

## 32K x 8 HIGH-SPEED CMOS STATIC RAM

AUGUST 1995

### FEATURES

- High-speed access time: 10, 12, 15, 20, 25 ns
- Low active power: 400 mW (typical)
- Low standby power
  - 250  $\mu$ W (typical) CMOS standby
  - 55 mW (typical) TTL standby
- Fully static operation: no clock or refresh required
- TTL compatible inputs and outputs
- Single 5V power supply
- Mix-mode outputs on IS61M256

### DESCRIPTION

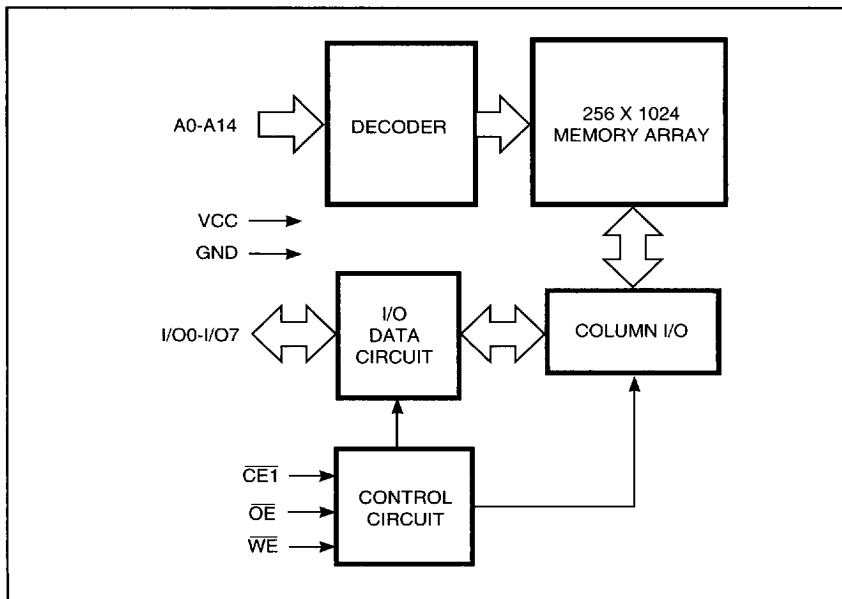
The *ISSI* IS61C256AH and IS61M256 are very high-speed, low power, 32,768 word by 8-bit static RAMs. They are fabricated using *ISSI*'s high-performance CMOS technology. This highly reliable process coupled with innovative circuit design techniques, yields access times as fast as 10 ns maximum.

When  $\overline{CE}$  is HIGH (deselected), the device assumes a standby mode at which the power dissipation can be reduced down to 250  $\mu$ W (typical) with CMOS input levels.

Easy memory expansion is provided by using an active LOW Chip Enable ( $\overline{CE}$ ) input and an active LOW Output Enable ( $\overline{OE}$ ) input. The active LOW Write Enable ( $\overline{WE}$ ) controls both writing and reading of the memory.

The IS61C256AH and IS61M256 are pin compatible with other 32K x 8 SRAMs and are available in 28-pin PDIP, SOJ, and TSOP packages.

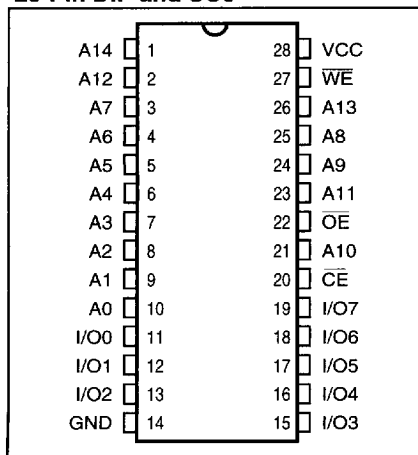
### FUNCTIONAL BLOCK DIAGRAM



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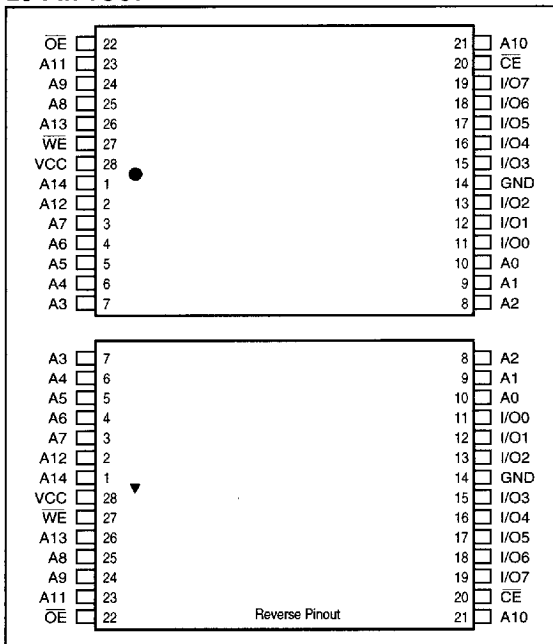
## PIN CONFIGURATION

### 28-Pin DIP and SOJ



## PIN CONFIGURATION

### 28-Pin TSOP



## PIN DESCRIPTIONS

|                 |                     |
|-----------------|---------------------|
| A0-A14          | Address Inputs      |
| $\overline{CE}$ | Chip Enable Input   |
| $\overline{OE}$ | Output Enable Input |
| $\overline{WE}$ | Write Enable Input  |
| I/O0-I/O7       | Bidirectional Ports |
| Vcc             | Power               |
| GND             | Ground              |

## TRUTH TABLE

| Mode                         | $\overline{WE}$ | $\overline{CE}$ | $\overline{OE}$ | I/O Operation | Vcc Current |
|------------------------------|-----------------|-----------------|-----------------|---------------|-------------|
| Not Selected<br>(Power-down) | X               | H               | X               | High-Z        | Isb1, Isb2  |
| Output Disabled              | H               | L               | H               | High-Z        | Icc1, Icc2  |
| Read                         | H               | L               | L               | Dout          | Icc1, Icc2  |
| Write                        | L               | L               | X               | Din           | Icc1, Icc2  |

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol            | Parameter                            | Value        | Unit |
|-------------------|--------------------------------------|--------------|------|
| V <sub>TERM</sub> | Terminal Voltage with Respect to GND | -0.5 to +7.0 | V    |
| T <sub>BIAS</sub> | Temperature Under Bias               | -55 to +125  | °C   |
| T <sub>STG</sub>  | Storage Temperature                  | -65 to +150  | °C   |
| P <sub>T</sub>    | Power Dissipation                    | 1.5          | W    |
| I <sub>OUT</sub>  | DC Output Current (LOW)              | 20           | mA   |

### Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**OPERATING RANGE**

| Range      | Ambient Temperature | V <sub>CC</sub> <sup>(1)</sup> |
|------------|---------------------|--------------------------------|
| Commercial | 0°C to +70°C        | 5V ± 10%                       |
| Industrial | -40°C to +85°C      | 5V ± 10%                       |

**Notes:**

1. V<sub>CC</sub> = 5V ± 5% for 10 ns only.

**DC ELECTRICAL CHARACTERISTICS** (Over Operating Range)

**2**

| Symbol          | Parameter                        | Test Conditions                                                | Min.             | Max.                  | Unit |
|-----------------|----------------------------------|----------------------------------------------------------------|------------------|-----------------------|------|
| V <sub>OH</sub> | Output HIGH Voltage              | V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA              | 2.4              | —                     | V    |
| V <sub>OL</sub> | Output LOW Voltage               | V <sub>CC</sub> = Min., I <sub>OL</sub> = 8.0 mA               | —                | 0.4                   | V    |
| V <sub>IH</sub> | Input HIGH Voltage               |                                                                | 2.2              | V <sub>CC</sub> + 0.5 | V    |
| V <sub>IL</sub> | Input LOW Voltage <sup>(1)</sup> |                                                                | -0.5             | 0.8                   | V    |
| I <sub>LI</sub> | Input Leakage                    | GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>                        | Com.<br>Ind. -10 | 5<br>+10              | μA   |
| I <sub>LO</sub> | Output Leakage                   | GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> ,<br>Outputs Disabled | Com.<br>Ind. -10 | 5<br>+10              | μA   |

**Notes:**

1. V<sub>IL</sub> = -3.0V for pulse width less than 10 ns.

**POWER SUPPLY CHARACTERISTICS<sup>(1)</sup>** (Over Operating Range)

| Symbol           | Parameter                                        | Test Conditions                                                                                                                                  |              | -10 ns |      | -12 ns |      | -15 ns |      | -20 ns |      | -25 ns |      | Unit |
|------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------|--------|------|--------|------|--------|------|--------|------|------|
|                  |                                                  |                                                                                                                                                  |              | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |
| I <sub>CC</sub>  | V <sub>CC</sub> Dynamic Operating Supply Current | V <sub>CC</sub> = Max., $\overline{CE} = V_{IL}$<br>I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>                                                | Com.<br>Ind. | —      | 180  | —      | 160  | —      | 150  | —      | 140  | —      | 130  | mA   |
| I <sub>SB1</sub> | TTL Standby Current (TTL Inputs)                 | V <sub>CC</sub> = Max.,<br>V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>$\overline{CE} \geq V_{IH}$ , f = 0                           | Com.<br>Ind. | —      | 25   | —      | 25   | —      | 25   | —      | 25   | —      | 25   | mA   |
| I <sub>SB2</sub> | CMOS Standby Current (CMOS Inputs)               | V <sub>CC</sub> = Max.,<br>$\overline{CE} \geq V_{CC} - 0.2V$ ,<br>V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V, or<br>V <sub>IN</sub> ≤ 0.2V, f = 0 | Com.<br>Ind. | —      | 5    | —      | 2    | —      | 2    | —      | 2    | —      | 2    | mA   |

**Notes:**

1. At f = f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.

**CAPACITANCE<sup>(1,2)</sup>**

| Symbol           | Parameter          | Conditions            | Max. | Unit |
|------------------|--------------------|-----------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance  | V <sub>IN</sub> = 0V  | 8    | pF   |
| C <sub>OUT</sub> | Output Capacitance | V <sub>OUT</sub> = 0V | 10   | pF   |

**Notes:**

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T<sub>A</sub> = 25°C, f = 1 MHz, V<sub>CC</sub> = 5.0V.

## READ CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

| Symbol                           | Parameter                               | -10 ns |      | -12 ns |      | -15 ns |      | -20 ns |      | -25 ns |      | Unit |
|----------------------------------|-----------------------------------------|--------|------|--------|------|--------|------|--------|------|--------|------|------|
|                                  |                                         | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |
| t <sub>RC</sub>                  | Read Cycle Time                         | 10     | —    | 12     | —    | 15     | —    | 20     | —    | 25     | —    | ns   |
| t <sub>AA</sub>                  | Address Access Time                     | —      | 10   | —      | 12   | —      | 15   | —      | 20   | —      | 25   | ns   |
| t <sub>OH</sub>                  | Output Hold Time                        | 2      | —    | 2      | —    | 2      | —    | 2      | —    | 2      | —    | ns   |
| t <sub>ACE</sub>                 | $\overline{\text{CE}}$ Access Time      | —      | 10   | —      | 12   | —      | 15   | —      | 20   | —      | 25   | ns   |
| t <sub>OE</sub>                  | $\overline{\text{OE}}$ Access Time      | —      | 5    | —      | 6    | —      | 7    | —      | 8    | —      | 9    | ns   |
| t <sub>LZOE</sub> <sup>(2)</sup> | $\overline{\text{OE}}$ to Low-Z Output  | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |
| t <sub>HZOE</sub> <sup>(2)</sup> | $\overline{\text{OE}}$ to High-Z Output | —      | 5    | —      | 6    | —      | 7    | —      | 9    | —      | 10   | ns   |
| t <sub>LZCE</sub> <sup>(2)</sup> | $\overline{\text{CE}}$ to Low-Z Output  | 2      | —    | 3      | —    | 3      | —    | 3      | —    | 3      | —    | ns   |
| t <sub>HZCE</sub> <sup>(2)</sup> | $\overline{\text{CE}}$ to High-Z Output | —      | 5    | —      | 7    | —      | 8    | —      | 9    | —      | 10   | ns   |
| t <sub>PU</sub> <sup>(3)</sup>   | $\overline{\text{CE}}$ to Power-Up      | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |
| t <sub>PD</sub> <sup>(3)</sup>   | $\overline{\text{CE}}$ to Power-Down    | —      | 10   | —      | 12   | —      | 15   | —      | 18   | —      | 20   | ns   |

### Notes:

1. Test conditions assume signal transition times of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
3. Not 100% tested.

## AC TEST CONDITIONS

| Parameter                                    | Unit                  |
|----------------------------------------------|-----------------------|
| Input Pulse Level                            | 0V to 3.0V            |
| Input Rise and Fall Times                    | 3 ns                  |
| Input and Output Timing and Reference Levels | 1.5V                  |
| Output Load                                  | See Figures 1a and 1b |

## AC TEST LOADS

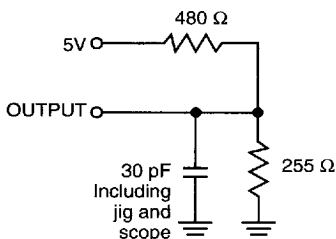


Figure 1a.

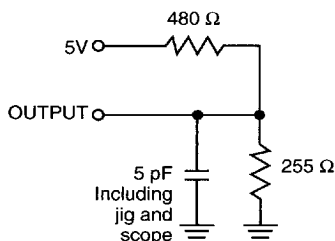
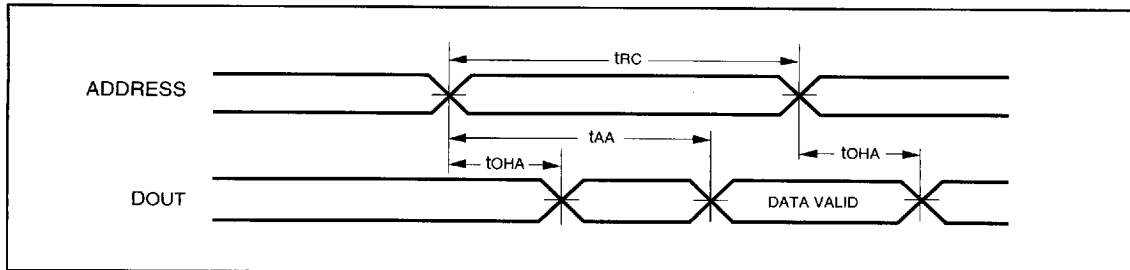


Figure 1b.

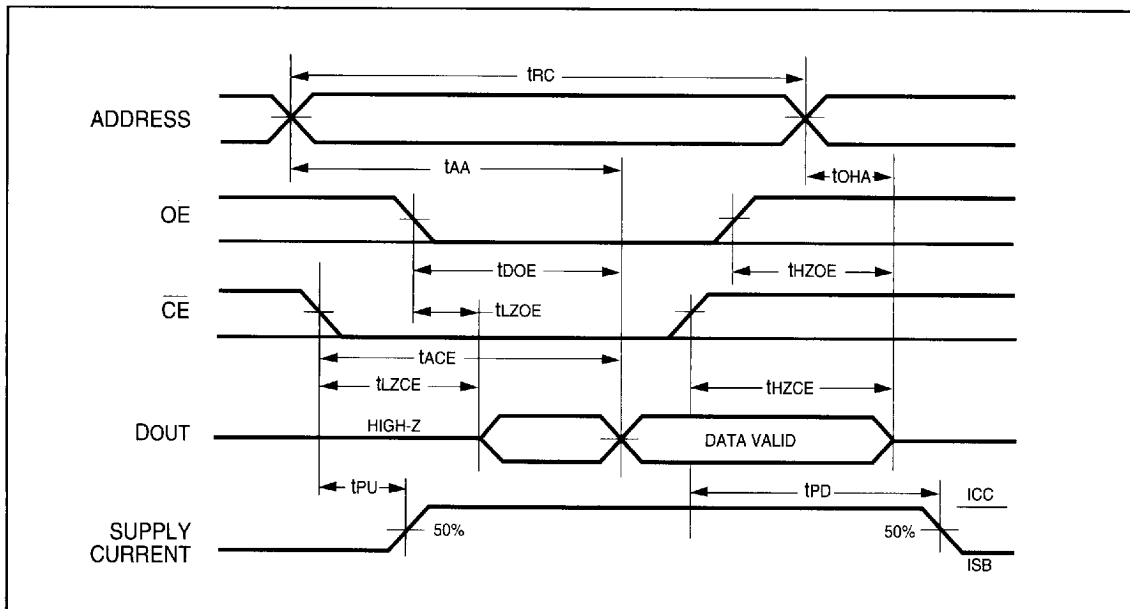
## AC WAVEFORMS

### READ CYCLE NO. 1<sup>(1,2)</sup>



2

### READ CYCLE NO. 2<sup>(1,3)</sup>



#### Notes:

1. WE is HIGH for a Read Cycle.
2. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE} = V_{IL}$ .
3. Address is valid prior to or coincident with  $\overline{CE}$  LOW transitions.

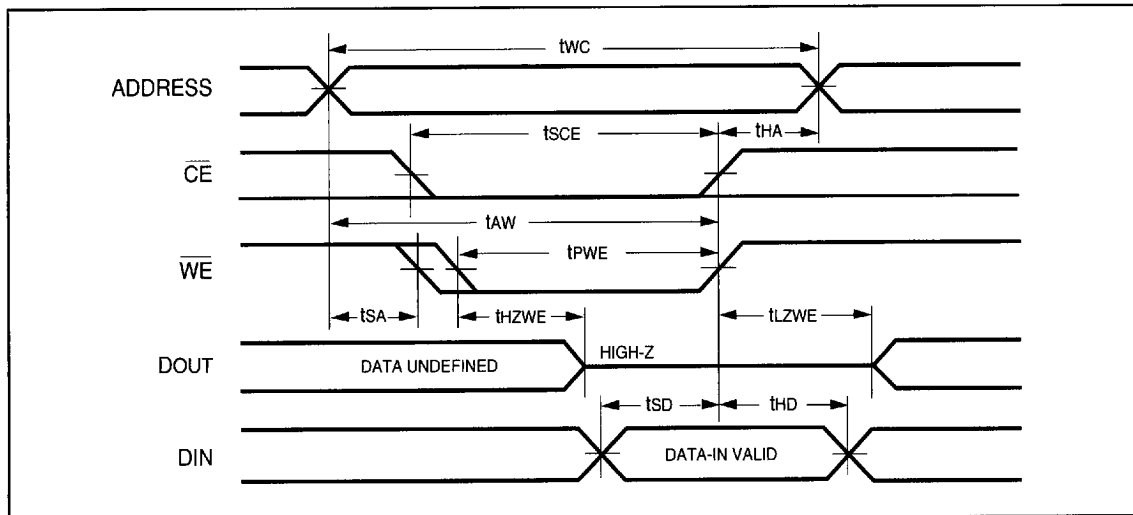
WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1,3)</sup> (Over Operating Range)

| Symbol                           | Parameter                            | -10 ns |      | -12 ns |      | -15 ns |      | -20 ns |      | -25 ns |      | Unit |
|----------------------------------|--------------------------------------|--------|------|--------|------|--------|------|--------|------|--------|------|------|
|                                  |                                      | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. | Min.   | Max. |      |
| t <sub>WC</sub>                  | Write Cycle Time                     | 10     | —    | 12     | —    | 15     | —    | 20     | —    | 25     | —    | ns   |
| t <sub>SCE</sub>                 | $\overline{CE}$ to Write End         | 9      | —    | 10     | —    | 12     | —    | 13     | —    | 15     | —    | ns   |
| t <sub>AW</sub>                  | Address Setup Time to Write End      | 9      | —    | 10     | —    | 12     | —    | 15     | —    | 20     | —    | ns   |
| t <sub>HA</sub>                  | Address Hold from Write End          | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |
| t <sub>SA</sub>                  | Address Setup Time                   | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |
| t <sub>PWE</sub> <sup>(4)</sup>  | $\overline{WE}$ Pulse Width          | 8      | —    | 8      | —    | 10     | —    | 13     | —    | 15     | —    | ns   |
| t <sub>SD</sub>                  | Data Setup to Write End              | 8      | —    | 8      | —    | 9      | —    | 10     | —    | 12     | —    | ns   |
| t <sub>HD</sub>                  | Data Hold from Write End             | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |
| t <sub>HZWE</sub> <sup>(2)</sup> | $\overline{WE}$ LOW to High-Z Output | —      | 6    | —      | 6    | —      | 7    | —      | 8    | —      | 10   | ns   |
| t <sub>LZWE</sub>                | $\overline{WE}$ HIGH to Low-Z Output | 0      | —    | 0      | —    | 0      | —    | 0      | —    | 0      | —    | ns   |

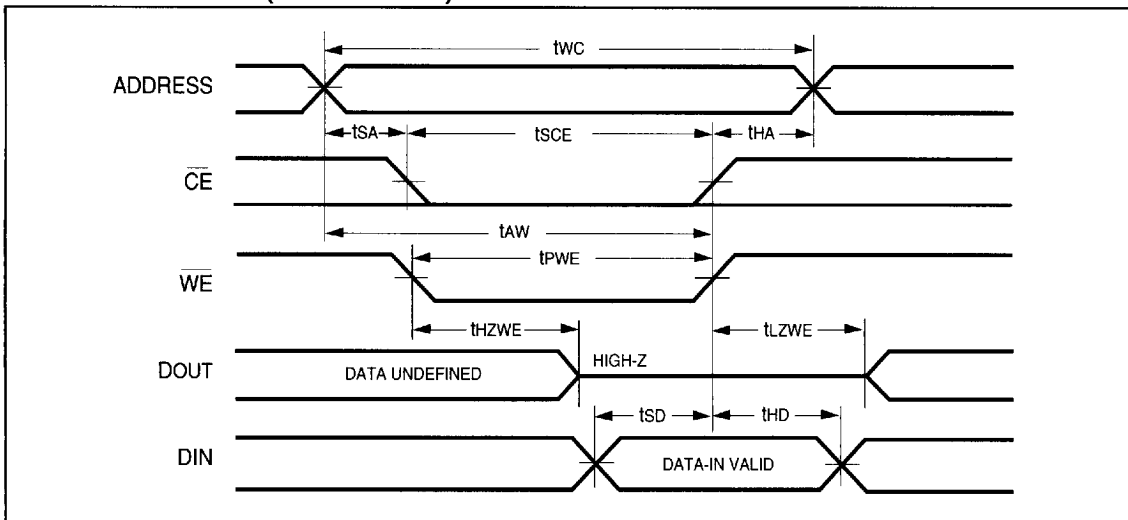
## Notes:

1. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
3. The internal write time is defined by the overlap of  $\overline{CE}$  LOW and  $\overline{WE}$  LOW. All signals must be in valid states to initiate a Write, but any one can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.
4. Tested with  $\overline{OE}$  HIGH.

## AC WAVEFORMS

WRITE CYCLE NO. 1 ( $\overline{WE}$  Controlled)<sup>(1,2)</sup>

## WRITE CYCLE NO. 2 ( $\overline{CE}$ Controlled)<sup>(1,2)</sup>



### Notes:

1. The internal write time is defined by the overlap of  $\overline{CE}$  LOW and  $\overline{WE}$  LOW. All signals must be in valid states to initiate a Write, but any one can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.
2. I/O will assume the High-Z state if  $\overline{OE} \geq V_{IH}$ .

**ORDERING INFORMATION: IS61C256AH****Commercial Range: 0°C to +70°C**

| Speed (ns) | Order Part Number | Package             |
|------------|-------------------|---------------------|
| 10         | IS61C256AH-10N    | 300-mil Plastic DIP |
| 10         | IS61C256AH-10J    | 300-mil Plastic SOJ |
| 12         | IS61C256AH-12N    | 300-mil Plastic DIP |
| 12         | IS61C256AH-12J    | 300-mil Plastic SOJ |
| 15         | IS61C256AH-15N    | 300-mil Plastic DIP |
| 15         | IS61C256AH-15J    | 300-mil Plastic SOJ |
| 15         | IS61C256AH-15T    | 450-MIL TSOP        |
| 15         | IS61C256AH-15TR   | TSOP Reverse Pinout |
| 20         | IS61C256AH-20N    | 300-mil Plastic DIP |
| 20         | IS61C256AH-20J    | 300-mil Plastic SOJ |
| 20         | IS61C256AH-20T    | 450-MIL TSOP        |
| 20         | IS61C256AH-20TR   | TSOP Reverse Pinout |
| 25         | IS61C256AH-25N    | 300-mil Plastic DIP |
| 25         | IS61C256AH-25J    | 300-mil Plastic SOJ |

**ORDERING INFORMATION: IS61C256AH****Industrial Range: -40°C to +85°C**

| Speed (ns) | Order Part Number | Package             |
|------------|-------------------|---------------------|
| 12         | IS61C256AH-12NI   | 300-mil Plastic DIP |
| 12         | IS61C256AH-12JI   | 300-mil Plastic SOJ |
| 15         | IS61C256AH-15NI   | 300-mil Plastic DIP |
| 15         | IS61C256AH-15JI   | 300-mil Plastic SOJ |
| 20         | IS61C256AH-20NI   | 300-mil Plastic DIP |
| 20         | IS61C256AH-20JI   | 300-mil Plastic SOJ |
| 25         | IS61C256AH-25NI   | 300-mil Plastic DIP |
| 25         | IS61C256AH-25JI   | 300-mil Plastic SOJ |

**ORDERING INFORMATION: IS61M256****Commercial Range: 0°C to +70°C**

| Speed (ns) | Order Part Number | Package             |
|------------|-------------------|---------------------|
| 10         | IS61M256-10N      | 300-mil Plastic DIP |
| 10         | IS61M256-10J      | 300-mil Plastic SOJ |
| 12         | IS61M256-12N      | 300-mil Plastic DIP |
| 12         | IS61M256-12J      | 300-mil Plastic SOJ |
| 15         | IS61M256-15N      | 300-mil Plastic DIP |
| 15         | IS61M256-15J      | 300-mil Plastic SOJ |
| 20         | IS61M256-20N      | 300-mil Plastic DIP |
| 20         | IS61M256-20J      | 300-mil Plastic SOJ |
| 25         | IS61M256-25N      | 300-mil Plastic DIP |
| 25         | IS61M256-25J      | 300-mil Plastic SOJ |