | 4 µA | PDIP, SOIC, TSSOP |
| **23X256** | 32 KB (256 Kbits) | 20 MHz | 1.8V, 3V | -40°C to +125°C | 3 mA | 4 µA | PDIP, SOIC, TSSOP |

1. Voltage Range: A = 1.5- 1.95V; K = 2.7V-3.6V
2. All Devices are Pb-Free, RoHS Compliant and Halogen Free

**For up to date product information visit: www.microchip.com/memory**

# Serial Memory Ordering Information

## Part Number Suffix Designations

Ordering information for Microchip SEEPROM products.

**24 AA 02 T - I /SN**

**Package Type:**

| | | | |
|---|---|---|---|
| SN | 8-SOIC (150 mil) | MNY/MC/MF | 8-TDFN/DFN |
| TT/OT | 3/5/6 SOT-23 | LT | 5-SC70 |
| ST | 8-TSSOP | W/WF/S | Wafer/Die |
| P | 8-PDIP | CS | WLCSP – die size |
| SM | 8-SOIJ (208 mil) | TO | TO92 |
| MS | 8-MSOP | | |

**Operating Temperature Range:**

| | |
|---|---|
| I: | Industrial (-40°C to +85°C) |
| E: | Extended Industrial Range (-40°C to +125°C) |
| H: | Extended (-40°C to +150°C) |

**Tape and Reel**

| | |
|---|---|
| T: | Tape and Reel |
| blank: | Standard (bulk) |

**Density:**

| | | | |
|---|---|---|---|
| 00: | 128 bits | 32/320: | 32 Kbit |
| 01/010/014: | 1 Kbit | 64/640: | 64 Kbit |
| 02/020/024: | 2 Kbit | 128: | 128 Kbit |
| 04/040: | 4 Kbit | 256: | 256 Kbit |
| 08/080: | 8 Kbit | 512: | 512 Kbit |
| 16/160: | 16 Kbit | 1024/1025: | 1 Mbit |

**Voltage Range:**

| | |
|---|---|
| AA | 1.8V-5.5V |
| LC | 2.5V-5.5V |
| C | 4.5V-5.5V |
| K | 1.8-3.6V |
| A | 1.5-1.95V |
| VL | 1.5V-3.6V |

**Bus Type:**

| | |
|---|---|
| 24/34: | $I^2C$ |
| 25: | SPI |
| 93: | Microwire |
| 11: | UNI/O Bus |
| 23: | SRAM (SPI) |

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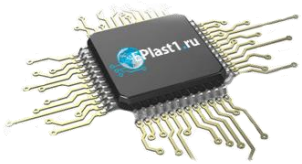
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