



Obsolete Device

# 28C04A

## 4K (512 x 8) CMOS EEPROM

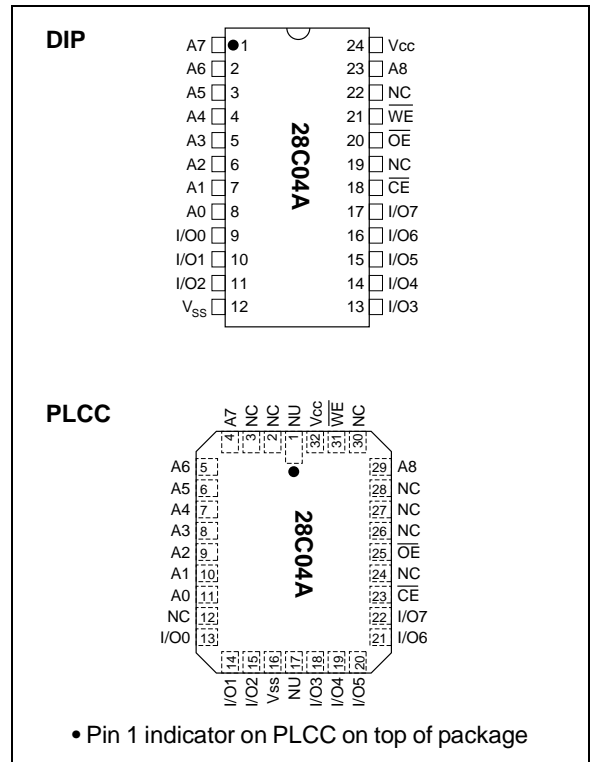
### FEATURES

- Fast Read Access Time—150 ns
- CMOS Technology for Low Power Dissipation
  - 30 mA Active
  - 100  $\mu$ A Standby
- Fast Byte Write Time—200  $\mu$ s or 1 ms
- Data Retention >200 years
- Endurance - Minimum  $10^4$  Erase/Write Cycles
  - Automatic Write Operation
  - Internal Control Timer
  - Auto-Clear Before Write Operation
  - On-Chip Address and Data Latches
- Data Polling
- Chip Clear Operation
- Enhanced Data Protection
  - VCC Detector
  - Pulse Filter
  - Write Inhibit
- 5-Volt-Only Operation
- Organized 512x8 JEDEC standard pinout
  - 24-pin Dual-In-Line Package
  - 32-pin PLCC Package
- Available for Extended Temperature Ranges:
  - Commercial: 0°C to +70°C
  - Industrial: -40°C to +85°C

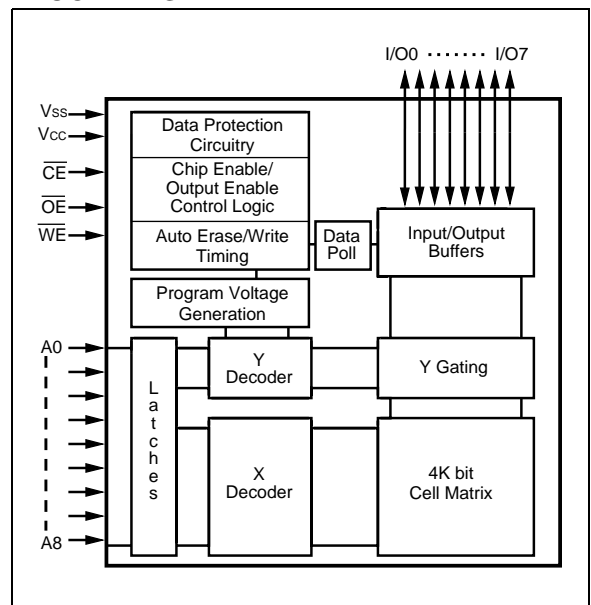
### DESCRIPTION

The Microchip Technology Inc. 28C04A is a CMOS 4K non-volatile electrically Erasable and Programmable Read Only Memory (EEPROM). The 28C04A is accessed like a static RAM for the read or write cycles without the need of external components. During a "byte write", the address and data are latched internally, freeing the microprocessor address and data bus for other operations. Following the initiation of write cycle, the device will go to a busy state and automatically clear and write the latched data using an internal control timer. To determine when a write cycle is complete, the 28C04A uses Data polling. Data polling allows the user to read the location last written to when the write operation is complete. CMOS design and processing enables this part to be used in systems where reduced power consumption and reliability are required. A complete family of packages is offered to provide the utmost flexibility in applications.

### PACKAGE TYPES



### BLOCK DIAGRAM



# 28C04A

## 1.0 ELECTRICAL CHARACTERISTICS

### 1.1 MAXIMUM RATINGS\*

Vcc and input voltages w.r.t. Vss ..... -0.6V to + 6.25V  
 Voltage on  $\overline{OE}$  w.r.t. Vss..... -0.6V to +13.5V  
 Output Voltage w.r.t. Vss .....-0.6V to Vcc+0.6V  
 Storage temperature .....-65°C to +125°C  
 Ambient temp. with power applied .....-50°C to +95°C

**\*Notice:** Stresses above those listed under "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 operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

**TABLE 1-1: PIN FUNCTION TABLE**

Name	Function
A0 - A8	Address Inputs
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable
$\overline{WE}$	Write Enable
I/O0 - I/O7	Data Inputs/Outputs
Vcc	+5V Power Supply
Vss	Ground
NC	No Connect; No Internal Connection
NU	Not Used; No External Connection is Allowed

**TABLE 1-2: READ/WRITE OPERATION DC CHARACTERISTICS**

Vcc = +5V ±10%						
Commercial (C): Tamb = 0°C to +70°C						
Industrial (I): Tamb = -40°C to +85°C						
Parameter	Status	Symbol	Min	Max	Units	Conditions
Input Voltages	Logic '1'	V <sub>IH</sub>	2.0	V <sub>CC</sub> +1	V	
	Logic '0'	V <sub>IL</sub>	-0.1	0.8	V	
Input Leakage		I <sub>LI</sub>	-10	10	μA	V <sub>IN</sub> = -0.1V to V <sub>CC</sub> +1
Input Capacitance		C <sub>IN</sub>		10	pF	V <sub>IN</sub> = 0V; Tamb = 25°C; f = 1 MHz
Output Voltages	Logic '1'	V <sub>OH</sub>	2.4		V	I <sub>OH</sub> = -400 μA I <sub>OL</sub> = 2.1 mA
	Logic '0'	V <sub>OL</sub>		0.45	V	
Output Leakage		I <sub>LO</sub>	-10	10	μA	V <sub>OUT</sub> = -0.1V TO V <sub>CC</sub> + 0.1V
Output Capacitance		C <sub>OUT</sub>		12	pF	V <sub>IN</sub> = 0V; T <sub>AMB</sub> = 25°C; f = 1 MHz
Power Supply Current, Active	TTL input	I <sub>CC</sub>		30	mA	f = 5 MHz (Note 1) V <sub>CC</sub> = 5.5V
Power Supply Current, Standby	TTL input	I <sub>CC(S)TTL</sub>		2	mA	$\overline{CE}$ = V <sub>IH</sub> (0°C to +70°C) $\overline{CE}$ = V <sub>IH</sub> (-40°C to +85°C) $\overline{CE}$ = V <sub>CC</sub> -0.3 to V <sub>CC</sub> +1 $\overline{OE}$ = V <sub>CC</sub> All inputs equal V <sub>CC</sub> or V <sub>SS</sub>
	TTL input	I <sub>CC(S)TTL</sub>		3	mA	
	CMOS input	I <sub>CC(S)CMOS</sub>		100	μA	

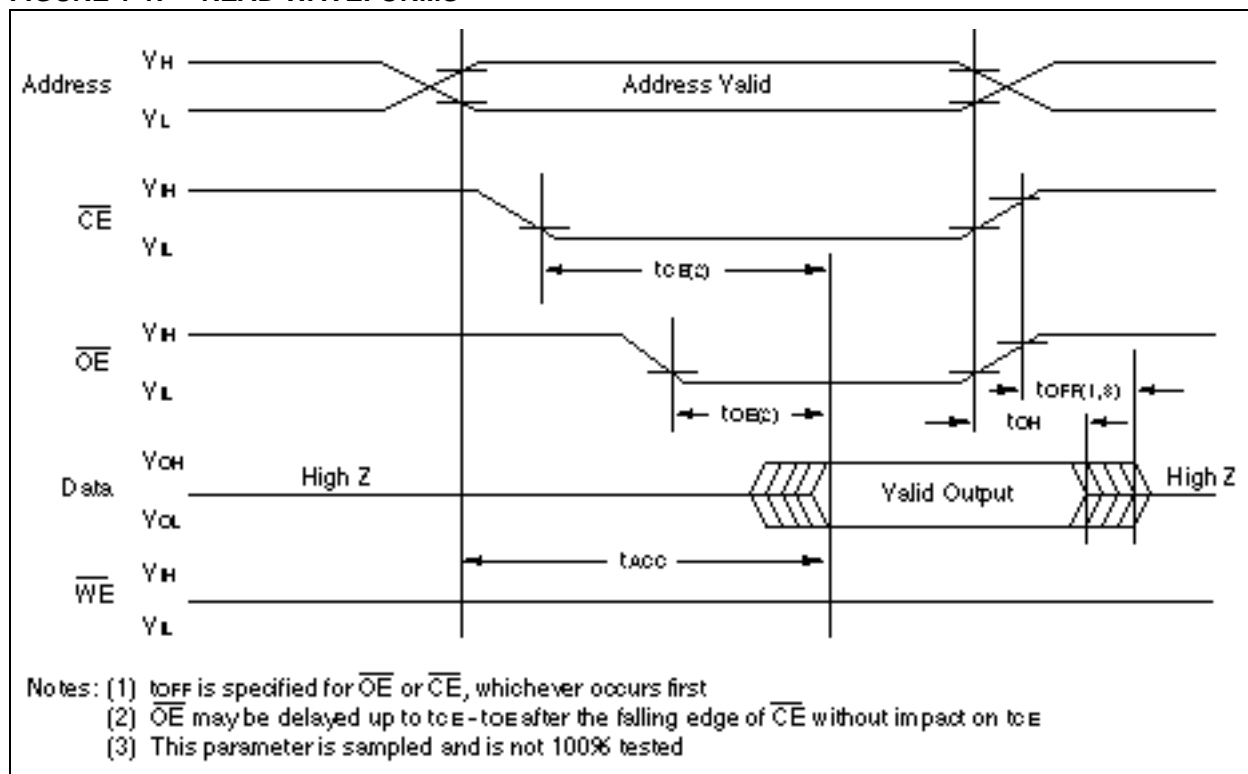
Note 1: AC power supply current above 5 MHz; 1 mA/MHz.

**TABLE 1-3: READ OPERATION AC CHARACTERISTICS**

		AC Testing Waveform:		Output Load:		Input Rise and Fall Times:		Ambient Temperature:	
		$V_{IH} = 2.4V; V_{IL} = 0.45V; V_{OH} = 2.0V; V_{OL} = 0.8V$		1 TTL Load + 100 pF		20 ns		Commercial (C): $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$ Industrial (I): $T_{amb} = -40^{\circ}C$ to $+85^{\circ}C$	
Parameter	Sym	28C04A-15		28C04A-20		28C04A-25		Units	Conditions
		Min	Max	Min	Max	Min	Max		
Address to Output Delay	$t_{ACC}$		150		200		250	ns	$\overline{OE} = \overline{CE} = V_{IL}$
$\overline{CE}$ to Output Delay	$t_{CE}$		150		200		250	ns	$\overline{OE} = V_{IL}$
$\overline{OE}$ to Output Delay	$t_{OE}$		70		80		100	ns	$\overline{CE} = V_{IL}$
$\overline{CE}$ to $\overline{OE}$ High Output Float	$t_{OFF}$	0	50	0	55	0	70	ns	
Output Hold from Address, $\overline{CE}$ or $\overline{OE}$ , whichever occurs first	$t_{OH}$	0		0		0		ns	
Endurance	—	1M	—	1M	—	1M	—	cycles	$25^{\circ}C, V_{CC} = 5.0V$ , Block Mode (Note)

Note: This parameter is not tested but guaranteed by characterization. For endurance estimates in a specific application, please consult the Total Endurance Model which can be obtained on our BBS or website.

**FIGURE 1-1: READ WAVEFORMS**



# 28C04A

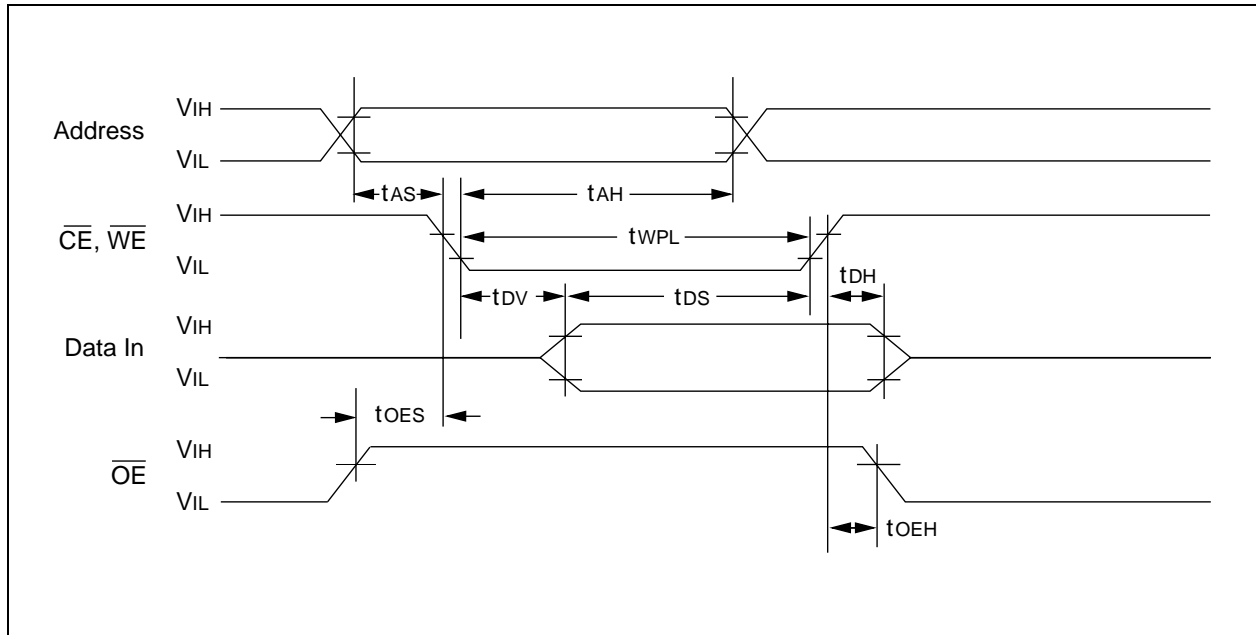
**TABLE 1-4: BYTE WRITE AC CHARACTERISTICS**

Parameter	Symbol	Min	Max	Units	Remarks
AC Testing Waveform:		$V_{IH} = 2.4V$ ; $V_{IL} = 0.45V$ ; $V_{OH} = 2.0V$ ; $V_{OL} = 0.8V$ Output Load: 1 TTL Load + 100 pF Input Rise/Fall Times: 20 nsec Ambient Temperature: Commercial (C): $T_{amb} = 0^{\circ}C$ to $70^{\circ}C$ Industrial (I): $T_{amb} = -40^{\circ}C$ to $85^{\circ}C$			
Address Set-Up Time	tAS	10		ns	
Address Hold Time	tAH	50		ns	
Data Set-Up Time	tDS	50		ns	
Data Hold Time	tDH	10		ns	
Write Pulse Width	twPL	100		ns	Note 1
Write Pulse High Time	twPH	50		ns	
$\overline{OE}$ Hold Time	toEH	10		ns	
$\overline{OE}$ Set-Up Time	toES	10		ns	
Data Valid Time	tDV		1000	ns	Note 2
Write Cycle Time (28C04A)	tWC		1	ms	0.5 ms typical
Write Cycle Time (28C04AF)	tWC		200	$\mu s$	100 $\mu s$ typical

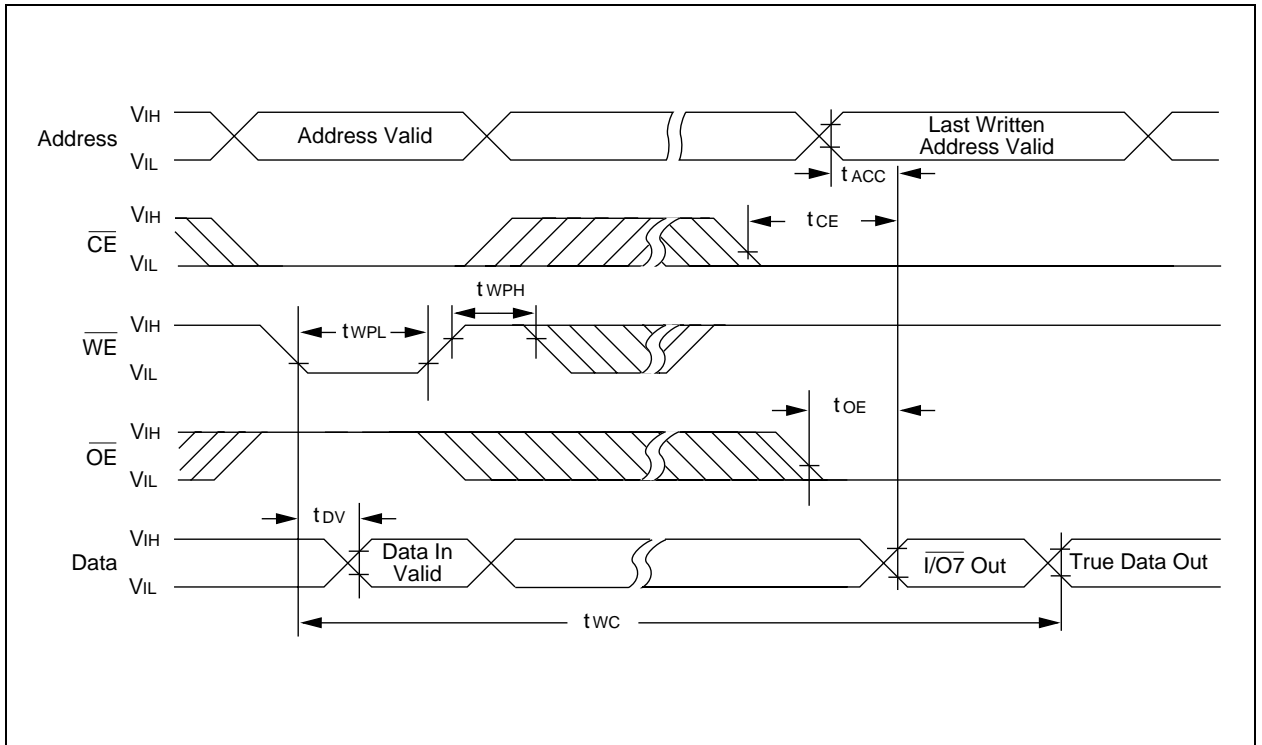
Note 1: A write cycle can be initiated by  $\overline{CE}$  or  $\overline{WE}$  going low, whichever occurs last. The data is latched on the positive edge of  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs first.

2: Data must be valid within 1000ns max. after a write cycle is initiated and must be stable at least until tDH after the positive edge of  $\overline{WE}$  or  $\overline{CE}$ , whichever occurs first.

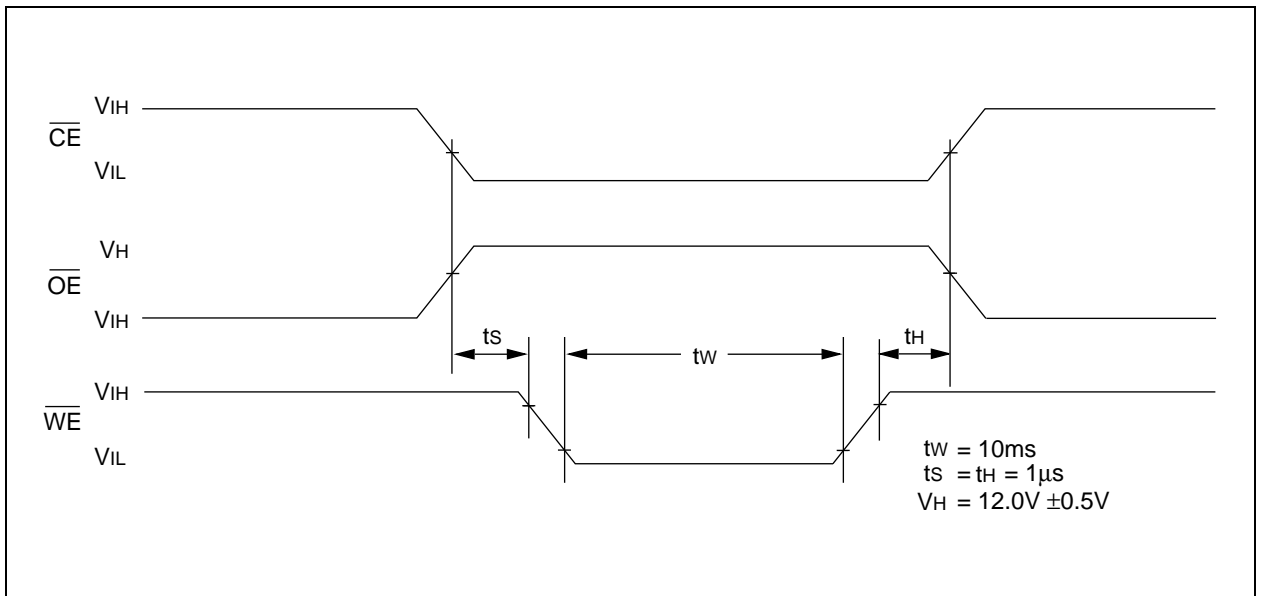
**FIGURE 1-2: PROGRAMMING WAVEFORMS**



**FIGURE 1-3: DATA POLLING WAVEFORMS**



**FIGURE 1-4: CHIP CLEAR WAVEFORMS**



# 28C04A

## 2.0 DEVICE OPERATION

The Microchip Technology Inc. 28C04A has four basic modes of operation—read, standby, write inhibit, and byte write—as outlined in the following table.

Operation Mode	$\overline{\text{CE}}$	$\overline{\text{IE}}$	$\overline{\text{WE}}$	I/O
Read	L	L	H	DOUT
Standby	H	X	X	High Z
Write Inhibit	H	X	X	High Z
Write Inhibit	X	L	X	High Z
Write Inhibit	X	X	H	High Z
Byte Write	L	H	L	DIN
Byte Clear	Automatic Before Each "Write"			

X = Any TTL level.

### 2.1 Read Mode

The 28C04A has two control functions, both of which must be logically satisfied in order to obtain data at the outputs. Chip enable ( $\overline{\text{CE}}$ ) is the power control and should be used for device selection. Output Enable ( $\overline{\text{OE}}$ ) is the output control and is used to gate data to the output pins independent of device selection. Assuming that addresses are stable, address access time ( $t_{\text{ACC}}$ ) is equal to the delay from  $\overline{\text{CE}}$  to output ( $t_{\text{CE}}$ ). Data is available at the output  $t_{\text{OE}}$  after the falling edge of  $\overline{\text{OE}}$ , assuming that  $\overline{\text{CE}}$  has been low and addresses have been stable for at least  $t_{\text{ACC}}-t_{\text{OE}}$ .

### 2.2 Standby Mode

The 28C04A is placed in the standby mode by applying a high signal to the  $\overline{\text{CE}}$  input. When in the standby mode, the outputs are in a high impedance state, independent of the  $\overline{\text{OE}}$  input.

### 2.3 Data Protection

In order to ensure data integrity, especially during critical power-up and power-down transitions, the following enhanced data protection circuits are incorporated:

First, an internal  $V_{\text{CC}}$  detect (3.3 volts typical) will inhibit the initiation of non-volatile programming operation when  $V_{\text{CC}}$  is less than the  $V_{\text{CC}}$  detect circuit trip.

Second, there is a  $\overline{\text{WE}}$  filtering circuit that prevents  $\overline{\text{WE}}$  pulses of less than 10 ns duration from initiating a write cycle.

Third, holding  $\overline{\text{WE}}$  or  $\overline{\text{CE}}$  high or  $\overline{\text{OE}}$  low, inhibits a write cycle during power-on and power-off ( $V_{\text{CC}}$ ).

### 2.4 Write Mode

The 28C04A has a write cycle similar to that of a Static RAM. The write cycle is completely self-timed and initiated by a low going pulse on the  $\overline{\text{WE}}$  pin. On the falling edge of  $\overline{\text{WE}}$ , the address information is latched. On rising edge, the data and the control pins ( $\overline{\text{CE}}$  and  $\overline{\text{OE}}$ ) are latched.

### 2.5 Data Polling

The 28C04A features Data polling to signal the completion of a byte write cycle. During a write cycle, an attempted read of the last byte written results in the data complement of I/O7 (I/O0 to I/O6 are indeterminate). After completion of the write cycle, true data is available. Data polling allows a simple read/compare operation to determine the status of the chip eliminating the need for external hardware.

### 2.6 Chip Clear

All data may be cleared to 1's in a chip clear cycle by raising  $\overline{\text{OE}}$  to 12 volts and bringing the  $\overline{\text{WE}}$  and  $\overline{\text{CE}}$  low. This procedure clears all data.

# 28C04A

## 28C04A Product Identification System

To order or to obtain information, e.g., on pricing or delivery, please use the listed part numbers, and refer to the factory or the listed sales offices.

<b>28C04A</b>	<b>F</b>	<b>T</b>	<b>-</b>	<b>15</b>	<b>I</b>	<b>/P</b>	
							<b>Package:</b>
							L = Plastic Leaded Chip Carrier (PLCC) P = Plastic DIP (600mil)
							<b>Temperature Range:</b>
							Blank = 0°C to +70°C I = -40°C to +85°C
							<b>Access Time:</b>
							15 150 ns 20 200 ns 25 250 ns
							<b>Shipping:</b>
							Blank Tube T Tape and Reel "L" only
							<b>Option:</b>
							Blank = twc = 1ms F = twc = 200 μs
							<b>Device:</b>
							28C04A 512 x 8 CMOS EEPROM

# 28C04A

---

NOTES:



---

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

**Trademarks**

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELOQ, microID, MPLAB, PIC, PICmicro, PICSTART, PRO MATE, PowerSmart, rfPIC, and SmartShunt are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


AmpLab, FilterLab, MXDEV, MXLAB, PICMASTER, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, dsPICDEM, dsPICDEM.net, dsPICworks, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, PICkit, PICDEM, PICDEM.net, PICLAB, PICTail, PowerCal, PowerInfo, PowerMate, PowerTool, rLAB, rfPICDEM, Select Mode, Smart Serial, SmartTel and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2004, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

**QUALITY MANAGEMENT SYSTEM  
CERTIFIED BY DNV  
== ISO/TS 16949:2002 ==**

*Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*



## WORLDWIDE SALES AND SERVICE

### AMERICAS

#### Corporate Office

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
Fax: 480-792-7277  
Technical Support: 480-792-7627  
Web Address: www.microchip.com

#### Atlanta

3780 Mansell Road, Suite 130  
Alpharetta, GA 30022  
Tel: 770-640-0034  
Fax: 770-640-0307

#### Boston

2 Lan Drive, Suite 120  
Westford, MA 01886  
Tel: 978-692-3848  
Fax: 978-692-3821

#### Chicago

333 Pierce Road, Suite 180  
Itasca, IL 60143  
Tel: 630-285-0071  
Fax: 630-285-0075

#### Dallas

16200 Addison Road, Suite 255  
Addison Plaza  
Addison, TX 75001  
Tel: 972-818-7423  
Fax: 972-818-2924

#### Detroit

Tri-Atria Office Building  
32255 Northwestern Highway, Suite 190  
Farmington Hills, MI 48334  
Tel: 248-538-2250  
Fax: 248-538-2260

#### Kokomo

2767 S. Albright Road  
Kokomo, IN 46902  
Tel: 765-864-8360  
Fax: 765-864-8387

#### Los Angeles

25950 Acero St., Suite 200  
Mission Viejo, CA 92691  
Tel: 949-462-9523  
Fax: 949-462-9608

#### San Jose

1300 Terra Bella Avenue  
Mountain View, CA 94043  
Tel: 650-215-1444  
Fax: 650-961-0286

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699  
Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Unit 32 41 Rawson Street  
Epping 2121, NSW  
Sydney, Australia  
Tel: 61-2-9868-6733  
Fax: 61-2-9868-6755

#### China - Beijing

Unit 706B  
Wan Tai Bei Hai Bldg.  
No. 6 Chaoyangmen Bei Str.  
Beijing, 100027, China  
Tel: 86-10-85282100  
Fax: 86-10-85282104

#### China - Chengdu

Rm. 2401-2402, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-86766200  
Fax: 86-28-86766599

#### China - Fuzhou

Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506  
Fax: 86-591-7503521

#### China - Hong Kong SAR

Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200  
Fax: 852-2401-3431

#### China - Shanghai

Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700  
Fax: 86-21-6275-5060

#### China - Shenzhen

Rm. 1812, 18/F, Building A, United Plaza  
No. 5022 Binhe Road, Futian District  
Shenzhen 518033, China  
Tel: 86-755-82901380  
Fax: 86-755-8295-1393

#### China - Shunde

Room 401, Hongjian Building, No. 2  
Fengxiangnan Road, Ronggui Town, Shunde  
District, Foshan City, Guangdong 528303, China  
Tel: 86-757-28395507 Fax: 86-757-28395571

#### China - Qingdao

Rm. B505A, Fullhope Plaza,  
No. 12 Hong Kong Central Rd.  
Qingdao 266071, China  
Tel: 86-532-5027355 Fax: 86-532-5027205

#### India

Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaughnessey Road  
Bangalore, 560 025, India  
Tel: 91-80-22290061 Fax: 91-80-22290062

#### Japan

Yusen Shin Yokohama Building 10F  
3-17-2, Shin Yokohama, Kohoku-ku,  
Yokohama, Kanagawa, 222-0033, Japan  
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

#### Korea

168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5932 or  
82-2-558-5934

#### Singapore

200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

#### Taiwan

Kaohsiung Branch  
30F - 1 No. 8  
Min Chuan 2nd Road  
Kaohsiung 806, Taiwan  
Tel: 886-7-536-4816  
Fax: 886-7-536-4817

#### Taiwan

Taiwan Branch  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

#### Taiwan

Taiwan Branch  
13F-3, No. 295, Sec. 2, Kung Fu Road  
Hsinchu City 300, Taiwan  
Tel: 886-3-572-9526  
Fax: 886-3-572-6459

### EUROPE

#### Austria

Durisolstrasse 2  
A-4600 Wels  
Austria  
Tel: 43-7242-2244-399  
Fax: 43-7242-2244-393

#### Denmark

Regus Business Centre  
Lautrup hoy 1-3  
Ballerup DK-2750 Denmark  
Tel: 45-4420-9895 Fax: 45-4420-9910

#### France

Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

#### Germany

Steinheilstrasse 10  
D-85737 Ismaning, Germany  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

#### Italy

Via Salvatore Quasimodo, 12  
20025 Legnano (MI)  
Milan, Italy  
Tel: 39-0331-742611  
Fax: 39-0331-466781

#### Netherlands

Waegenburghtplein 4  
NL-5152 JR, Drunen, Netherlands  
Tel: 31-416-690399  
Fax: 31-416-690340

#### United Kingdom

505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44-118-921-5869  
Fax: 44-118-921-5820