



# 64K x 16 Static RAM

## Features

- Pin- and function-compatible with CY7C1021BV33
- High speed
  - $t_{AA}$  = 8, 10, 12, and 15 ns
- CMOS for optimum speed/power
- Low active power
  - 360 mW (max.)
- Data retention at 2.0V
- Automatic power-down when deselected
- Independent control of upper and lower bits
- Available in 44-pin TSOP II, 400-mil SOJ, 48-ball FBGA

## Functional Description

The CY7C1021CV33 is a high-performance CMOS static RAM organized as 65,536 words by 16 bits. This device has an automatic power-down feature that significantly reduces power consumption when deselected.

Writing to the device is accomplished by taking Chip Enable (CE) and Write Enable (WE) inputs LOW. If Byte Low Enable

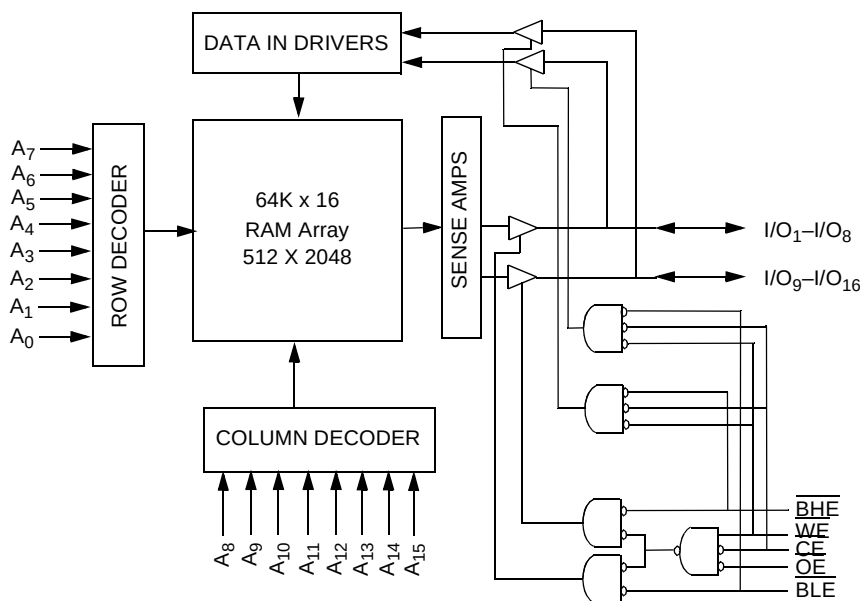
(BLE) is LOW, then data from I/O pins (I/O<sub>1</sub> through I/O<sub>8</sub>), is written into the location specified on the address pins (A<sub>0</sub> through A<sub>15</sub>). If Byte High Enable (BHE) is LOW, then data from I/O pins (I/O<sub>9</sub> through I/O<sub>16</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>15</sub>).

Reading from the device is accomplished by taking Chip Enable (CE) and Output Enable (OE) LOW while forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins will appear on I/O<sub>1</sub> to I/O<sub>8</sub>. If Byte High Enable (BHE) is LOW, then data from memory will appear on I/O<sub>9</sub> to I/O<sub>16</sub>. See the truth table at the end of this data sheet for a complete description of Read and Write modes.

The input/output pins (I/O<sub>1</sub> through I/O<sub>16</sub>) are placed in a high-impedance state when the device is deselected (CE HIGH), the outputs are disabled (OE HIGH), the BHE and BLE are disabled (BHE, BLE HIGH), or during a Write operation (CE LOW, and WE LOW).

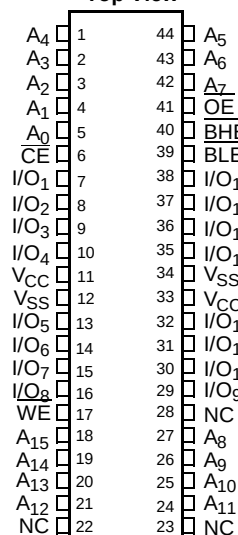
The CY7C1021CV33 is available in standard 44-pin TSOP Type II 400-mil-wide SOJ packages, as well as a 48-ball FBGA.

## Logic Block Diagram



## Pin Configuration

### SOJ / TSOP II Top View



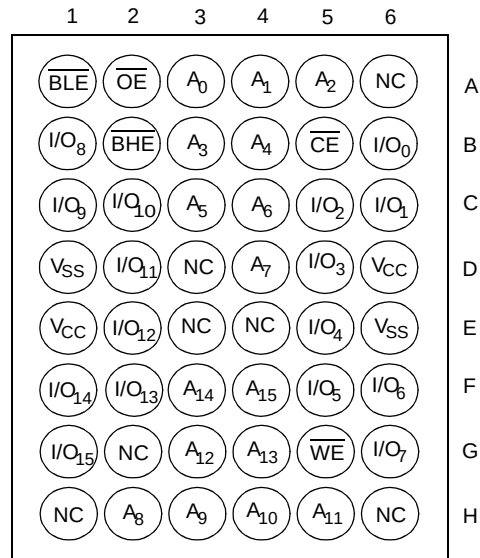
## Selection Guide

|                              | CY7C1021CV33-8 | CY7C1021CV33-10 | CY7C1021CV33-12 | CY7C1021CV33-15 | Unit |
|------------------------------|----------------|-----------------|-----------------|-----------------|------|
| Maximum Access Time          | 8              | 10              | 12              | 15              | ns   |
| Maximum Operating Current    | 95             | 90              | 85              | 80              | mA   |
| Maximum CMOS Standby Current | 5              | 5               | 5               | 5               | mA   |

Pin Configuration

48-ball FBGA

(Top View)



## Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... -65°C to +150°C

Ambient Temperature with Power Applied ..... -55°C to +125°C

Supply Voltage on  $V_{CC}$  to Relative GND<sup>[1]</sup> .... -0.5V to +4.6V

DC Voltage Applied to Outputs in High-Z State<sup>[1]</sup> ..... -0.5V to  $V_{CC}+0.5V$

DC Input Voltage<sup>[1]</sup> ..... -0.5V to  $V_{CC}+0.5V$

Current into Outputs (LOW) ..... 20 mA

Static Discharge Voltage ..... >2001V (per MIL-STD-883, Method 3015)

Latch-up Current ..... >200 mA

## Operating Range

| Range      | Ambient Temperature | $V_{CC}$   |
|------------|---------------------|------------|
| Commercial | 0°C to +70°C        | 3.3V ± 10% |
| Industrial | -40°C to +85°C      | 3.3V ± 10% |

## Electrical Characteristics Over the Operating Range

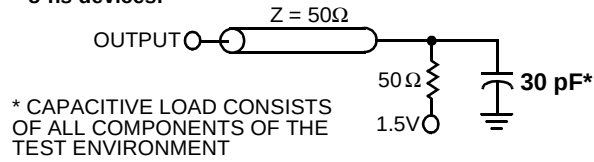
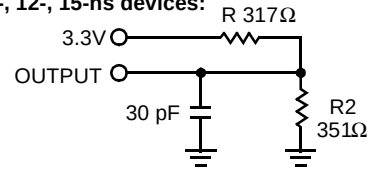
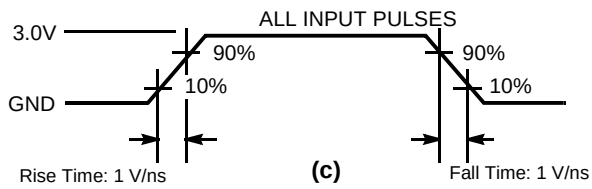
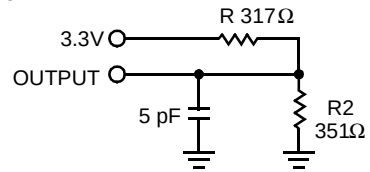
| Parameter | Description                                   | Test Conditions                                                                                                 | 1021CV33-8 |                | 1021CV33-10 |                | 1021CV33-12 |                | 1021CV33-15 |                | Unit |
|-----------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------|----------------|-------------|----------------|-------------|----------------|-------------|----------------|------|
|           |                                               |                                                                                                                 | Min.       | Max.           | Min.        | Max.           | Min.        | Max.           | Min.        | Max.           |      |
| $V_{OH}$  | Output HIGH Voltage                           | $V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$                                                                | 2.4        |                | 2.4         |                | 2.4         |                | 2.4         |                | V    |
| $V_{OL}$  | Output LOW Voltage                            | $V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$                                                                 |            | 0.4            |             | 0.4            |             | 0.4            |             | 0.4            | V    |
| $V_{IH}$  | Input HIGH Voltage                            |                                                                                                                 | 2.0        | $V_{CC} + 0.3$ | 2.0         | $V_{CC} + 0.3$ | 2.0         | $V_{CC} + 0.3$ | 2.0         | $V_{CC} + 0.3$ | V    |
| $V_{IL}$  | Input LOW Voltage <sup>[1]</sup>              |                                                                                                                 | -0.3       | 0.8            | -0.3        | 0.8            | -0.3        | 0.8            | -0.3        | 0.8            | V    |
| $I_{IX}$  | Input Load Current                            | $GND \leq V_I \leq V_{CC}$                                                                                      | -1         | +1             | -1          | +1             | -1          | +1             | -1          | +1             | μA   |
| $I_{OZ}$  | Output Leakage Current                        | $GND \leq V_I \leq V_{CC}, \text{Output Disabled}$                                                              | -1         | +1             | -1          | +1             | -1          | +1             | -1          | +1             | μA   |
| $I_{OS}$  | Output Short Circuit Current <sup>[2]</sup>   | $V_{CC} = \text{Max.}, V_{OUT} = GND$                                                                           |            | -300           |             | -300           |             | -300           |             | -300           | mA   |
| $I_{CC}$  | $V_{CC}$ Operating Supply Current             | $V_{CC} = \text{Max.}, I_{OUT} = 0 \text{ mA}, f = f_{MAX} = 1/t_{RC}$                                          |            | 95             |             | 90             |             | 85             |             | 80             | mA   |
| $I_{SB1}$ | Automatic CE Power-Down Current — TTL Inputs  | Max. $V_{CC}, \overline{CE} \geq V_{IH}, V_{IN} \geq V_{IH} \text{ or } V_{IN} \leq V_{IL}, f = f_{MAX}$        |            | 15             |             | 15             |             | 15             |             | 15             | mA   |
| $I_{SB2}$ | Automatic CE Power-Down Current — CMOS Inputs | Max. $V_{CC}, \overline{CE} \geq V_{CC} - 0.3V, V_{IN} \geq V_{CC} - 0.3V, \text{ or } V_{IN} \leq 0.3V, f = 0$ |            | 5              |             | 5              |             | 5              |             | 5              | mA   |

## Capacitance<sup>[3]</sup>

| Parameter | Description        | Test Conditions                                            | Max. | Unit |
|-----------|--------------------|------------------------------------------------------------|------|------|
| $C_{IN}$  | Input Capacitance  | $T_A = 25^\circ\text{C}, f = 1 \text{ MHz}, V_{CC} = 3.3V$ | 8    | pF   |
| $C_{OUT}$ | Output Capacitance |                                                            | 8    | pF   |

### Notes:

- $V_{IL}(\text{min.}) = -2.0V$  for pulse durations of less than 20 ns.
- Not more than one output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
- Tested initially and after any design or process changes that may affect these parameters.

**AC Test Loads and Waveforms<sup>[4]</sup>**
**8-ns devices:**

**(a)**
**10-, 12-, 15-ns devices:**

**(b)**

**(c)**
**High-Z characteristics:**

**(d)**
**Note:**

4. AC characteristics (except High-Z) for all 8-ns parts are tested using the load conditions shown in Figure (a). All other speeds are tested using the Thevenin load shown in Figure (b). High-Z characteristics are tested for all speeds using the test load shown in Figure (d).

**Switching Characteristics Over the Operating Range<sup>[5]</sup>**

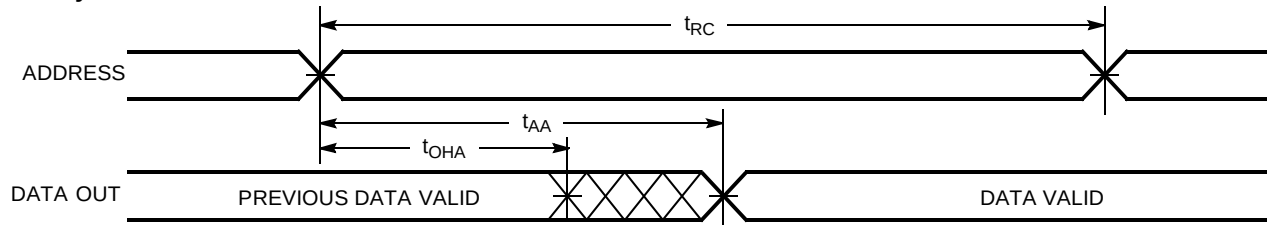
| Parameter                      | Description                                      | 1021CV33-8 |      | 1021CV33-10 |      | 1021CV33-12 |      | 1021CV33-15 |      | Unit |
|--------------------------------|--------------------------------------------------|------------|------|-------------|------|-------------|------|-------------|------|------|
|                                |                                                  | Min.       | Max. | Min.        | Max. | Min.        | Max. | Min.        | Max. |      |
| Read Cycle                     |                                                  |            |      |             |      |             |      |             |      |      |
| t <sub>RC</sub>                | Read Cycle Time                                  | 8          |      | 10          |      | 12          |      | 15          |      | ns   |
| t <sub>AA</sub>                | Address to Data Valid                            |            | 8    |             | 10   |             | 12   |             | 15   | ns   |
| t <sub>OHA</sub>               | Data Hold from Address Change                    | 3          |      | 3           |      | 3           |      | 3           |      | ns   |
| t <sub>ACE</sub>               | CE LOW to Data Valid                             |            | 8    |             | 10   |             | 12   |             | 15   | ns   |
| t <sub>DOE</sub>               | $\overline{OE}$ LOW to Data Valid                |            | 5    |             | 5    |             | 6    |             | 7    | ns   |
| t <sub>LZOE</sub>              | $\overline{OE}$ LOW to Low-Z <sup>[6]</sup>      | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>HZOE</sub>              | OE HIGH to High-Z <sup>[6, 7]</sup>              |            | 4    |             | 5    |             | 6    |             | 7    | ns   |
| t <sub>LZCE</sub>              | $\overline{CE}$ LOW to Low-Z <sup>[6]</sup>      | 3          |      | 3           |      | 3           |      | 3           |      | ns   |
| t <sub>HZCE</sub>              | $\overline{CE}$ HIGH to High-Z <sup>[6, 7]</sup> |            | 4    |             | 5    |             | 6    |             | 7    | ns   |
| t <sub>PU</sub> <sup>[8]</sup> | $\overline{CE}$ LOW to Power-Up                  | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>PD</sub> <sup>[8]</sup> | CE HIGH to Power-Down                            |            | 8    |             | 10   |             | 12   |             | 15   | ns   |
| t <sub>DBE</sub>               | Byte Enable to Data Valid                        |            | 5    |             | 5    |             | 6    |             | 7    | ns   |
| t <sub>LZBE</sub>              | Byte Enable to Low-Z                             | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>HZBE</sub>              | Byte Disable to High-Z                           |            | 4    |             | 5    |             | 6    |             | 7    | ns   |
| Write Cycle <sup>[9]</sup>     |                                                  |            |      |             |      |             |      |             |      |      |
| t <sub>WC</sub>                | Write Cycle Time                                 | 8          |      | 10          |      | 12          |      | 15          |      | ns   |
| t <sub>SCE</sub>               | $\overline{CE}$ LOW to Write End                 | 7          |      | 8           |      | 9           |      | 10          |      | ns   |
| t <sub>AW</sub>                | Address Set-Up to Write End                      | 7          |      | 8           |      | 9           |      | 10          |      | ns   |
| t <sub>HA</sub>                | Address Hold from Write End                      | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>SA</sub>                | Address Set-Up to Write Start                    | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>PWE</sub>               | $\overline{WE}$ Pulse Width                      | 6          |      | 7           |      | 8           |      | 10          |      | ns   |
| t <sub>SD</sub>                | Data Set-Up to Write End                         | 5          |      | 5           |      | 6           |      | 8           |      | ns   |
| t <sub>HD</sub>                | Data Hold from Write End                         | 0          |      | 0           |      | 0           |      | 0           |      | ns   |
| t <sub>LZWE</sub>              | $\overline{WE}$ HIGH to Low-Z <sup>[6]</sup>     | 3          |      | 3           |      | 3           |      | 3           |      | ns   |
| t <sub>HZWE</sub>              | $\overline{WE}$ LOW to High-Z <sup>[6, 7]</sup>  |            | 4    |             | 5    |             | 6    |             | 7    | ns   |
| t <sub>BW</sub>                | Byte Enable to End of Write                      | 6          |      | 7           |      | 8           |      | 9           |      | ns   |

**Notes:**

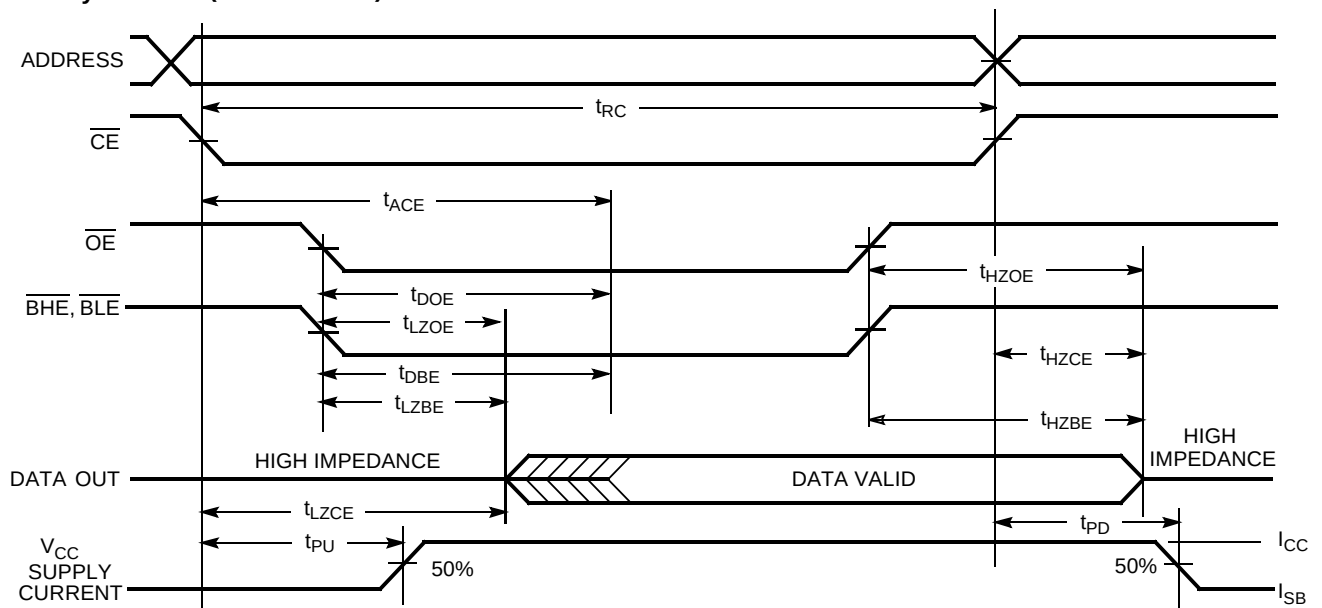
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V.
- At any given temperature and voltage condition,  $t_{HZCE}$  is less than  $t_{LZCE}$ ,  $t_{HZOE}$  is less than  $t_{LZOE}$ , and  $t_{HZWE}$  is less than  $t_{LZWE}$  for any given device.
- $t_{HZOE}$ ,  $t_{HZBE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (d) of AC Test Loads. Transition is measured  $\pm 500$  mV from steady-state voltage.
- This parameter is guaranteed by design and is not tested.
- The internal Write time of the memory is defined by the overlap of  $\overline{CE}$  LOW,  $\overline{WE}$  LOW and  $\overline{BHE}/\overline{BLE}$  LOW.  $\overline{CE}$ ,  $\overline{WE}$  and  $\overline{BHE}/\overline{BLE}$  must be LOW to initiate a Write, and the transition of these signals can terminate the Write. The input data set-up and hold timing should be referenced to the leading edge of the signal that terminates the Write.

## Switching Waveforms

### Read Cycle No. 1<sup>[10, 11]</sup>

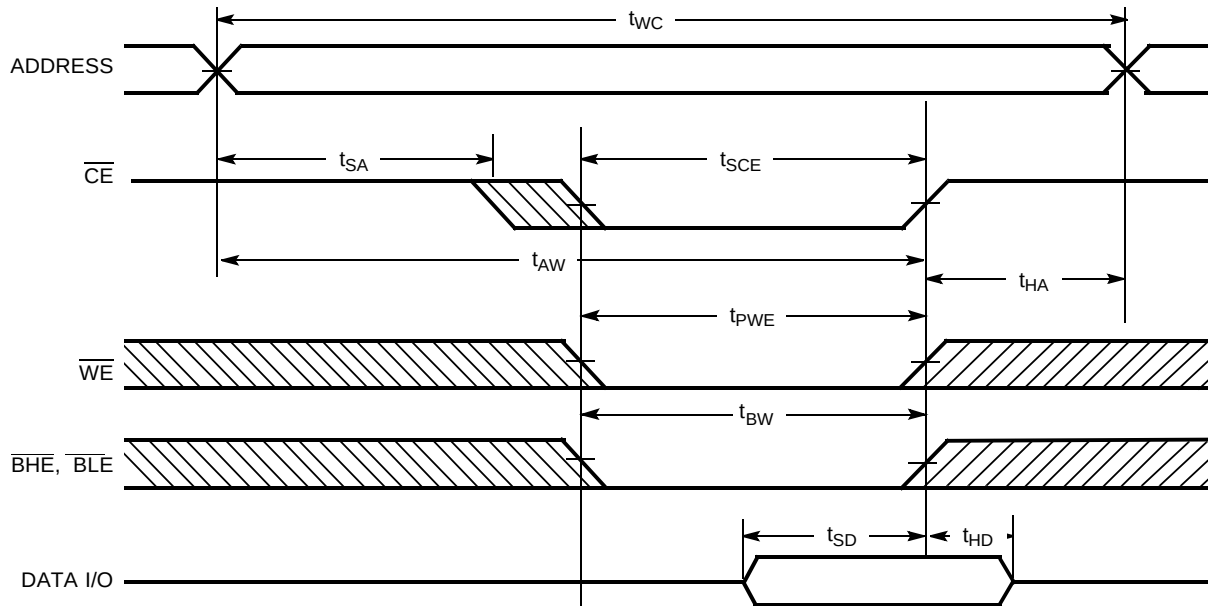
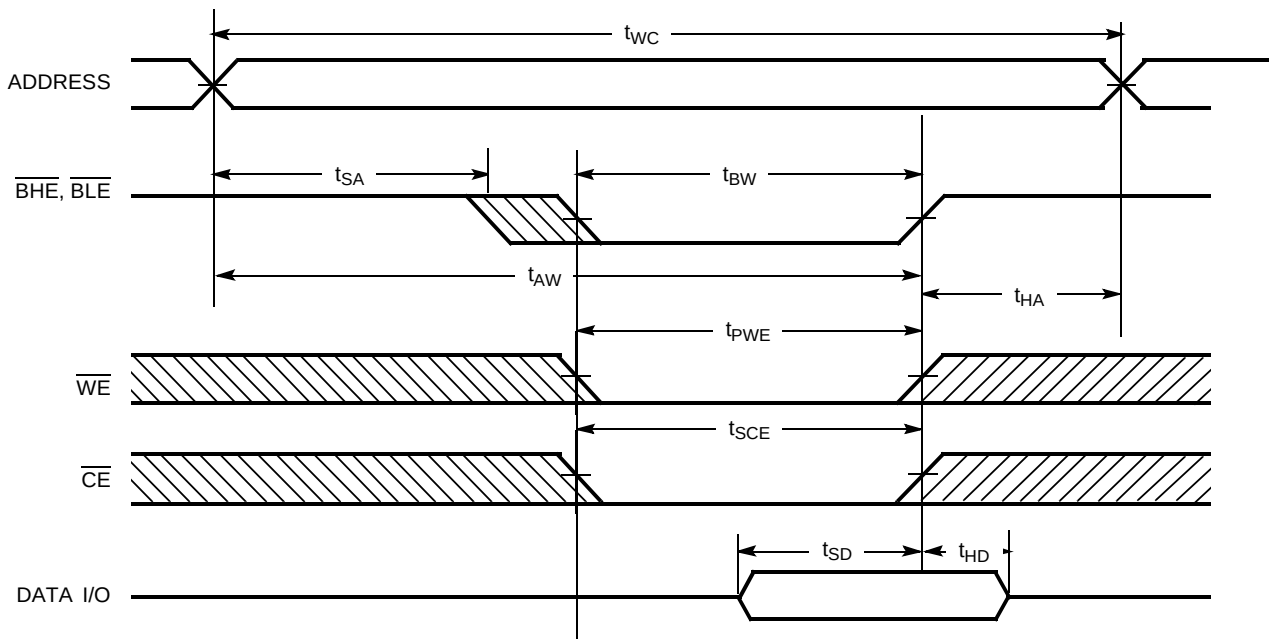


### Read Cycle No. 2 ( $\overline{OE}$ Controlled)<sup>[11, 12]</sup>



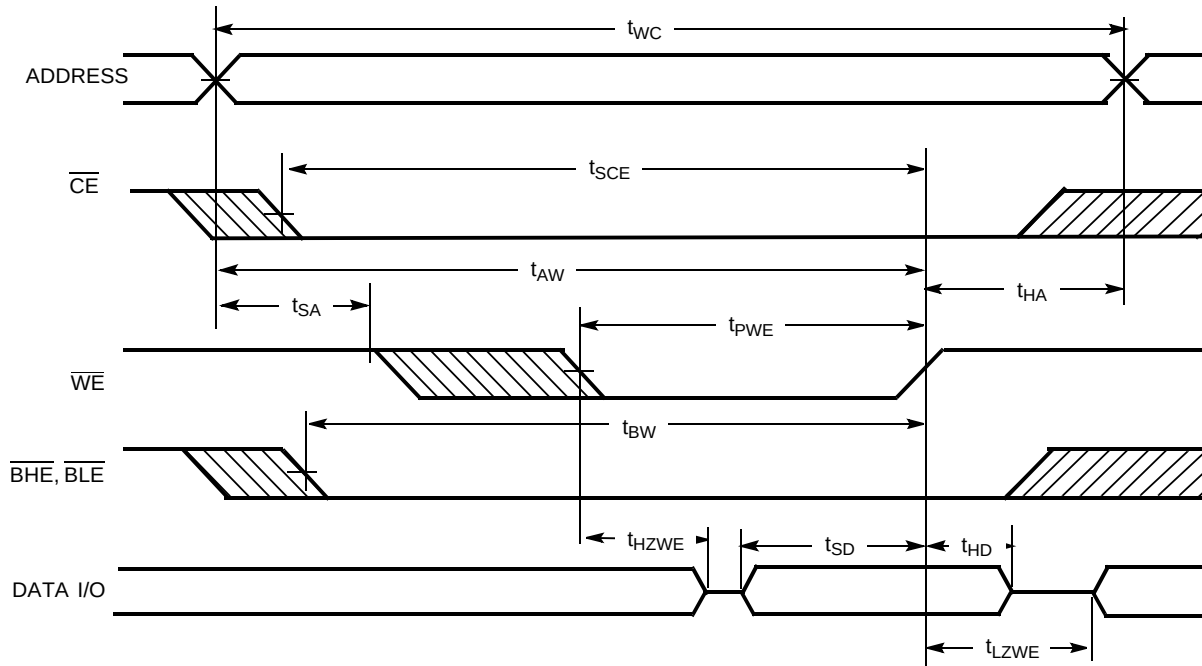
#### Notes:

10. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$ ,  $\overline{BHE}$  and/or  $\overline{BHE} = V_{IL}$ .
11.  $\overline{WE}$  is HIGH for Read cycle.
12. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

**Switching Waveforms (continued)**
**Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled) [13, 14]**

**Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled)**

**Notes:**

13. Data I/O is high impedance if  $\overline{\text{OE}}$  or  $\overline{\text{BHE}}$  and/or  $\overline{\text{BLE}} = V_{\text{IH}}$ .
14. If  $\overline{\text{CE}}$  goes HIGH simultaneously with  $\overline{\text{WE}}$  going HIGH, the output remains in a high-impedance state.

**Switching Waveforms** (continued)

**Write Cycle No. 3 ( $\overline{\text{WE}}$  Controlled, LOW)**

**Truth Table**

| CE | OE | WE | BLE | BHE | I/O <sub>1</sub> –I/O <sub>8</sub> | I/O <sub>9</sub> –I/O <sub>16</sub> | Mode                       | Power                       |
|----|----|----|-----|-----|------------------------------------|-------------------------------------|----------------------------|-----------------------------|
| H  | X  | X  | X   | X   | High-Z                             | High-Z                              | Power-down                 | Standby ( $I_{\text{SB}}$ ) |
| L  | L  | H  | L   | L   | Data Out                           | Data Out                            | Read – All bits            | Active ( $I_{\text{CC}}$ )  |
|    |    |    | L   | H   | Data Out                           | High-Z                              | Read – Lower bits only     | Active ( $I_{\text{CC}}$ )  |
|    |    |    | H   | L   | High-Z                             | Data Out                            | Read – Upper bits only     | Active ( $I_{\text{CC}}$ )  |
| L  | X  | L  | L   | L   | Data In                            | Data In                             | Write – All bits           | Active ( $I_{\text{CC}}$ )  |
|    |    |    | L   | H   | Data In                            | High-Z                              | Write – Lower bits only    | Active ( $I_{\text{CC}}$ )  |
|    |    |    | H   | L   | High-Z                             | Data In                             | Write – Upper bits only    | Active ( $I_{\text{CC}}$ )  |
| L  | H  | H  | X   | X   | High-Z                             | High-Z                              | Selected, Outputs Disabled | Active ( $I_{\text{CC}}$ )  |
| L  | X  | X  | H   | H   | High-Z                             | High-Z                              | Selected, Outputs Disabled | Active ( $I_{\text{CC}}$ )  |

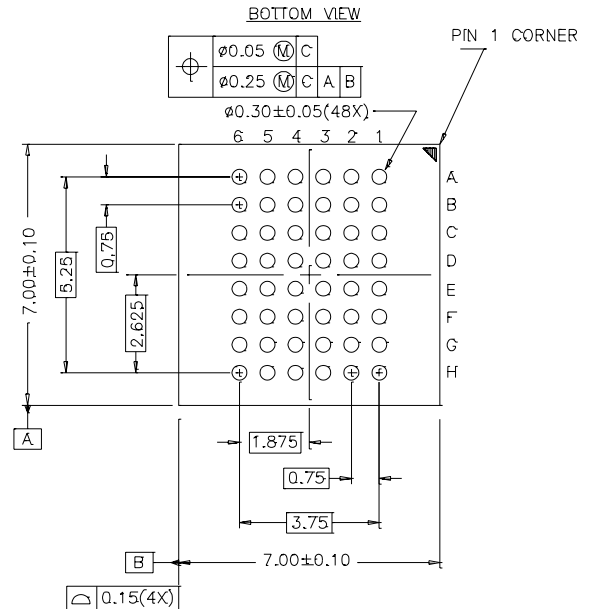
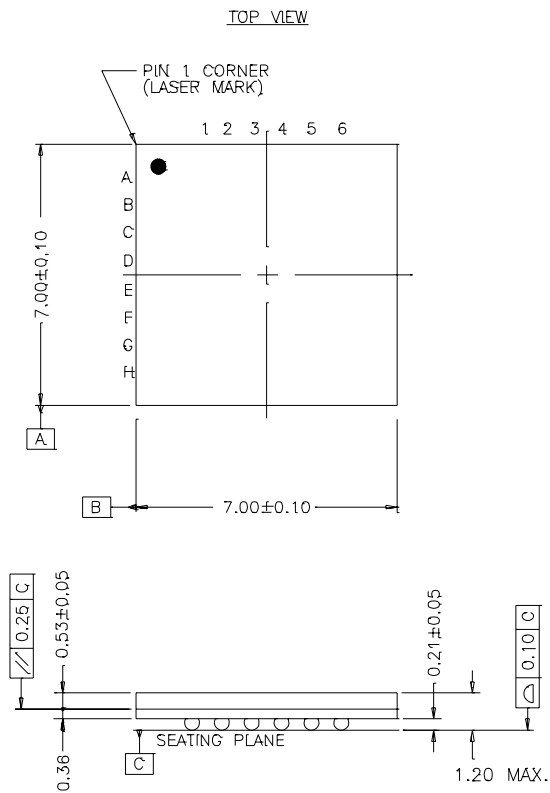


**Ordering Information**

| Speed (ns) | Ordering Code      | Package Name | Package Type                 | Operating Range |
|------------|--------------------|--------------|------------------------------|-----------------|
| 8          | CY7C1021CV33-8VC   | V34          | 44-lead (400-Mil) Molded SOJ | Commercial      |
|            | CY7C1021CV33-8ZC   | Z44          | 44-lead TSOP Type II         |                 |
|            | CY7C1021CV33-8BAC  | BA48A        | 48-ball FBGA                 |                 |
| 10         | CY7C1021CV33-10VC  | V34          | 44-lead (400-Mil) Molded SOJ | Commercial      |
|            | CY7C1021CV33-10VI  |              |                              | Industrial      |
|            | CY7C1021CV33-10ZC  | Z44          | 44-lead TSOP Type II         | Commercial      |
|            | CY7C1021CV33-10ZI  |              |                              | Industrial      |
|            | CY7C1021CV33-10BAC | BA48A        | 48-ball FBGA                 | Commercial      |
|            | CY7C1021CV33-10BAI |              |                              | Industrial      |
| 12         | CY7C1021CV33-12VC  | V34          | 44-lead (400-Mil) Molded SOJ | Commercial      |
|            | CY7C1021CV33-12VI  |              |                              | Industrial      |
|            | CY7C1021CV33-12ZC  | Z44          | 44-lead TSOP Type II         | Commercial      |
|            | CY7C1021CV33-12ZI  |              |                              | Industrial      |
|            | CY7C1021CV33-12BAC | BA48A        | 48-ball FBGA                 | Commercial      |
|            | CY7C1021CV33-12BAI |              |                              | Industrial      |
| 15         | CY7C1021CV33-15VC  | V34          | 44-lead (400-Mil) Molded SOJ | Commercial      |
|            | CY7C1021CV33-15VI  |              |                              | Industrial      |
|            | CY7C1021CV33-15ZC  | Z44          | 44-lead TSOP Type II         | Commercial      |
|            | CY7C1021CV33-15ZI  |              |                              | Industrial      |
|            | CY7C1021CV33-15BAC | BA48A        | 48-ball FBGA                 | Commercial      |
|            | CY7C1021CV33-15BAI |              |                              | Industrial      |

Package Diagrams

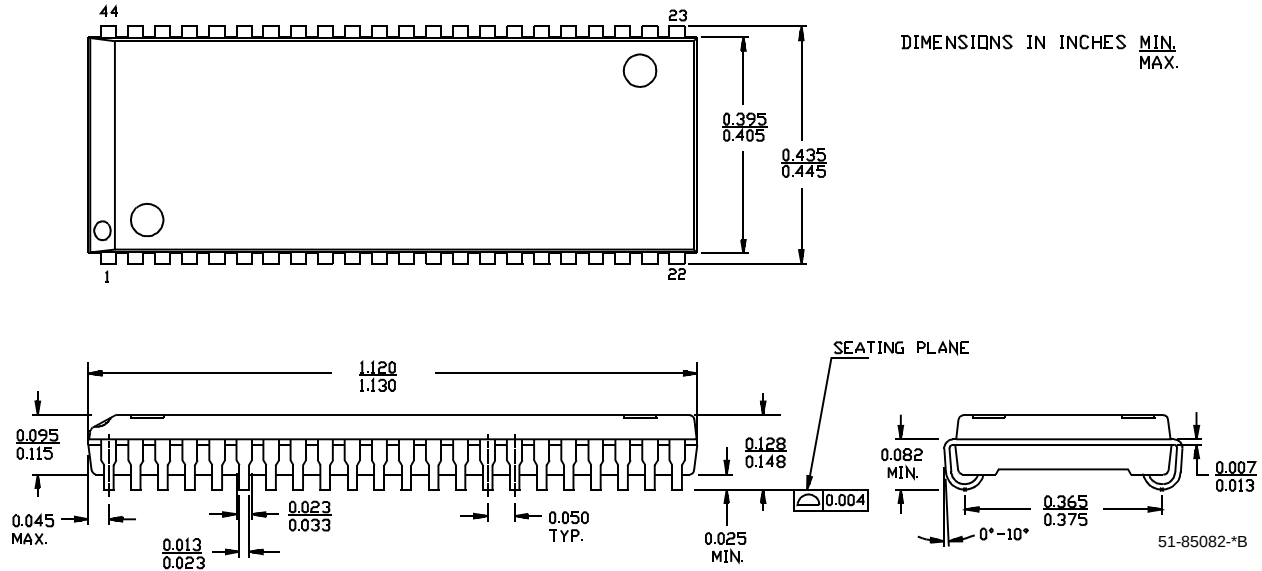
48-Ball (7.00 mm x 7.00 mm x 1.2 mm) FBGA BA48A



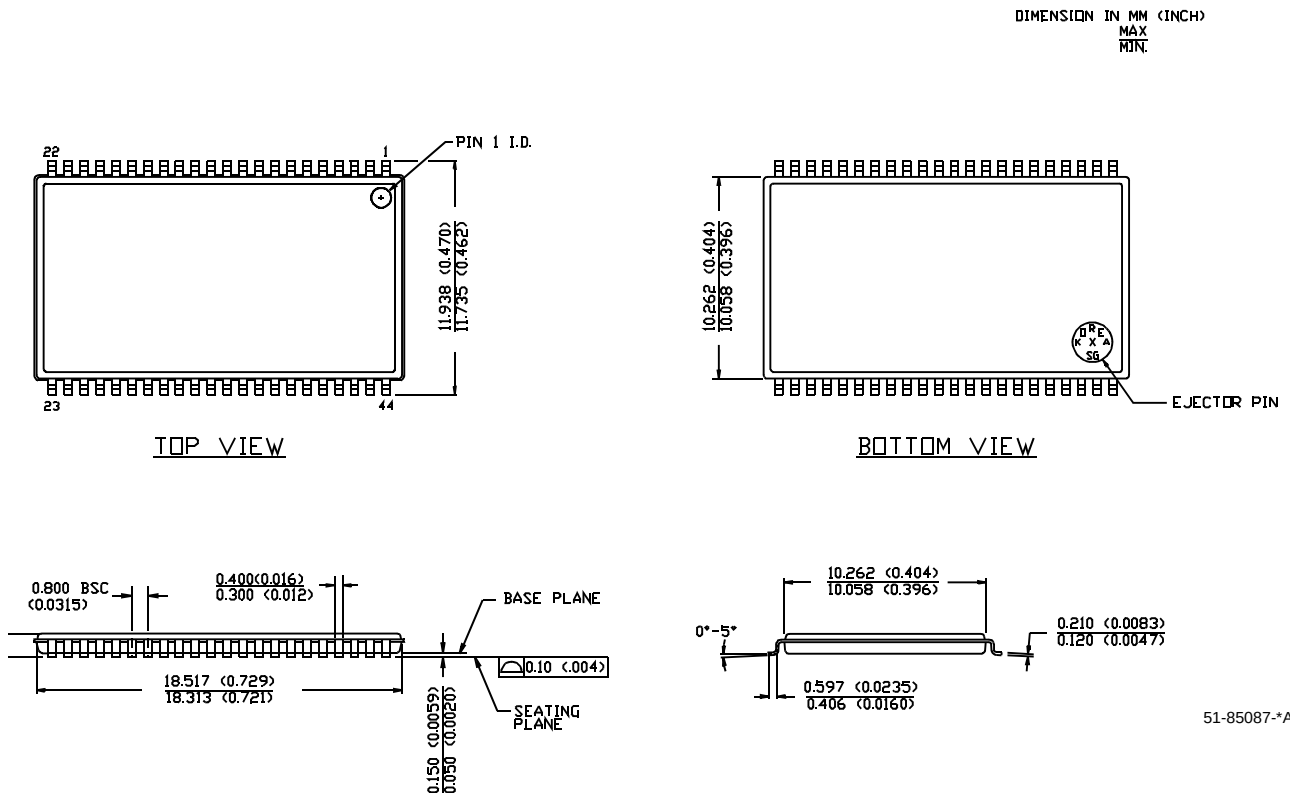
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Package Diagrams (continued)

44-Lead (400-Mil) Molded SOJ V34



44-pin TSOP II Z44



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## Document History Page

| Document Title: CY7C1021CV33 64K x 16 Static RAM<br>Document Number: 38-05132 |         |            |                 |                                                      |
|-------------------------------------------------------------------------------|---------|------------|-----------------|------------------------------------------------------|
| REV.                                                                          | ECN NO. | Issue Date | Orig. of Change | Description of Change                                |
| **                                                                            | 109472  | 12/06/01   | HGK             | New Data Sheet                                       |
| *A                                                                            | 115044  | 05/08/02   | HGK             | Ram7 version C4K x 16 Async.<br>Remove "Preliminary" |
| *B                                                                            | 115808  | 06/25/02   | HGK             | I <sub>SB1</sub> and I <sub>CC</sub> values changed  |
| *C                                                                            | 120413  | 10/31/02   | DFP             | Updated BGA pin E4 to NC.                            |