

## Features

- High speed: 45 ns
- Wide voltage range: 4.5 V to 5.5 V
- Pin compatible with CY62138V
- Ultra low standby power
  - Typical standby current: 1  $\mu$ A
  - Maximum standby current: 5  $\mu$ A
- Ultra low active power
  - Typical active current: 1.6 mA @ f = 1 MHz
- Easy memory expansion with  $\overline{CE}_1$ ,  $CE_2$ , and  $\overline{OE}$  features
- Automatic power down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed and power
- Available in Pb-free 32-pin SOIC and 32-pin thin small outline package (TSOP) II packages

## Functional Description

The CY62138F is a high performance CMOS static RAM organized as 256K words by 8 bits. This device features advanced circuit design to provide ultra low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable applications. The device also has an automatic power down feature that significantly reduces power consumption when addresses are not toggling. Placing the device into standby mode reduces power consumption by more than 99% when deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW).

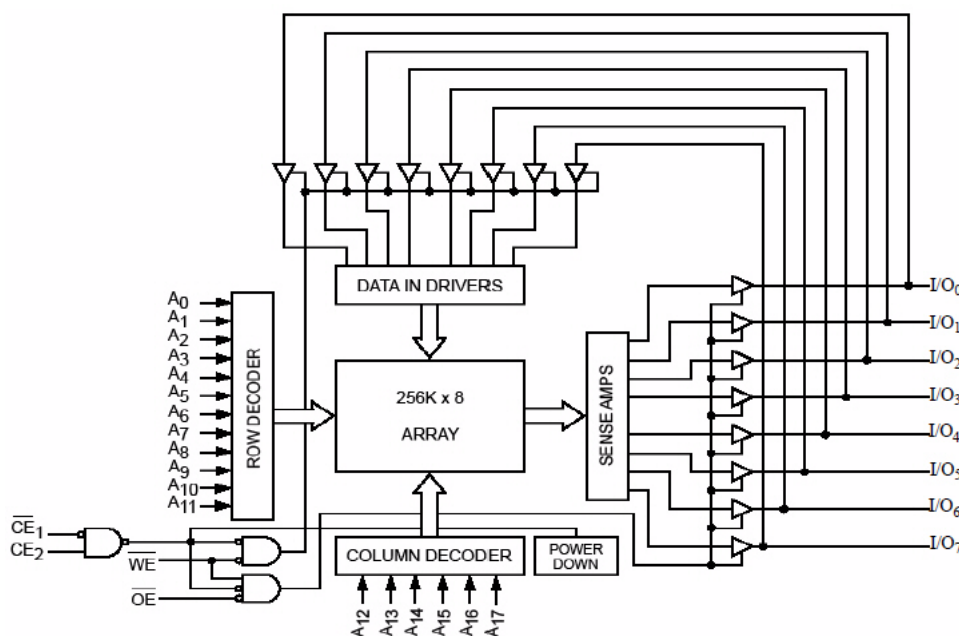
To write to the device, take Chip Enable ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) and Write Enable ( $\overline{WE}$ ) inputs LOW. Data on the eight I/O pins ( $I/O_0$  through  $I/O_7$ ) is then written into the location specified on the address pins ( $A_0$  through  $A_{17}$ ).

To read from the device, take Chip Enable ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) and output enable ( $\overline{OE}$ ) LOW while forcing Write Enable ( $\overline{WE}$ ) HIGH. Under these conditions, the contents of the memory location specified by the address pins appear on the I/O pins.

The eight input and output pins ( $I/O_0$  through  $I/O_7$ ) are placed in a high impedance state when the device is deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW), the outputs are disabled ( $\overline{OE}$  HIGH), or during a write operation ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH and  $\overline{WE}$  LOW).

The CY62138F device is suitable for interfacing with processors that have TTL I/P levels. It is not suitable for processors that require CMOS I/P levels. Please see [Electrical Characteristics](#) on page 4 for more details and suggested alternatives.

## Logic Block Diagram

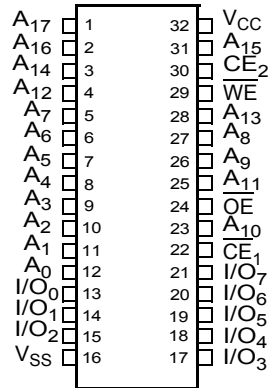


## Contents

|   |           |  |           |
|---|-----------|--|-----------|
| <b>Pin Configurations</b> .....             | <b>3</b>  | <b>Ordering Information</b> .....                    | <b>11</b> |
| <b>Product Portfolio</b> .....              | <b>3</b>  | Ordering Code Definitions .....                      | 11        |
| <b>Maximum Ratings</b> .....                | <b>4</b>  | <b>Package Diagrams</b> .....                        | <b>12</b> |
| <b>Operating Range</b> .....                | <b>4</b>  | <b>Acronyms</b> .....                                | <b>14</b> |
| <b>Electrical Characteristics</b> .....     | <b>4</b>  | <b>Documents Conventions</b> .....                   | <b>14</b> |
| <b>Capacitance</b> .....                    | <b>5</b>  | Units of Measure .....                               | 14        |
| <b>Thermal Resistance</b> .....             | <b>5</b>  | <b>Document History Page</b> .....                   | <b>15</b> |
| <b>AC Test Loads and Waveforms</b> .....    | <b>5</b>  | <b>Sales, Solutions, and Legal Information</b> ..... | <b>16</b> |
| <b>Data Retention Characteristics</b> ..... | <b>6</b>  | Worldwide Sales and Design Support .....             | 16        |
| <b>Data Retention Waveform</b> .....        | <b>6</b>  | Products .....                                       | 16        |
| <b>Switching Characteristics</b> .....      | <b>7</b>  | PSoC® Solutions .....                                | 16        |
| <b>Switching Waveforms</b> .....            | <b>8</b>  | Cypress Developer Community .....                    | 16        |
| <b>Truth Table</b> .....                    | <b>10</b> | Technical Support .....                              | 16        |

## Pin Configurations

Figure 1. 32-pin SOIC/TSOP II Pinout (Top View)



## Product Portfolio

| Product    | V <sub>CC</sub> Range (V) |                    |                      | Speed (ns) | Power Dissipation              |     |                    |     |                               |     |
|------------|---------------------------|--------------------|----------------------|------------|--------------------------------|-----|--------------------|-----|-------------------------------|-----|
|            |                           |                    |                      |            | Operating I <sub>CC</sub> (mA) |     |                    |     | Standby I <sub>SB2</sub> (μA) |     |
|            | f = 1 MHz                 |                    | f = f <sub>max</sub> |            |                                |     |                    |     |                               |     |
|            | Min                       | Typ <sup>[1]</sup> | Max                  |            | Typ <sup>[1]</sup>             | Max | Typ <sup>[1]</sup> | Max | Typ <sup>[1]</sup>            | Max |
| CY62138FLL | 4.5 V                     | 5.0 V              | 5.5 V                | 45         | 1.6                            | 2.5 | 13                 | 18  | 1                             | 5   |

**Note**

1. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = V<sub>CC(typ)</sub>, T<sub>A</sub> = 25 °C.

## Maximum Ratings

Exceeding maximum ratings may impair the useful life of the device. These user guidelines are not tested.

Storage temperature ..... -65 °C to + 150 °C  
 Ambient temperature with power applied ..... -55 °C to + 125 °C  
 Supply voltage to ground potential ..... -0.5 V to 6.0 V ( $V_{CCmax} + 0.5 V$ )  
 DC voltage applied to outputs in High Z state <sup>[2, 3]</sup> ..... -0.5 V to 6.0 V ( $V_{CCmax} + 0.5 V$ )

DC Input Voltage <sup>[2, 3]</sup> ..... -0.5 V to 6.0 V ( $V_{CCmax} + 0.5 V$ )  
 Output Current into Outputs (LOW) ..... 20 mA  
 Static Discharge Voltage (MIL-STD-883, Method 3015) ..... > 2001 V  
 Latch-up Current ..... > 200 mA

## Operating Range

| Device     | Range      | Ambient Temperature | V <sub>CC</sub> <sup>[4]</sup> |
|------------|------------|---------------------|--------------------------------|
| CY62138FLL | Industrial | -40 °C to +85 °C    | 4.5 V to 5.5 V                 |

## Electrical Characteristics

Over the Operating Range

| Parameter                       | Description                                 | Test Conditions   |   | 45 ns |                    |                       | Unit |
|---------------------------------|---|---|---|-------|--------------------|-----------------------|------|
|                                 |   |   |   | Min   | Typ <sup>[5]</sup> | Max                   |      |
| V <sub>OH</sub>                 | Output HIGH voltage                         | V <sub>CC</sub> = 4.5 V   | I <sub>OH</sub> = -1.0 mA   | 2.4   | -                  | -                     | V    |
|                                 |   | V <sub>CC</sub> = 5.5 V   | I <sub>OH</sub> = -0.1 mA   | -     | -                  | 3.4 <sup>[6]</sup>    |      |
| V <sub>OL</sub>                 | Output LOW voltage                          | I <sub>OL</sub> = 2.1 mA  |   | -     | -                  | 0.4                   | V    |
| V <sub>IH</sub>                 | Input HIGH voltage                          | V <sub>CC</sub> = 4.5 V to 5.5 V  |   | 2.2   | -                  | V <sub>CC</sub> + 0.5 | V    |
| V <sub>IL</sub>                 | Input LOW voltage                           | V <sub>CC</sub> = 4.5 V to 5.5 V  |   | -0.5  | -                  | 0.8                   | V    |
| I <sub>IX</sub>                 | Input leakage current                       | GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>  |   | -1    | -                  | +1                    | μA   |
| I <sub>OZ</sub>                 | Output leakage current                      | GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output disabled  |   | -1    | -                  | +1                    | μA   |
| I <sub>CC</sub>                 | V <sub>CC</sub> operating supply Current    | f = f <sub>max</sub> = 1/t <sub>RC</sub>  | V <sub>CC</sub> = V <sub>CC(max)</sub> ,<br>I <sub>OUT</sub> = 0 mA,<br>CMOS levels | -     | 13                 | 18                    | mA   |
|                                 |   | f = 1 MHz   |   | -     | 1.6                | 2.5                   |      |
| I <sub>SB2</sub> <sup>[7]</sup> | Automatic CE Power-down current CMOS inputs | CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2 V or CE <sub>2</sub> ≤ 0.2 V,<br>V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V or V <sub>IN</sub> ≤ 0.2 V,<br>f = 0, V <sub>CC</sub> = V <sub>CC(max)</sub> |   | -     | 1                  | 5                     | μA   |

### Notes

- V<sub>IL(min)</sub> = -2.0 V for pulse durations less than 20 ns.
- V<sub>IH(max)</sub> = V<sub>CC</sub> + 0.75 V for pulse durations less than 20 ns.
- Full device AC operation assumes a 100 μs ramp time from 0 to V<sub>CC(min)</sub> and 200 μs wait time after V<sub>CC</sub> stabilization.
- Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = V<sub>CC(typ)</sub>, T<sub>A</sub> = 25 °C.
- Please note that the maximum V<sub>OH</sub> limit does not exceed minimum CMOS V<sub>IH</sub> of 3.5 V. If you are interfacing this SRAM with 5 V legacy processors that require a minimum V<sub>IH</sub> of 3.5 V, please refer to Application Note AN6081 for technical details and options you may consider.
- Chip enables (CE<sub>1</sub> and CE<sub>2</sub>) must be at CMOS level to meet the I<sub>SB2</sub> / I<sub>CCDR</sub> spec. Other inputs can be left floating.

### Capacitance

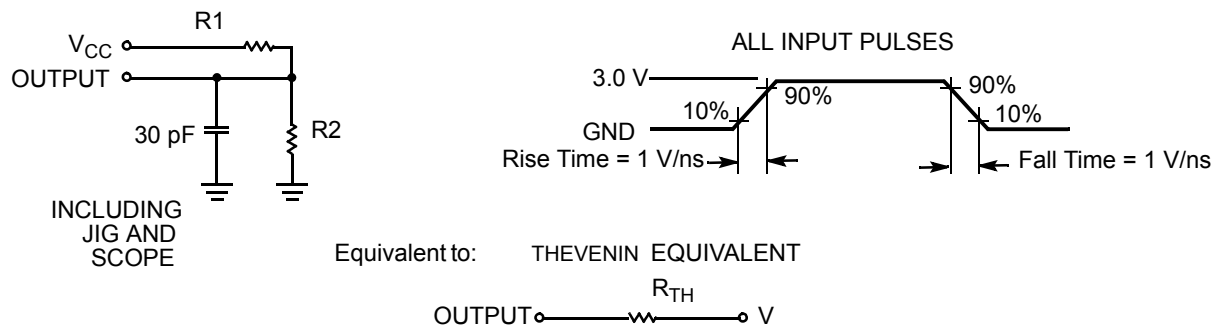
| Parameter <sup>[8]</sup> | Description        | Test Conditions   | Max | Unit |
|--------------------------|--------------------|---|-----|------|
| C <sub>IN</sub>          | Input capacitance  | T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = V <sub>CC(typ)</sub> | 10  | pF   |
| C <sub>OUT</sub>         | Output capacitance |   | 10  | pF   |

### Thermal Resistance

| Parameter <sup>[8]</sup> | Description                              | Test Conditions   | 32-pin SOIC | 32-pin TSOP II | Unit |
|--------------------------|--|---|-------------|----------------|------|
| θ <sub>JA</sub>          | Thermal resistance (Junction to Ambient) | Still air, soldered on a 3 × 4.5 inch two-layer printed circuit board | 44.53       | 44.16          | °C/W |
| θ <sub>JC</sub>          | Thermal resistance (Junction to Case)    |   | 24.05       | 11.97          | °C/W |

### AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms



| Parameters      | 5.0 V | Unit |
|-----------------|-------|------|
| R <sub>1</sub>  | 1800  | Ω    |
| R <sub>2</sub>  | 990   | Ω    |
| R <sub>TH</sub> | 639   | Ω    |
| V <sub>TH</sub> | 1.77  | V    |

**Note**

8. Tested initially and after any design or process changes that may affect these parameters.

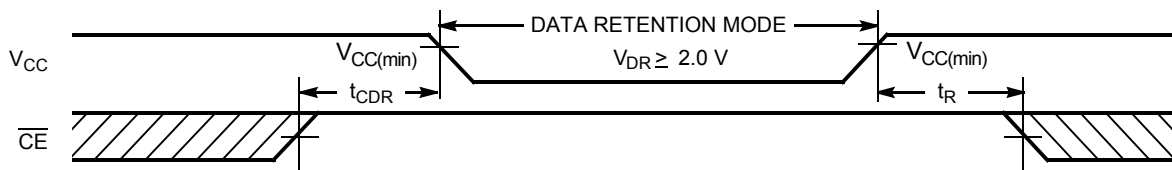
## Data Retention Characteristics

Over the Operating Range

| Parameter                  | Description                          | Conditions   | Min | Typ <sup>[9]</sup> | Max | Unit    |
|----------------------------|--------------------------------------|--|-----|--------------------|-----|---------|
| $V_{DR}$                   | $V_{CC}$ for Data retention          |  | 2.0 | –                  | –   | V       |
| $I_{CCDR}$ <sup>[10]</sup> | Data retention current               | $V_{CC} = V_{DR}$ , $\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V,<br>$V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V | –   | 1                  | 5   | $\mu$ A |
| $t_{CDR}$ <sup>[9]</sup>   | Chip deselect to data retention time |  | 0   | –                  | –   | ns      |
| $t_R$ <sup>[11]</sup>      | Operation recovery time              |  | 45  | –                  | –   | ns      |

## Data Retention Waveform

Figure 3. Data Retention Waveform<sup>[12]</sup>



### Notes

9. Tested initially and after any design or process changes that may affect these parameters. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{CC} = V_{CC(typ)}$ ,  $T_A = 25$  °C.
10. Chip enables ( $CE_1$  and  $CE_2$ ) must be at CMOS level to meet the  $I_{SB2} / I_{CCDR}$  spec. Other inputs can be left floating.
11. Full device AC operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(min)} \geq 100$   $\mu$ s or stable at  $V_{CC(min)} \geq 100$   $\mu$ s.
12.  $\overline{CE}$  is the logical combination of  $CE_1$  and  $CE_2$ . When  $CE_1$  is LOW and  $CE_2$  is HIGH,  $\overline{CE}$  is LOW; when  $CE_1$  is HIGH or  $CE_2$  is LOW,  $\overline{CE}$  is HIGH.

## Switching Characteristics

Over the Operating Range

| Parameter [13, 14]      | Description  | 45 ns |     | Unit |
|-------------------------|--|-------|-----|------|
|                         |  | Min   | Max |      |
| <b>Read Cycle</b>       |  |       |     |      |
| $t_{RC}$                | Read cycle time  | 45    | –   | ns   |
| $t_{AA}$                | Address to data valid  | –     | 45  | ns   |
| $t_{OHA}$               | Data hold from address change                                      | 10    | –   | ns   |
| $t_{ACE}$               | $\overline{CE}_1$ LOW and $\overline{CE}_2$ HIGH to data valid     | –     | 45  | ns   |
| $t_{DOE}$               | $\overline{OE}$ LOW to data valid                                  | –     | 22  | ns   |
| $t_{LZOE}$              | $\overline{OE}$ LOW to low Z [15]                                  | 5     | –   | ns   |
| $t_{HZOE}$              | $\overline{OE}$ HIGH to high Z [15, 16]                            | –     | 18  | ns   |
| $t_{LZCE}$              | $\overline{CE}_1$ LOW and $\overline{CE}_2$ HIGH to low Z [15]     | 10    | –   | ns   |
| $t_{HZCE}$              | $\overline{CE}_1$ HIGH or $\overline{CE}_2$ LOW to high Z [15, 16] | –     | 18  | ns   |
| $t_{PU}$                | $\overline{CE}_1$ LOW and $\overline{CE}_2$ HIGH to power-up       | 0     | –   | ns   |
| $t_{PD}$                | $\overline{CE}_1$ HIGH or $\overline{CE}_2$ LOW to power-down      | –     | 45  | ns   |
| <b>Write Cycle [17]</b> |  |       |     |      |
| $t_{WC}$                | Write cycle time   | 45    | –   | ns   |
| $t_{SCE}$               | $\overline{CE}_1$ LOW and $\overline{CE}_2$ HIGH to write end      | 35    | –   | ns   |
| $t_{AW}$                | Address setup to write end   | 35    | –   | ns   |
| $t_{HA}$                | Address hold from write end  | 0     | –   | ns   |
| $t_{SA}$                | Address setup to write start                                       | 0     | –   | ns   |
| $t_{PWE}$               | $\overline{WE}$ pulse width  | 35    | –   | ns   |
| $t_{SD}$                | Data setup to write end  | 25    | –   | ns   |
| $t_{HD}$                | Data hold from write end   | 0     | –   | ns   |
| $t_{HZWE}$              | $\overline{WE}$ LOW to high Z [15, 16]                             | –     | 18  | ns   |
| $t_{LZWE}$              | $\overline{WE}$ HIGH to low Z [15]                                 | 10    | –   | ns   |

### Notes

13. In an earlier revision of this device, under a specific application condition, READ and WRITE operations were limited to switching of the chip enable signal as described in the Application Note AN66311. However, the issue has been fixed and in production now, and hence, this Application Notes is no longer applicable. It is available for download on our website as it contains information on the date code of the parts, beyond which the fix has been in production.
14. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns (1 V/ns) or less, timing reference levels of  $V_{CC(typ)}/2$ , input pulse levels of 0 to  $V_{CC(typ)}$ , and output loading of the specified  $I_{OL}/I_{OH}$  as shown in the Figure 2 on page 5.
15. 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.
16.  $t_{HZOE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high impedance state.
17. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE}_1 = V_{IL}$ , and  $\overline{CE}_2 = V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.

## Switching Waveforms

Figure 4. Read Cycle 1 (Address Transition Controlled) [18, 19]

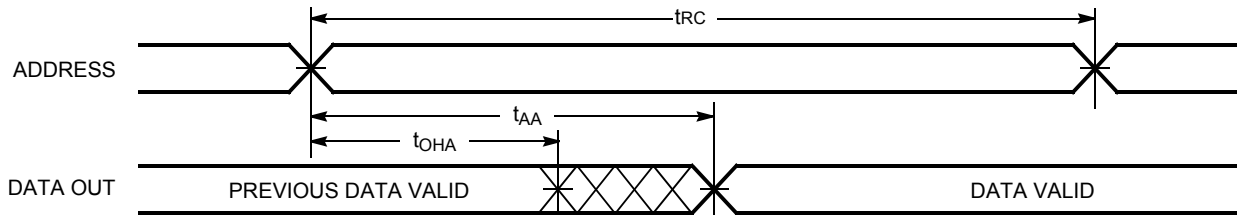


Figure 5. Read Cycle No. 2 (OE Controlled) [19, 20, 21]

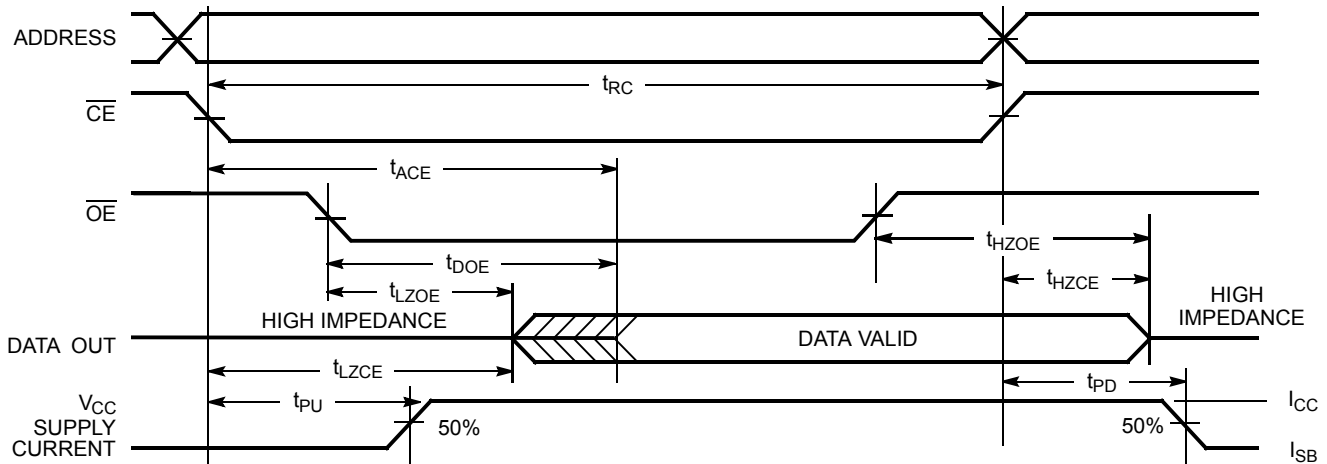
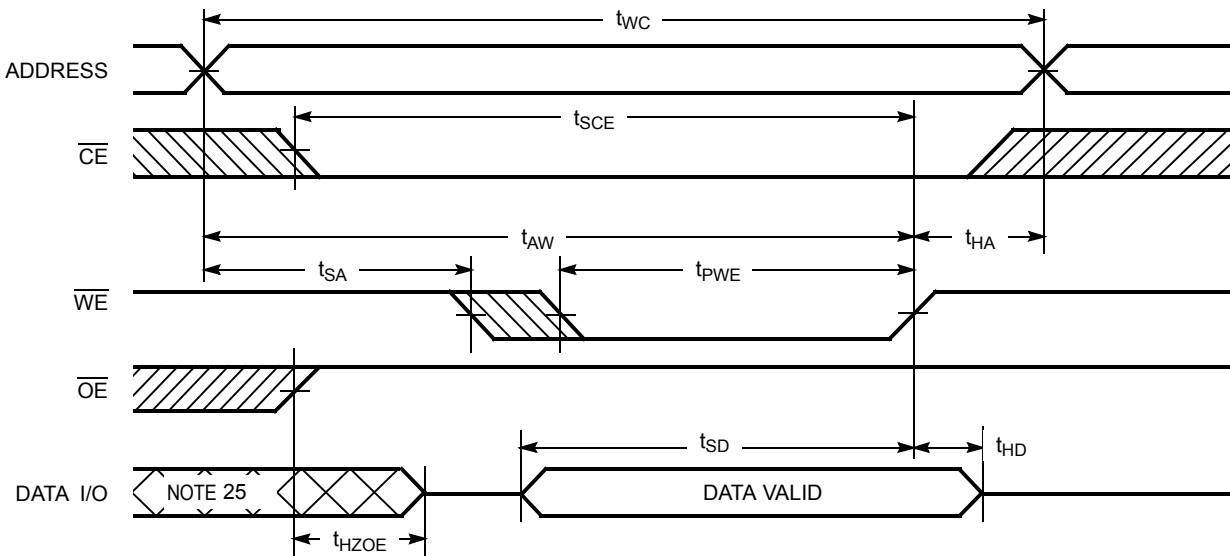


Figure 6. Write Cycle No. 1 (WE Controlled) [21, 22, 23, 24]



### Notes

18. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}_1 = V_{IL}$ ,  $CE_2 = V_{IH}$ .

19. WE is HIGH for read cycle.

20. Address valid before or similar to  $\overline{CE}_1$  transition LOW and  $CE_2$  transition HIGH.

21.  $\overline{CE}$  is the logical combination of  $\overline{CE}_1$  and  $CE_2$ . When  $\overline{CE}_1$  is LOW and  $CE_2$  is HIGH,  $\overline{CE}$  is LOW; when  $\overline{CE}_1$  is HIGH or  $CE_2$  is LOW,  $\overline{CE}$  is HIGH.

22. The internal write time of the memory is defined by the overlap of WE,  $\overline{CE}_1 = V_{IL}$ , and  $CE_2 = V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.

23. Data I/O is high impedance if  $OE = V_{IH}$ .

24. If  $\overline{CE}_1$  goes HIGH or  $CE_2$  goes LOW simultaneously with  $\overline{WE}$  HIGH, the output remains in high impedance state.

25. During this period, the I/Os are in output state. Do not apply input signals.



Switching Waveforms (continued)

Figure 7. Write Cycle No. 2 ( $\overline{CE}_1$  or  $\overline{CE}_2$  Controlled) [26, 27, 28, 29]

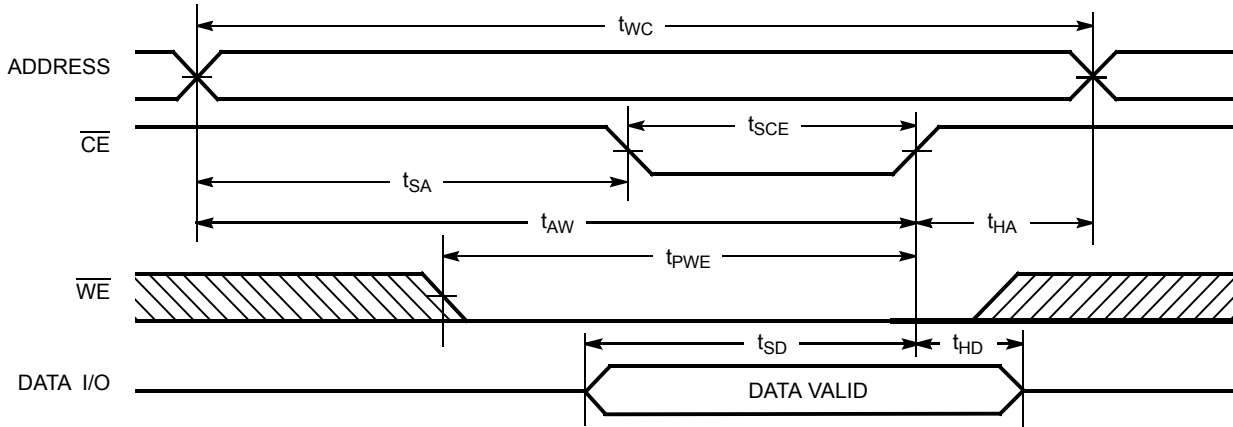
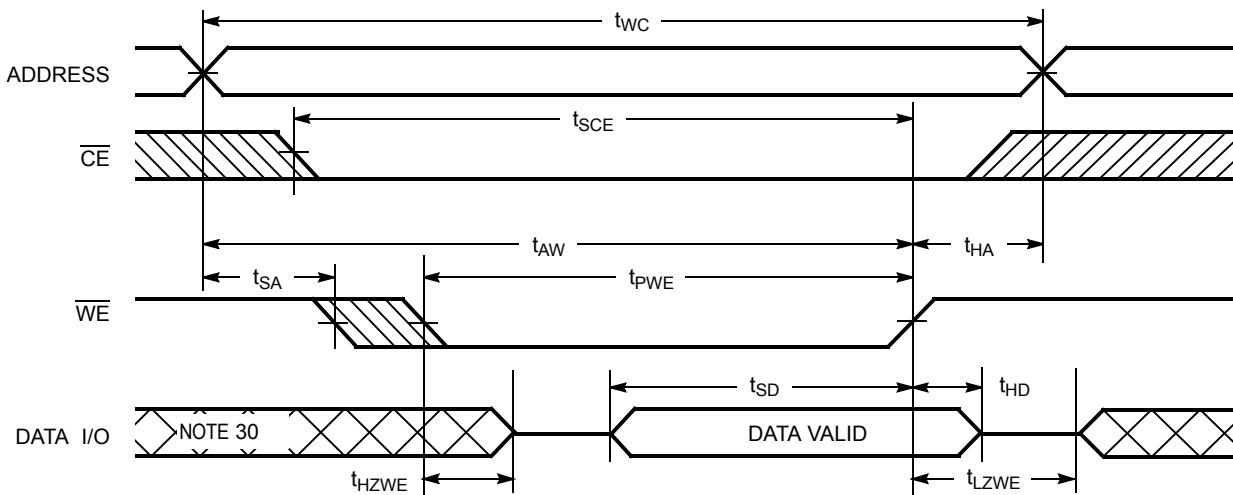


Figure 8. Write Cycle No. 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW) [26, 29]



Notes

- 26.  $\overline{CE}$  is the logical combination of  $\overline{CE}_1$  and  $\overline{CE}_2$ . When  $\overline{CE}_1$  is LOW and  $\overline{CE}_2$  is HIGH,  $\overline{CE}$  is LOW; when  $\overline{CE}_1$  is HIGH or  $\overline{CE}_2$  is LOW,  $\overline{CE}$  is HIGH.
- 27. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE}_1 = V_{IL}$ , and  $\overline{CE}_2 = V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.
- 28. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
- 29. If  $\overline{CE}_1$  goes HIGH or  $\overline{CE}_2$  goes LOW simultaneously with  $\overline{WE}$  HIGH, the output remains in high impedance state.
- 30. During this period, the I/Os are in output state. Do not apply input signals.

**Truth Table**

| $\overline{CE}_1$ | $\overline{CE}_2$ | $\overline{WE}$ | $\overline{OE}$ | Inputs/Outputs | Mode                | Power                |
|-------------------|-------------------|-----------------|-----------------|----------------|---------------------|----------------------|
| H                 | X <sup>[31]</sup> | X               | X               | High Z         | Deselect/Power-down | Standby ( $I_{SB}$ ) |
| X <sup>[31]</sup> | L                 | X               | X               | High Z         | Deselect/Power-down | Standby ( $I_{SB}$ ) |
| L                 | H                 | H               | L               | Data out       | Read                | Active ( $I_{CC}$ )  |
| L                 | H                 | H               | H               | High Z         | Output disabled     | Active ( $I_{CC}$ )  |
| L                 | H                 | L               | X               | Data in        | Write               | Active ( $I_{CC}$ )  |

**Note**

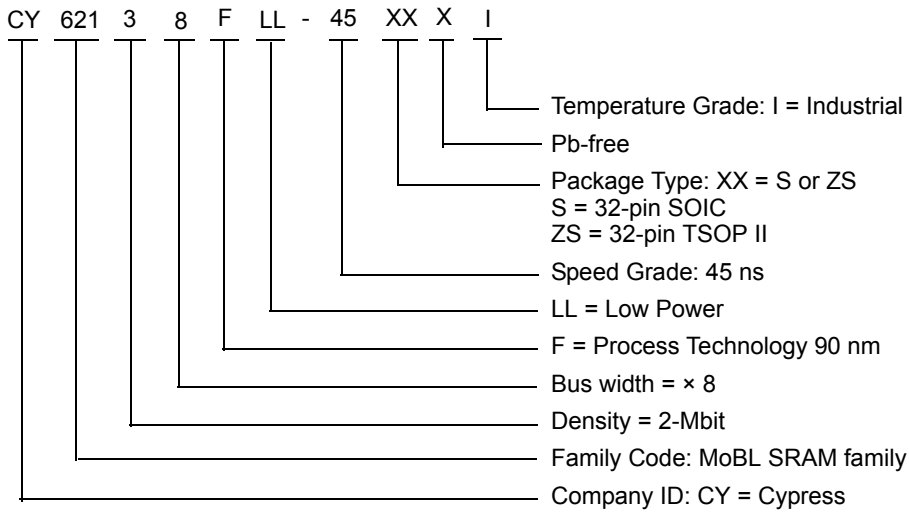
31. The 'X' (Don't care) state for the Chip enables ( $\overline{CE}_1$  and  $\overline{CE}_2$ ) in the truth table refer to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins is not permitted.

**Ordering Information**

| Speed (ns) | Ordering Code    | Package Diagram | Package Type          | Operating Range |
|------------|------------------|-----------------|-----------------------|-----------------|
| 45         | CY62138FLL-45SXI | 51-85081        | 32-pin SOIC (Pb-free) | Industrial      |

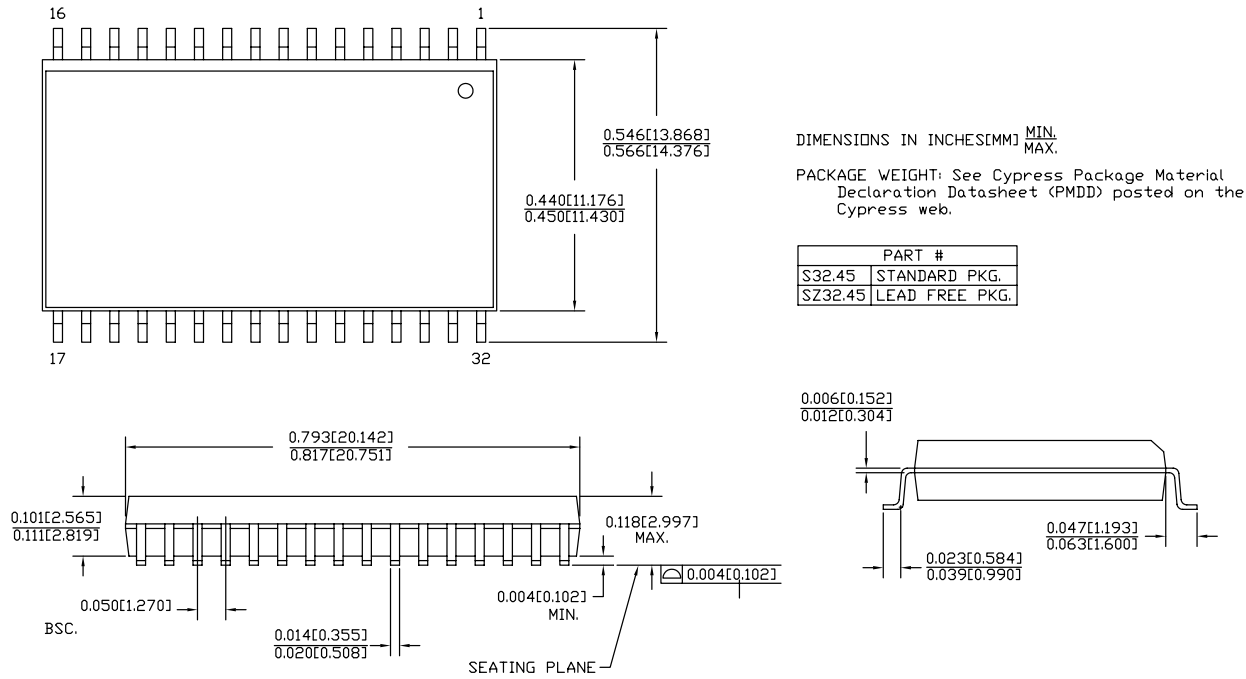
Contact your local Cypress sales representative for availability of these parts.

**Ordering Code Definitions**



Package Diagrams

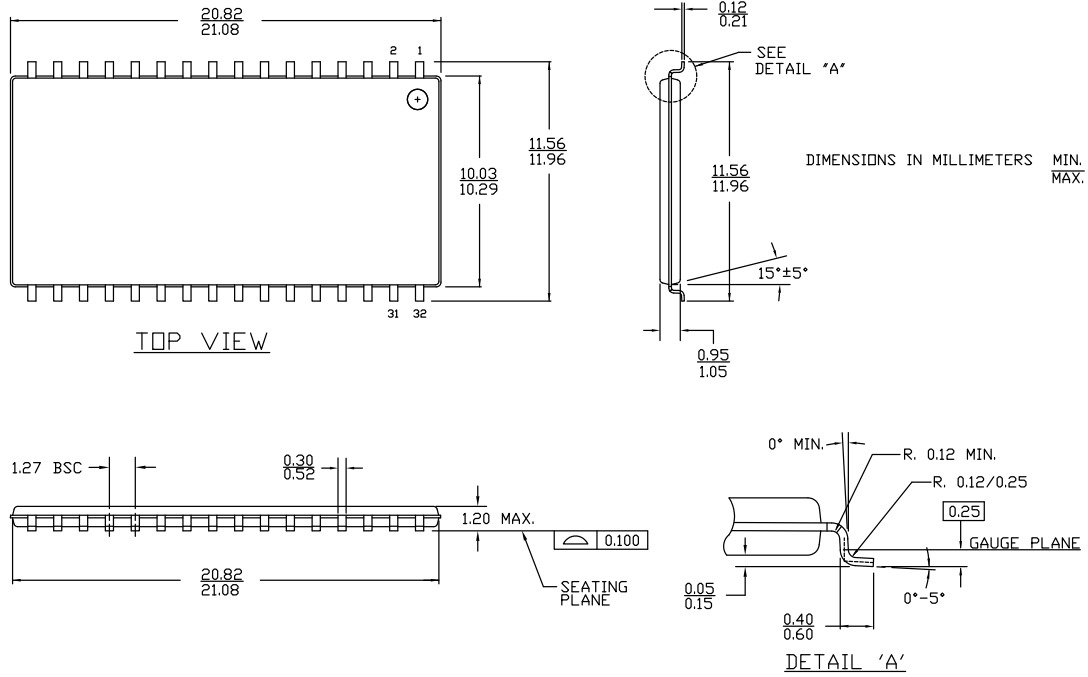
Figure 9. 32-pin SOIC (450 Mil) S32.45/SZ32.45 Package Outline, 51-85081



51-85081 \*E

Package Diagrams (continued)

Figure 10. 32-pin TSOP II (20.95 × 11.76 × 1.0 mm) ZS32 Package Outline, 51-85095



51-85095 \*B

**Acronyms**

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal Oxide Semiconductor |
| I/O     | Input/Output                            |
| OE      | Output Enable                           |
| SOIC    | Small Outline Integrated Circuit        |
| SRAM    | Static Random Access Memory             |
| TSOP    | Thin Small Outline Package              |
| WE      | Write Enable                            |

**Documents Conventions**

**Units of Measure**

| Symbol | Unit of Measure |
|--------|-----------------|
| °C     | degree Celsius  |
| MHz    | megahertz       |
| μA     | microampere     |
| μs     | microsecond     |
| mA     | milliampere     |
| ns     | nanosecond      |
| Ω      | ohm             |
| %      | percent         |
| pF     | picofarad       |
| V      | volt            |
| W      | watt            |

Document History Page

| Document Title: CY62138F MoBL®, 2-Mbit (256 K × 8) Static RAM<br>Document Number: 001-13194 |         |            |                 |  |
|---|---------|------------|-----------------|--|
| REV.  | ECN NO. | Issue Date | Orig. of Change | Description of Change  |
| **  | 797956  | See ECN    | VKN             | New data sheet.  |
| *A  | 940341  | See ECN    | VKN             | Added footnote #7 related to I <sub>SB2</sub> and I <sub>CCDR</sub>  |
| *B  | 3055174 | 13/10/2010 | RAME            | Updated As per new template<br>Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> table.<br>Added <a href="#">Ordering Code Definitions</a> .<br>Footnotes updated<br>Updated Package Diagram <a href="#">Figure 9</a> and <a href="#">Figure 10</a> .  |
| *C  | 3061313 | 15/10/2010 | RAME            | Minor change: Corrected "IO" to "I/O"  |
| *D  | 3232735 | 04/18/2011 | RAME            | Removed the Note "For best practice recommendations, refer to the Cypress application note "System Design Guidelines" at <a href="http://www.cypress.com">http://www.cypress.com</a> " in page 1.  |
| *E  | 3287636 | 06/20/2011 | RAME            | Updated <a href="#">Package Diagrams</a> .<br>Updated in new template.   |
| *F  | 3846281 | 12/19/2012 | TAVA            | Updated <a href="#">Ordering Information</a> (Updated part numbers).<br>Updated <a href="#">Package Diagrams</a> :<br>spec 51-85081 – Changed revision from *C to *E.  |
| *G  | 4013949 | 06/04/2013 | MEMJ            | Updated <a href="#">Functional Description</a> .<br><br>Updated <a href="#">Electrical Characteristics</a> :<br>Added one more Test Condition "V <sub>CC</sub> = 5.5 V, I <sub>OH</sub> = -0.1 mA" for V <sub>OH</sub> parameter and added maximum value corresponding to that Test Condition.<br>Added Note 6 and referred the same note in maximum value for V <sub>OH</sub> parameter corresponding to Test Condition "V <sub>CC</sub> = 5.5 V, I <sub>OH</sub> = -0.1 mA". |
| *H  | 4099045 | 08/19/2013 | VINI            | Updated <a href="#">Switching Characteristics</a> :<br>Added Note 13 and referred the same note in "Parameter" column.<br><br>Updated in new template.   |

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