

4K (512 x 8) CMOS EEPROM

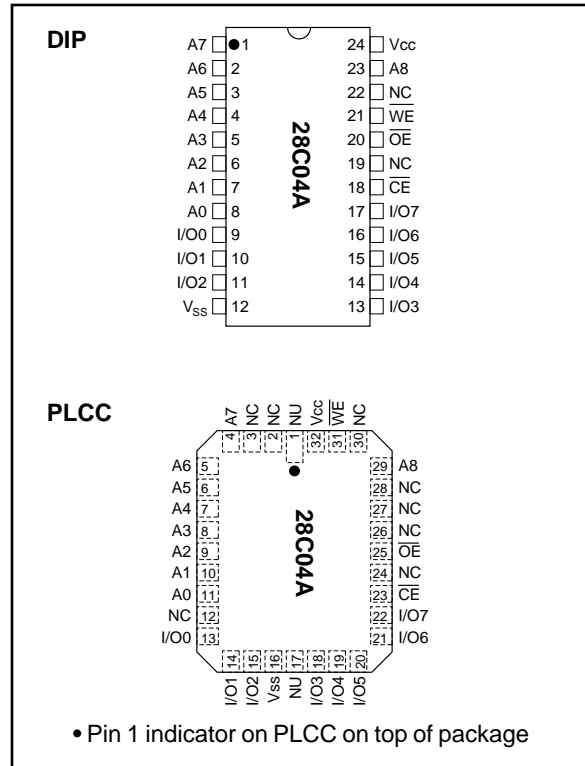
FEATURES

- Fast Read Access Time—150 ns
- CMOS Technology for Low Power Dissipation
 - 30 mA Active
 - 100 μ A Standby
- Fast Byte Write Time—200 μ 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

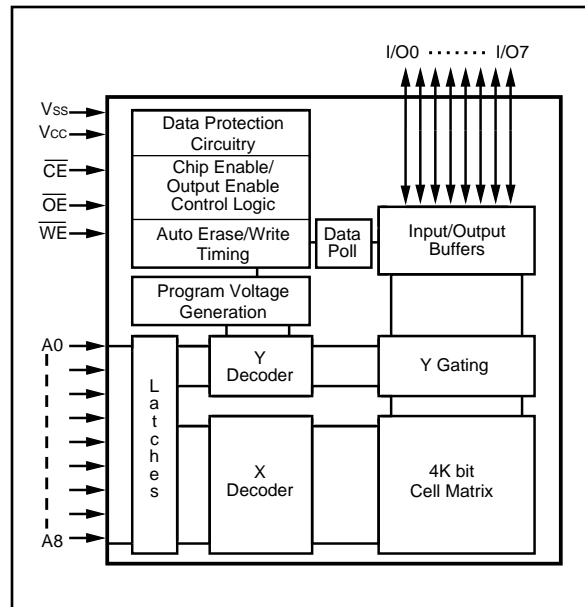
DESCRIPTION

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*

V_{CC} and input voltages w.r.t. V_{SS} -0.6V to + 6.25V
 Voltage on \overline{OE} w.r.t. V_{SS}.....-0.6V to +13.5V
 Output Voltage w.r.t. V_{SS}-0.6V to V_{CC}+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 |
| V _{CC} | +5V Power Supply |
| V _{SS} | Ground |
| NC | No Connect; No Internal Connection |
| NU | Not Used; No External Connection is Allowed |

TABLE 1-2: READ/WRITE OPERATION DC CHARACTERISTICS

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

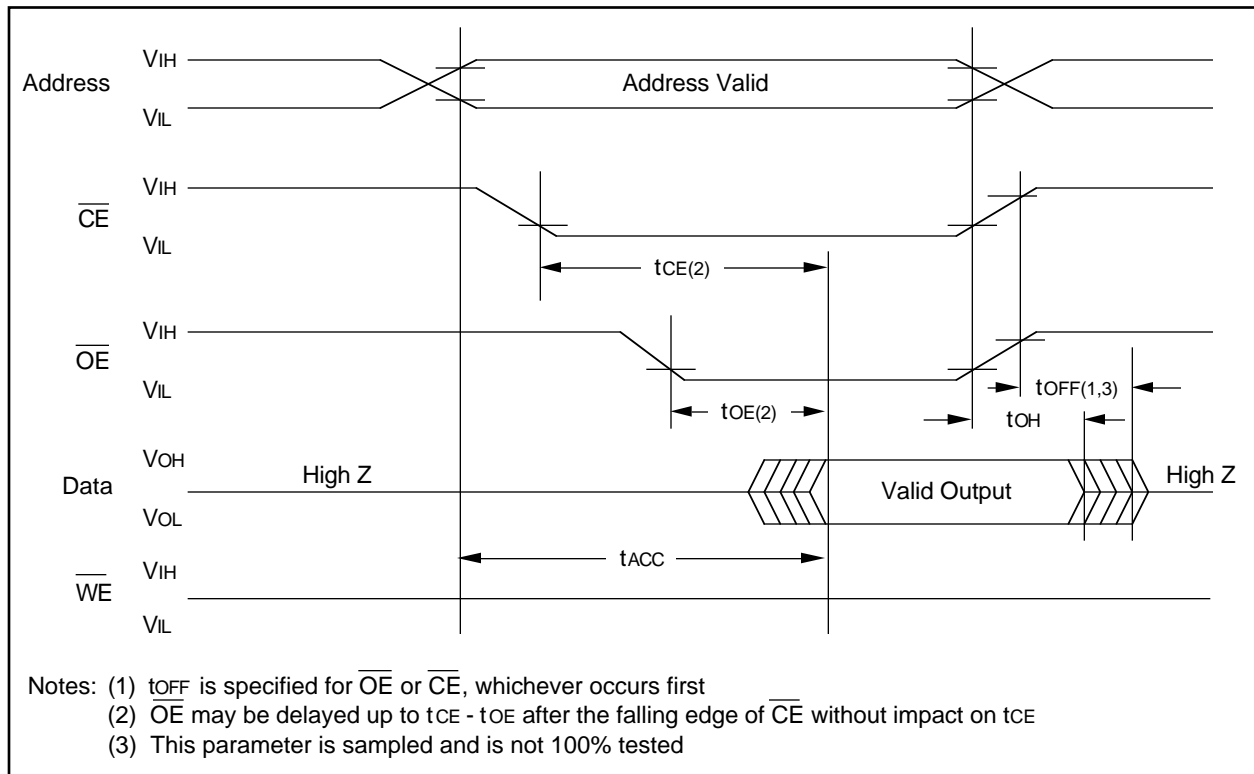
Note 1: AC power supply current above 5 MHz; 1 mA/MHz.

TABLE 1-3: READ OPERATION AC CHARACTERISTICS

| Parameter | Sym | 28C04A-15 | | 28C04A-20 | | 28C04A-25 | | Units | Conditions |
|---|-----------|--|-----|-----------|-----|-----------|-----|--------|---|
| | | Min | Max | Min | Max | Min | Max | | |
| | | 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 and Fall Times: 20 ns 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 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



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TABLE 1-4: BYTE WRITE AC CHARACTERISTICS

| | | AC Testing Waveform: | | VIH = 2.4V; VIL = 0.45V; VOH = 2.0V; VOL = 0.8V | |
|-----------------------------|--------|------------------------|------|---|---------------------|
| | | Output Load: | | 1 TTL Load + 100 pF | |
| | | Input Rise/Fall Times: | | 20 nsec | |
| | | Ambient Temperature: | | Commercial (C): Tamb= 0°C to 70°C | |
| | | | | Industrial (I): Tamb= -40°C to 85°C | |
| Parameter | Symbol | Min | Max | Units | Remarks |
| 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 | μ s | 100 μ 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

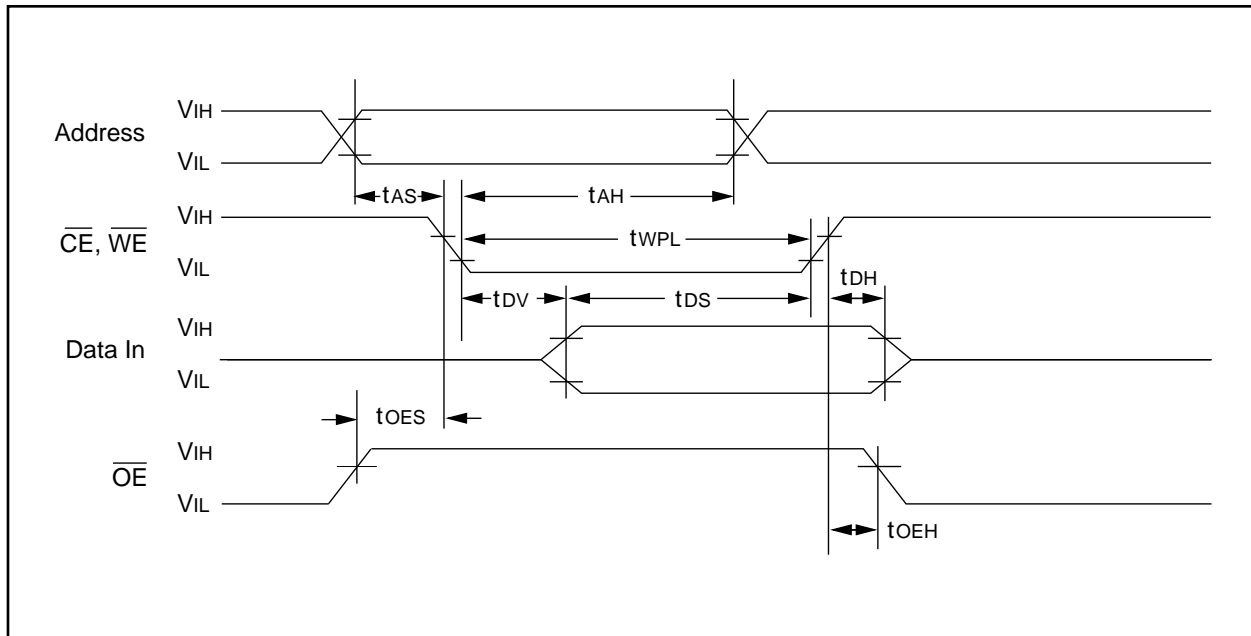


FIGURE 1-3: DATA POLLING WAVEFORMS

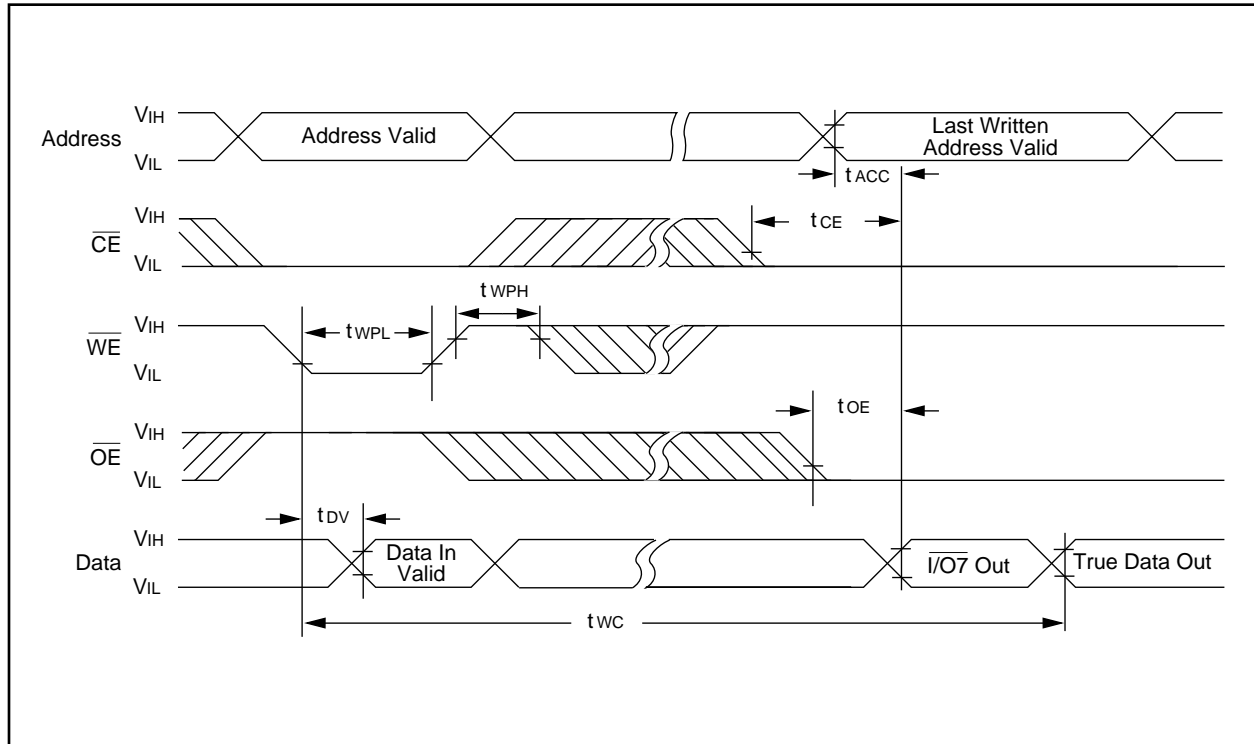
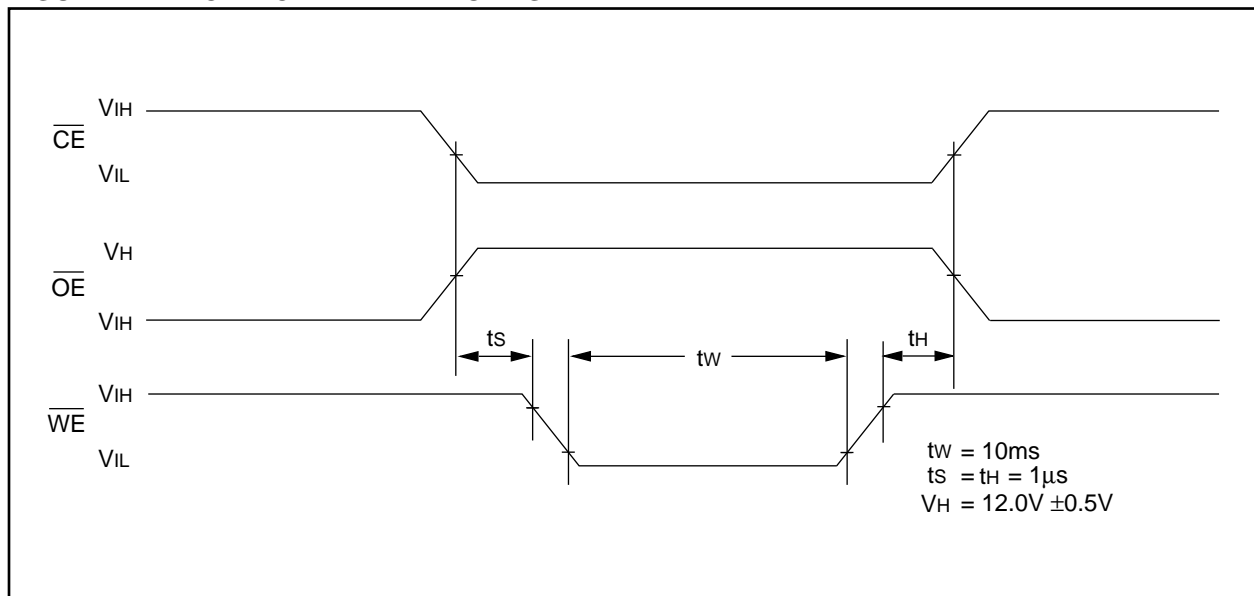


FIGURE 1-4: CHIP CLEAR WAVEFORMS



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{CE} | \overline{IE} | \overline{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{CE}) is the power control and should be used for device selection. Output Enable (\overline{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_{ACC}) is equal to the delay from \overline{CE} to output (t_{CE}). Data is available at the output t_{OE} after the falling edge of \overline{OE} , assuming that \overline{CE} has been low and addresses have been stable for at least $t_{ACC}-t_{OE}$.

2.2 Standby Mode

The 28C04A is placed in the standby mode by applying a high signal to the \overline{CE} input. When in the standby mode, the outputs are in a high impedance state, independent of the \overline{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 VCC detect (3.3 volts typical) will inhibit the initiation of non-volatile programming operation when VCC is less than the VCC detect circuit trip.

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

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

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{WE} pin. On the falling edge of \overline{WE} , the address information is latched. On rising edge, the data and the control pins (\overline{CE} and \overline{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.

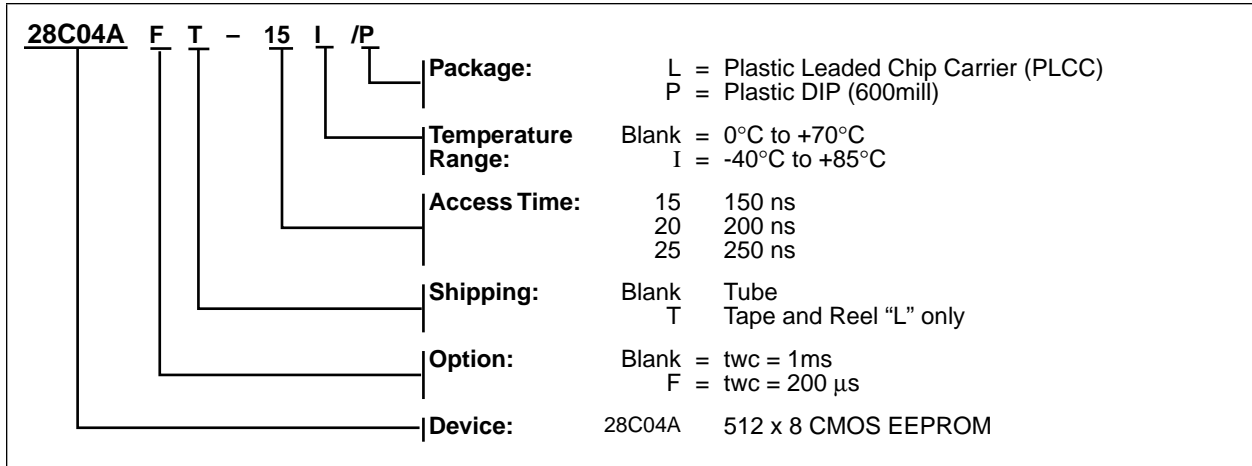
2.6 Chip Clear

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

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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.



WORLDWIDE SALES & SERVICE

AMERICAS

Corporate Office

Microchip Technology Inc.
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 602 786-7200 Fax: 602 786-7277
Technical Support: 602 786-7627
Web: <http://www.microchip.com>

Atlanta

Microchip Technology Inc.
500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770 640-0034 Fax: 770 640-0307

Boston

Microchip Technology Inc.
5 Mount Royal Avenue
Marlborough, MA 01752
Tel: 508 480-9990 Fax: 508 480-8575

Chicago

Microchip Technology Inc.
333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 708 285-0071 Fax: 708 285-0075

Dallas

Microchip Technology Inc.
14651 Dallas Parkway, Suite 816
Dallas, TX 75240-8809
Tel: 972 991-7177 Fax: 972 991-8588

Dayton

Microchip Technology Inc.
Suite 150
Two Prestige Place
Miamisburg, OH 45342
Tel: 513 291-1654 Fax: 513 291-9175

Los Angeles

Microchip Technology Inc.
18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 714 263-1888 Fax: 714 263-1338

New York

Microchip Technmgy Inc.
150 Motor Parkway, Suite 416
Hauppauge, NY 11788
Tel: 516 273-5305 Fax: 516 273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408 436-7950 Fax: 408 436-7955

Toronto

Microchip Technology Inc.
5925 Airport Road, Suite 200
Mississauga, Ontario L4V 1W1, Canada
Tel: 905 405-6279 Fax: 905 405-6253

ASIA/PACIFIC

China

Microchip Technology
Unit 406 of Shanghai Golden Bridge Bldg.
2077 Yan'an Road West, Hongjiao District
Shanghai, Peoples Republic of China
Tel: 86 21 6275 5700
Fax: 011 86 21 6275 5060

Hong Kong

Microchip Technology
RM 3801B, Tower Two
Metroplaza
223 Hing Fong Road
Kwai Fong, N.T. Hong Kong
Tel: 852 2 401 1200 Fax: 852 2 401 3431

India

Microchip Technology
No. 6, Legacy, Convent Road
Bangalore 560 025 India
Tel: 91 80 526 3148 Fax: 91 80 559 9840

Korea

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

Singapore

Microchip Technology
200 Middle Road
#10-03 Prime Centre
Singapore 188980
Tel: 65 334 8870 Fax: 65 334 8850

Taiwan, R.O.C

Microchip Technology
10F-1C 207
Tung Hua North Road
Taipei, Taiwan, ROC
Tel: 886 2 717 7175 Fax: 886 2 545 0139

EUROPE

United Kingdom

Arizona Microchip Technology Ltd.
Unit 6, The Courtyard
Meadow Bank, Furlong Road
Bourne End, Buckinghamshire SL8 5AJ
Tel: 44 1628 850303 Fax: 44 1628 850178

France

Arizona Microchip Technology SARL
Zone Industrielle de la Bonde
2 Rue du Buisson aux Fraises
91300 Massy - France
Tel: 33 1 69 53 63 20 Fax: 33 1 69 30 90 79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann-Ring 125
D-81739 Muenchen, Germany
Tel: 49 89 627 144 0 Fax: 49 89 627 144 44

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleone Pas Taurus 1
Viale Colleoni 1
20041 Agrate Brianza
Milan Italy
Tel: 39 39 6899939 Fax: 39 39 689 9883

JAPAN

Microchip Technology Intl. Inc.
Benex S-1 6F
3-18-20, Shin Yokohama
Kohoku-Ku, Yokohama
Kanagawa 222 Japan
Tel: 81 45 471 6166 Fax: 81 45 471 6122

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