

## 4K I<sup>2</sup>C™ Serial EEPROM

### Device Selection Table

| Part Number | Vcc Range | Max. Clock Frequency   | Temp. Ranges |
|-------------|-----------|------------------------|--------------|
| 24AA04      | 1.7-5.5   | 400 kHz <sup>(1)</sup> | I            |
| 24LC04B     | 2.5-5.5   | 400 kHz                | I, E         |

**Note 1:** 100 kHz for Vcc < 2.5V

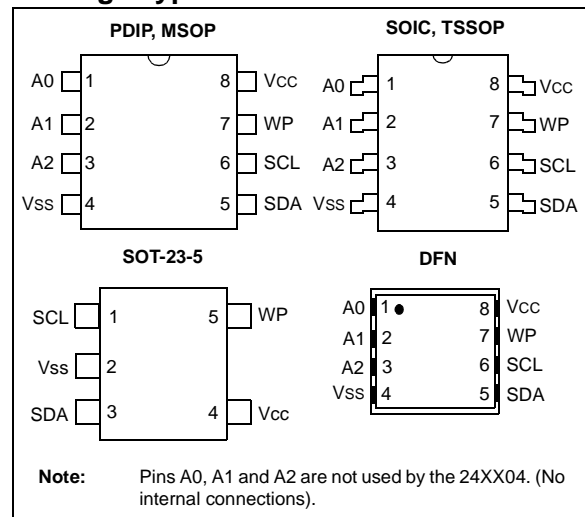
### Features:

- Single supply with operation down to 1.7V for 24AA04 devices, 2.5V for 24LC04B devices
- Low-power CMOS technology:
  - Read current 1 mA, typical
  - Standby current 1 μA, typical
- 2-wire serial interface, I<sup>2</sup>C™ compatible
- Schmitt Trigger inputs for noise suppression
- Output slope control to eliminate ground bounce
- 100 kHz and 400 kHz clock compatibility
- Page write time 3 ms, typical
- Self-timed erase/write cycle
- 16-byte page write buffer
- Hardware write-protect
- ESD protection >4,000V
- More than 1 million erase/write cycles
- Data retention >200 years
- Factory programming available
- Packages include 8-lead PDIP, SOIC, TSSOP, DFN, MSOP and 5-lead SOT-23
- Pb-free and RoHS compliant
- Temperature ranges:
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

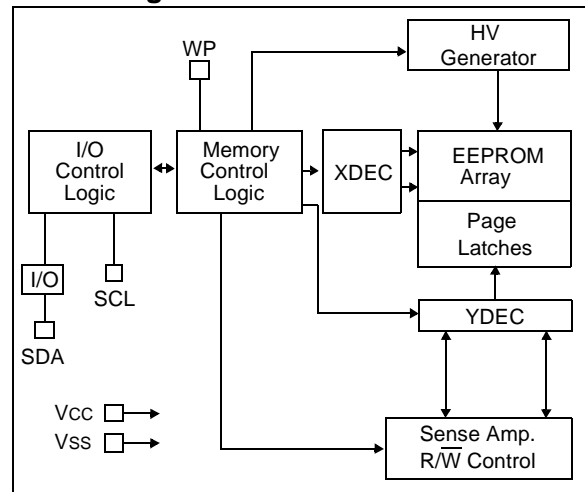
### Description:

The Microchip Technology Inc. 24AA04/24LC04B (24XX04\*) is a 4 Kbit Electrically Erasable PROM. The device is organized as two blocks of 256 x 8-bit memory with a 2-wire serial interface. Low-voltage design permits operation down to 1.7V, with standby and active currents of only 1 μA and 1 mA, respectively. The 24XX04 also has a page write capability for up to 16 bytes of data. The 24XX04 is available in the standard 8-pin PDIP, surface mount SOIC, TSSOP, 2x3 DFN and MSOP packages and is also available in the 5-lead SOT-23 package.

### Package Types



### Block Diagram



# 24AA04/24LC04B

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings (†)

|   |                                |
|---|--------------------------------|
| V <sub>CC</sub> .....                               | 6.5V                           |
| All inputs and outputs w.r.t. V <sub>SS</sub> ..... | -0.3V to V <sub>CC</sub> +1.0V |
| Storage temperature .....                           | -65°C to +150°C                |
| Ambient temperature with power applied.....         | -40°C to +125°C                |
| ESD protection on all pins .....                    | ≥ 4 kV                         |

† NOTICE: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

**TABLE 1-1: DC CHARACTERISTICS**

| DC CHARACTERISTICS |                                       |                                      | Industrial (I): TA = -40°C to +85°C, V <sub>CC</sub> = +1.7V to +5.5V<br>Automotive (E): TA = -40°C to +125°C, V <sub>CC</sub> = +2.5V to +5.5V |      |                     |       |   |
|--------------------|---------------------------------------|--------------------------------------|---|------|---------------------|-------|---|
| Param. No.         | Sym.                                  | Characteristic                       | Min.  | Typ. | Max.                | Units | Conditions  |
| D1                 | V <sub>IH</sub>                       | <b>WP, SCL and SDA pins</b>          | —   | —    | —                   | —     | —   |
| D2                 | —                                     | High-level input voltage             | 0.7 V <sub>CC</sub>   | —    | —                   | V     | —   |
| D3                 | V <sub>IL</sub>                       | Low-level input voltage              | —   | —    | 0.3 V <sub>CC</sub> | V     | —   |
| D4                 | V <sub>HYS</sub>                      | Hysteresis of Schmitt Trigger inputs | 0.05 V <sub>CC</sub>  | —    | —                   | V     | <b>(Note)</b>   |
| D5                 | V <sub>OL</sub>                       | Low-level output voltage             | —   | —    | 0.40                | V     | I <sub>OL</sub> = 3.0 mA, V <sub>CC</sub> = 2.5V                                |
| D6                 | I <sub>LI</sub>                       | <b>Input leakage current</b>         | —   | —    | ±1                  | μA    | V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub>                            |
| D7                 | I <sub>LO</sub>                       | <b>Output leakage current</b>        | —   | —    | ±1                  | μA    | V <sub>OUT</sub> = V <sub>SS</sub> or V <sub>CC</sub>                           |
| D8                 | C <sub>IN</sub> ,<br>C <sub>OUT</sub> | Pin capacitance (all inputs/outputs) | —   | —    | 10                  | pF    | V <sub>CC</sub> = 5.0V <b>(Note)</b><br>TA = 25°C, F <sub>CLK</sub> = 1 MHz     |
| D9                 | I <sub>CC</sub> write                 | <b>Operating current</b>             | —   | 0.1  | 3                   | mA    | V <sub>CC</sub> = 5.5V, SCL = 400 kHz   |
| D10                | I <sub>CC</sub> read                  |                                      | —   | 0.05 | 1                   | mA    | —   |
| D11                | I <sub>CCS</sub>                      | <b>Standby current</b>               | —   | 0.01 | 1                   | μA    | Industrial<br>Automotive<br>SDA = SCL = V <sub>CC</sub><br>WP = V <sub>SS</sub> |
|                    |                                       |                                      | —   | —    | 5                   | μA    |   |

**Note:** This parameter is periodically sampled and not 100% tested.

**TABLE 1-2: AC CHARACTERISTICS**

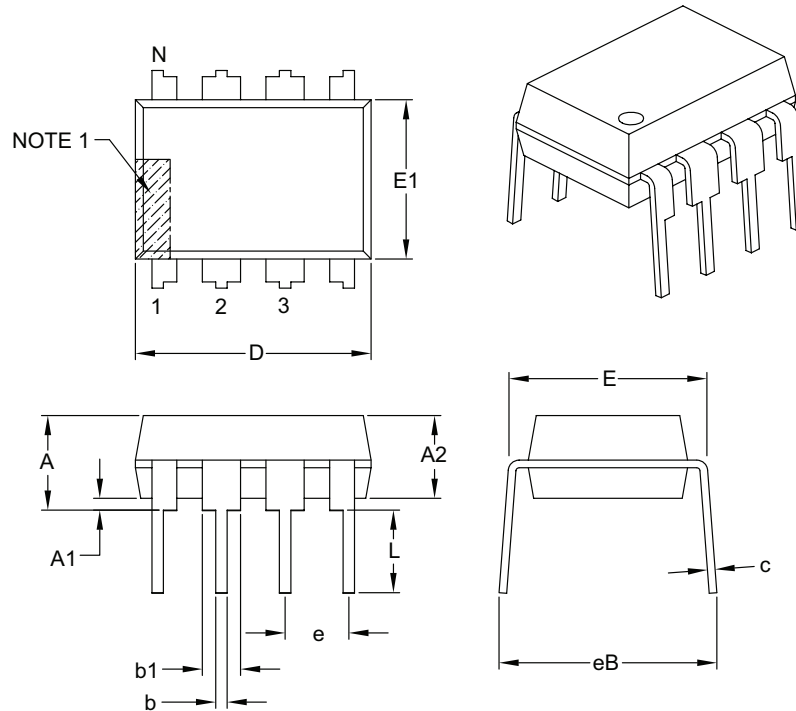
| AC CHARACTERISTICS |         |  | Industrial (I): |        | TA = -40°C to +85°C, VCC = +1.7V to +5.5V  |        |   |
|--------------------|---------|--|-----------------|--------|--|--------|---|
|                    |         |  | Automotive (E): |        | TA = -40°C to +125°C, VCC = +2.5V to +5.5V |        |   |
| Param. No.         | Sym.    | Characteristic   | Min.            | Typ.   | Max.                                       | Units  | Conditions  |
| 1                  | FCLK    | Clock frequency  | —<br>—          | —<br>— | 400<br>100                                 | kHz    | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 2                  | THIGH   | Clock high time  | 600<br>4000     | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 3                  | TLOW    | Clock low time   | 1300<br>4700    | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 4                  | TR      | SDA and SCL rise time (Note 1)   | —<br>—          | —<br>— | 300<br>1000                                | ns     | 2.5V ≤ VCC ≤ 5.5V (Note 1)<br>1.7V ≤ VCC < 2.5V (24AA04) (Note 1) |
| 5                  | TF      | SDA and SCL fall time  | —               | —<br>— | 300  | ns     | (Note 1)  |
| 6                  | THD:STA | Start condition hold time  | 600<br>4000     | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 7                  | TSU:STA | Start condition setup time   | 600<br>4700     | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 8                  | THD:DAT | Data input hold time   | 0               | —<br>— | —  | ns     | (Note 2)  |
| 9                  | TSU:DAT | Data input setup time  | 100<br>250      | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 10                 | TSU:STO | Stop condition setup time  | 600<br>4000     | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 11                 | TAA     | Output valid from clock (Note 2)   | —<br>—          | —<br>— | 900<br>3500                                | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 12                 | TBUF    | Bus free time: Time the bus must be free before a new transmission can start | 1300<br>4700    | —<br>— | —<br>—                                     | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 13                 | TOF     | Output fall time from VIH minimum to VIL maximum                             | 20+0.1CB<br>—   | —<br>— | 250<br>250                                 | ns     | 2.5V ≤ VCC ≤ 5.5V<br>1.7V ≤ VCC < 2.5V (24AA04)                   |
| 14                 | TSP     | Input filter spike suppression (SDA and SCL pins)                            | —               | —      | 50   | ns     | (Notes 1 and 3)   |
| 15                 | TWC     | Write cycle time (byte or page)  | —               | —      | 5  | ms     | —   |
| 16                 | —       | Endurance  | 1M              | —      | —  | cycles | 25°C, (Note 4)  |

**Note 1:** Not 100% tested. CB = total capacitance of one bus line in pF.

- 2:** As a transmitter, the device must provide an internal minimum delay time to bridge the undefined region (minimum 300 ns) of the falling edge of SCL to avoid unintended generation of Start or Stop conditions.
- 3:** The combined TSP and VHYS specifications are due to new Schmitt Trigger inputs which provide improved noise spike suppression. This eliminates the need for a Ti specification for standard operation.
- 4:** This parameter is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model which can be obtained from Microchip's web site

# 24AA04/24LC04B

## 8-Lead Plastic Dual In-Line (P or PA) – 300 mil Body [PDIP]



|                            |    | Units | INCHES   |      |      |
|----------------------------|----|-------|----------|------|------|
| Dimension Limits           |    |       | MIN      | NOM  | MAX  |
| Number of Pins             | N  |       | 8        |      |      |
| Pitch                      | e  |       | .100 BSC |      |      |
| Top to Seating Plane       | A  | -     | -        | -    | .210 |
| Molded Package Thickness   | A2 | .115  | .130     | .195 |      |
| Base to Seating Plane      | A1 | .015  | -        | -    |      |
| Shoulder to Shoulder Width | E  | .290  | .310     | .325 |      |
| Molded Package Width       | E1 | .240  | .250     | .280 |      |
| Overall Length             | D  | .348  | .365     | .400 |      |
| Tip to Seating Plane       | L  | .115  | .130     | .150 |      |
| Lead Thickness             | c  | .008  | .010     | .015 |      |
| Upper Lead Width           | b1 | .040  | .060     | .070 |      |
| Lower Lead Width           | b  | .014  | .018     | .022 |      |
| Overall Row Spacing §      | eB | -     | -        | -    | .430 |

### Notes:

- Pin 1 visual index feature may vary, but must be located with the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M.

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-018B

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| PART NO.  |                   | X | XX   |
|---|-------------------|---|--|
| Device  | Temperature Range |   | Package  |
| <p><b>Device:</b></p> <p>24AA04: = 1.7V, 4 Kbit I<sup>2</sup>C Serial EEPROM</p> <p>24AA04T: = 1.7V, 4 Kbit I<sup>2</sup>C Serial EEPROM (Tape and Reel)</p> <p>24LC04B: = 2.5V, 4 Kbit I<sup>2</sup>C Serial EEPROM</p> <p>24LC04BT: = 2.5V, 4 Kbit I<sup>2</sup>C Serial EEPROM (Tape and Reel)</p> |                   |   |  |
| <p><b>Temperature Range:</b></p> <p>I = -40°C to +85°C</p> <p>E = -40°C to +125°C</p>   |                   |   |  |
| <p><b>Package:</b></p> <p>MC = 2x3 DFN, 8-lead</p> <p>P = Plastic DIP (300 mil body), 8-lead</p> <p>SN = Plastic SOIC (3.90 mm body), 8-lead</p> <p>ST = Plastic TSSOP (4.4 mm), 8-lead</p> <p>MS = Plastic Micro Small Outline (MSOP), 8-lead</p> <p>OT = SOT-23, 5-lead (Tape and Reel only)</p>    |                   |   |  |
|   |                   |   | <p><b>Examples:</b></p> <p>a) 24AA04-I/P: Industrial Temperature, 1.7V, PDIP package</p> <p>b) 24AA04-I/SN: Industrial Temperature, 1.7V, SOIC package</p> <p>c) 24AA04T-I/OT: Industrial Temperature, 1.7V, SOT-23 package, tape and reel</p> <p>d) 24LC04B-I/P: Industrial Temperature, 2.5V, PDIP package</p> <p>e) 24LC04B-E/SN: Extended Temperature, 2.5V, SOIC package</p> <p>f) 24LC04BT-I/OT: Industrial Temperature, 2.5V, SOT-23 package, tape and reel</p> |