# CY62137FV30 MoBL®

# Automotive 2-Mbit (128 K × 16) Static RAM

## Features

- Very high speed: 45 ns
- Temperature ranges
  - Automotive-A: –40 °C to +85 °C
  - Automotive-E: –40 °C to +125 °C
- Wide voltage range: 2.20 V–3.60 V
- Pin compatible with CY62137CV/CV25/CV30/CV33, CY62137V, and CY62137EV30
- Ultra low standby power
  - Typical standby current: 1 µA (Automotive-A)
  - Maximum standby current: 5 µA (Automotive-A)
- Ultra low active power
  - Typical active current: 1.6 mA at f = 1 MHz (45 ns speed)
- Easy memory expansion with $\overline{CE}$ and $\overline{OE}$ features
- Automatic power down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed and power
- Byte power down feature
- Available in 44-pin thin small outline package (TSOP) II package

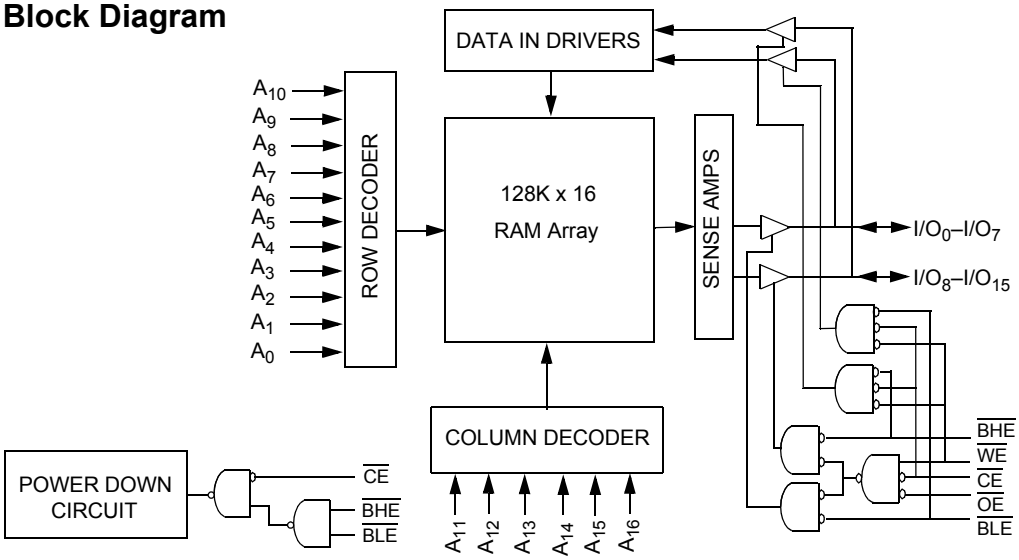
## Functional Description

The CY62137FV30 is a high performance CMOS static RAM organized as 128K words by 16 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 such as cellular telephones. 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 ($\overline{CE}$ HIGH or both $\overline{BLE}$ and $\overline{BHE}$ are HIGH). The input and output pins ($I/O_0$ through $I/O_{15}$) are placed in a high impedance state in the following conditions when the device is deselected ($\overline{CE}$ HIGH), the outputs are disabled ($\overline{OE}$ HIGH), both the Byte High Enable and the Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH), or during an active write operation ($\overline{CE}$ LOW and $\overline{WE}$ LOW).

Write to the device by taking Chip Enable ($\overline{CE}$) and Write Enable ($\overline{WE}$) inputs LOW. If Byte Low Enable ($\overline{BLE}$) is LOW, then data from I/O pins ($I/O_0$ through $I/O_7$) is written into the location specified on the address pins ($A_0$ through $A_{16}$). If Byte High Enable ($\overline{BHE}$) is LOW, then data from I/O pins ($I/O_8$ through $I/O_{15}$) is written into the location specified on the address pins ($A_0$ through $A_{16}$).

Read from the device by taking Chip Enable ($\overline{CE}$) and Output Enable ($\overline{OE}$) LOW, while forcing the Write Enable ($\overline{WE}$) HIGH. If Byte Low Enable ($\overline{BLE}$) is LOW, then data from the memory location specified by the address pins appear on $I/O_0$ to $I/O_7$. If Byte High Enable ($\overline{BHE}$) is LOW, then data from memory appears on $I/O_8$ to $I/O_{15}$. See the Truth Table on page 11 for a complete description of read and write modes.

## Logic Block Diagram



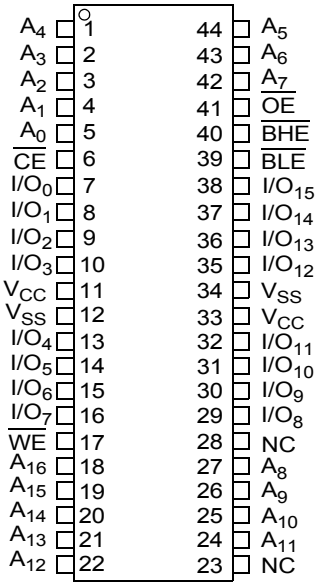
## Contents

## Product Portfolio

| Product | Range | $V_{CC}$ Range (V) | | | Speed (ns) | Power Dissipation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Operating $I_{CC}$ (mA) | | | | Standby $I_{SB2}$ (µA) | |
| | | | | | | f = 1MHz | | f = $f_{max}$ | | | |
| | | Min | Typ [1] | Max | | Typ [1] | Max | Typ [1] | Max | Typ [1] | Max |
| CY62137FV30LL | Automotive-A | 2.2 V | 3.0 V | 3.6 V | 45 | 1.6 | 2.5 | 13 | 18 | 1 | 5 |
| | Automotive-E | 2.2 V | 3.0 V | 3.6 V | 55 | 2 | 3 | 15 | 25 | 1 | 20 |

## Pin Configuration

**Figure 1. 44-pin TSOP II pinout [2]**




**Notes**
1. 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.
2. NC pins are not connected on the die.

## Maximum Ratings

Exceeding the 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 .....–0.3 V to 3.9 V

DC voltage applied to outputs in High Z state [3, 4] .....–0.3 V to 3.9 V

DC input voltage [4] .....–0.3 V to 3.9 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 | $V_{CC}$[5] |
|---|---|---|---|
| CY62137FV30LL | Automotive-A | –40 °C to +85 °C | 2.2 V to 3.6 V |
| | Automotive-E | –40 °C to +125 °C | |

## Electrical Characteristics

Over the Operating Range

| Parameter | Description | Test Conditions | | 45 ns (Automotive-A) | | | 55 ns (Automotive-E) | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ [6] | Max | Min | Typ [6] | Max | |
| $V_{OH}$ | Output high voltage | $2.2 \le V_{CC} \le 2.7$ | $I_{OH}$ = –0.1 mA | 2.0 | – | – | 2.0 | – | – | V |
| | | $2.7 \le V_{CC} \le 3.6$ | $I_{OH}$ = –1.0 mA | 2.4 | – | – | 2.4 | – | – | V |
| $V_{OL}$ | Output low voltage | $2.2 \le V_{CC} \le 2.7$ | $I_{OL}$ = 0.1 mA | – | – | 0.4 | – | – | 0.4 | V |
| | | $2.7 \le V_{CC} \le 3.6$ | $I_{OL}$ = 2.1 mA | – | – | 0.4 | – | – | 0.4 | V |
| $V_{IH}$ | Input high voltage | $2.2 \le V_{CC} \le 2.7$ | | 1.8 | – | $V_{CC}$ + 0.3 | 1.8 | – | $V_{CC}$ + 0.3 | V |
| | | $2.7 \le V_{CC} \le 3.6$ | | 2.2 | – | $V_{CC}$ + 0.3 | 2.2 | – | $V_{CC}$ + 0.3 | V |
| $V_{IL}$ | Input low voltage | $2.2 \le V_{CC} \le 2.7$ | | –0.3 | – | 0.6 | –0.3 | – | 0.6 | V |
| | | $2.7 \le V_{CC} \le 3.6$ | | –0.3 | – | 0.8 | –0.3 | – | 0.8 | V |
| $I_{IX}$ | Input leakage current | $GND \le V_I \le V_{CC}$ | | –1 | – | +1 | –4 | – | +4 | µA |
| $I_{OZ}$ | Output leakage current | $GND \le V_O \le V_{CC}$, Output disabled | | –1 | – | +1 | –4 | – | +4 | µA |
| $I_{CC}$ | $V_{CC}$ operating supply current | $f = f_{max} = 1/t_{RC}$ | $V_{CC} = V_{CC(max)}$, $I_{OUT}$ = 0 mA CMOS levels | – | 13 | 18 | – | 15 | 25 | mA |
| | | f = 1 MHz | | – | 1.6 | 2.5 | – | 2 | 3 | |
| $I_{SB1}$[7] | Automatic power down current – CMOS inputs | $\overline{CE} \ge V_{CC}$ – 0.2 V or ($\overline{BHE}$ and $\overline{BLE}$) $\ge V_{CC}$ – 0.2 V, $V_{IN} \ge V_{CC}$ – 0.2 V, $V_{IN} \le$ 0.2 V, $f = f_{max}$ (address and data only), f = 0 ($\overline{OE}$ and $\overline{WE}$), $V_{CC} = V_{CC(max)}$ | | – | 1 | 5 | – | 1 | 20 | µA |
| $I_{SB2}$ [7] | Automatic power down current – CMOS inputs | $\overline{CE} \ge V_{CC}$ – 0.2 V or ($\overline{BHE}$ and $\overline{BLE}$) $\ge V_{CC}$– 0.2 V, $V_{IN} \ge V_{CC}$ – 0.2 V or $V_{IN} \le$ 0.2 V, f = 0, $V_{CC} = V_{CC(max)}$ | | – | 1 | 5 | – | 1 | 20 | µA |

**Notes**

3. $V_{IL(min)}$ = –2.0 V for pulse durations less than 20 ns.
4. $V_{IH(max)} = V_{CC}$ + 0.75 V for pulse durations less than 20 ns.
5. Full device AC operation assumes a minimum of 100 µs ramp time from 0 to $V_{CC(min)}$ and 200 µs wait time after $V_{CC}$ stabilization.
6. 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.
7. Chip enable ($\overline{CE}$) and byte enables ($\overline{BHE}$ and $\overline{BLE}$) need to be tied to CMOS levels to meet the $I_{SB1}$ / $I_{SB2}$ / $I_{CCDR}$ specification. Other inputs can be left floating.

## Capacitance

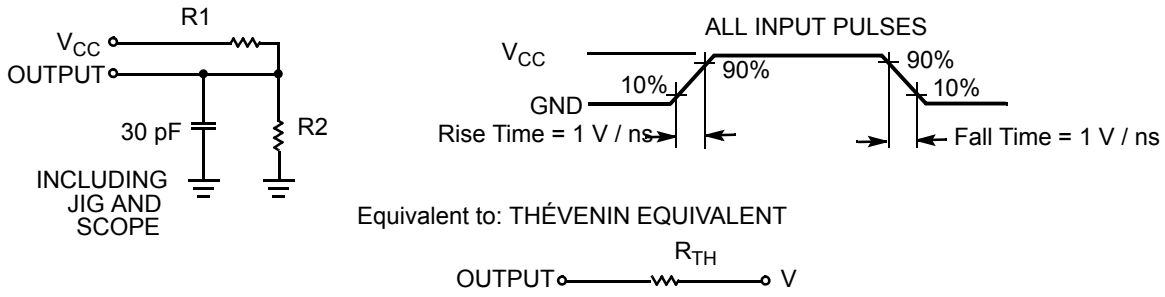
| Parameter [8] | Description | Test Conditions | Max | Unit |
|---|---|---|---|---|
| $C_{IN}$ | Input capacitance | $T_A$ = 25 °C, f = 1 MHz, $V_{CC}$ = $V_{CC(typ)}$ | 10 | pF |
| $C_{OUT}$ | Output capacitance | | 10 | pF |

## Thermal Resistance

| Parameter [8] | Description | Test Conditions | TSOP II | Unit |
|---|---|---|---|---|
| $\Theta_{JA}$ | Thermal resistance (junction to ambient) | Still air, soldered on a 3 × 4.5 inch, two layer printed circuit board | 77 | °C/W |
| $\Theta_{JC}$ | Thermal resistance (junction to case) | | 13 | °C/W |

## AC Test Loads and Waveforms

**Figure 2. AC Test Loads and Waveforms**




| Parameters | 2.5 V (2.2 V to 2.7 V) | 3.0 V (2.7 V to 3.6 V) | Unit |
|---|---|---|---|
| R1 | 16667 | 1103 | Ω |
| R2 | 15385 | 1554 | Ω |
| $R_{TH}$ | 8000 | 645 | Ω |
| $V_{TH}$ | 1.20 | 1.75 | V |

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

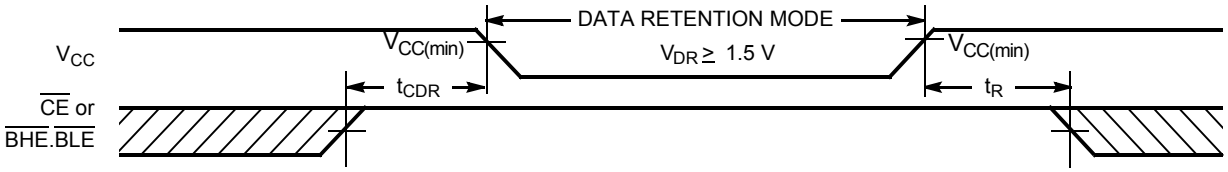
## Data Retention Characteristics

Over the Operating Range

| Parameter | Description | Conditions | | Min | Typ [9] | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DR}$ | $V_{CC}$ for data retention | | | 1.5 | – | – | V |
| $I_{CCDR}$ [10] | Data retention current | $V_{CC}$ = 1.5 V, $\overline{CE} \geq V_{CC} - 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) $\geq V_{CC} - 0.2$ V $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V | Automotive-A | – | – | 4 | µA |
| | | | Automotive-E | – | – | 12 | – |
| $t_{CDR}$ [11] | Chip deselect to data retention time | | | 0 | – | – | ns |
| $t_R$ [12] | Operation recovery time | | CY62137FV30LL-45 | 45 | – | – | ns |
| | | | CY62137FV30LL-55 | 55 | | | |

## Data Retention Waveform

**Figure 3. Data Retention Waveform** [13]




**Notes**
9. 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 enable ($\overline{CE}$) and byte enables ($\overline{BHE}$ and $\overline{BLE}$) need to be tied to CMOS levels to meet the $I_{SB1}$ / $I_{SB2}$ / $I_{CCDR}$ specification. Other inputs can be left floating.
11. Tested initially and after any design or process changes that may affect these parameters.
12. Full device operation requires linear $V_{CC}$ ramp from $V_{DR}$ to $V_{CC(min)} \geq 100$ µs or stable at $V_{CC(min)} \geq 100$ µs.
13. $\overline{BHE}.\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Deselect the chip by either disabling chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

## Switching Characteristics

| Parameter [14, 15] | Description | 45 ns (Automotive-A) | | 55 ns (Automotive-E) | | Unit |
|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | |
| **Read Cycle** | | | | | | |
| $t_{RC}$ | Read cycle time | 45 | – | 55 | – | ns |
| $t_{AA}$ | Address to data valid | – | 45 | – | 55 | ns |
| $t_{OHA}$ | Data hold from address change | 10 | – | 10 | – | ns |
| $t_{ACE}$ | $\overline{CE}$ LOW to data valid | – | 45 | – | 55 | ns |
| $t_{DOE}$ | $\overline{OE}$ LOW to data valid | – | 22 | – | 25 | ns |
| $t_{LZOE}$ | $\overline{OE}$ LOW to low Z [16] | 5 | – | 5 | – | ns |
| $t_{HZOE}$ | $\overline{OE}$ HIGH to high Z [16, 17] | – | 18 | – | 20 | ns |
| $t_{LZCE}$ | $\overline{CE}$ LOW to low Z [16] | 10 | – | 10 | – | ns |
| $t_{HZCE}$ | $\overline{CE}$ HIGH to high Z [16, 17] | – | 18 | – | 20 | ns |
| $t_{PU}$ | $\overline{CE}$ LOW to power-up | 0 | – | 0 | – | ns |
| $t_{PD}$ | $\overline{CE}$ HIGH to power-down | – | 45 | – | 55 | ns |
| $t_{DBE}$ | $\overline{BLE}$/$\overline{BHE}$ LOW to data valid | – | 45 | – | 55 | ns |
| $t_{LZBE}$ | $\overline{BLE}$/$\overline{BHE}$ LOW to low Z [16, 18] | 5 | – | 10 | – | ns |
| $t_{HZBE}$ | $\overline{BLE}$/$\overline{BHE}$ HIGH to high Z [16, 17] | – | 18 | – | 20 | ns |
| **Write Cycle** [19] | | | | | | |
| $t_{WC}$ | Write cycle time | 45 | – | 55 | – | ns |
| $t_{SCE}$ | $\overline{CE}$ LOW to write end | 35 | – | 40 | – | ns |
| $t_{AW}$ | Address setup to write end | 35 | – | 40 | – | ns |
| $t_{HA}$ | Address hold from write end | 0 | – | 0 | – | ns |
| $t_{SA}$ | Address setup to write start | 0 | – | 0 | – | ns |
| $t_{PWE}$ | $\overline{WE}$ pulse width | 35 | – | 40 | – | ns |
| $t_{BW}$ | $\overline{BLE}$/$\overline{BHE}$ LOW to write end | 35 | – | 40 | – | ns |
| $t_{SD}$ | Data setup to write end | 25 | – | 25 | – | ns |
| $t_{HD}$ | Data hold from write end | 0 | – | 0 | – | ns |
| $t_{HZWE}$ | $\overline{WE}$ LOW to high Z [16, 17] | – | 18 | – | 20 | ns |
| $t_{LZWE}$ | $\overline{WE}$ HIGH to low Z [16] | 10 | – | 10 | – | ns |

**Notes**
14. Test conditions for all parameters, other than tristate 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 Figure 2 on page 5.
15. AC timing parameters are subject to byte enable signals ($\overline{BHE}$ or $\overline{BLE}$) not switching when chip is disabled. Please see application note AN13842 for further clarification.
16. At any temperature and voltage condition, $t_{HZCE}$ is less than $t_{LZCE}$, $t_{HZBE}$ is less than $t_{LZBE}$, $t_{HZOE}$ is less than $t_{LZOE}$, and $t_{HZWE}$ is less than $t_{LZWE}$ for any device.
17. $t_{HZOE}$, $t_{HZCE}$, $t_{HZBE}$, and $t_{HZWE}$ transitions are measured when the outputs enter a high impedance state.
18. If both byte enables are toggled together, this value is 10 ns.
19. The internal write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}$ = $V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE}$ = $V_{IL}$. All signals are ACTIVE to initiate a write and any of these signals terminate a write by going INACTIVE. The data input setup and hold timing are referenced to the edge of the signal that terminates the write.

## Switching Waveforms

**Figure 4. Read Cycle 1: Address Transition Controlled** [20, 21]

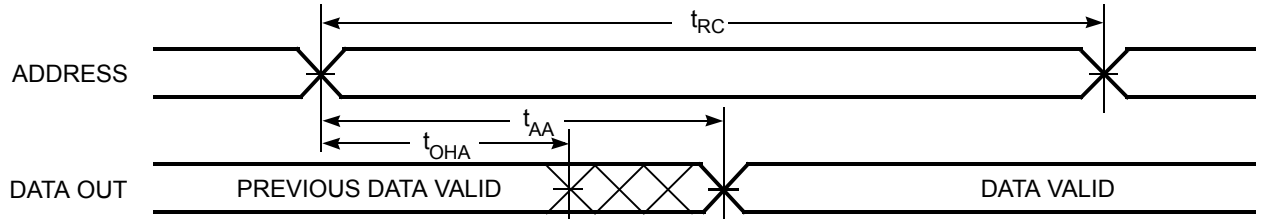
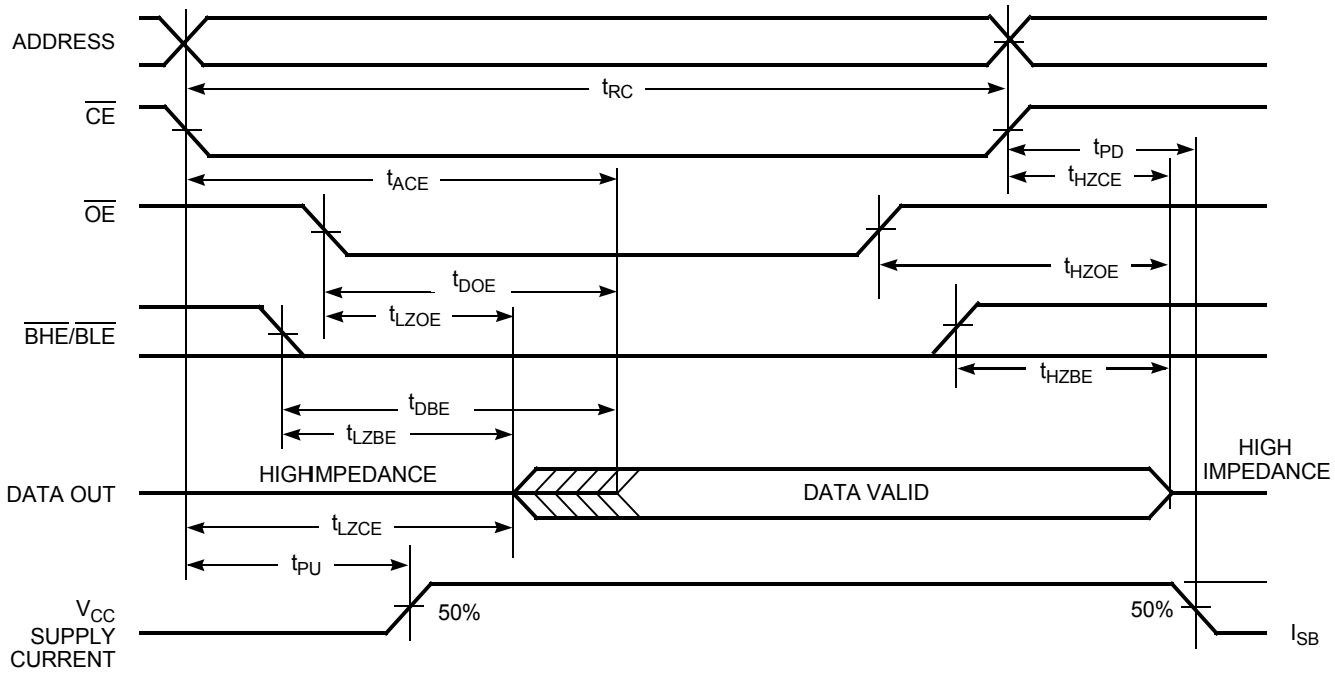



**Figure 5. Read Cycle 2: $\overline{OE}$ Controlled** [21, 22]




**Notes**
20. The device is continuously selected. $\overline{OE}$, $\overline{CE}$ = $V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE}$ = $V_{IL}$.
21. $\overline{WE}$ is HIGH for read cycle.
22. Address valid before or similar to $\overline{CE}$ and $\overline{BHE}$, $\overline{BLE}$ transition LOW.

## Switching Waveforms (continued)

**Figure 6. Write Cycle 1: $\overline{WE}$ Controlled** [23, 24, 25]

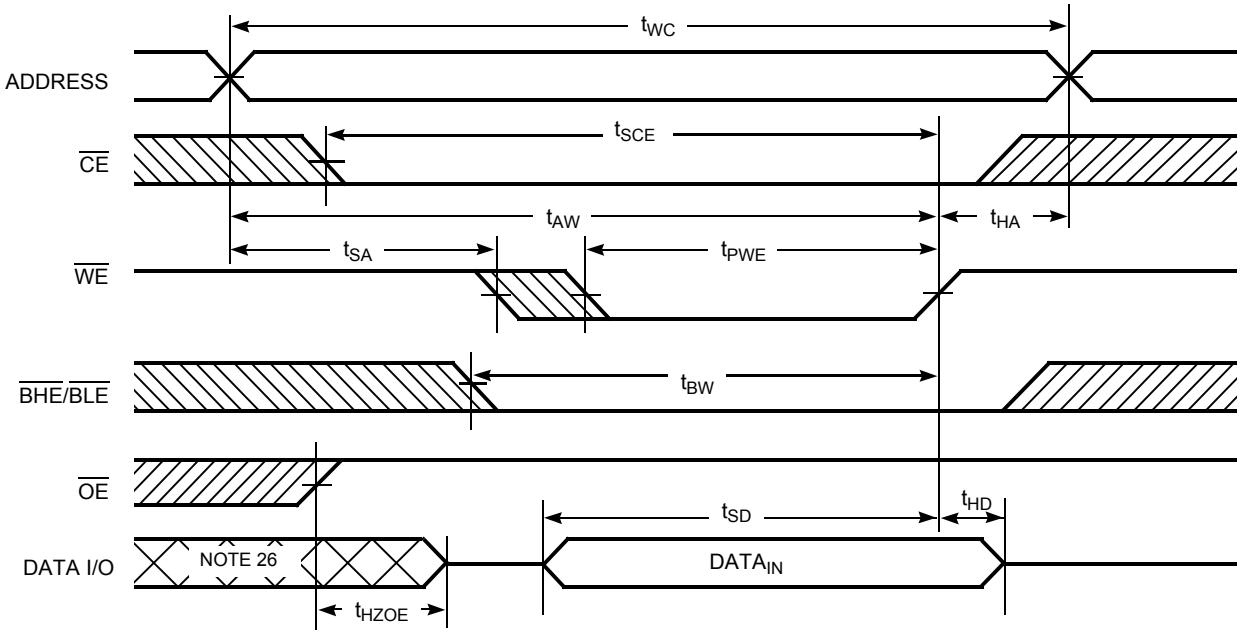
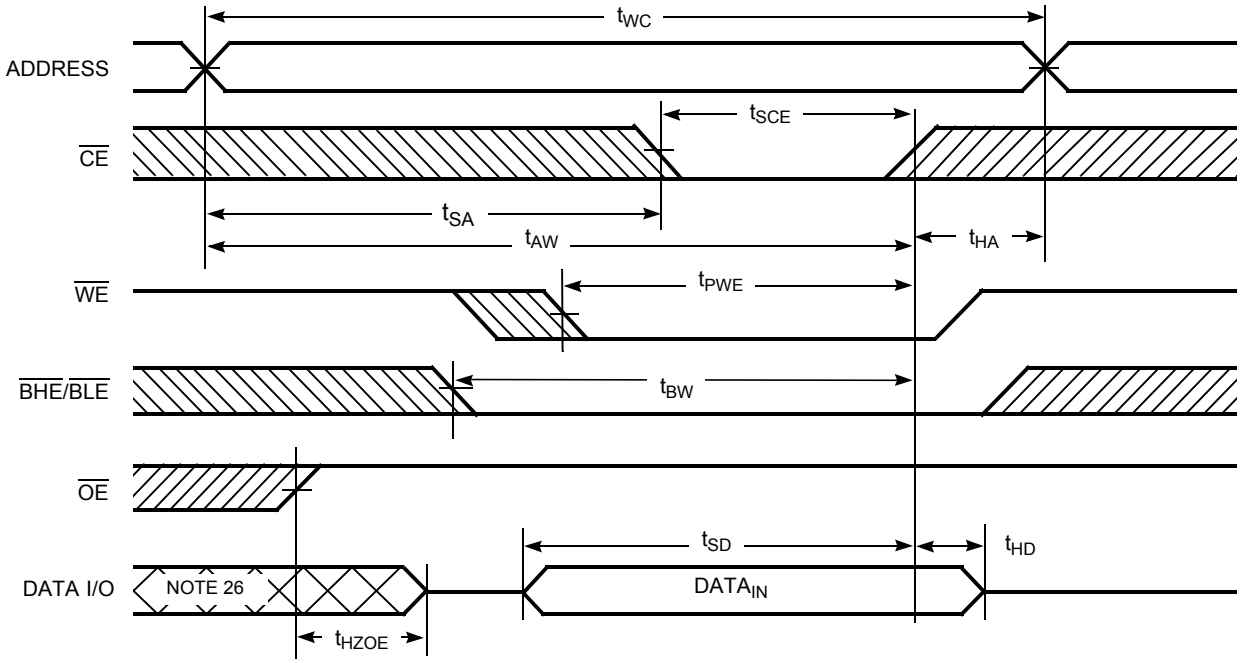



**Figure 7. Write Cycle 2: $\overline{CE}$ Controlled** [23, 24, 25]




**Notes**

23. The internal write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}$ = $V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE}$ = $V_{IL}$. All signals are ACTIVE to initiate a write and any of these signals terminate a write by going INACTIVE. The data input setup and hold timing are referenced to the edge of the signal that terminates the write.
24. Data I/O is high impedance if $\overline{OE}$ = $V_{IH}$.
25. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ = $V_{IH}$, the output remains in a high impedance state.
26. During this period, the I/Os are in output state. Do not apply input signals.

## Switching Waveforms (continued)

**Figure 8. Write Cycle 3: $\overline{WE}$ Controlled, $\overline{OE}$ LOW [27]**

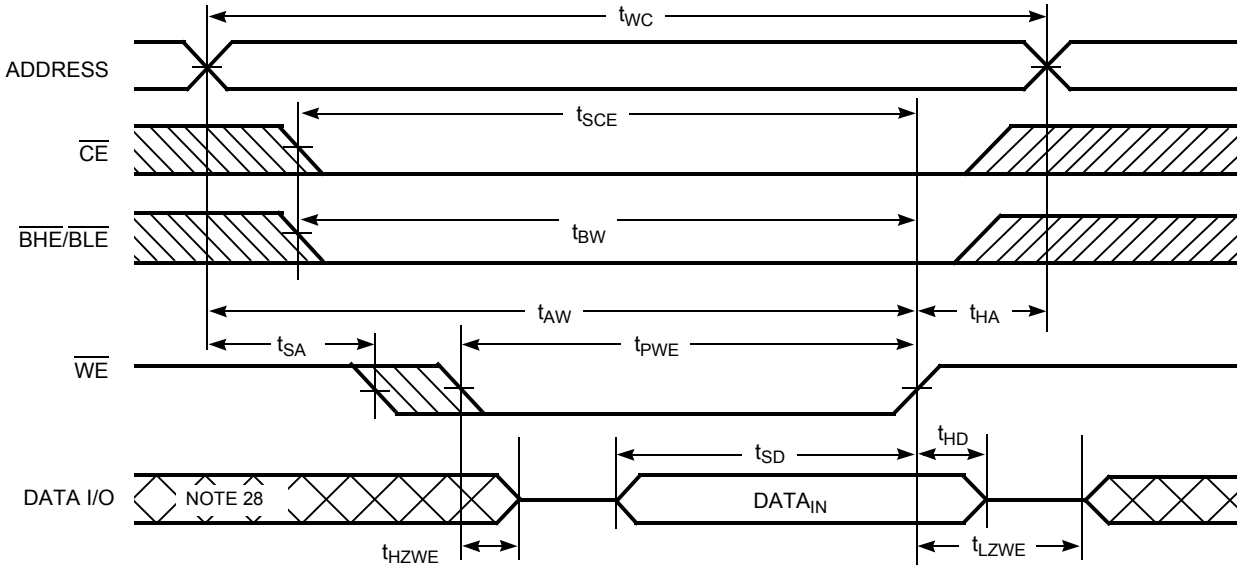
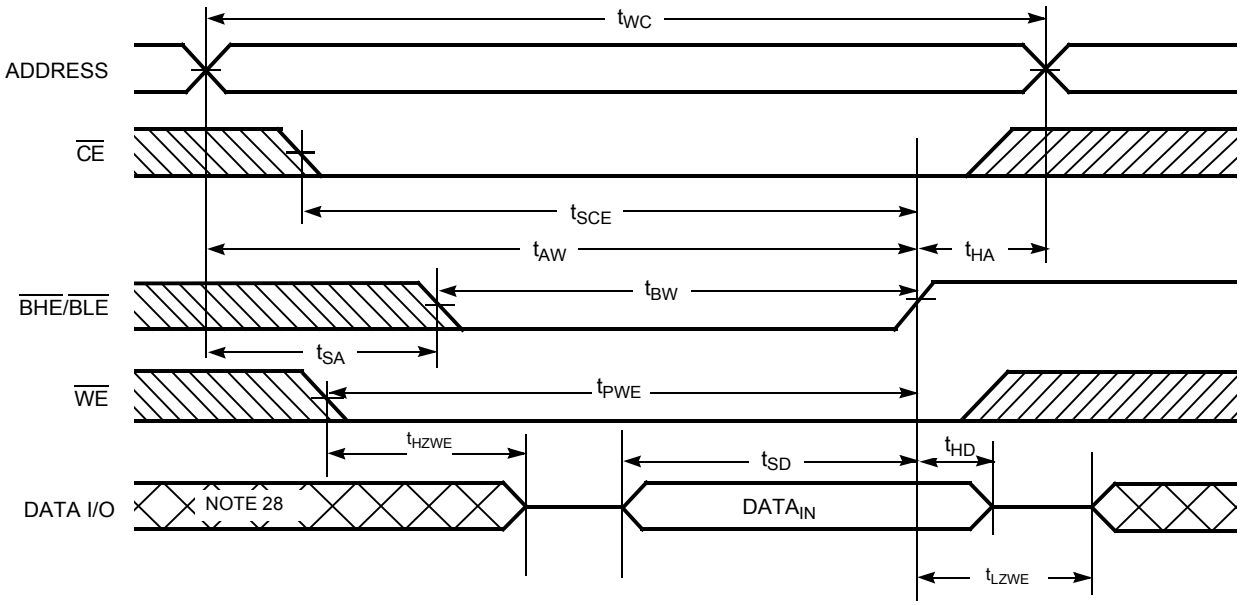



**Figure 9. Write Cycle 4: $\overline{BHE}$/$\overline{BLE}$ Controlled, $\overline{OE}$ LOW [27]**




**Notes**
27. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ = $V_{IH}$, the output remains in a high impedance state.
28. During this period, the I/Os are in output state. Do not apply input signals.

## Truth Table

| $\overline{CE}$ | $\overline{WE}$ | $\overline{OE}$ | $\overline{BHE}$ | $\overline{BLE}$ | Inputs or Outputs | Mode | Power |
|---|---|---|---|---|---|---|---|
| H | X | X | X [29] | X [29] | High Z | Deselect or power-down | Standby ($I_{SB}$) |
| X [29] | X | X | H | H | High Z | Deselect or power-down | Standby ($I_{SB}$) |
| L | H | L | L | L | Data out ($I/O_0$–$I/O_{15}$) | Read | Active ($I_{CC}$) |
| L | H | L | H | L | Data out ($I/O_0$–$I/O_7$); $I/O_8$–$I/O_{15}$ in High Z | Read | Active ($I_{CC}$) |
| L | H | L | L | H | Data out ($I/O_8$–$I/O_{15}$); $I/O_0$–$I/O_7$ in High Z | Read | Active ($I_{CC}$) |
| L | H | H | L | L | High Z | Output disabled | Active ($I_{CC}$) |
| L | H | H | H | L | High Z | Output disabled | Active ($I_{CC}$) |
| L | H | H | L | H | High Z | Output disabled | Active ($I_{CC}$) |
| L | L | X | L | L | Data in ($I/O_0$–$I/O_{15}$) | Write | Active ($I_{CC}$) |
| L | L | X | H | L | Data in ($I/O_0$–$I/O_7$); $I/O_8$–$I/O_{15}$ in High Z | Write | Active ($I_{CC}$) |
| L | L | X | L | H | Data in ($I/O_8$–$I/O_{15}$); $I/O_0$–$I/O_7$ in High Z | Write | Active ($I_{CC}$) |

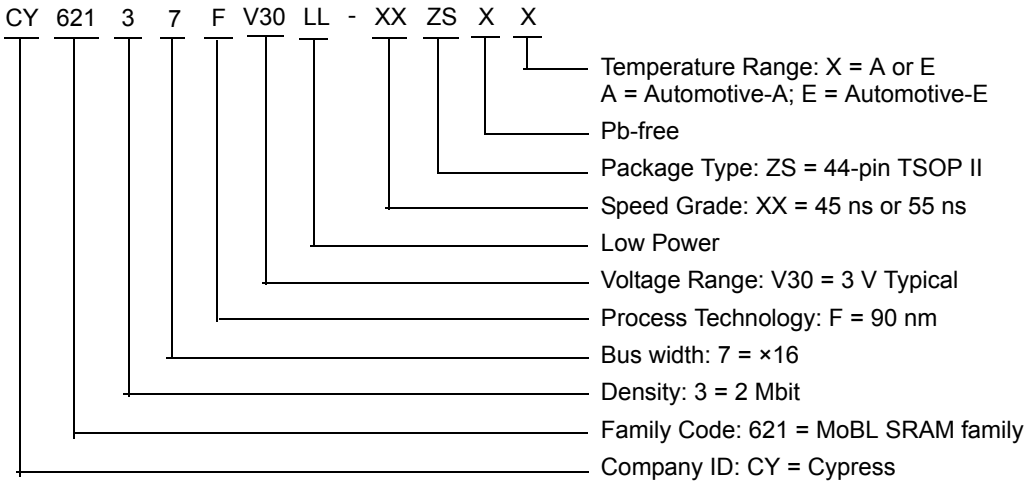
**Note**
29. The 'X' (Don't care) state for the Chip enable ($\overline{CE}$) and Byte enables ($\overline{BHE}$ and $\overline{BLE}$) in the truth table refer to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins is not permitted.

## Ordering Information

| Speed (ns) | Ordering Code | Package Diagram | Package Type | Operating Range |
|---|---|---|---|---|
| 45 | CY62137FV30LL-45ZSXA | 51-85087 | 44-pin TSOP II (Pb-free) | Automotive-A |
| 55 | CY62137FV30LL-55ZSXE | | | Automotive-E |

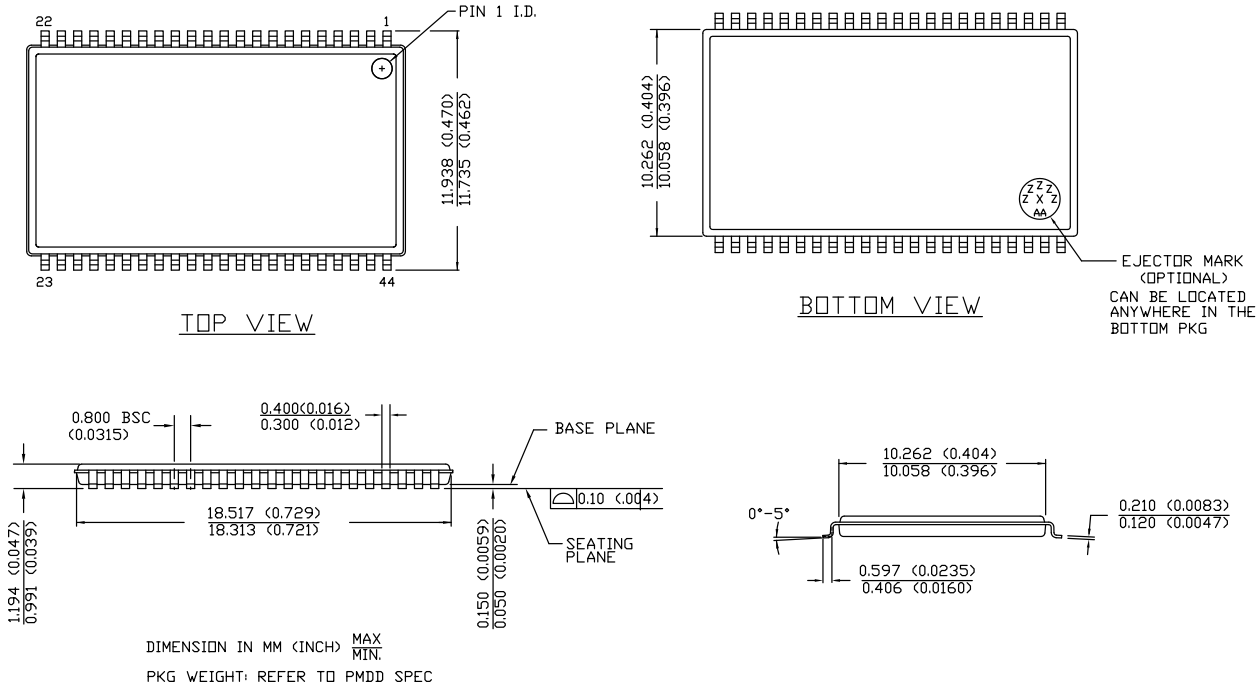
Contact your local Cypress sales representative for availability of these parts.

### Ordering Code Definitions



## Package Diagrams

**Figure 10. 44-pin TSOP Z44-II Package Outline, 51-85087**




51-85087 *E

## Acronyms

| Acronym | Description |
|---|---|
| $\overline{BHE}$ | Byte High Enable |
| $\overline{BLE}$ | Byte Low Enable |
| $\overline{CE}$ | Chip Enable |
| CMOS | Complementary Metal Oxide Semiconductor |
| I/O | Input/Output |
| $\overline{OE}$ | Output Enable |
| SRAM | Static Random Access Memory |
| TSOP | Thin Small Outline Package |
| $\overline{WE}$ | Write Enable |

## Document Conventions

### Units of Measure

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

## Document History Page

| Document Title: CY62137FV30 MoBL®, Automotive 2-Mbit (128 K × 16) Static RAM<br>Document Number: 001-66190 | | | | |
|---|---|---|---|---|
| **Rev.** | **ECN No.** | **Issue Date** | **Orig. of Change** | **Description of Change** |
| ** | 3124003 | 01/12/2011 | RAME | Created new Automotive datasheet from document number 001-07141 Rev. *H |
| *A | 3503362 | 01/20/2012 | TAVA | Updated Functional Description.<br>Updated Package Diagrams.<br>Updated in new template. |
| *B | 4250476 | 01/17/2014 | VINI | Updated Package Diagrams:<br>spec 51-85087 – Changed revision from *D to *E.<br><br>Updated in new template.<br><br>Completing Sunset Review. |

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### Cypress Developer Community

Community | Forums | Blogs | Video | Training

### Technical Support

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