24AA512/24LC512/24FC512

512K I²C™ CMOS Serial EEPROM

Device Selection Table

Part Number	Vcc Range	Max. Clock Frequency	Temp. Ranges
24AA512	1.7-5.5V	400 kHz(1)	I
24LC512	2.5-5.5V	400 kHz	I, E
24FC512	1.7-5.5V	1 MHz(2)	I

Note 1: 100 kHz for VCC < 2.5V

2: 400 kHz for VCC < 2.5V

Features:

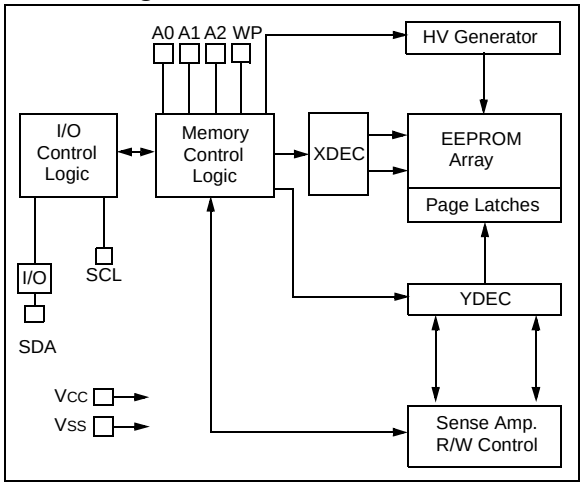
- Single Supply with Operation Down to 1.7V for 24AA512 and 24FC512 Devices, 2.5V for 24LC512 Devices
- Low-Power CMOS Technology:
  - Active current 400 uA, typical
  - Standby current 100 nA, typical
- 2-Wire Serial Interface, I²C™ Compatible
- Cascadable for up to Eight Devices
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 100 kHz and 400 kHz Clock Compatibility
- Page Write Time 5 ms max.
- Self-Timed Erase/Write Cycle
- 128-Byte Page Write Buffer
- Hardware Write-Protect
- ESD Protection >4000V
- More than 1 Million Erase/Write Cycles
- Data Retention > 200 years
- Packages Include 8-lead PDIP, SOIJ and DFN
- Pb-Free and RoHS Compliant
- Temperature Ranges:
  - Industrial (I): -40°C to +85°C
  - Automotive (E):-40°C to +125°C

* 24XX512 is used in this document as a generic part number for the 24AA512/24LC512/24FC512 devices.

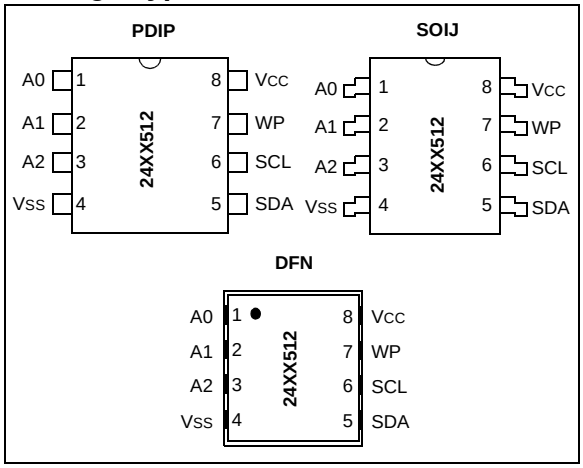
Description:

The Microchip Technology Inc. 24AA512/24LC512/24FC512 (24XX512*) is a 64K x 8 (512 Kbit) Serial Electrically Erasable PROM, capable of operation across a broad voltage range (1.7V to 5.5V). It has been developed for advanced, low-power applications such as personal communications and data acquisition. This device also has a page write capability of up to 128 bytes of data. This device is capable of both random and sequential reads up to the 512K boundary. Functional address lines allow up to eight devices on the same bus, for up to 4 Mbit address space. This device is available in the standard 8-pin plastic DIP, SOIJ and DFN packages.

Block Diagram



Package Type



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (†)

VCC.....6.5V

All inputs and outputs w.r.t. VSS ..... -0.6V 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			**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			
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
D1	—	A0, A1, A2, SCL, SDA and WP pins:	—	—	—	—
D2	VIH	High-level input voltage	0.7 VCC	—	V	—
D3	VIL	Low-level input voltage	—	0.3 VCC 0.2 VCC	V V	VCC ≥ 2.5V VCC < 2.5V
D4	VHYS	Hysteresis of Schmitt Trigger inputs (SDA, SCL pins)	0.05 VCC	—	V	VCC ≥ 2.5V **(Note)**
D5	VOL	Low-level output voltage	—	0.40	V	IOL = 3.0 ma @ VCC = 4.5V IOL = 2.1 ma @ VCC = 2.5V
D6	ILI	Input leakage current	—	±1	µA	VIN = VSS or VCC, WP = VSS VIN = VSS or VCC, WP = VCC
D7	ILO	Output leakage current	—	±1	µA	VOUT = VSS or VCC
D8	CIN, COUT	Pin capacitance (all inputs/outputs)	—	10	pF	VCC = 5.0V **(Note)** TA = 25°C, FCLK = 1 MHz
D9	ICC Read	Operating current	—	400	µA	VCC = 5.5V, SCL = 400 kHz
	ICC Write		—	5	mA	VCC = 5.5V
D10	ICCS	Standby current	—	1	µA	TA = -40°C to +85°C SCL = SDA = VCC = 5.5V A0, A1, A2, WP = VSS
			—	5	µA	TA = -40°C to +125°C SCL = SDA = VCC = 5.5V A0, A1, A2, WP = VSS

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

TABLE 1-2: AC CHARACTERISTICS

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			
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
1	FCLK	Clock frequency	— — — —	100 400 400 1000	kHz	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
2	THIGH	Clock high time	4000 600 600 500	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
3	TLOW	Clock low time	4700 1300 1300 500	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
4	TR	SDA and SCL rise time **(Note 1)**	— — —	1000 300 300	ns	1.7V ≤ Vcc< 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC ≤ 5.5V 24FC512
5	TF	SDA and SCL fall time **(Note 1)**	— —	300 100	ns	All except, 24FC512 1.7V ≤ VCC ≤ 5.5V 24FC512
6	THD:STA	Start condition hold time	4000 600 600 250	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
7	TSU:STA	Start condition setup time	4700 600 600 250	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
8	THD:DAT	Data input hold time	0	—	ns	**(Note 2)**
9	TSU:DAT	Data input setup time	250 100 100	— — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC ≤ 5.5V 24FC512
10	TSU:STO	Stop condition setup time	4000 600 600 250	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
11	TSU:WP	WP setup time	4000 600 600	— — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC ≤ 5.5V 24FC512
12	THD:WP	WP hold time	4700 1300 1300	— — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC ≤ 5.5V 24FC512
13	TAA	Output valid from clock **(Note 2)**	— — — —	3500 900 900 400	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512
14	TBUF	Bus free time: Time the bus must be free before a new transmission can start	4700 1300 1300 500	— — — —	ns	1.7V ≤ VCC < 2.5V 2.5V ≤ VCC ≤ 5.5V 1.7V ≤ VCC < 2.5V 24FC512 2.5V ≤ VCC ≤ 5.5V 24FC512

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

AC CHARACTERISTICS (Continued)			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			
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
16	TSP	Input filter spike suppression (SDA and SCL pins)	—	50	ns	All except, 24FC512 **(Notes 1 and 3)**
17	TWC	Write cycle time (byte or page)	—	5	ms	—
18	—	Endurance	1,000,000	—	cycles	25°C **(Note 4)**

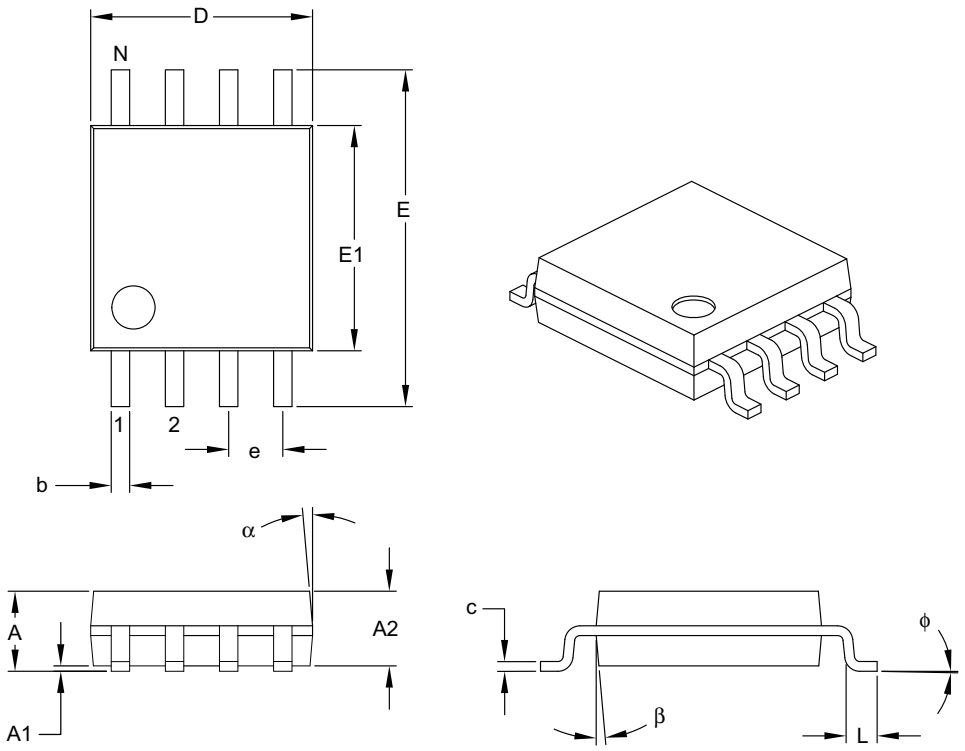
Note 1: Not 100% tested. CB = total capacitance of one bus line in pF.

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 at www.microchip.com.

8-Lead Plastic Small Outline (SM) – Medium, 5.28 mm Body [SOIJ]



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	1.77	–	2.03
Molded Package Thickness	A2	1.75	–	1.98
Standoff §	A1	0.05	–	0.25
Overall Width	E	7.62	–	8.26
Molded Package Width	E1	5.11	–	5.38
Overall Length	D	5.13	–	5.33
Foot Length	L	0.51	–	0.76
Foot Angle	ϕ	0°	–	8°
Lead Thickness	c	0.15	–	0.25
Lead Width	b	0.36	–	0.51
Mold Draft Angle Top	α	–	–	15°
Mold Draft Angle Bottom	β	–	–	15°

Notes:

1. SOIJ, JEITA/EIAJ Standard, formerly called SOIC.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25 mm per side.

Microchip Technology Drawing C04-056B

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

Device:	24AA512:	512 Kbit 1.8V I^2C Serial EEPROM
	24AA512T:	512 Kbit 1.8V I^2C Serial EEPROM (Tape and Reel)
	24LC512:	512 Kbit 2.5V I^2C Serial EEPROM
	24LC512T:	512 Kbit 2.5V I^2C Serial EEPROM (Tape and Reel)
	24FC512:	512 Kbit 1 MHz I^2C Serial EEPROM
	24FC512T:	512 Kbit 1 MHz I^2C 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
	SM =	Plastic SOIJ (5.28 mm body), 8-lead
	MF =	Micro Lead Frame (6x5 mm body), 8-lead

Examples:

a) 24AA512-I/P: Industrial Temp., 1.7V, PDIP package.

b) 24AA512T-I/SM: Tape and Reel, Industrial Temp., 1.7V, SOIJ package.

c) 24AA512-I/MF: Industrial Temp., 1.7V, DFN package.

d) 24LC512-E/P: Extended Temp., 2.5V, PDIP package.

e) 24LC512-I/SM: Industrial Temp., 2.5V, SOIJ package.

f) 24LC512T-I/SM: Tape and Reel, Industrial Temp., 2.5V, SOIJ package.

g) 24LC512-I/MF: Industrial Temp., 2.5V, DFN package.

h) 24FC512-I/P: Industrial Temp., 1.7V, High Speed, PDIP package.

i) 24FC512-I/SM: Industrial Temp., 1.7V, High Speed, SOIJ package.

j) 24FC512T-I/SM: Tape and Reel, Industrial Temp., 1.7V, High Speed, SOIJ package.