MICROCHIP

24AA64/24LC64/24FC64

64K I^{2}C™ Serial EEPROM

Device Selection Table

Part Number	Vcc Range	Max. Clock Frequency	Temp. Ranges
24AA64	1.7-5.5	400 kHz[1]	I
24LC64	2.5-5.5	400 kHz	I, E
24FC64	1.7-5.5	1 MHz[2]	I

Note 1: 100 kHz for V_{CC} <2.5V

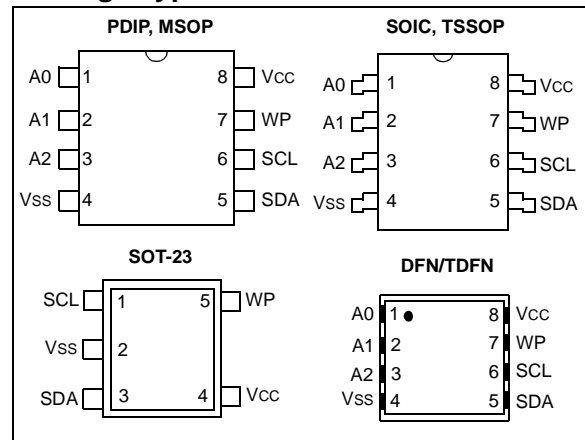**2:** 400 kHz for V_{CC} <2.5V

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^{2}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

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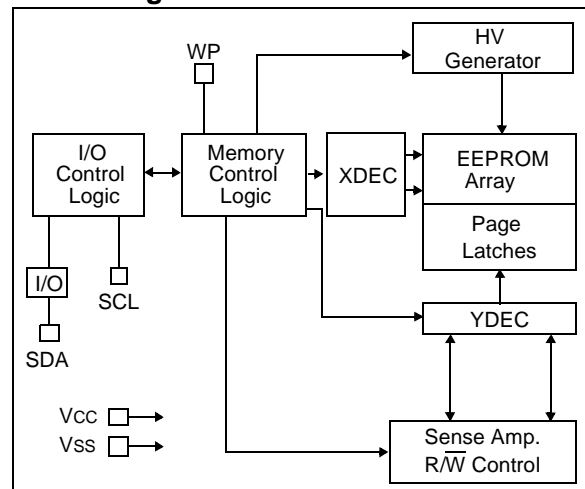
Description:

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

24AA64/24LC64/24FC64

1.0   ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings [†]

VCC...6.5V

All inputs and outputs w.r.t. VSS .... -0.3V to VCC +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, 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
	—	**A0, A1, A2, WP, SCL and SDA pins**	—	—	—	—	—
D1	VIH	High-level input voltage	0.7 VCC	—	—	V	—
D2	VIL	Low-level input voltage	—	—	0.3 VCC 0.2 VCC	V V	VCC ≥ 2.5V VCC < 2.5V
D3	VHYS	Hysteresis of Schmitt Trigger inputs (SDA, SCL pins)	0.05 VCC	—	—	V	VCC ≥ 2.5V **(Note 1)**
D4	VOL	Low-level output voltage	—	—	0.40	V	IOL = 3.0 mA @ VCC = 4.5V IOL = 2.1 mA @ VCC = 2.5V
D5	ILI	**Input leakage current**	—	—	±1	μA	VIN = VSS or VCC, WP = VSS VIN = VSS or VCC, WP = VCC
D6	ILO	**Output leakage current**	—	—	±1	μA	VOUT = VSS or VCC
D7	CIN, COUT	Pin capacitance (all inputs/outputs)	—	—	10	pF	VCC = 5.0V **(Note 1)** TA = 25°C, FCLK = 1 MHz
D8	ICC write	**Operating current**	—	0.1	3	mA	VCC = 5.5V, SCL = 400 kHz
D9	ICC read		—	0.05	400	μA	
D10	ICCS	**Standby current**	— —	.01 —	1 5	μA μA	Industrial Automotive SDA = SCL = VCC A0, A1, A2, WP = VSS

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

     2:   Typical measurements taken at room temperature.

TABLE 1-2: AC CHARACTERISTICS

AC CHARACTERISTICS			Electrical Characteristics: Industrial (I): V_{CC} = +1.7V to 5.5V T_A = -40°C to +85°C Automotive (E): V_{CC} = +2.5V to 5.5V T_A = -40°C to 125°C			
Param. No.	Sym.	Characteristic	Min.	Max.	Units	Conditions
1	F_{CLK}	Clock frequency	— — — —	100 400 400 1000	kHz	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} < 2.5V$ 24FC64 $2.5V \leq V_{CC} \leq 5.5V$ 24FC64
2	T_{HIGH}	Clock high time	4000 600 600 500	— — — —	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
3	T_{LOW}	Clock low time	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
4	T_R	SDA and SCL rise time **(Note 1)**	— — —	1000 300 300	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} \leq 5.5V$ 24FC64
5	T_F	SDA and SCL fall time **(Note 1)**	— —	300 100	ns	All except, 24FC64 $1.7V \leq V_{CC} \leq 5.5V$ 24FC64
6	$T_{HD:STA}$	Start condition hold time	4000 600 600 250	— — — —	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
7	$T_{SU:STA}$	Start condition setup time	4700 600 600 250	— — — —	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
8	$T_{HD:DAT}$	Data input hold time	0	—	ns	**(Note 2)**
9	$T_{SU:DAT}$	Data input setup time	250 100 100	— — —	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} \leq 5.5V$ 24FC64
10	$T_{SU:STO}$	Stop condition setup time	4000 600 600 250	— — — —	ns	$1.7 V \leq V_{CC} < 2.5V$ $2.5 V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} < 2.5V$ 24FC64 $2.5 V \leq V_{CC} \leq 5.5V$ 24FC64
11	$T_{SU:WP}$	WP setup time	4000 600 600	— — —	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} \leq 5.5V$ 24FC64
12	$T_{HD:WP}$	WP hold time	4700 1300 1300	— — —	ns	$1.7V \leq V_{CC} < 2.5V$ $2.5V \leq V_{CC} \leq 5.5V$ $1.7V \leq V_{CC} \leq 5.5V$ 24FC64

Note 1: Not 100% tested. C_B = 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 T_{SP} and V_{HYS} specifications are due to new Schmitt Trigger inputs, which provide improved noise spike suppression. This eliminates the need for a T_I 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

| Param. No.	Sym.	Characteristic	Min.	Max.	Units	Conditions
AC CHARACTERISTICS			Electrical Characteristics: Industrial (I): VCC = +1.7V to 5.5V TA = -40°C to +85°C Automotive (E): VCC = +2.5V to 5.5V TA = -40°C to 125°C			
13	TAA	Output valid from clock **(Note 2)**	— — — —	3500 900 900 400	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 **(Note 1)** 24FC64 **(Note 1)**
16	TSP	Input filter spike suppression (SDA and SCL pins)	—	50	ns	All except, 24FC64 **(Notes 1 and 3)**
17	TWC	Write cycle time (byte or page)	—	5	ms	—
18	—	Endurance	1,000,000	—	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.
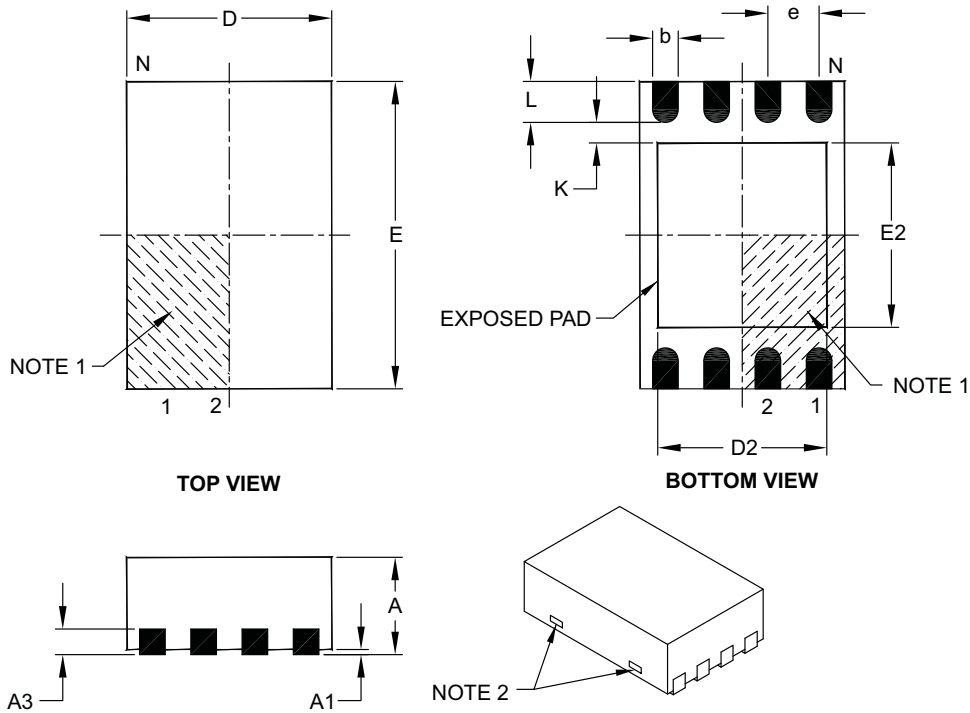
4: This parameter is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model, which can be obtained from Microchip's web site

FIGURE 1-1: BUS TIMING DATA
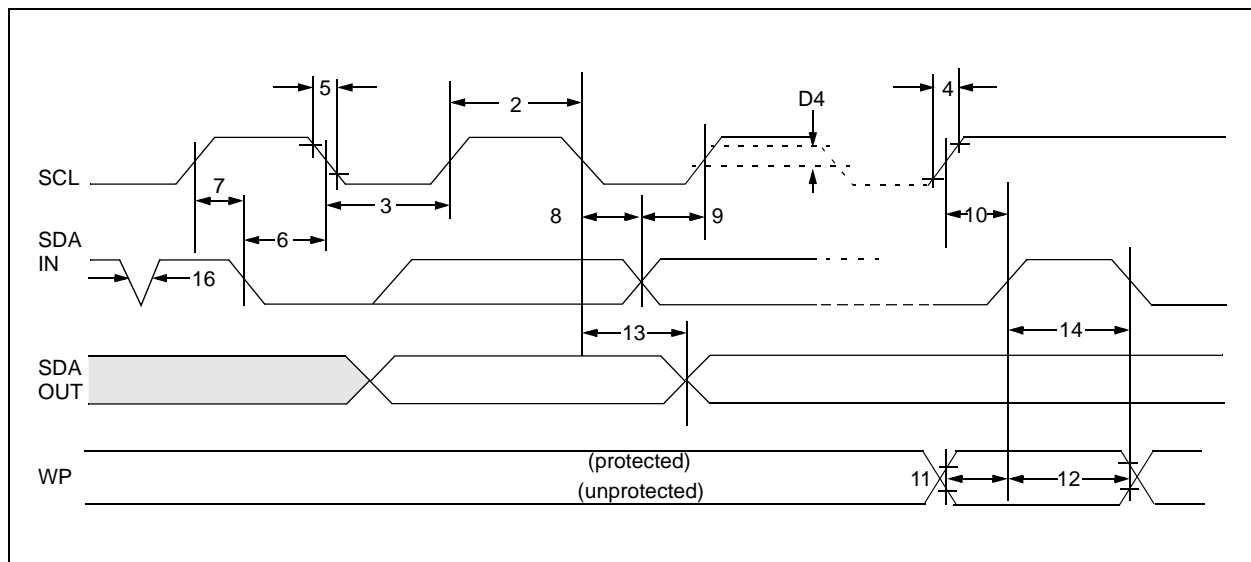
8-Lead Plastic Dual Flat, No Lead Package (MC) – 2x3x0.9 mm Body [DFN]

TOP VIEW

BOTTOM VIEW

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Length	D		2.00 BSC	
Overall Width	E		3.00 BSC	
Exposed Pad Length	D2	1.30	–	1.55
Exposed Pad Width	E2	1.50	–	1.75
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.30	0.40	0.50
Contact-to-Exposed Pad	K	0.20	–	–

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package may have one or more exposed tie bars at ends.
3. Package is saw singulated.
4. 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 C04-123C

PRODUCT IDENTIFICATION SYSTEM

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

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PART NO.          X          /XX

Device      Temperature   Package
              Range
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Device:	24AA64:	1.7V, 64 Kbit I^{2}C™ Serial EEPROM
	24AA64T:	1.7V, 64 Kbit I^{2}C Serial EEPROM (Tape and Reel)
	24LC64:	2.5V, 64 Kbit I^{2}C Serial EEPROM
	24LC64T:	2.5V, 64 Kbit I^{2}C Serial EEPROM (Tape and Reel)
	24FC64:	2.5V, 64 Kbit I^{2}C Serial EEPROM
	24FC64T:	2.5V, 64 Kbit I^{2}C Serial EEPROM (Tape and Reel)

Temperature Range:	I	=	-40°C to +85°C
	E	=	-40°C to +125°C

Package:	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[1]	=	TDFN (2x3x0.75 mm body), 8-lead
	OT	=	SOT-23 (Tape and Reel only), 5-lead

Note 1: "Y" indicates a Nickel Palladium Gold (NiPdAu) finish.

Examples:

a) 24AA64-I/P: Industrial Temperature, 1.7V, PDIP package

b) 24AA64-I/SN: Industrial Temperature, 1.7V, SOIC package

c) 24AA64-I/SM: Industrial Temperature, 1.7V, SOIC (5.28 mm) package

d) 24AA64T-I/ST: Industrial Temperature, 1.7V, TSSOP package, tape and reel

e) 24LC64-I/P: Industrial Temperature, 2.5V, PDIP package

f) 24LC64-E/SN: Extended Temperature, 2.5V, SOIC package

g) 24LC64-E/SM: Extended Temperature, 2.5V, SOIC (5.28 mm) package

h) 24LC64-I/ST: Industrial Temperature, 2.5V, TSSOP package