



# MICROCHIP 24AA64/24LC64/24FC64

## 64K I<sup>2</sup>C™ Serial EEPROM

### Device Selection Table

Part Number	Vcc Range	Max. Clock Frequency	Temp. Ranges
24AA64	1.7-5.5	400 kHz <sup>(1)</sup>	I
24LC64	2.5-5.5	400 kHz	I, E
24FC64	1.7-5.5	1 MHz <sup>(2)</sup>	I

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

**2:** 400 kHz for Vcc <2.5V

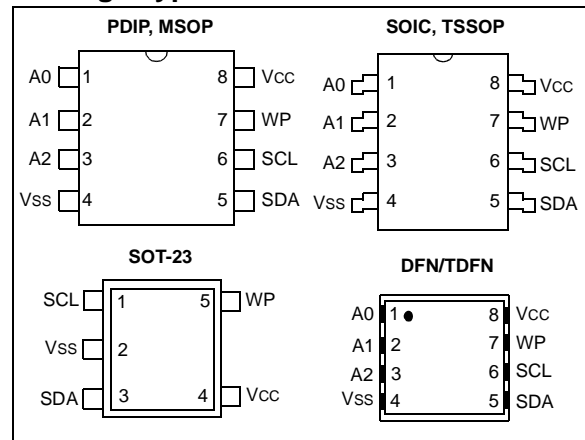
### Features:

- Single-Supply with Operation down to 1.7V for 24AA64/24FC64 devices, 2.5V for 24LC64 devices
- Low-Power CMOS Technology:
  - Active current 1 mA, typical
  - Standby current 1 µA, typical
- 2-Wire Serial Interface, I<sup>2</sup>C™ Compatible
- Cascadable up to 8 Devices
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 100 kHz and 400 kHz Clock Compatibility
- 1 MHz Clock for FC versions
- Page Write Time 5 ms, typical
- Self-timed Erase/Write Cycle
- 32-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, MSOP, DFN, TDFN 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

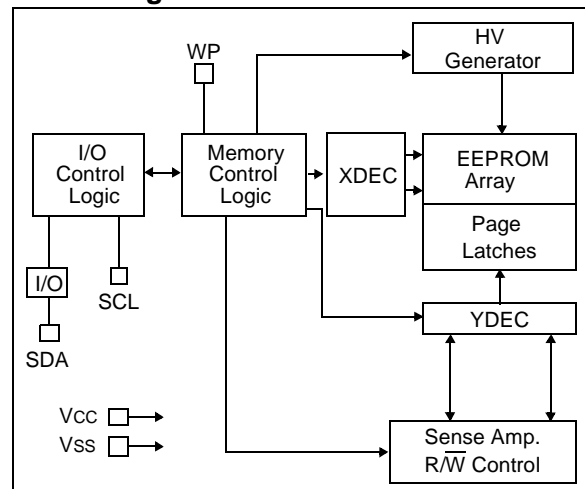
### Description:

The Microchip Technology Inc. 24AA64/24LC64/24FC64 (24XX64\*) is a 64 Kbit Electrically Erasable PROM. The device is organized as a single block of 8K 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. It has been developed for advanced, low-power applications such as personal communications or data acquisition. The 24XX64 also has a page write capability for up to 32 bytes of data. Functional address lines allow up to eight devices on the same bus, for up to 512 Kbits address space. The 24XX64 is available in the standard 8-pin PDIP, surface mount SOIC, TSSOP, DFN, TDFN and MSOP packages. The 24XX64 is also available in the 5-lead SOT-23 package.

### Package Types



### Block Diagram



\* 24XX64 is used in this document as a generic part number for the 24AA64/24LC64/24FC64 devices.

# 24AA64/24LC64/24FC64

## 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): T <sub>A</sub> = -40°C to +85°C, V <sub>CC</sub> = +1.7V to +5.5V Automotive (E): T <sub>A</sub> = -40°C to +125°C, V <sub>CC</sub> = +2.5V to +5.5V				
Param. No.	Sym.	Characteristic	Min.	Typ.	Max.	Units	Conditions
	—	<b>A0, A1, A2, WP, SCL and SDA pins</b>	—	—	—	—	—
D1	V <sub>IH</sub>	High-level input voltage	0.7 V <sub>CC</sub>	—	—	V	—
D2	V <sub>IL</sub>	Low-level input voltage	—	—	0.3 V <sub>CC</sub> 0.2 V <sub>CC</sub>	V V	V <sub>CC</sub> ≥ 2.5V V <sub>CC</sub> < 2.5V
D3	V <sub>HYS</sub>	Hysteresis of Schmitt Trigger inputs (SDA, SCL pins)	0.05 V <sub>CC</sub>	—	—	V	V <sub>CC</sub> ≥ 2.5V ( <b>Note 1</b> )
D4	V <sub>OL</sub>	Low-level output voltage	—	—	0.40	V	I <sub>OL</sub> = 3.0 mA @ V <sub>CC</sub> = 4.5V I <sub>OL</sub> = 2.1 mA @ V <sub>CC</sub> = 2.5V
D5	I <sub>LI</sub>	<b>Input leakage current</b>	—	—	±1	μA	V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , WP = V <sub>SS</sub> V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub> , WP = V <sub>CC</sub>
D6	I <sub>LO</sub>	<b>Output leakage current</b>	—	—	±1	μA	V <sub>OUT</sub> = V <sub>SS</sub> or V <sub>CC</sub>
D7	C <sub>IN</sub> , C <sub>OUT</sub>	Pin capacitance (all inputs/outputs)	—	—	10	pF	V <sub>CC</sub> = 5.0V ( <b>Note 1</b> ) T <sub>A</sub> = 25°C, F <sub>CLK</sub> = 1 MHz
D8	I <sub>CC</sub> write	<b>Operating current</b>	—	0.1	3	mA	V <sub>CC</sub> = 5.5V, SCL = 400 kHz
D9	I <sub>CC</sub> read		—	0.05	400	μA	
D10	I <sub>CCS</sub>	<b>Standby current</b>	—	.01	1	μA	Industrial Automotive SDA = SCL = V <sub>CC</sub> A0, A1, A2, WP = V <sub>SS</sub>
			—	—	5	μA	

**Note 1:** This parameter is periodically sampled and not 100% tested.

**2:** Typical measurements taken at room temperature.

# 24AA64/24LC64/24FC64

**TABLE 1-2: AC CHARACTERISTICS**

AC CHARACTERISTICS			Electrical Characteristics:			
			Industrial (I): V <sub>CC</sub> = +1.7V to 5.5V TA = -40°C to +85°C			
			Automotive (E): V <sub>CC</sub> = +2.5V to 5.5V TA = -40°C to 125°C			
Param. No.	Sym.	Characteristic	Min.	Max.	Units	Conditions
1	FCLK	Clock frequency	— — — —	100 400 400 1000	kHz	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
2	THIGH	Clock high time	4000 600 600 500	— — — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
3	TLOW	Clock low time	4700 1300 1300 500	— — — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
4	TR	SDA and SCL rise time (Note 1)	— — —	1000 300 300	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
5	TF	SDA and SCL fall time (Note 1)	— —	300 100	ns	All except, 24FC64 1.7V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
6	THD:STA	Start condition hold time	4000 600 600 250	— — — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
7	TSU:STA	Start condition setup time	4700 600 600 250	— — — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
8	THD:DAT	Data input hold time	0	—	ns	(Note 2)
9	TSU:DAT	Data input setup time	250 100 100	— — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
10	TSU:STO	Stop condition setup time	4000 600 600 250	— — — —	ns	1.7 V ≤ V <sub>CC</sub> < 2.5V 2.5 V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> < 2.5V 24FC64 2.5 V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
11	TSU:WP	WP setup time	4000 600 600	— — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64
12	THD:WP	WP hold time	4700 1300 1300	— — —	ns	1.7V ≤ V <sub>CC</sub> < 2.5V 2.5V ≤ V <sub>CC</sub> ≤ 5.5V 1.7V ≤ V <sub>CC</sub> ≤ 5.5V 24FC64

**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

# 24AA64/24LC64/24FC64

AC CHARACTERISTICS			Electrical Characteristics:			
			Industrial (I): $V_{CC} = +1.7V$ to $5.5V$ $T_A = -40^{\circ}C$ to $+85^{\circ}C$			
			Automotive (E): $V_{CC} = +2.5V$ to $5.5V$ $T_A = -40^{\circ}C$ to $125^{\circ}C$			
Param. No.	Sym.	Characteristic	Min.	Max.	Units	Conditions
13	TAA	Output valid from clock ( <b>Note 2</b> )	—	3500	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} < 2.5V$ 24FC64 $2.5V \leq V_{CC} \leq 5.5V$ 24FC64
14	TBUF	Bus free time: Time the bus must be free before a new transmission can start	4700 1300 1300 500	—	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} < 2.5V$ 24FC64 $2.5V \leq V_{CC} \leq 5.5V$ 24FC64
15	TOF	Output fall time from $V_{IH}$ minimum to $V_{IL}$ maximum $C_B \leq 100$ pF	$10 + 0.1C_B$	250 250	ns	All except, 24FC64 ( <b>Note 1</b> ) 24FC64 ( <b>Note 1</b> )
16	TSP	Input filter spike suppression (SDA and SCL pins)	—	50	ns	All except, 24FC64 ( <b>Notes 1 and 3</b> )
17	TWC	Write cycle time (byte or page)	—	5	ms	—
18	—	Endurance	1,000,000	—	cycles	$25^{\circ}C$ ( <b>Note 4</b> )

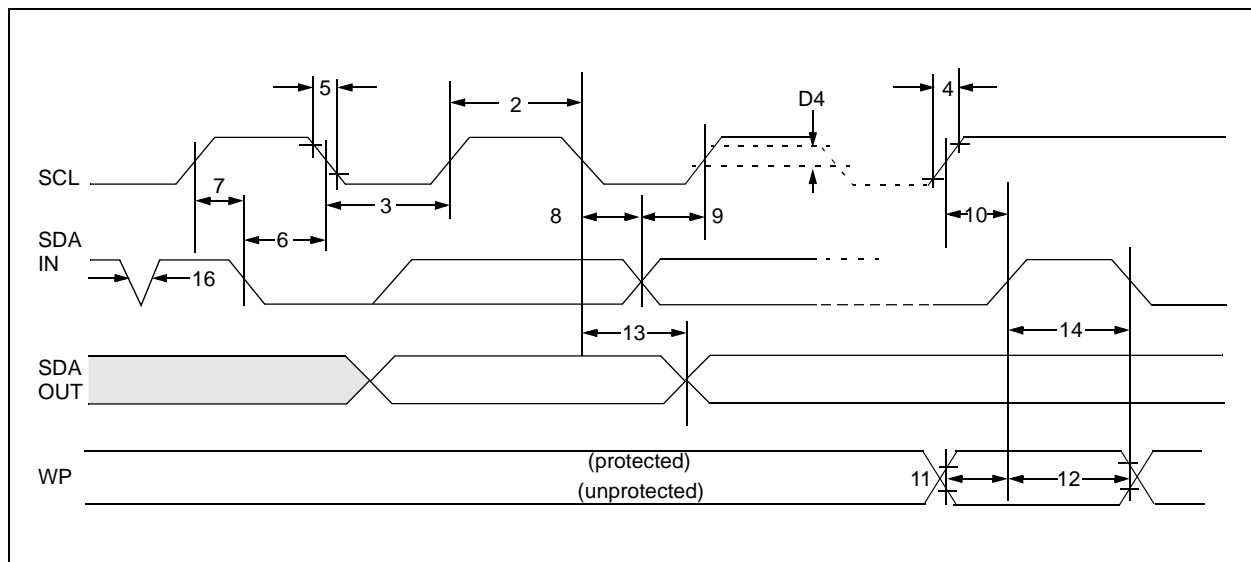
**Note 1:** Not 100% tested.  $C_B$  = total capacitance of one bus line in pF.

**Note 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.

**Note 3:** The combined TSP and  $V_{HYS}$  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.

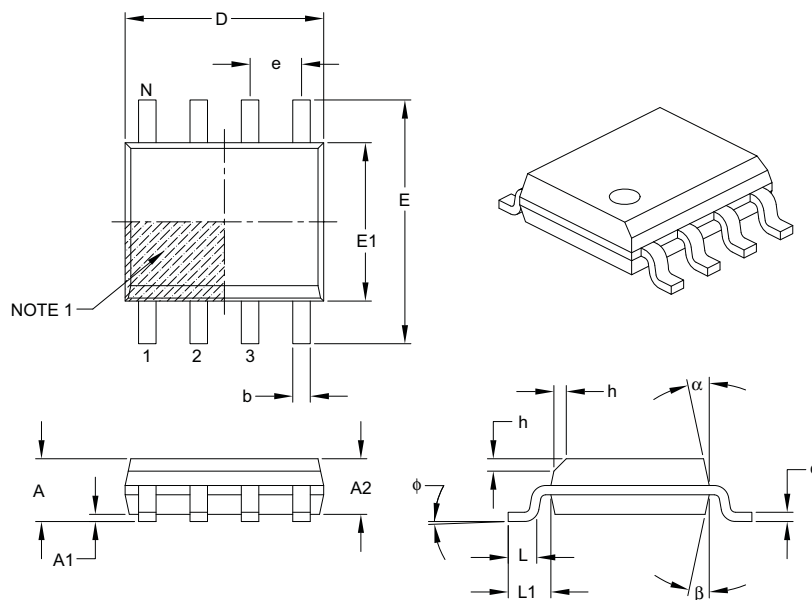
**Note 4:** This parameter is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model, which can be obtained from Microchip's web site at [www.microchip.com](http://www.microchip.com).

**FIGURE 1-1: BUS TIMING DATA**



# 24AA64/24LC64/24FC64

## 8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	–
Standoff §	A1	0.10	–	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1	1.04 REF		
Foot Angle	$\phi$	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	$\alpha$	5°	–	15°
Mold Draft Angle Bottom	$\beta$	5°	–	15°

### Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M.

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

REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-057B

# 24AA64/24LC64/24FC64

## 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
<b>Device:</b>	24AA64:	1.7V, 64 Kbit I <sup>2</sup> C™ Serial EEPROM	
	24AA64T:	1.7V, 64 Kbit I <sup>2</sup> C Serial EEPROM (Tape and Reel)	
	24LC64:	2.5V, 64 Kbit I <sup>2</sup> C Serial EEPROM	
	24LC64T:	2.5V, 64 Kbit I <sup>2</sup> C Serial EEPROM (Tape and Reel)	
	24FC64:	2.5V, 64 Kbit I <sup>2</sup> C Serial EEPROM	
	24FC64T:	2.5V, 64 Kbit I <sup>2</sup> C Serial EEPROM (Tape and Reel)	
<b>Temperature Range:</b>	I	= -40°C to +85°C	
	E	= -40°C to +125°C	
<b>Package:</b>	P	= Plastic DIP (300 mil body), 8-lead	
	SN	= Plastic SOIC (3.90 mm body), 8-lead	
	SM	= Plastic SOIC (5.28 mm body), 8-lead	
	ST	= Plastic TSSOP (4.4 mm), 8-lead	
	MS	= Plastic Micro Small Outline (MSOP), 8-lead	
	MC	= 2x3 DFN, 8-lead	
	MNY <sup>(1)</sup>	= TDFN (2x3x0.75 mm body), 8-lead	
	OT	= SOT-23 (Tape and Reel only), 5-lead	
<b>Note 1:</b> "Y" indicates a Nickel Palladium Gold (NiPdAu) finish.			

### Examples:

- 24AA64-I/P: Industrial Temperature, 1.7V, PDIP package
- 24AA64-I/SN: Industrial Temperature, 1.7V, SOIC package
- 24AA64-I/SM: Industrial Temperature, 1.7V, SOIC (5.28 mm) package
- 24AA64T-I/ST: Industrial Temperature, 1.7V, TSSOP package, tape and reel
- 24LC64-I/P: Industrial Temperature, 2.5V, PDIP package
- 24LC64-E/SN: Extended Temperature, 2.5V, SOIC package
- 24LC64-E/SM: Extended Temperature, 2.5V, SOIC (5.28 mm) package
- 24LC64-I/ST: Industrial Temperature, 2.5V, TSSOP package