

# IS62LV12816L IS62LV12816LL



## 128K x 16 LOW VOLTAGE, ULTRA LOW POWER CMOS STATIC RAM

### FEATURES

- High-speed access times: 55, 70, 100 ns
- CMOS low power operation
  - 120 mW (typical) operating
  - 6  $\mu$ W (typical) CMOS standby
- TTL compatible interface levels
- Single 2.7V-3.6V Vcc power supply
- Fully static operation: no clock or refresh required
- Three state outputs
- Data control for upper and lower bytes
- Industrial temperature available
- Available in the 44-pin TSOP-2 and 48-pin 6\*8mm TF-BGA

### DESCRIPTION

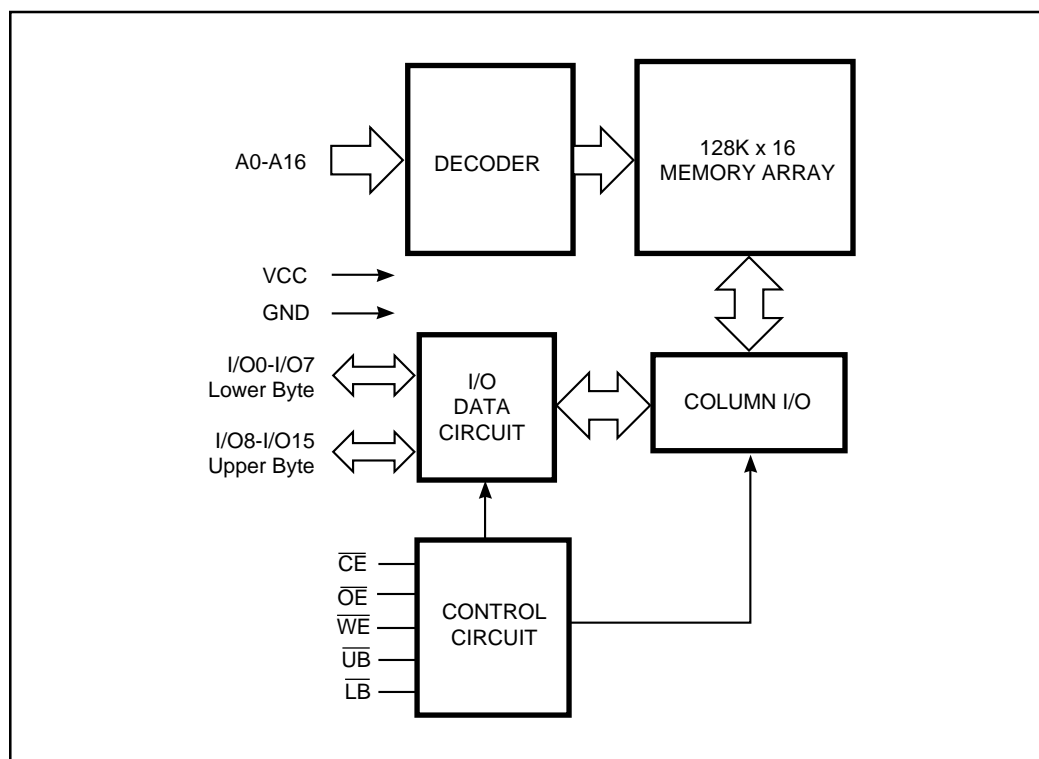
The *ICSI* IS62LV12816L and IS62LV12816LL are high-speed, 2,097,152-bit static RAMs organized as 131,072 words by 16 bits. They are fabricated using *ICSI*'s high-performance CMOS technology. This highly reliable process coupled with innovative circuit design techniques, yields high-performance and low power consumption devices.

When  $\overline{CE}$  is HIGH (deselected) or when  $\overline{CE}$  is low and both  $\overline{LB}$  and  $\overline{UB}$  are HIGH, the device assumes a standby mode at which the power dissipation can be reduced by using CMOS input levels.

Easy memory expansion is provided by using Chip Enable Output and Enable inputs,  $\overline{CE}$  and  $\overline{OE}$ . The active LOW Write Enable ( $\overline{WE}$ ) controls both writing and reading of the memory. A data byte allows Upper Byte ( $\overline{UB}$ ) and Lower Byte ( $\overline{LB}$ ) access.

The IS62LV12816L and IS62LV12816LL are packaged in the JEDEC standard 44-pin 400mil TSOP-2 and 48-pin 6\*8mm TF-BGA.

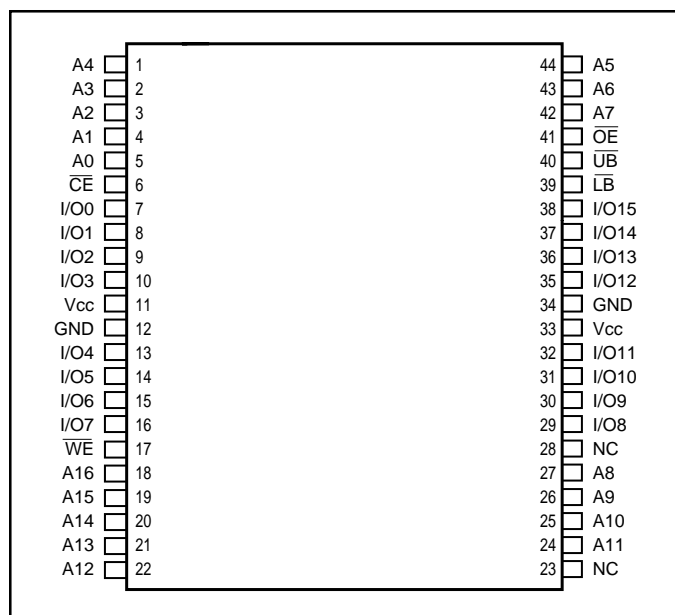
### FUNCTIONAL BLOCK DIAGRAM



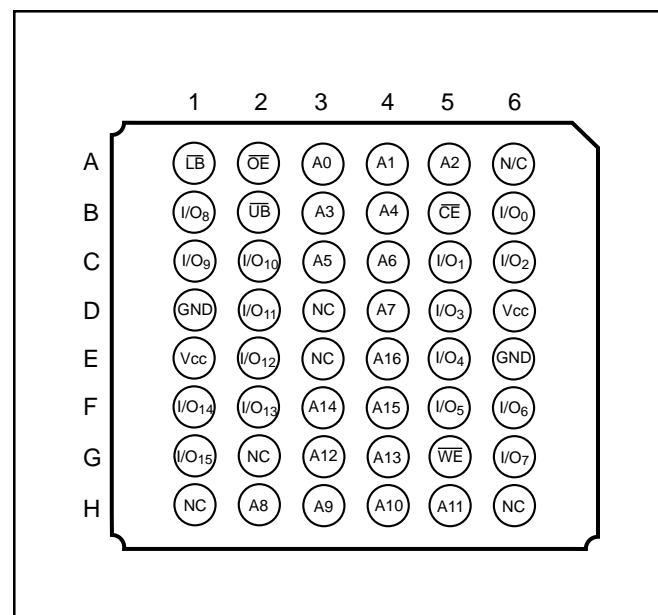
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## PIN CONFIGURATIONS

### 44-Pin TSOP-2



### 48-Pin TF-BGA



## PIN DESCRIPTIONS

|                 |                     |
|-----------------|---------------------|
| A0-A16          | Address Inputs      |
| I/O0-I/O15      | Data Input/Output   |
| $\overline{CE}$ | Chip Enable Input   |
| $\overline{OE}$ | Output Enable Input |
| $\overline{WE}$ | Write Enable Input  |

|                 |                                 |
|-----------------|---------------------------------|
| $\overline{LB}$ | Lower-byte Control (I/O0-I/O7)  |
| $\overline{UB}$ | Upper-byte Control (I/O8-I/O15) |
| NC              | No Connection                   |
| Vcc             | Power                           |
| GND             | Ground                          |

## TRUTH TABLE

| Mode            | I/O PIN         |                 |                 |                 |                 |            | Vcc Current |            |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|-------------|------------|
|                 | $\overline{WE}$ | $\overline{CE}$ | $\overline{OE}$ | $\overline{LB}$ | $\overline{UB}$ | I/O0/-I/O7 |             | I/O8-I/O15 |
| Not Selected    | X               | H               | X               | X               | X               | High-Z     | High-Z      | ISB1, ISB2 |
|                 | X               | L               | X               | H               | H               | High-Z     | High-Z      | ISB1, ISB2 |
| Output Disabled | H               | L               | H               | X               | X               | High-Z     | High-Z      | Icc        |
|                 | X               | L               | X               | H               | H               | High-Z     | High-Z      | ISB        |
| Read            | H               | L               | L               | L               | H               | DOUT       | High-Z      | Icc        |
|                 | H               | L               | L               | H               | L               | High-Z     | DOUT        |            |
|                 | H               | L               | L               | L               | L               | DOUT       | DOUT        |            |
| Write           | L               | L               | X               | L               | H               | DIN        | High-Z      | Icc        |
|                 | L               | L               | X               | H               | L               | High-Z     | DIN         |            |
|                 | L               | L               | X               | L               | L               | DIN        | DIN         |            |

## OPERATING RANGE

| Range      | Ambient Temperature | V <sub>CC</sub> |
|------------|---------------------|-----------------|
| Commercial | 0°C to +70°C        | 2.7V - 3.6V     |
| Industrial | −40°C to +85°C      | 2.7V - 3.6V     |

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

| Symbol            | Parameter                            | Value                         | Unit |
|-------------------|--------------------------------------|-------------------------------|------|
| V <sub>TERM</sub> | Terminal Voltage with Respect to GND | −0.5 to V <sub>CC</sub> + 0.5 | V    |
| T <sub>BIAS</sub> | Temperature Under Bias               | −40 to +85                    | °C   |
| V <sub>CC</sub>   | V <sub>CC</sub> related to GND       | −0.3 to +4.0                  | V    |
| T <sub>STG</sub>  | Storage Temperature                  | −65 to +150                   | °C   |
| P <sub>T</sub>    | Power Dissipation                    | 1.0                           | W    |

## 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.

## DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

| Symbol                         | Parameter                        | Test Conditions   | Min. | Max.                  | Unit |
|--------------------------------|----------------------------------|---|------|-----------------------|------|
| V <sub>OH</sub>                | Output HIGH Voltage              | V <sub>CC</sub> = Min., I <sub>OH</sub> = −1 mA             | 2.0  | —                     | V    |
| V <sub>OL</sub>                | Output LOW Voltage               | V <sub>CC</sub> = Min., I <sub>OL</sub> = 2.1 mA            | —    | 0.4                   | V    |
| V <sub>IH</sub>                | Input HIGH Voltage               |   | 2.2  | V <sub>CC</sub> + 0.2 | V    |
| V <sub>IL</sub> <sup>(1)</sup> | Input LOW Voltage <sup>(1)</sup> |   | −0.2 | 0.4                   | V    |
| I <sub>LI</sub>                | Input Leakage                    | GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>                     | −1   | 1                     | μA   |
| I <sub>LO</sub>                | Output Leakage                   | GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> , OUTPUTS DISABLED | −1   | 1                     | μA   |

## Notes:

1. V<sub>IL</sub>(min.) = −2.0V for pulse width less than 10 ns.

CAPACITANCE<sup>(1)</sup>

| Symbol           | Parameter          | Conditions            | Max. | Unit |
|------------------|--------------------|-----------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance  | V <sub>IN</sub> = 0V  | 6    | pF   |
| C <sub>OUT</sub> | Output Capacitance | V <sub>OUT</sub> = 0V | 8    | pF   |

## Notes:

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

## AC TEST CONDITIONS

| Parameter                                   | Unit                |
|---|---------------------|
| Input Pulse Level                           | 0.4V to 2.2V        |
| Input Rise and Fall Times                   | 5 ns                |
| Input and Output Timing and Reference Level | 1.3V                |
| Output Load                                 | See Figures 1 and 2 |

## AC TEST LOADS

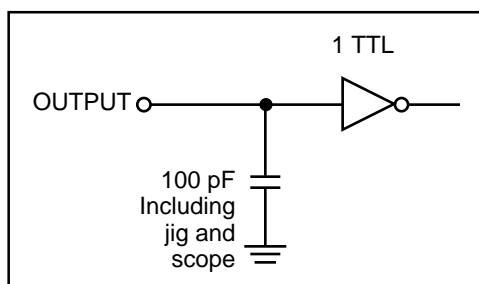


Figure 1

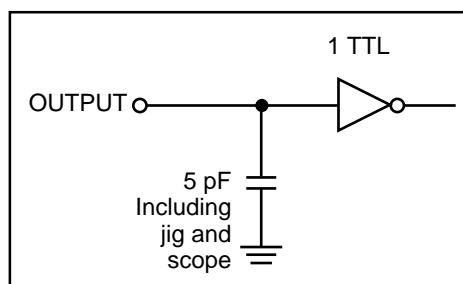


Figure 2

## IS62LV12816L POWER SUPPLY CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

| Symbol           | Parameter  | Test Conditions   |              | -55    |            | -70    |            | -100   |            | Unit |
|------------------|--|---|--------------|--------|------------|--------|------------|--------|------------|------|
|                  |  |   |              | Min.   | Max.       | Min.   | Max.       | Min.   | Max.       |      |
| I <sub>CC</sub>  | V <sub>CC</sub> Dynamic Operating Supply Current | V <sub>CC</sub> = Max.,<br>I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>  | Com.<br>Ind. | —<br>— | 40<br>45   | —<br>— | 30<br>35   | —<br>— | 20<br>25   | 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>$\overline{CE} \leq V_{IH}$ , f = 0  | Com.<br>Ind. | —<br>— | 0.4<br>1.0 | —<br>— | 0.4<br>1.0 | —<br>— | 0.4<br>1.0 | mA   |
|                  | OR   |   |              |        |            |        |            |        |            |      |
|                  | ULB Control                                      | V <sub>CC</sub> = Max., V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>$\overline{CE} = V_{IL}$ , f = 0, $\overline{UB} = V_{IH}$ , $\overline{LB} = V_{IH}$ |              |        |            |        |            |        |            |      |
| 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. | —<br>— | 35<br>50   | —<br>— | 35<br>50   | —<br>— | 35<br>50   | μA   |
|                  | OR   |   |              |        |            |        |            |        |            |      |
|                  | ULB Control                                      | V <sub>CC</sub> = Max., $\overline{CE} = V_{IL}$ ,<br>V <sub>IN</sub> ≤ 0.2V, f = 0, $\overline{UB} / \overline{LB} = V_{CC} - 0.2V$                                    |              |        |            |        |            |        |            |      |

Note:

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

IS62LV12816LL POWER SUPPLY CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

| Symbol           | Parameter  | Test Conditions   |      | -55  |      | -70  |      | -100 |      | Unit |
|------------------|--|---|------|------|------|------|------|------|------|------|
|                  |  |   |      | Min. | Max. | Min. | Max. | Min. | Max. |      |
| I <sub>CC</sub>  | V <sub>CC</sub> Dynamic Operating Supply Current | V <sub>CC</sub> = Max.,   | Com. | —    | 40   | —    | 30   | —    | 20   | mA   |
|                  |  | I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>   | Ind. | —    | 45   | —    | 35   | —    | 25   |      |
| I <sub>SB1</sub> | TTL Standby Current (TTL Inputs)                 | V <sub>CC</sub> = Max.,   | Com. | —    | 0.4  | —    | 0.4  | —    | 0.4  | mA   |
|                  |  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>CE ≥ V <sub>IH</sub> , f = 0  | Ind. | —    | 1.0  | —    | 1.0  | —    | 1.0  |      |
|                  | OR   |   |      |      |      |      |      |      |      |      |
|                  | ULB Control                                      | V <sub>CC</sub> = Max., V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>CE = V <sub>IL</sub> , f = 0, UB = V <sub>IH</sub> , LB = V <sub>IH</sub> |      |      |      |      |      |      |      |      |
| I <sub>SB2</sub> | CMOS Standby Current (CMOS Inputs)               | V <sub>CC</sub> = Max., f = 0   | Com. | —    | 10   | —    | 10   | —    | 10   | μA   |
|                  |  | CE ≥ V <sub>CC</sub> - 0.2V,<br>V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V, or<br>V <sub>IN</sub> ≤ 0.2V, f = 0   | Ind. | —    | 15   | —    | 15   | —    | 15   |      |
|                  | OR   |   |      |      |      |      |      |      |      |      |
|                  | ULB Control                                      | V <sub>CC</sub> = Max., CE = V <sub>IL</sub><br>V <sub>IN</sub> ≤ 0.2V, f = 0, UB / LB = V <sub>CC</sub> - 0.2V   |      |      |      |      |      |      |      |      |

Note:

1. At f = f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.READ CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

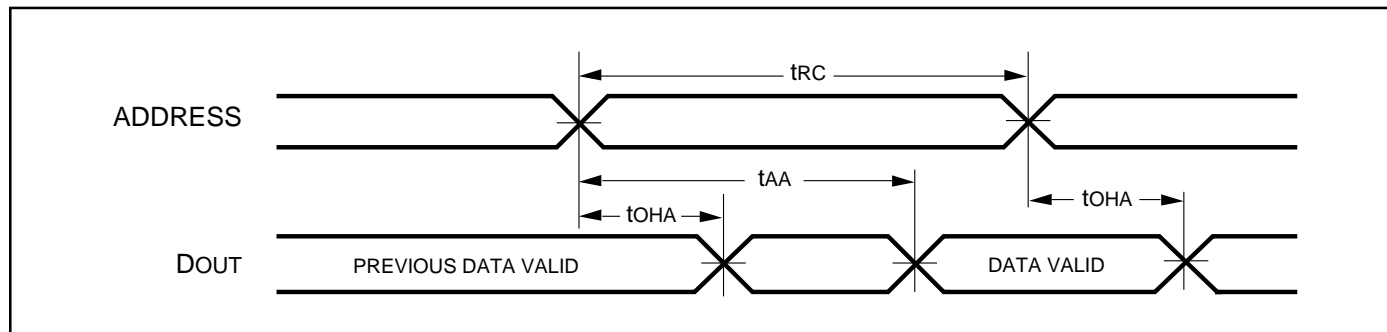
| Symbol                           | Parameter               | -55  |      | -70  |      | -100 |      | Unit |
|----------------------------------|-------------------------|------|------|------|------|------|------|------|
|                                  |                         | Min. | Max. | Min. | Max. | Min. | Max. |      |
| t <sub>RC</sub>                  | Read Cycle Time         | 55   | —    | 70   | —    | 100  | —    | ns   |
| t <sub>AA</sub>                  | Address Access Time     | —    | 55   | —    | 70   | —    | 100  | ns   |
| t <sub>OH</sub>                  | Output Hold Time        | 10   | —    | 10   | —    | 15   | —    | ns   |
| t <sub>ACE</sub>                 | CE Access Time          | —    | 55   | —    | 70   | —    | 100  | ns   |
| t <sub>DOE</sub>                 | OE Access Time          | —    | 30   | —    | 35   | —    | 50   | ns   |
| t <sub>HZOE</sub> <sup>(2)</sup> | OE to High-Z Output     | —    | 20   | —    | 25   | —    | 30   | ns   |
| t <sub>LZOE</sub> <sup>(2)</sup> | OE to Low-Z Output      | 5    | —    | 5    | —    | 5    | —    | ns   |
| t <sub>HZCE</sub> <sup>(2)</sup> | CE to High-Z Output     | 0    | 20   | 0    | 25   | 0    | 30   | ns   |
| t <sub>LZCE</sub> <sup>(2)</sup> | CE to Low-Z Output      | 10   | —    | 10   | —    | 10   | —    | ns   |
| t <sub>BA</sub>                  | LB, UB Access Time      | —    | 55   | —    | 70   | —    | 100  | ns   |
| t <sub>HZB</sub>                 | LB, UB to High-Z Output | 0    | 25   | 0    | 25   | 0    | 35   | ns   |
| t <sub>LZB</sub>                 | LB, UB to Low-Z Output  | 0    | —    | 0    | —    | 0    | —    | ns   |

Notes:

- Test conditions assume signal transition times of 5 ns or less, timing reference levels of 1.3V, input pulse levels of 0.4V to 2.2V and output loading specified in Figure 1.
- Tested with the load in Figure 2. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.

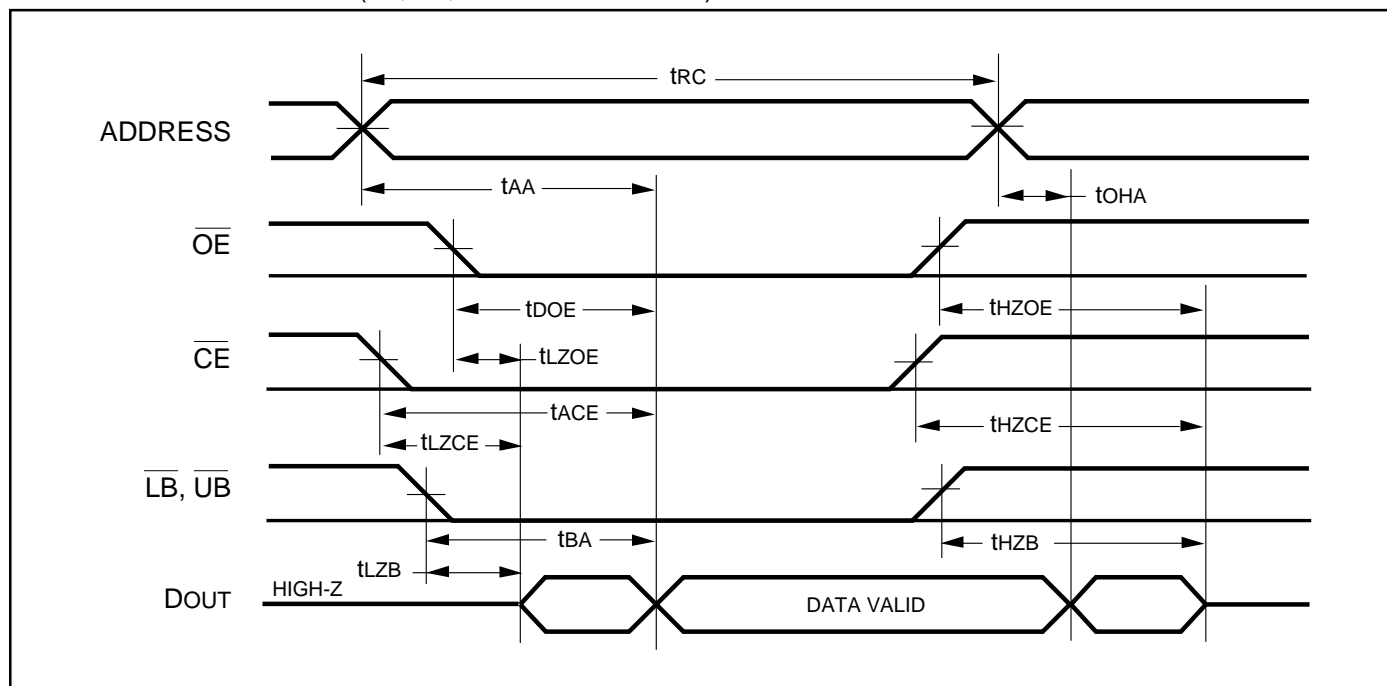
## AC TEST LOADS

READ CYCLE NO.1<sup>(1,2)</sup> (Address Controlled) ( $\overline{CE} = \overline{OE} = V_{IL}$ ,  $\overline{UB}$  or  $\overline{LB} = V_{IL}$ )



## AC WAVEFORMS

READ CYCLE NO. 2<sup>(1,3)</sup> ( $\overline{CS}$ ,  $\overline{OE}$ , AND  $\overline{UB}/\overline{LB}$  Controlled)



### Notes:

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

## WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1,2)</sup> (Over Operating Range)

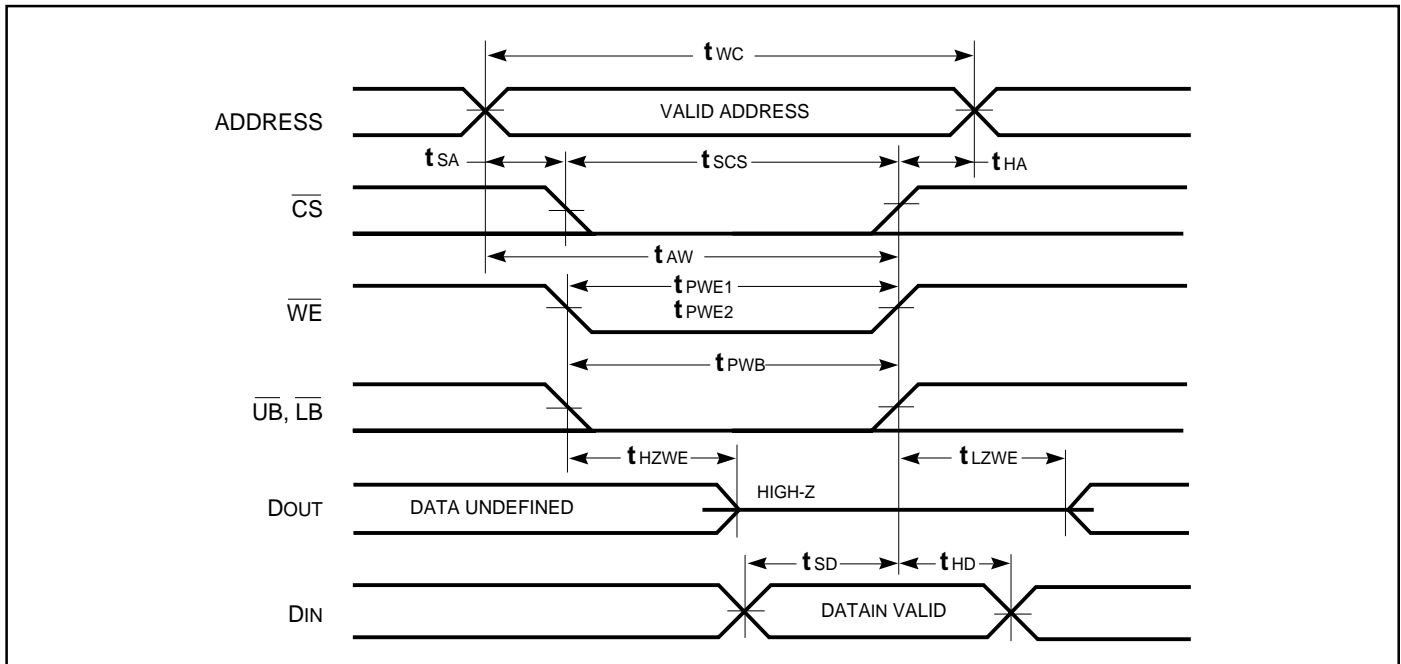
| Symbol                           | Parameter   | -55  |      | -70  |      | -100 |      | Unit |
|----------------------------------|---|------|------|------|------|------|------|------|
|                                  |   | Min. | Max. | Min. | Max. | Min. | Max. |      |
| t <sub>WC</sub>                  | Write Cycle Time  | 55   | —    | 70   | —    | 100  | —    | ns   |
| t <sub>SCE</sub>                 | $\overline{CE}$ to Write End                            | 50   | —    | 65   | —    | 80   | —    | ns   |
| t <sub>AW</sub>                  | Address Setup Time to Write End                         | 50   | —    | 65   | —    | 80   | —    | ns   |
| t <sub>HA</sub>                  | Address Hold from Write End                             | 0    | —    | 0    | —    | 0    | —    | ns   |
| t <sub>SA</sub>                  | Address Setup Time                                      | 0    | —    | 0    | —    | 0    | —    | ns   |
| t <sub>PWB</sub>                 | $\overline{LB}$ , $\overline{UB}$ Valid to End of Write | 45   | —    | 60   | —    | 80   | —    | ns   |
| t <sub>PWE</sub>                 | $\overline{WE}$ Pulse Width                             | 45   | —    | 60   | —    | 80   | —    | ns   |
| t <sub>SD</sub>                  | Data Setup to Write End                                 | 25   | —    | 30   | —    | 40   | —    | ns   |
| t <sub>HD</sub>                  | Data Hold from Write End                                | 0    | —    | 0    | —    | 0    | —    | ns   |
| t <sub>HZWE</sub> <sup>(3)</sup> | $\overline{WE}$ LOW to High-Z Output                    | —    | 30   | —    | 30   | —    | 40   | ns   |
| t <sub>LZWE</sub> <sup>(3)</sup> | $\overline{WE}$ HIGH to Low-Z Output                    | 5    | —    | 5    | —    | 5    | —    | ns   |

### Notes:

- Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.3V, input pulse levels of 0.4V to 2.2V and output loading specified in Figure 1.
- The internal write time is defined by the overlap of  $\overline{CE}$  LOW, and  $\overline{UB}$  or  $\overline{LB}$ , 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.
- Tested with the load in Figure 2. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.

## AC WAVEFORMS

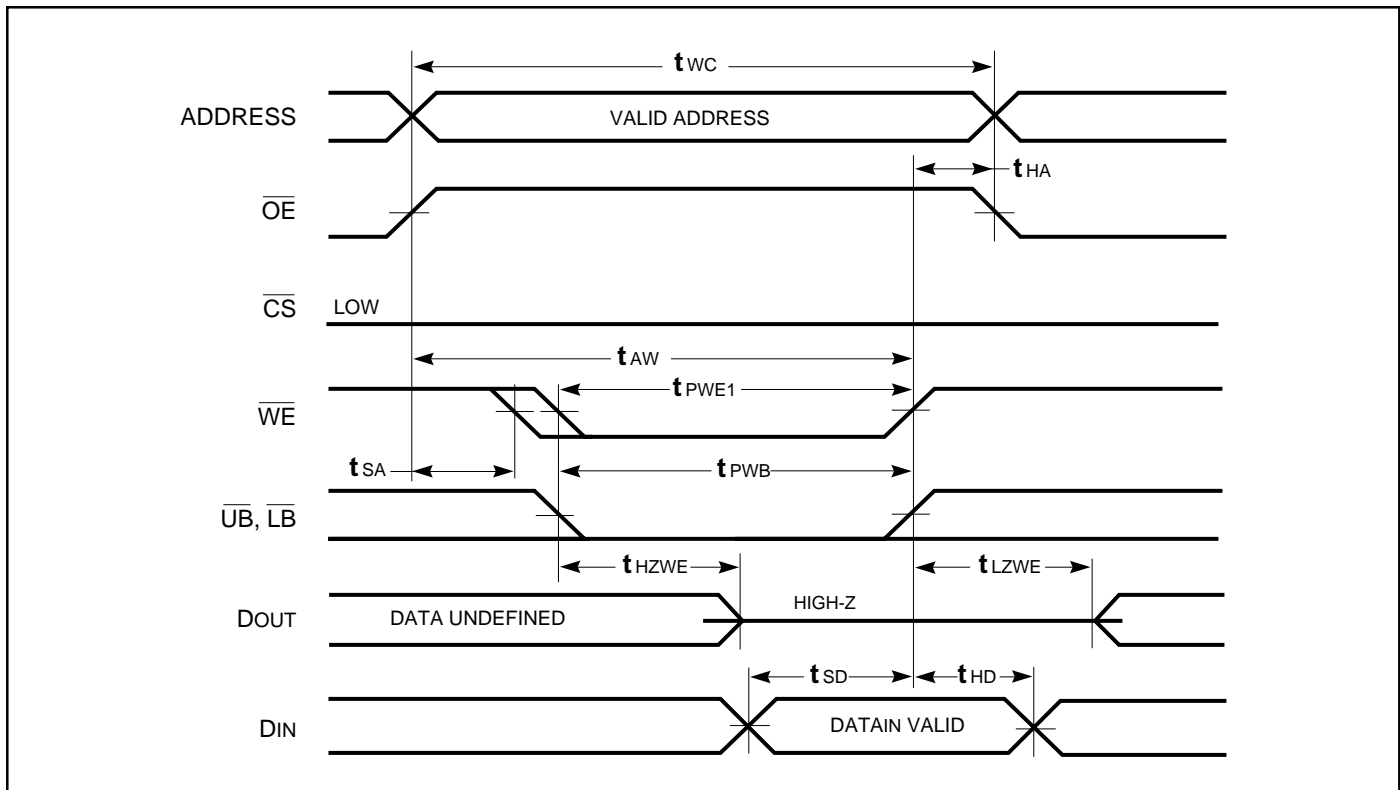
### WRITE CYCLE NO. 1<sup>(1,2)</sup> ( $\overline{CS}$ , Controlled, $\overline{OE}$ = HIGH or LOW)



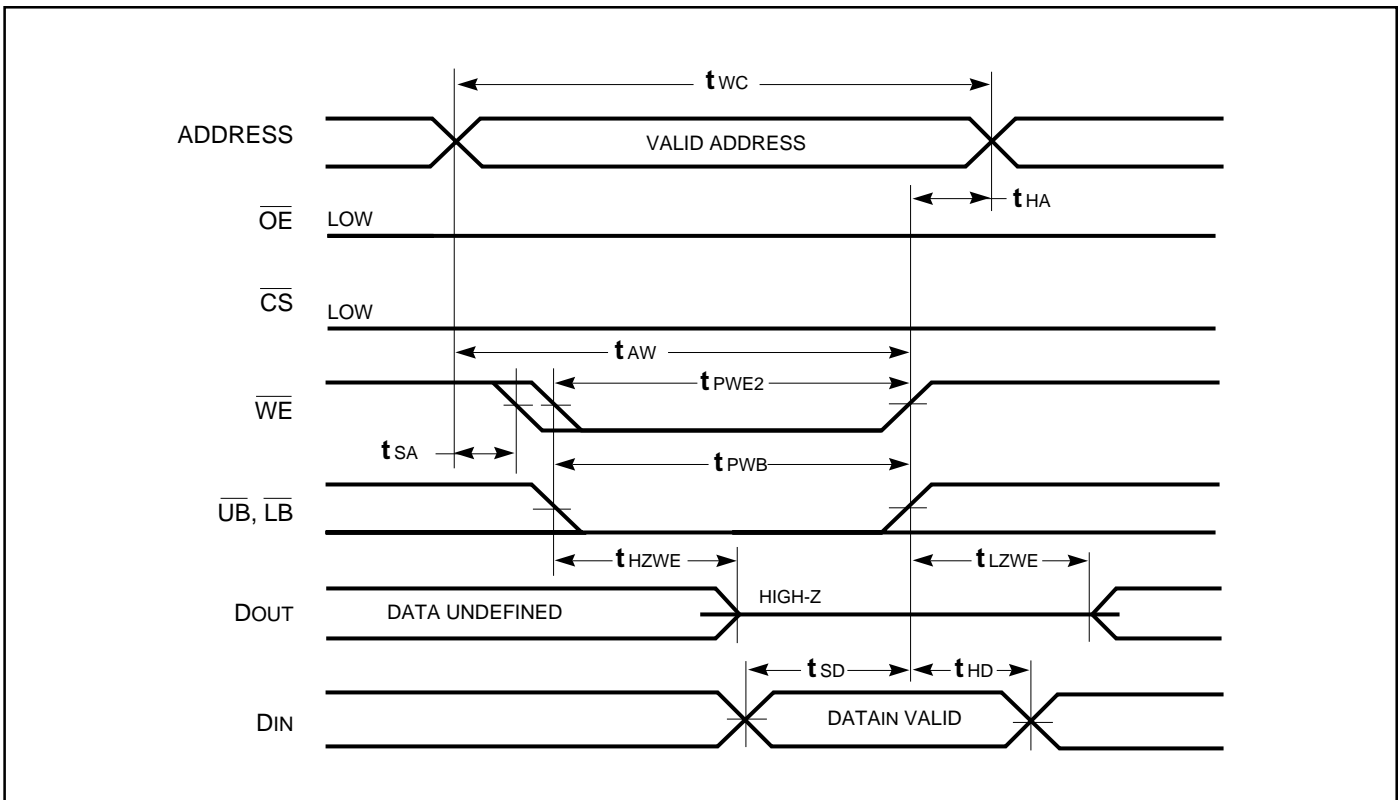
### Notes:

- WRITE is an internally generated signal asserted during an overlap of the LOW states on the  $\overline{CS}$  and  $\overline{WE}$  inputs and at least one of the  $\overline{LB}$  and  $\overline{UB}$  inputs being in the LOW state.
- WRITE = ( $\overline{CS}$ ) [ ( $\overline{LB}$ ) = ( $\overline{UB}$ ) ] ( $\overline{WE}$ ).

WRITE CYCLE NO. 2 ( $\overline{WE}$  Controlled;  $\overline{OE}$  is HIGH During Write Cycle)

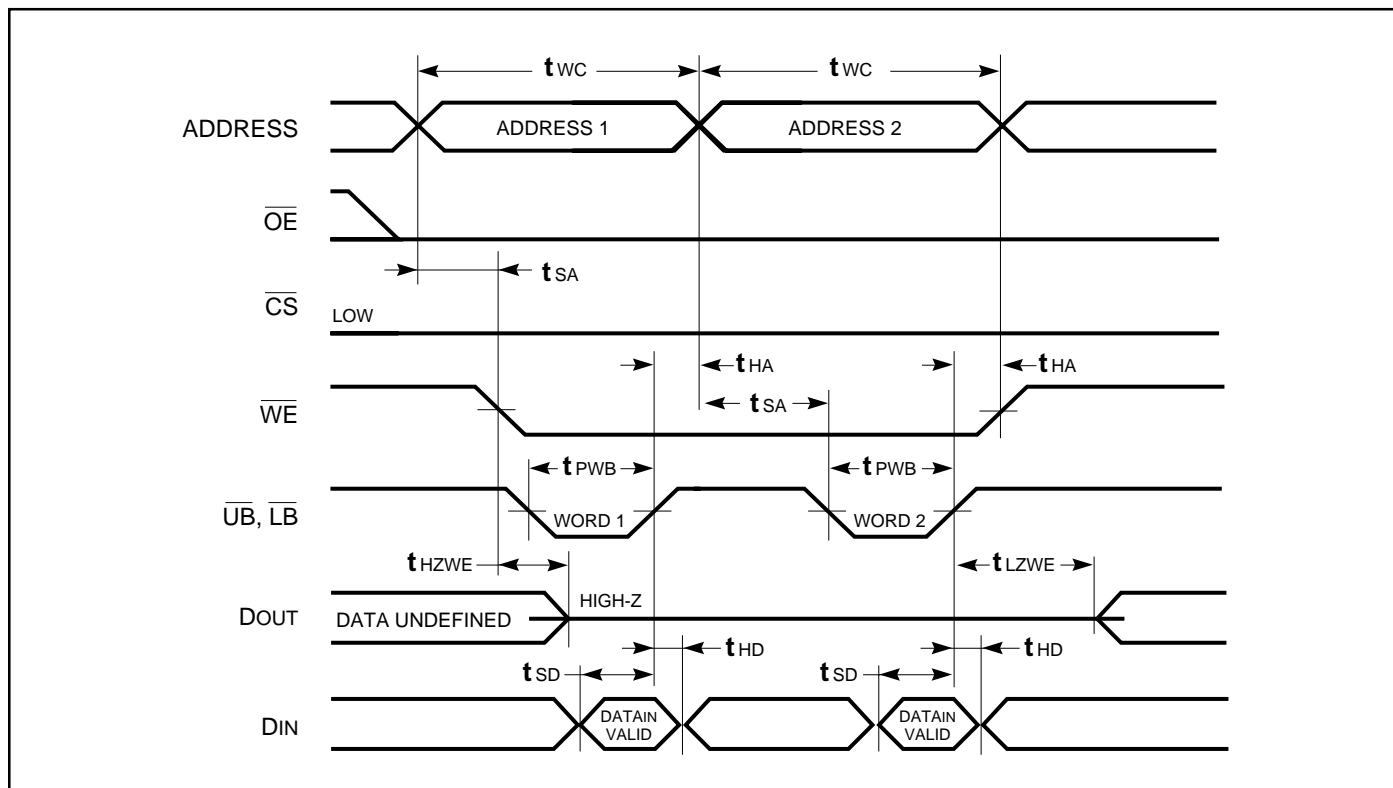


WRITE CYCLE NO. 3 ( $\overline{WE}$  Controlled;  $\overline{OE}$  is LOW During Write Cycle)





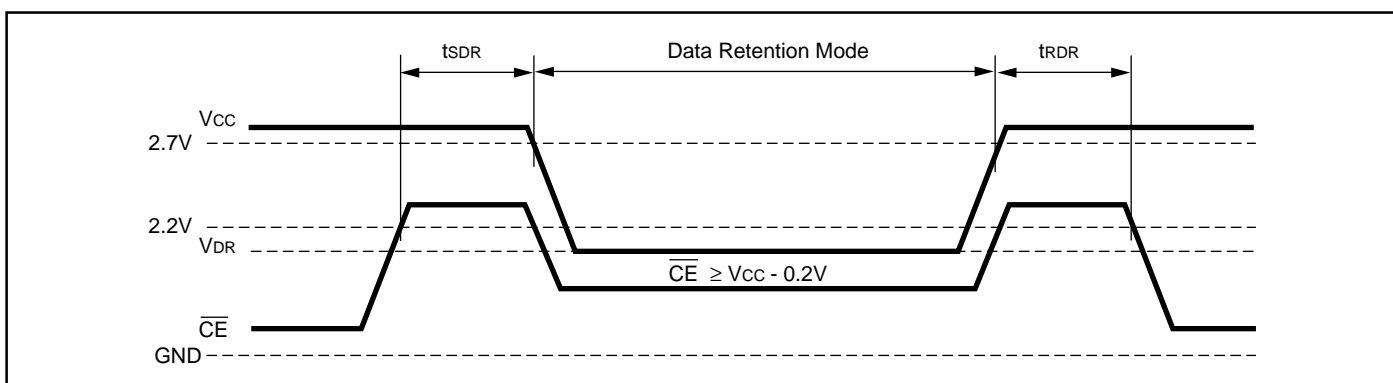
## WRITE CYCLE NO. 4 ( $\overline{UB}$ / $\overline{LB}$ Controlled)



## DATA RETENTION SWITCHING CHARACTERISTICS (L/LL)

| Symbol    | Parameter                   | Test Condition                                    | Min.     | Max. | Unit    |
|-----------|-----------------------------|---|----------|------|---------|
| $V_{DR}$  | $V_{CC}$ for Data Retention | See Data Retention Waveform                       | 1.5      | 3.6  | V       |
| $I_{DR}$  | Data Retention Current      | $V_{CC} = 2.0V, \overline{CE} \geq V_{CC} - 0.2V$ |          |      |         |
|           |                             | Com. (-L)   | —        | 20   | $\mu A$ |
|           |                             | Com. (-LL)  | —        | 5    | $\mu A$ |
|           |                             | Ind. (-L)   | —        | 25   | $\mu A$ |
|           |                             | Ind. (-LL)  | —        | 7    | $\mu A$ |
| $t_{SDR}$ | Data Retention Setup Time   | See Data Retention Waveform                       | 0        | —    | ns      |
| $t_{RDR}$ | Recovery Time               | See Data Retention Waveform                       | $t_{RC}$ | —    | ns      |

## DATA RETENTION WAVEFORM ( $\overline{CE}$ Controlled)



## ORDERING INFORMATION

Commercial Range: 0°C to +70°C

| Speed (ns) | Order Part No.    | Package       |
|------------|-------------------|---------------|
| 55         | IS62LV12816L-55T  | 400mil TSOP-2 |
|            | IS62LV12816L-55B  | 6*8mm TF-BGA  |
| 70         | IS62LV12816L-70T  | 400mil TSOP-2 |
|            | IS62LV12816L-70B  | 6*8mm TF-BGA  |
| 100        | IS62LV12816L-100T | 400mil TSOP-2 |
|            | IS62LV12816L-100B | 6*8mm TF-BGA  |

Industrial Range: -40°C to +85°C

| Speed (ns) | Order Part No.     | Package       |
|------------|--------------------|---------------|
| 55         | IS62LV12816L-55TI  | 400mil TSOP-2 |
|            | IS62LV12816L-55BI  | 6*8mm TF-BGA  |
| 70         | IS62LV12816L-70TI  | 400mil TSOP-2 |
|            | IS62LV12816L-70BI  | 6*8mm TF-BGA  |
| 100        | IS62LV12816L-100TI | 400mil TSOP-2 |
|            | IS62LV12816L-100BI | 6*8mm TF-BGA  |

## ORDERING INFORMATION

Commercial Range: 0°C to +70°C

| Speed (ns) | Order Part No.     | Package       |
|------------|--------------------|---------------|
| 55         | IS62LV12816LL-55T  | 400mil TSOP-2 |
|            | IS62LV12816LL-55B  | 6*8mm TF-BGA  |
| 70         | IS62LV12816LL-70T  | 400mil TSOP-2 |
|            | IS62LV12816LL-70B  | 6*8mm TF-BGA  |
| 100        | IS62LV12816LL-100T | 400mil TSOP-2 |
|            | IS62LV12816LL-100B | 6*8mm TF-BGA  |

Industrial Range: -40°C to +85°C

| Speed (ns) | Order Part No.      | Package       |
|------------|---------------------|---------------|
| 55         | IS62LV12816LL-55TI  | 400mil TSOP-2 |
|            | IS62LV12816LL-55BI  | 6*8mm TF-BGA  |
| 70         | IS62LV12816LL-70TI  | 400mil TSOP-2 |
|            | IS62LV12816LL-70BI  | 6*8mm TF-BGA  |
| 100        | IS62LV12816LL-100TI | 400mil TSOP-2 |
|            | IS62LV12816LL-100BI | 6*8mm TF-BGA  |



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