

**MOSEL-VITELIC****V53C464A FAMILY****HIGH PERFORMANCE, LOW POWER****64K X 4 BIT FAST PAGE MODE****CMOS DYNAMIC RAM**

| <b>HIGH PERFORMANCE V53C464A</b>               | <b>60/60L</b> | <b>70/70L</b> | <b>80/80L</b> | <b>10/10L</b> |
|------------------------------------------------|---------------|---------------|---------------|---------------|
| Max. RAS Access Time, ( $t_{RAC}$ )            | 60 ns         | 70 ns         | 80 ns         | 100 ns        |
| Max. Column Address Access Time, ( $t_{CAA}$ ) | 30 ns         | 35 ns         | 40 ns         | 45 ns         |
| Min. Fast Page Mode Cycle Time, ( $t_{PC}$ )   | 45 ns         | 50 ns         | 55 ns         | 65 ns         |
| Min. Read-Write Cycle Time, ( $t_{RC}$ )       | 115 ns        | 130 ns        | 145 ns        | 175 ns        |
| <b>LOW POWER V53C464AL</b>                     | <b>60L</b>    | <b>70L</b>    | <b>80L</b>    | <b>10L</b>    |
| Max. CMOS Standby Current, ( $I_{DD6}$ )       | 1.2 mA        | 1.2 mA        | 1.2 mA        | 1.2 mA        |

**2****Features**

- Low power dissipation for V53C464A-10
  - Operating Current—65 mA max.
  - TTL Standby Current—3.5 mA max.
- Low CMOS Standby Current
  - V53C464A—3 mA max.
  - V53C464AL—1.2 mA max.
- Read-Modify-Write, RAS-only Refresh, CAS-before-RAS Refresh capability
- Fast Page Mode operation for a sustained data rate greater than 21 MHz
- 256 Refresh cycles/4 ms
- Standard packages are 18 pin Plastic DIP and 18 pin PLCC

**Description**

The V53C464A is a high speed 65,536 x 4 bit CMOS dynamic random access memory. Fabricated with VICMOS III technology, the V53C464A offers a combination of size and features unattainable with NMOS technology: Fast Page Mode for high data bandwidth, fast usable speed, CMOS

standby current and, on request extended refresh for very low data retention power (V53C464AL).

All inputs and outputs are TTL compatible. Input and output capacitances are significantly lowered to allow increased system performance. Fast Page Mode operation allows random access of up to 256 (x4) bits within a row with cycle times as short as 45 ns. Because of static circuitry, the CAS clock is not in the critical timing path. The flow-through column address latches allow address pipelining while relaxing many critical system timing requirements for fast usable speed. These features make the V53C464A ideally suited for graphics, digital signal processing and high performance computing systems.

The V53C464AL-10 offers a maximum data retention power of 10 mW when operating in CMOS standby mode and performing RAS-only or CAS-before-RAS refresh cycles. For selected V53C464AL devices with Refresh Interval longer than 4 ms, consult the factory.

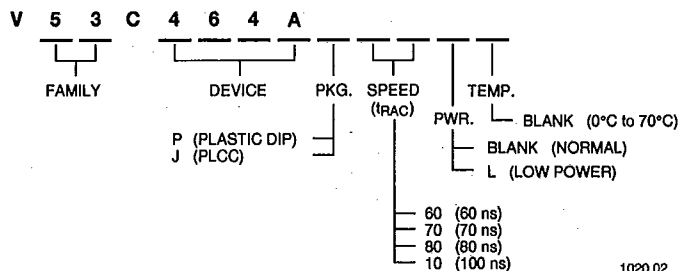
**Device Usage Chart**

| Operating Temperature Range | Package Outline |   | Access Time (ns) |    |    |     | Power |      | Temperature Mark |
|-----------------------------|-----------------|---|------------------|----|----|-----|-------|------|------------------|
|                             | P               | J | 60               | 70 | 80 | 100 | Low   | Std. |                  |
| 0°C to 70°C                 | •               | • | •                | •  | •  | •   | •     | •    | Blank            |

V53C464A Rev. 00 June 1990

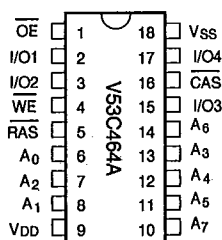
## MOSEL-VITELIC

## V53C464A

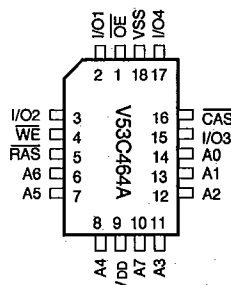


| Description | Pkg. | Pin Count |
|-------------|------|-----------|
| Plastic DIP | P    | 18        |
| PLCC        | J    | 18        |

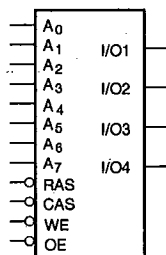
**18 Lead Plastic DIP  
PIN CONFIGURATION  
Top View**



**18 Lead PLCC Package  
PIN CONFIGURATION  
Top View**



## LOGIC SYMBOL



1020 03

## Absolute Maximum Ratings\*

Ambient Temperature

Under Bias ..... -10°C to +80°C

Storage Temperature (plastic) .... -55°C to +125°C

Voltage on any Pin Except V<sub>DD</sub>Relative to V<sub>SS</sub> ..... -1.0V to +7.0 VVoltage on V<sub>DD</sub> relative to V<sub>SS</sub> ..... -1.0V to +7.0 V

Data Out Current ..... 50 mA

Power Dissipation ..... 1.0 W

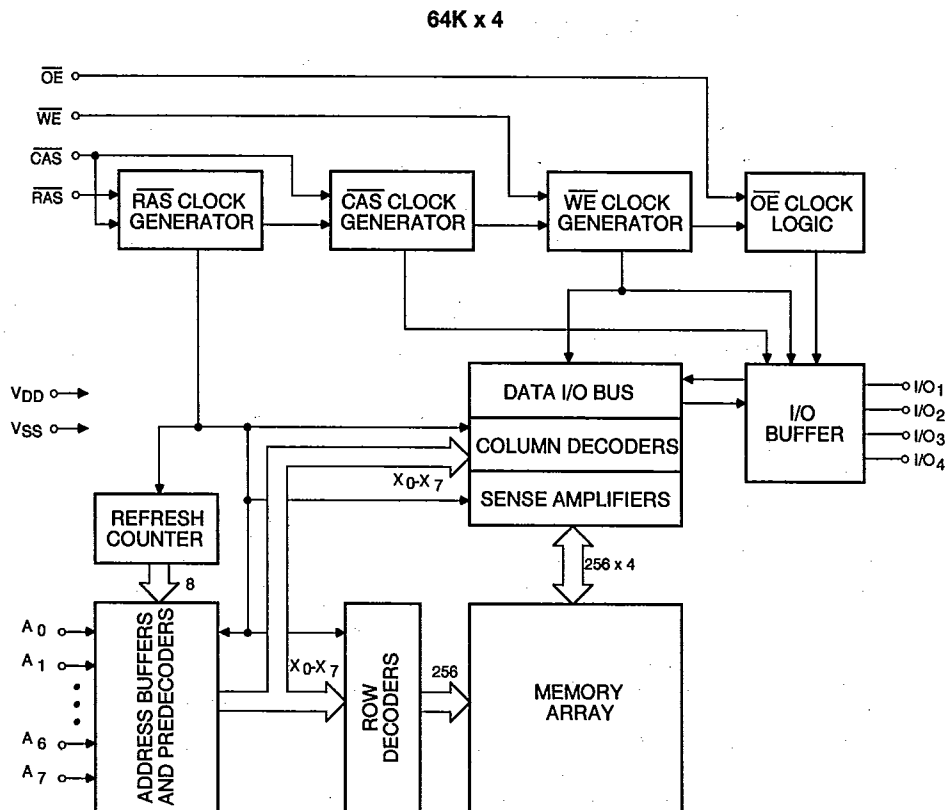
## Capacitance\*

T<sub>A</sub> = 25°C, V<sub>DD</sub> = 5 V ±10%, V<sub>SS</sub> = 0 V

| Symbol           | Parameter        | Typ. | Max. | Unit |
|------------------|------------------|------|------|------|
| C <sub>IN1</sub> | Address          | 3    | 4    | pF   |
| C <sub>IN2</sub> | RAS, CAS, WE, OE | 4    | 5    | pF   |
| C <sub>OUT</sub> | I/O              | 4    | 6    | pF   |

\*Note: Capacitance is sampled and not 100% tested

\*Note: Operation above Absolute Maximum Ratings can adversely affect device reliability.

**MOSEL-VITELIC****V53C464A****Block Diagram**

1020 01

## MOSEL-VITELIC

## V53C464A

## DC and Operating Characteristics (1-2)

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ , unless otherwise specified.

| Symbol    | Parameter                                               | Access Time | V53C464A |              | V53C464AL |              | Unit          | Test Conditions                                                                       | Notes |
|-----------|---------------------------------------------------------|-------------|----------|--------------|-----------|--------------|---------------|---------------------------------------------------------------------------------------|-------|
|           |                                                         |             | Min.     | Max.         | Min.      | Max.         |               |                                                                                       |       |
| $I_{LI}$  | Input Leakage Current<br>(any input pin)                |             | -10      | 10           | -10       | 10           | $\mu\text{A}$ | $V_{SS} \leq V_{IN} \leq V_{DD}$                                                      |       |
| $I_{LO}$  | Output Leakage Current<br>(for High-Z State)            |             | -10      | 10           | -10       | 10           | $\mu\text{A}$ | $V_{SS} \leq V_{OUT} \leq V_{DD}$<br>RAS, CAS at $V_{IH}$                             |       |
| $I_{DD1}$ | $V_{DD}$ Supply Current,<br>Operating                   | 60          |          | 80           |           | 80           | mA            | $t_{RC} = t_{RC}(\text{min.})$                                                        | 1,2   |
|           |                                                         | 70          |          | 75           |           | 75           |               |                                                                                       |       |
|           |                                                         | 80          |          | 70           |           | 70           |               |                                                                                       |       |
|           |                                                         | 100         |          | 65           |           | 65           |               |                                                                                       |       |
| $I_{DD2}$ | $V_{DD}$ Supply Current,<br>TTL Standby                 |             |          | 3.5          |           | 2.0          | mA            | RAS, CAS at $V_{IH}$<br>other inputs $\geq V_{SS}$                                    |       |
| $I_{DD3}$ | $V_{DD}$ Supply Current,<br>RAS-Only Refresh            | 60          |          | 80           |           | 80           | mA            | $t_{RC} = t_{RC}(\text{min.})$                                                        | 2     |
|           |                                                         | 70          |          | 75           |           | 75           |               |                                                                                       |       |
|           |                                                         | 80          |          | 65           |           | 65           |               |                                                                                       |       |
|           |                                                         | 100         |          | 55           |           | 55           |               |                                                                                       |       |
| $I_{DD4}$ | $V_{DD}$ Supply Current,<br>Fast Page Mode<br>Operation | 60          |          | 50           |           | 50           | mA            | Minimum Cycle                                                                         | 1,2   |
|           |                                                         | 70          |          | 45           |           | 45           |               |                                                                                       |       |
|           |                                                         | 80          |          | 40           |           | 40           |               |                                                                                       |       |
|           |                                                         | 100         |          | 35           |           | 35           |               |                                                                                       |       |
| $I_{DD5}$ | $V_{DD}$ Supply Current,<br>Standby, Output Enabled     |             |          | 4            |           | 2.5          | mA            | RAS= $V_{IH}$ , CAS= $V_{IL}$<br>other inputs $\geq V_{SS}$                           | 1     |
| $I_{DD6}$ | $V_{DD}$ Supply Current,<br>CMOS Standby                |             |          | 3            |           | 1.2          | mA            | RAS $\geq V_{DD} - 0.2\text{ V}$ ,<br>CAS at $V_{IH}$ , other<br>inputs $\geq V_{SS}$ |       |
| $V_{IL}$  | Input Low Voltage                                       |             | -1       | 0.8          | -1        | 0.8          | V             |                                                                                       | 3     |
| $V_{IH}$  | Input High Voltage                                      |             | 2.4      | $V_{DD} + 1$ | 2.4       | $V_{DD} + 1$ | V             |                                                                                       | 3     |
| $V_{OL}$  | Output Low Voltage                                      |             |          | 0.4          |           | 0.4          | V             | $I_{OL} = 4.2\text{ mA}$                                                              |       |
| $V_{OH}$  | Output High Voltage                                     |             | 2.4      |              | 2.4       |              | V             | $I_{OH} = -5\text{ mA}$                                                               |       |

**MOSEL-VITELIC****V53C464A****AC Characteristics**
 $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ ,  $V_{DD} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ , unless otherwise noted

AC Test conditions, Input pulse levels 0 to 3 V

| #  | JEDEC Symbol    | Symbol       | Parameter                                                | 60/60L |      | 70/70L |      | 80/80L |      | 10/10L |      | Unit | Notes  |
|----|-----------------|--------------|----------------------------------------------------------|--------|------|--------|------|--------|------|--------|------|------|--------|
|    |                 |              |                                                          | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |        |
| 1  | $t_{RL1RH1}$    | $t_{RAS}$    | $\overline{RAS}$ Pulse Width                             | 60     | 75K  | 70     | 75K  | 80     | 75K  | 100    | 75K  | ns   |        |
| 2  | $t_{RL2RL2}$    | $t_{RC}$     | Read or Write Cycle Time                                 | 115    |      | 130    |      | 145    |      | 175    |      | ns   |        |
| 3  | $t_{RH2RL2}$    | $t_{RP}$     | $\overline{RAS}$ Precharge Time                          | 45     |      | 50     |      | 55     |      | 65     |      | ns   |        |
| 4  | $t_{RL1CH1}$    | $t_{CSH}$    | $\overline{CAS}$ Hold Time                               | 60     |      | 70     |      | 80     |      | 100    |      | ns   |        |
| 5  | $t_{CL1CH1}$    | $t_{CAS}$    | $\overline{CAS}$ Pulse Width                             | 20     |      | 20     |      | 20     |      | 25     |      | ns   |        |
| 6  | $t_{RL1CL1}$    | $t_{RCD}$    | $\overline{RAS}$ to $\overline{CAS}$ Delay               | 20     | 40   | 25     | 45   | 25     | 50   | 25     | 65   | ns   | 4      |
| 7  | $t_{WH2CL2}$    | $t_{RCS}$    | Read Command Setup Time                                  | 0      |      | 0      |      | 0      |      | 0      |      | ns   |        |
| 8  | $t_{AVRL2}$     | $t_{ASR}$    | Row Address Setup Time                                   | 0      |      | 0      |      | 0      |      | 0      |      | ns   |        |
| 9  | $t_{RL1AX}$     | $t_{RAH}$    | Row Address Hold Time                                    | 10     |      | 15     |      | 15     |      | 15     |      | ns   |        |
| 10 | $t_{AVCL2}$     | $t_{ASC}$    | Column Address Setup Time                                | 0      |      | 0      |      | 0      |      | 0      |      | ns   |        |
| 11 | $t_{CL1AX}$     | $t_{CAH}$    | Column Address Hold Time                                 | 10     |      | 15     |      | 15     |      | 20     |      | ns   |        |
| 12 | $t_{CL1RH1(R)}$ | $t_{RSH(R)}$ | $\overline{RAS}$ Hold Time (Read Cycle)                  | 20     |      | 25     |      | 30     |      | 35     |      | ns   |        |
| 13 | $t_{CH2RL2}$    | $t_{CRP}$    | $\overline{CAS}$ to $\overline{RAS}$ Precharge Time      | 10     |      | 15     |      | 15     |      | 15     |      | ns   |        |
| 14 | $t_{CH2WX}$     | $t_{RCH}$    | Read Command Hold Time Referenced to $\overline{CAS}$    | 5      |      | 5      |      | 5      |      | 5      |      | ns   | 5      |
| 15 | $t_{RH2WX}$     | $t_{RRH}$    | Read Command Hold Time Referenced to $\overline{RAS}$    | 5      |      | 5      |      | 5      |      | 5      |      | ns   | 5      |
| 16 | $t_{OEL1RH2}$   | $t_{ROH}$    | $\overline{RAS}$ Hold Time Referenced to $\overline{OE}$ | 15     |      | 15     |      | 20     |      | 25     |      | ns   |        |
| 17 | $t_{GL1QV}$     | $t_{OAC}$    | Access Time from $\overline{OE}$                         |        | 15   |        | 15   |        | 20   |        | 25   | ns   |        |
| 18 | $t_{CL1QV}$     | $t_{CAC}$    | Access Time from $\overline{CAS}$                        |        | 20   |        | 20   |        | 20   |        | 25   | ns   | 6,7    |
| 19 | $t_{RL1QV}$     | $t_{RAC}$    | Access Time from $\overline{RAS}$                        |        | 60   |        | 70   |        | 80   |        | 100  | ns   | 6,8,9  |
| 20 | $t_{AVQV}$      | $t_{CAA}$    | Access Time from Column Address                          |        | 30   |        | 35   |        | 40   |        | 45   | ns   | 6,7,10 |

**MOSEL-VITELIC****V53C464A****AC Characteristics (Cont'd.)**

| #  | JEDEC Symbol      | Symbol       | Parameter                                            | 60/60L |      | 70/70L |      | 80/80L |      | 10/10L |      | Unit | Notes |
|----|-------------------|--------------|------------------------------------------------------|--------|------|--------|------|--------|------|--------|------|------|-------|
|    |                   |              |                                                      | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |       |
| 21 | $t_{CL1QX}$       | $t_{LZ}$     | $\overline{OE}$ or $\overline{CAS}$ to Low-Z Output  | 0      |      | 0      |      | 0      |      | 0      |      | ns   | 17    |
| 22 | $t_{CH2QZ}$       | $t_{HZ}$     | $\overline{OE}$ or $\overline{CAS}$ to High-Z Output | 0      | 10   | 0      | 15   | 0      | 20   | 0      | 25   | ns   | 17    |
| 23 | $t_{RL1AX}$       | $t_{AR}$     | Column Address Hold Time from RAS                    | 50     |      | 55     |      | 60     |      | 70     |      | ns   |       |
| 24 | $t_{RL1AV}$       | $t_{RAD}$    | RAS to Column Address Delay Time                     | 15     | 30   | 20     | 35   | 20     | 40   | 20     | 55   | ns   | 11    |
| 25 | $t_{CL1RH1(W)}$   | $t_{RSH(W)}$ | RAS or $\overline{CAS}$ Hold Time in Write Cycle     | 20     |      | 25     |      | 30     |      | 35     |      | ns   |       |
| 26 | $t_{WL1CH1}$      | $t_{CWL}$    | Write Command to $\overline{CAS}$ Lead Time          | 20     |      | 25     |      | 30     |      | 35     |      | ns   |       |
| 27 | $t_{WL1CL2}$      | $t_{WCS}$    | Write Command Setup Time                             | 0      |      | 0      |      | 0      |      | 0      |      | ns   | 12,13 |
| 28 | $t_{CL1WH1}$      | $t_{WCH}$    | Write Command Hold Time                              | 10     |      | 15     |      | 15     |      | 20     |      | ns   |       |
| 29 | $t_{WL1WH1}$      | $t_{WP}$     | Write Pulse Width                                    | 10     |      | 15     |      | 15     |      | 20     |      | ns   |       |
| 30 | $t_{RL1WH1}$      | $t_{WCR}$    | Write Command Hold Time from RAS                     | 50     |      | 55     |      | 60     |      | 70     |      | ns   |       |
| 31 | $t_{WL1RH1}$      | $t_{RWL}$    | Write Command to RAS Lead Time                       | 20     |      | 25     |      | 30     |      | 35     |      | ns   |       |
| 32 | $t_{DVWL2}$       | $t_{DS}$     | Data In Setup Time                                   | 0      |      | 0      |      | 0      |      | 0      |      | ns   | 14    |
| 33 | $t_{WL1DX}$       | $t_{DH}$     | Data In Hold Time                                    | 10     |      | 15     |      | 15     |      | 20     |      | ns   | 14    |
| 34 | $t_{WL1GL2}$      | $t_{WOH}$    | Write to $\overline{OE}$ Hold Time                   | 10     |      | 20     |      | 20     |      | 25     |      | ns   |       |
| 35 | $t_{GH2DX}$       | $t_{OED}$    | $\overline{OE}$ to Data Delay Time                   | 15     |      | 20     |      | 25     |      | 30     |      | ns   |       |
| 36 | $t_{RL2RL2(RMW)}$ | $t_{RWC}$    | Read-Modify-Write Cycle Time                         | 170    |      | 185    |      | 210    |      | 250    |      | ns   |       |
| 37 | $t_{RL1RH1(RMW)}$ | $t_{RRW}$    | Read-Modify-Write Cycle RAS Pulse Width              | 105    |      | 125    |      | 145    |      | 175    |      | ns   |       |
| 38 | $t_{CL1WL2}$      | $t_{CWD}$    | $\overline{CAS}$ to $\overline{WE}$ Delay            | 40     |      | 50     |      | 60     |      | 70     |      | ns   | 12    |

**MOSEL-VITELIC****V53C464A****AC Characteristics (Cont'd.)**

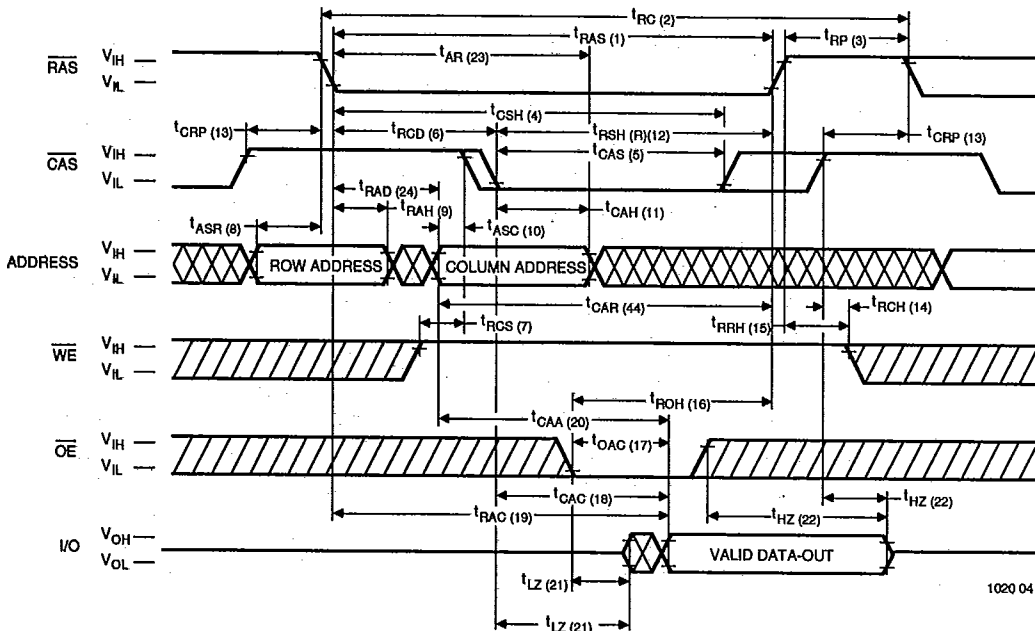
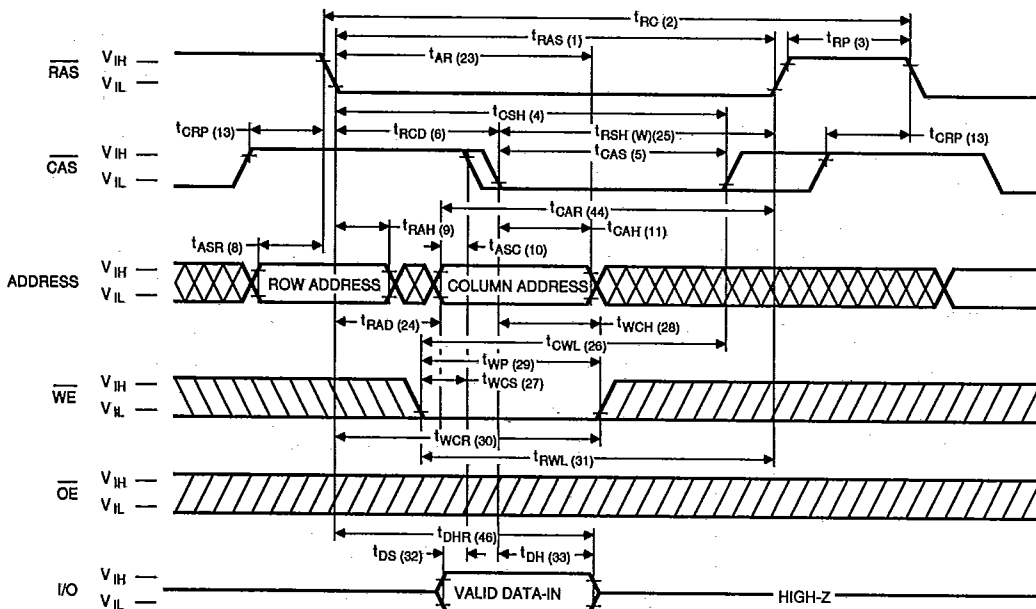
| #  | JEDEC Symbol              | Symbol           | Parameter                                   | 60/60L |      | 70/70L |      | 80/80L |      | 10/10L |      | Unit | Notes |
|----|---------------------------|------------------|---------------------------------------------|--------|------|--------|------|--------|------|--------|------|------|-------|
|    |                           |                  |                                             | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |       |
| 39 | t <sub>RL1WL2</sub>       | t <sub>RWD</sub> | RAS to WE Delay in Read-Modify-Write Cycle  | 80     |      | 95     |      | 110    |      | 135    |      | ns   | 12    |
| 40 | t <sub>CL1CH1</sub>       | t <sub>CRW</sub> | CAS Pulse Width (RMW)                       | 65     |      | 80     |      | 95     |      | 110    |      | ns   |       |
| 41 | t <sub>AVWL2</sub>        | t <sub>AWD</sub> | Col. Address to WE Delay                    | 50     |      | 60     |      | 70     |      | 80     |      | ns   | 12    |
| 42 | t <sub>CL2CL2</sub>       | t <sub>PC</sub>  | Fast Page Mode Read or Write Cycle Time     | 45     |      | 50     |      | 55     |      | 65     |      | ns   |       |
| 43 | t <sub>CH2CL2</sub>       | t <sub>CP</sub>  | CAS Precharge Time                          | 10     |      | 10     |      | 10     |      | 10     |      | ns   |       |
| 44 | t <sub>AVRH1</sub>        | t <sub>CAR</sub> | Column Address to RAS Setup Time            | 30     |      | 35     |      | 40     |      | 45     |      | ns   |       |
| 45 | t <sub>CH2QV</sub>        | t <sub>CAP</sub> | Access Time from Column Precharge           |        | 40   |        | 45   |        | 50   |        | 55   | ns   | 6, 7  |
| 46 | t <sub>RL1DX</sub>        | t <sub>DHR</sub> | Data in Hold Time Referenced to RAS         | 50     |      | 55     |      | 60     |      | 70     |      | ns   |       |
| 47 | t <sub>CL1RL2</sub>       | t <sub>CSR</sub> | CAS Setup Time<br>CAS-before-RAS Refresh    | 10     |      | 10     |      | 10     |      | 10     |      | ns   |       |
| 48 | t <sub>RH2CL2</sub>       | t <sub>RPC</sub> | RAS to CAS Precharge Time                   | 0      |      | 0      |      | 0      |      | 0      |      | ns   |       |
| 49 | t <sub>RL1CH1</sub>       | t <sub>CHR</sub> | CAS Hold Time<br>CAS-before-RAS Refresh     | 15     |      | 20     |      | 25     |      | 30     |      | ns   |       |
| 50 | t <sub>CL2CL2 (RMW)</sub> | t <sub>PCM</sub> | Fast Page Mode Read-Modify-Write Cycle Time | 85     |      | 105    |      | 120    |      | 140    |      | ns   |       |
|    | t <sub>T</sub>            | t <sub>T</sub>   | Transition Time (Rise and Fall)             | 3      | 50   | 3      | 50   | 3      | 50   | 3      | 50   | ns   | 15    |
|    |                           | t <sub>RI</sub>  | Refresh Interval (256 Cycles)               |        | 4    |        | 4    |        | 4    |        | 4    | ms   | 16    |

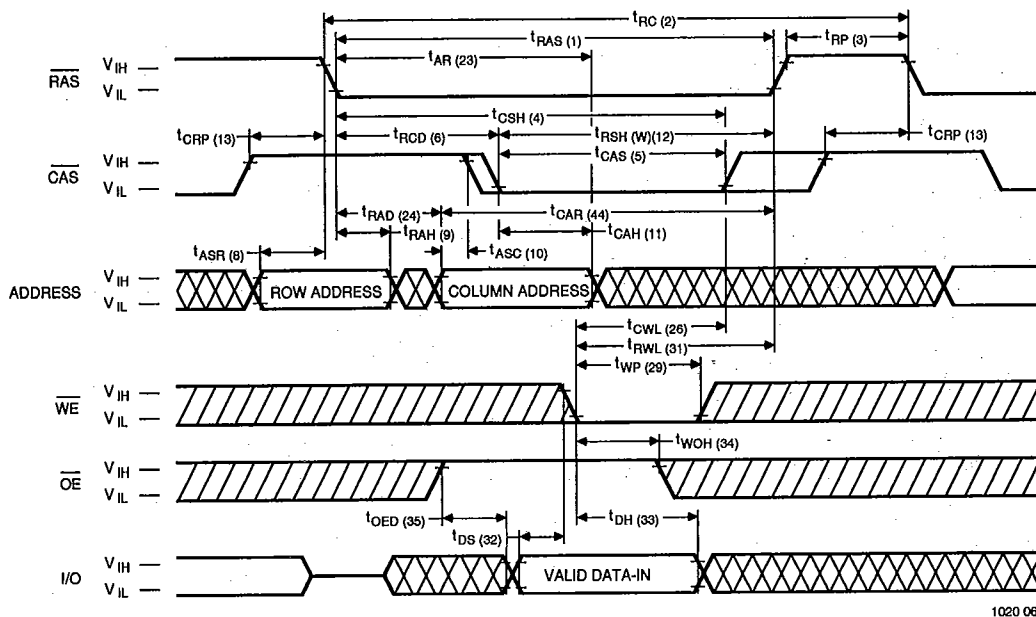
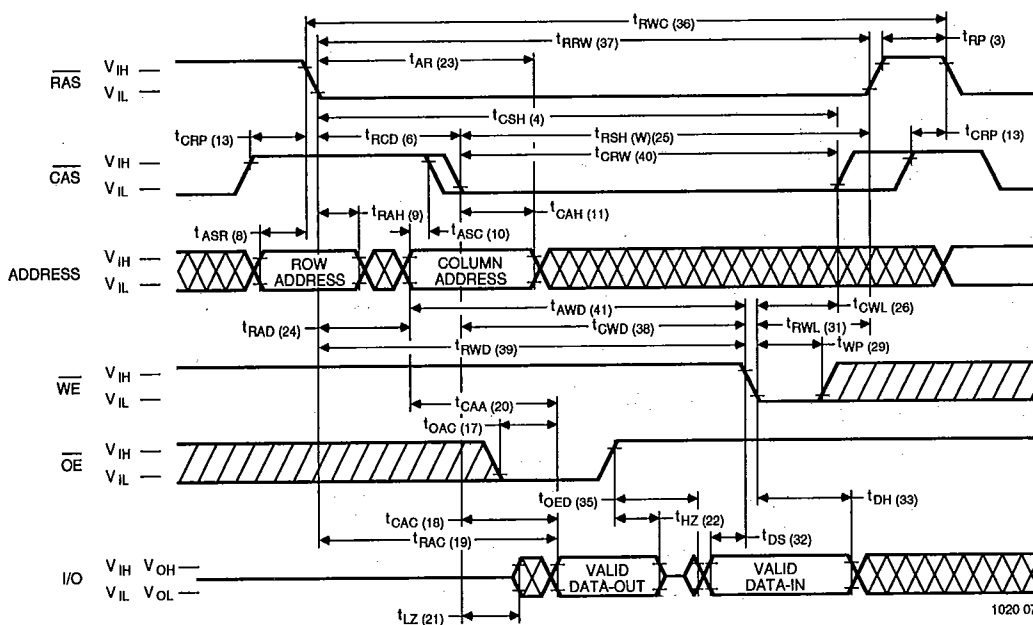
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**MOSEL-VITELIC****V53C464A**

## Notes:

1.  $I_{DD}$  is dependent on output loading when the device output is selected. Specified  $I_{DD}$  (max.) is measured with the output open.
2.  $I_{DD}$  is dependent upon the number of address transitions. Specified  $I_{DD}$  (max.) is measured with a maximum of two transitions per address cycle in Fast Page Mode.
3. Specified  $V_{IL}$  (min.) is steady state operating. During transitions,  $V_{IL}$  (min.) may undershoot to  $-1.0$  V for a period not to exceed 20 ns. All AC parameters are measured with  $V_{IL}$  (min.)  $\geq V_{SS}$  and  $V_{IH}$  (max.)  $\leq V_{DD}$ .
4.  $t_{RCD}$  (max.) is specified for reference only. Operation within  $t_{RCD}$  (max.) limits insures that  $t_{RAC}$  (max.) and  $t_{CAA}$  (max.) can be met. If  $t_{RCD}$  is greater than the specified  $t_{RCD}$  (max.), the access time is controlled by  $t_{CAA}$  and  $t_{CAC}$ .
5. Either  $t_{RRH}$  or  $t_{RCH}$  must be satisfied for a Read Cycle to occur.
6. Measured with a load equivalent to two TTL inputs and 100 pF.
7. Access time is determined by the longest of  $t_{CAA}$ ,  $t_{CAC}$  and  $t_{CAP}$ .
8. Assumes that  $t_{RAD} \leq t_{RAD}$  (max.). If  $t_{RAD}$  is greater than  $t_{RAD}$  (max.),  $t_{RAC}$  will increase by the amount that  $t_{RAD}$  exceeds  $t_{RAD}$  (max.).
9. Assumes that  $t_{RCD} \leq t_{RCD}$  (max.). If  $t_{RCD}$  is greater than  $t_{RCD}$  (max.),  $t_{RAC}$  will increase by the amount that  $t_{RCD}$  exceeds  $t_{RCD}$  (max.).
10. Assumes that  $t_{RAD} \geq t_{RAD}$  (max.).
11. Operation within the  $t_{RAD}$  (max.) limit insures that  $t_{RAC}$  (max.) can be met.  $t_{RAD}$  (max.) is specified as a reference point only. If  $t_{RAD}$  is greater than the specified  $t_{RAD}$  (max.) limit, the access time is controlled by  $t_{CAA}$  and  $t_{CAC}$ .
12.  $t_{WCS}$ ,  $t_{RWD}$ ,  $t_{AWD}$  and  $t_{CWD}$  are not restrictive operating parameters.
13.  $t_{WCS}$  (min.) must be satisfied in an Early Write Cycle.
14.  $t_{DS}$  and  $t_{DH}$  are referenced to the latter occurrence of  $\overline{CAS}$  or  $\overline{WE}$ .
15.  $t_T$  is measured between  $V_{IH}$  (min.) and  $V_{IL}$  (max.). AC-measurements assume  $t_T = 5$  ns.
16. An initial 200  $\mu$ s pause and 8  $\overline{RAS}$ -containing cycles are required when exiting an extended period of bias without clocks. An extended period of time without clocks is defined as one that exceeds the specified Refresh Interval.
17. Assumes a three-state test load of 5 pF and a 380 Ohm Thevenin equivalent.

**MOSEL-VITELIC****V53C464A****Waveforms of Read Cycle****Waveforms of Early Write Cycle**

**MOSEL-VITELIC****V53C464A****Waveforms of OE Controlled Write Cycle****Waveforms of Read-Modify-Write Cycle**

**V53C464A**

## 2

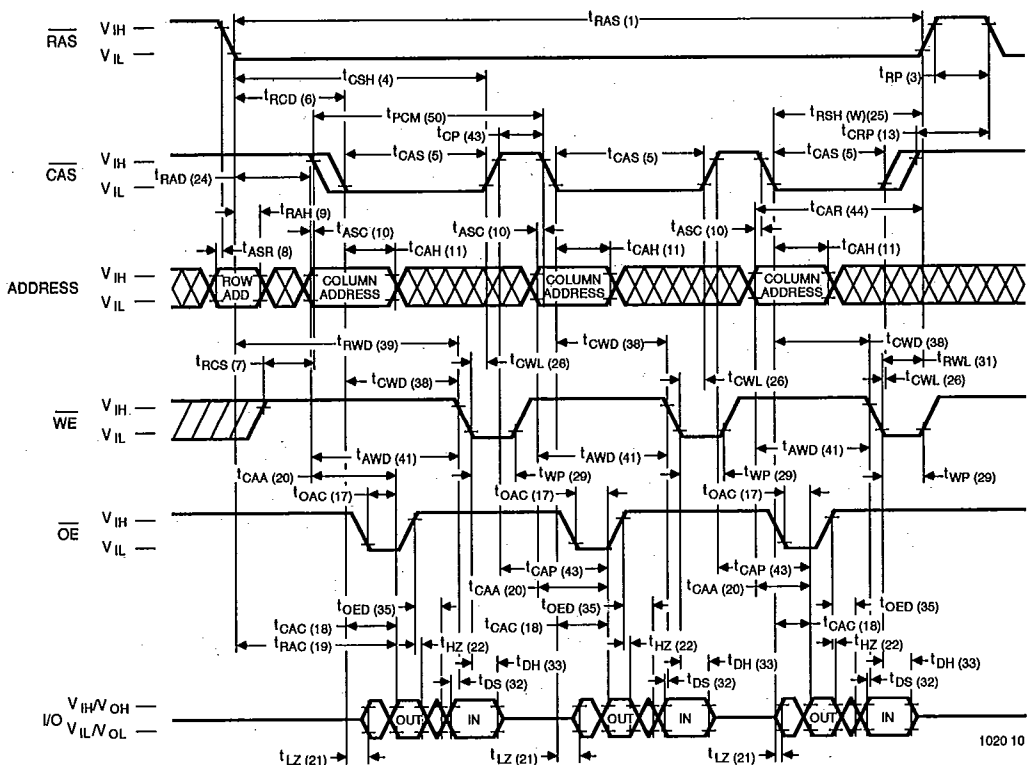


## 1020 08

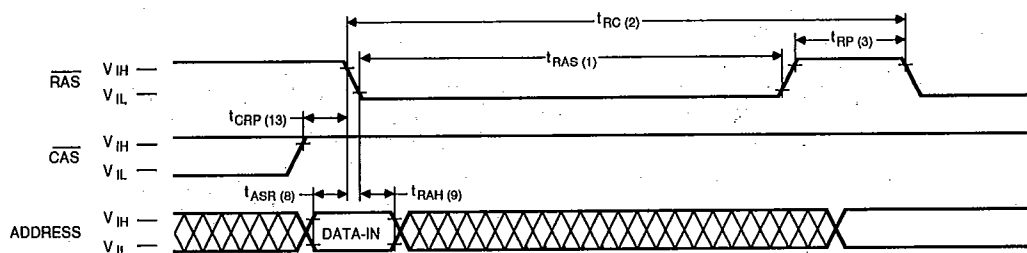
## MOSEL-VITELIC

V53C464A

## Waveforms of Fast Page Mode Read-Write Cycle

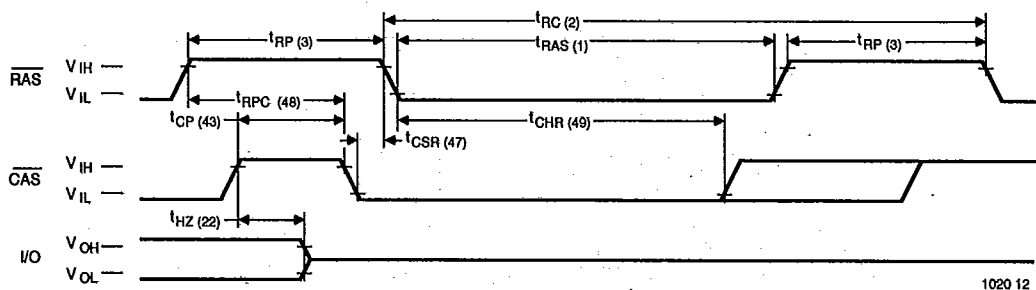


## Waveforms of RAS-Only Refresh Cycle

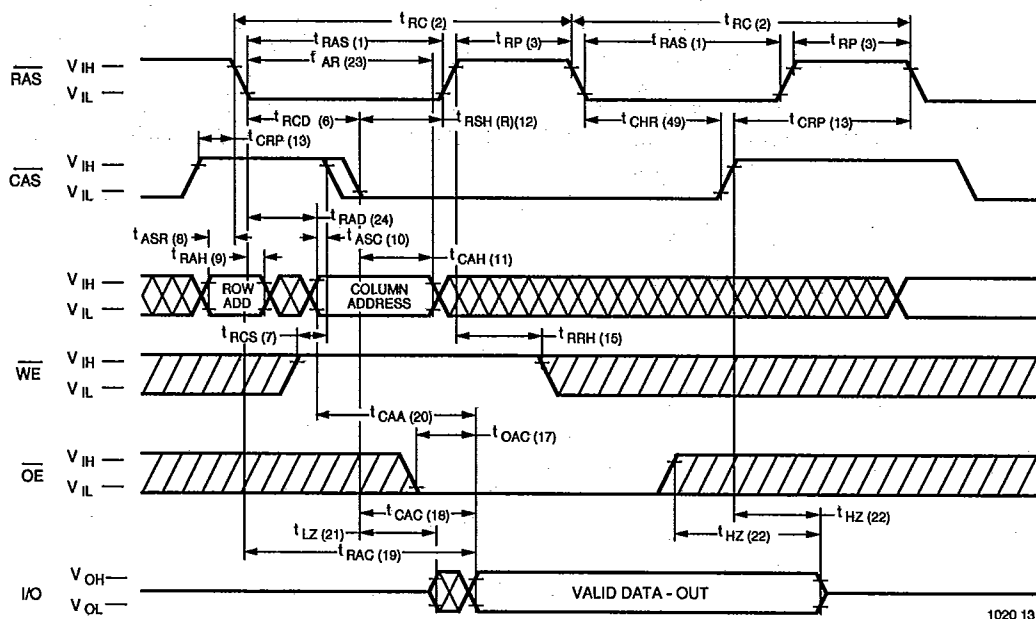
NOTE:  $\overline{WE}$ ,  $\overline{OE}$  = Don't care

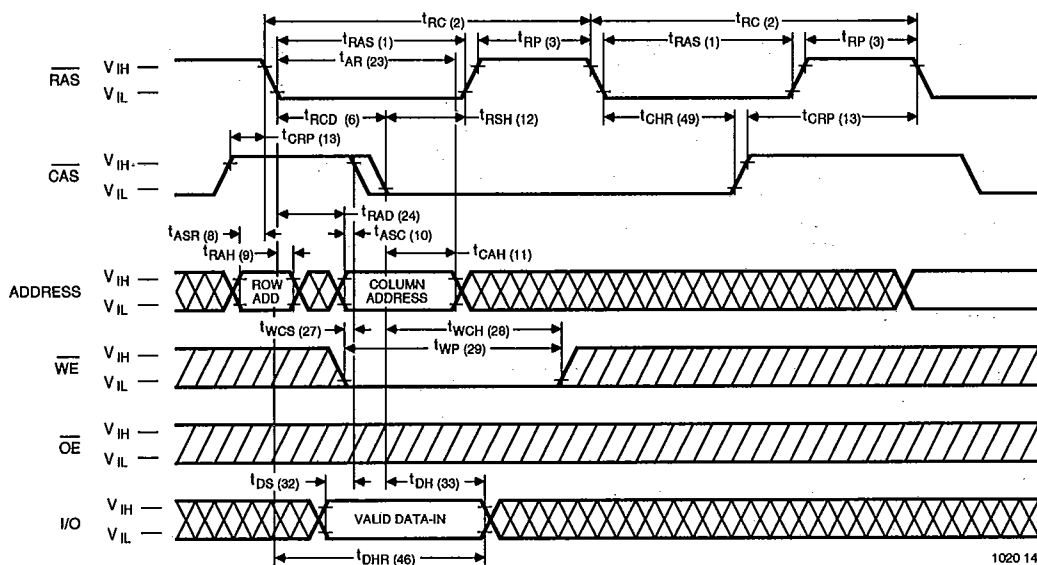
## MOSEL-VITELIC

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Waveforms of  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  Refresh Cycle

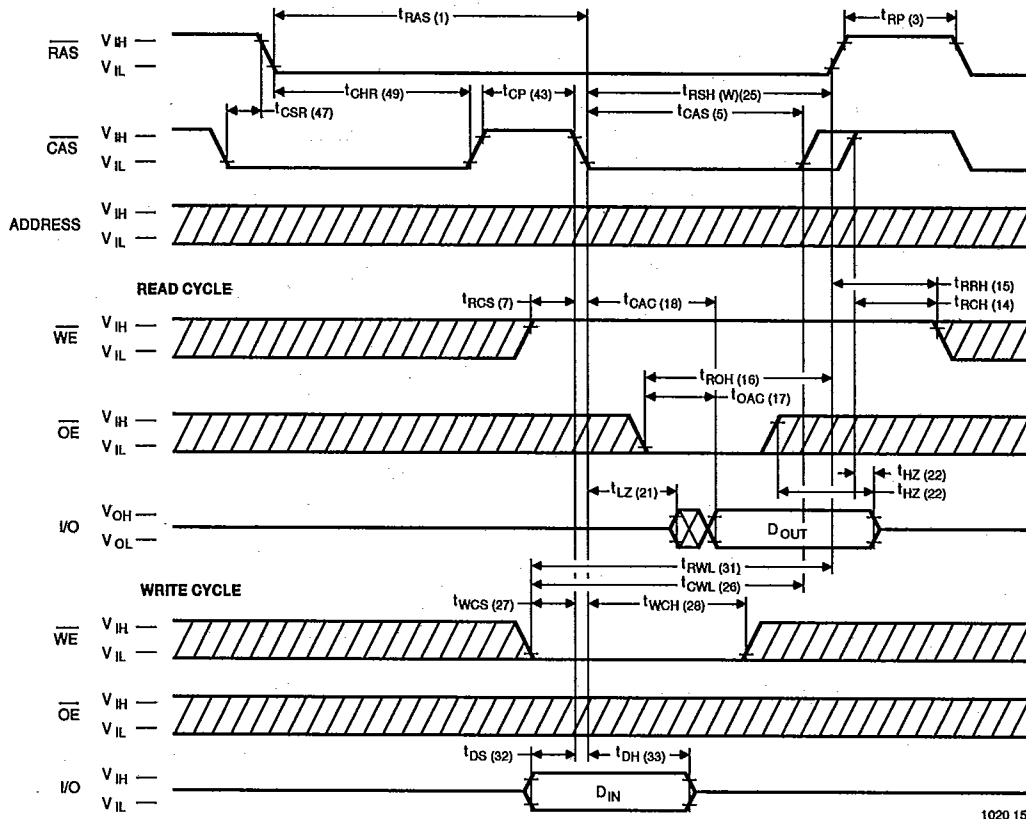
## Waveforms of Hidden Refresh Cycle (Read)



**MOSEL-VITELIC****V53C464A****Waveforms of Hidden Refresh Cycle (Write)**

## MOSEL-VITELIC

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Waveforms of  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  Refresh Counter Test Cycle

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**MOSEL-VITELIC****V53C464A****Functional Description**

The V53C464A is a CMOS dynamic RAM optimized for high data bandwidth, low power applications. It is functionally similar to a traditional dynamic RAM. The V53C464A reads and writes data by multiplexing a 16-bit address into an 8-bit row and an 8-bit column address. The row address is latched by the Row Address Strobe ( $\overline{\text{RAS}}$ ). The column address "flows through" an internal address buffer and is latched by the Column Address Strobe ( $\overline{\text{CAS}}$ ). Because access time is primarily dependent on a valid column address rather than the precise time that the  $\overline{\text{CAS}}$  edge occurs, the delay time from  $\overline{\text{RAS}}$  to  $\overline{\text{CAS}}$  has little effect on the access time.

**Memory Cycle**

A memory cycle is initiated by bringing  $\overline{\text{RAS}}$  low. Any memory cycle, once initiated, must not be ended or aborted before the minimum  $t_{\text{RAS}}$  time has expired. This insures proper device operation and data integrity. A new cycle must not be initiated until the minimum precharge time  $t_{\text{RP}}/t_{\text{CP}}$  has elapsed.

**Read Cycle**

A Read cycle is performed by holding the Write Enable ( $\overline{\text{WE}}$ ) signal high during a  $\overline{\text{RAS}}$ / $\overline{\text{CAS}}$  operation. The column address must be held for a minimum specified by  $t_{\text{AR}}$ . Data Out becomes valid only when  $t_{\text{OAC}}$ ,  $t_{\text{RAC}}$ ,  $t_{\text{CAA}}$  and  $t_{\text{CAC}}$  are all satisfied. As a result, the access time is dependent on the timing relationships between these parameters. For example, the access time is limited by  $t_{\text{CAA}}$  when  $t_{\text{RAC}}$ ,  $t_{\text{CAC}}$  and  $t_{\text{OAC}}$  are all satisfied.

**Write Cycle**

A Write Cycle is performed by taking  $\overline{\text{WE}}$  and  $\overline{\text{CAS}}$  low during a  $\overline{\text{RAS}}$  operation. The column address is latched by  $\overline{\text{CAS}}$ . The Write Cycle can be  $\overline{\text{WE}}$ -controlled or  $\overline{\text{CAS}}$ -controlled, depending on whether  $\overline{\text{WE}}$  or  $\overline{\text{CAS}}$  falls later. Consequently, the input data must be valid at or before the falling edge of  $\overline{\text{WE}}$  or  $\overline{\text{CAS}}$ , whichever occurs last. In the  $\overline{\text{CAS}}$ -controlled Write Cycle when the leading edge of  $\overline{\text{WE}}$  occurs prior to the  $\overline{\text{CAS}}$  low transition, the I/O data pins will be in the High-Z state at the beginning of the Write function. Ending the Write with  $\overline{\text{RAS}}$  or  $\overline{\text{CAS}}$  will maintain the output in the High-Z state.

In the  $\overline{\text{WE}}$ -controlled Write Cycle,  $\overline{\text{OE}}$  must be in the high state, and  $t_{\text{OED}}$  must be satisfied.

**Refresh Cycle**

To retain data, 256 Refresh Cycles are required in each 4 ms period. There are two ways to refresh the memory:

1. By selecting each of the 256 row addresses determined by  $A_0$  through  $A_7$ , at least once every 4 ms. Any Read, Write, Read-Modify-Write or  $\overline{\text{RAS}}$ -only cycle refreshes the addressed row.
2. Using a  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  Refresh Cycle. If  $\overline{\text{CAS}}$  is low during the falling edge of  $\overline{\text{RAS}}$ ,  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh is activated. The V53C464A will use the output of an internal 8-bit counter as the source of row addresses and ignore external address inputs.

$\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  is a "refresh-only" mode and no data access or device selection is allowed. Thus, the output will remain in the High-Z state during the cycle. A  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  counter test mode is provided to ensure reliable operation of the internal refresh counter.

**Data Retention Mode**

The V53C464A offers a CMOS standby mode that is entered by causing the  $\overline{\text{RAS}}$  clock to swing between a valid  $V_{\text{IL}}$  and an "extra high"  $V_{\text{IH}}$  within 0.2 V of  $V_{\text{DD}}$ . While the  $\overline{\text{RAS}}$  clock is at the "extra high" level, the V53C464A power consumption is reduced to the low  $I_{\text{DD6}}$  level. Overall  $I_{\text{DD}}$  consumption when operating in this mode can be calculated as follows:

$$I = \frac{(t_{\text{RC}}) \times (I_{\text{DD1}}) + (t_{\text{RX}} - t_{\text{RC}}) \times (I_{\text{DD6}})}{t_{\text{RX}}}$$

Where  $t_{\text{RC}}$  = Refresh Cycle Time  
 $t_{\text{RX}}$  = Refresh Interval / 256

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## Fast Page Mode Operation

Fast Page Mode operation permits all 256 columns within a selected row of the device to be randomly accessed at a high data rate. Maintaining RAS low while performing successive CAS cycles retains the row address internally and eliminates the need to reapply it for each cycle. The column address buffer acts as a transparent or flow-through latch while CAS is high. Thus, access begins from the occurrence of a valid column address rather than from the falling edge of CAS, eliminating  $t_{ASC}$  and  $t_r$  from the critical timing path. CAS latches the address into the column address buffer and acts as an output enable. During Fast Page Mode operation, Read, Write, Read-Modify-Write or Read-Write-Read cycles are possible at random addresses within a row. Following the initial entry cycle into Fast Page Mode, access is  $t_{CAA}$  or  $t_{CAP}$  controlled. If the column address is valid prior to the rising edge of CAS, the access time is referenced to the CAS rising edge and is specified by  $t_{CAP}$ . If the column address is valid after the rising CAS edge, access is timed from the occurrence of a valid address and is specified by  $t_{CAA}$ . In both cases, the falling edge of CAS latches the address and enables the output.

Fast Page Mode provides a sustained data rate of over 19 MHz for applications that require high data rates such as bit-mapped graphics or high-speed signal processing. The following equation can be used to calculate the maximum data rate:

$$\text{Data Rate} = \frac{256}{t_{RC} + 255 \times t_{PC}}$$

## Data Output Operation

The V53C464A Input/Output is controlled by  $\overline{OE}$ , CAS, WE and RAS. A RAS low transition enables the transfer of data to and from the selected row address in the Memory Array. A RAS high transition disables data transfer and latches the output data if the output is enabled. After a memory cycle is initiated with a RAS low transition, a CAS low transition or CAS low level enables the internal I/O path. A CAS high transition or a CAS high level disables the I/O path and the output driver if it is enabled. A CAS low transition while RAS is high has no effect on the I/O data path or on the output drivers. The output drivers, when otherwise enabled, can be disabled by holding  $\overline{OE}$  high. The  $\overline{OE}$  signal has no

effect on any data stored in the output latches. A  $\overline{WE}$  low level can also disable the output drivers when CAS is low. During a Write cycle, if WE goes low at a time in relationship to CAS that would normally cause the outputs to be active, it is necessary to use OE to disable the output drivers prior to the WE low transition to allow Data In Setup Time ( $t_{DS}$ ) to be satisfied.

## Power-On

After application of the  $V_{DD}$  supply, an initial pause of 200  $\mu$ s is required, followed by a minimum of 8 initialization cycles (any combination of cycles containing a RAS clock). Eight initialization cycles are required after extended periods of bias without clocks (greater than the Refresh Interval).

During Power-On, the  $V_{DD}$  current requirement of the V53C464A is dependent on the input levels of RAS and CAS. If RAS is low during Power-On, the device will go into an active cycle, and  $I_{DD}$  will exhibit current transients. It is recommended that RAS and CAS track with  $V_{DD}$  or be held at a valid  $V_{IH}$  during Power-On to avoid current surges.

**Table 1. V53C464A Data Output Operation for Various Cycle Types**

| Cycle Type                               | I/O State                                                         |
|------------------------------------------|-------------------------------------------------------------------|
| Read Cycles                              | Data from Addressed Memory Cell                                   |
| CAS-Controlled Write Cycle (Early Write) | High-Z                                                            |
| WE-Controlled Write Cycle (Late Write)   | $\overline{OE}$ Controlled. High<br>$\overline{OE}$ = High-Z I/Os |
| Read-Modify-Write Cycles                 | Data from Addressed Memory Cell                                   |
| Fast Page Mode Read Cycle                | Data from Addressed Memory Cell                                   |
| Fast Page Mode Write Cycle (Early Write) | High-Z                                                            |
| Fast Page Mode Read-Modify-Write Cycle   | Data from Addressed Memory Cell                                   |
| RAS-only Refresh                         | High-Z                                                            |
| CAS-before-RAS Refresh Cycle             | Data remains as in previous cycle                                 |
| CAS-only Cycles                          | High-Z                                                            |