

## Features

- ◆ **High-speed access and chip select times**
  - Commercial: 15/20/25ns (max.)
  - Industrial: 20/25ns (max.)
  - Military: 20/25/35/45/55/70/90/120/150ns (max.)
- ◆ **Low-power consumption**
- ◆ **Battery backup operation**
  - 2V data retention voltage (LA version only)
- ◆ **Produced with advanced CMOS high-performance technology**
- ◆ **CMOS process virtually eliminates alpha particle soft-error rates**
- ◆ **Input and output directly TTL-compatible**
- ◆ **Static operation: no clocks or refresh required**
- ◆ **Available in ceramic 24-pin DIP, ceramic and plastic 24-pin Thin Dip and 24-pin SOIC**
- ◆ **Military product compliant to MIL-STD-883, Class B**
- ◆ **Industrial temperature range (–40°C to +85°C) is available for selected speeds**
- ◆ **Green parts available, see ordering information**

## Description

The IDT6116SA/LA is a 16,384-bit high-speed static RAM organized as 2K x 8. It is fabricated using high-performance, high-reliability CMOS technology.

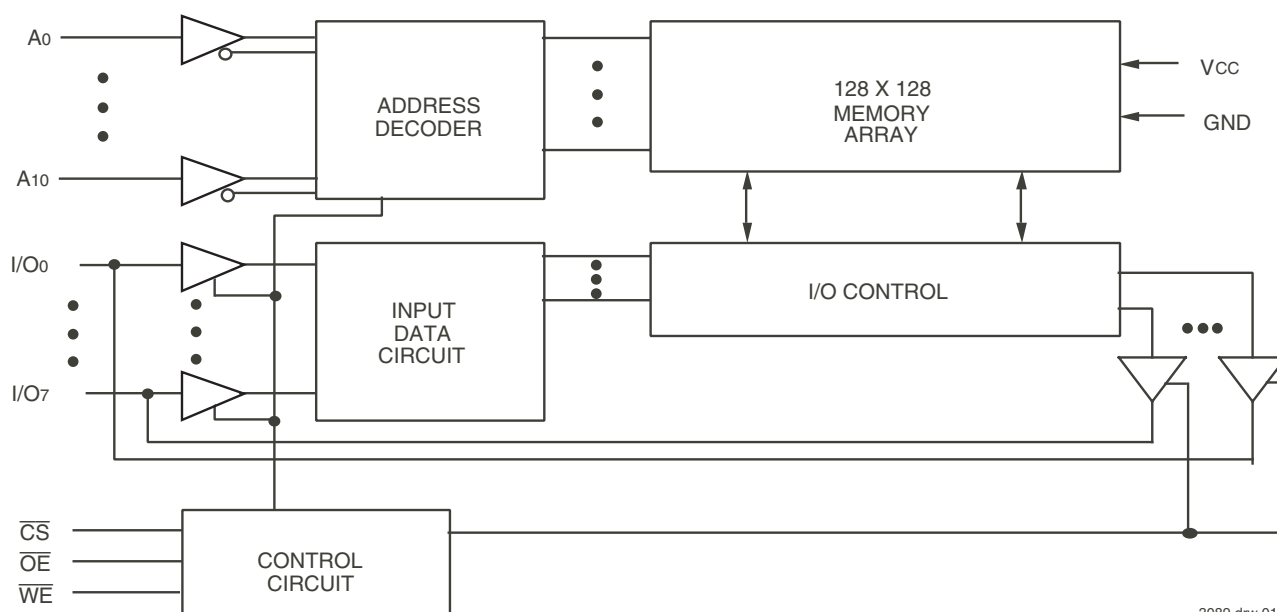
Access times as fast as 15ns are available. The circuit also offers a reduced power standby mode. When  $\overline{CS}$  goes HIGH, the circuit will automatically go to, and remain in, a standby power mode, as long as  $\overline{CS}$  remains HIGH. This capability provides significant system level power and cooling savings. The low-power (LA) version also offers a battery backup data retention capability where the circuit typically consumes only 1μW to 4μW operating off a 2V battery.

All inputs and outputs of the IDT6116SA/LA are TTL-compatible. Fully static asynchronous circuitry is used, requiring no clocks or refreshing for operation.

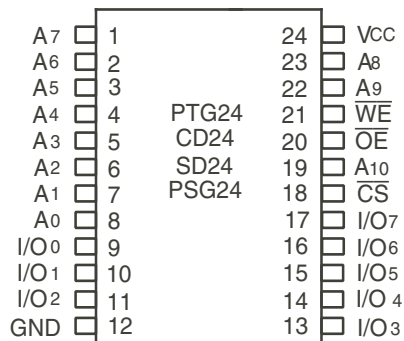
The IDT6116SA/LA is packaged in 24-pin 300mil plastic DIP, 24-pin 600mil and 300mil ceramic DIP, or 24-lead gull-wing SOIC providing high board-level packing densities.

Military grade product is manufactured in compliance to MIL-STD-883, Class B, making it ideally suited to military temperature applications demanding the highest level of performance and reliability.

## Functional Block Diagram



## Pin Configurations<sup>(1)</sup>



3089 drw 02

## DIP/SOIC Top View

### NOTE:

1. This text does not indicate orientation of actual part-marking.

## Pin Description

| Name                                | Description       |
|-------------------------------------|-------------------|
| A <sub>0</sub> - A <sub>10</sub>    | Address Inputs    |
| I/O <sub>0</sub> - I/O <sub>7</sub> | Data Input/Output |
| $\overline{CS}$                     | Chip Select       |
| $\overline{WE}$                     | Write Enable      |
| $\overline{OE}$                     | Output Enable     |
| V <sub>CC</sub>                     | Power             |
| GND                                 | Ground            |

3089 tbl 01

## Truth Table<sup>(1)</sup>

| Mode    | $\overline{CS}$ | $\overline{OE}$ | $\overline{WE}$ | I/O                 |
|---------|-----------------|-----------------|-----------------|---------------------|
| Standby | H               | X               | X               | High-Z              |
| Read    | L               | L               | H               | DATA <sub>OUT</sub> |
| Read    | L               | H               | H               | High-Z              |
| Write   | L               | X               | L               | DATA <sub>IN</sub>  |

3089 tbl 02

### NOTE:

1. H = V<sub>IH</sub>, L = V<sub>IL</sub>, X = Don't Care.

## Capacitance (T<sub>A</sub> = +25°C, f = 1.0 MHz)

| Symbol          | Parameter <sup>(1)</sup> | Conditions            | Max. | Unit |
|-----------------|--------------------------|-----------------------|------|------|
| C <sub>IN</sub> | Input Capacitance        | V <sub>IN</sub> = 0V  | 8    | pF   |
| C <sub>VO</sub> | I/O Capacitance          | V <sub>OUT</sub> = 0V | 8    | pF   |

3089 tbl 03

### NOTE:

1. This parameter is determined by device characterization, but is not production tested.

## Absolute Maximum Ratings<sup>(1)</sup>

| Symbol                           | Rating                               | Com'l.       | Mil.         | Unit |
|----------------------------------|--------------------------------------|--------------|--------------|------|
| V <sub>TERM</sub> <sup>(2)</sup> | Terminal Voltage with Respect to GND | -0.5 to +7.0 | -0.5 to +7.0 | V    |
| T <sub>A</sub>                   | Operating Temperature                | 0 to +70     | -55 to +125  | °C   |
| T <sub>BIAS</sub>                | Temperature Under Bias               | -55 to +125  | -65 to +135  | °C   |
| T <sub>STG</sub>                 | Storage Temperature                  | -55 to +125  | -65 to +150  | °C   |
| P <sub>T</sub>                   | Power Dissipation                    | 1.0          | 1.0          | W    |
| I <sub>OUT</sub>                 | DC Output Current                    | 50           | 50           | mA   |

3089 tbl 04

### NOTES:

1. Stresses 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.
2. V<sub>TERM</sub> must not exceed V<sub>CC</sub> +0.5V.

## Recommended Operating Temperature and Supply Voltage

| Grade      | Ambient Temperature | GND | V <sub>CC</sub> |
|------------|---------------------|-----|-----------------|
| Military   | -55°C to +125°C     | 0V  | 5.0V ± 10%      |
| Industrial | -40°C to +85°C      | 0V  | 5.0V ± 10%      |
| Commercial | 0°C to +70°C        | 0V  | 5.0V ± 10%      |

3089 tbl 05

## Recommended DC Operating Conditions

| Symbol          | Parameter          | Min.                | Typ. | Max.                  | Unit |
|-----------------|--------------------|---------------------|------|-----------------------|------|
| V <sub>CC</sub> | Supply Voltage     | 4.5                 | 5.0  | 5.5 <sup>(2)</sup>    | V    |
| GND             | Ground             | 0                   | 0    | 0                     | V    |
| V <sub>IH</sub> | Input High Voltage | 2.2                 | 3.5  | V <sub>CC</sub> + 0.5 | V    |
| V <sub>IL</sub> | Input Low Voltage  | -0.5 <sup>(1)</sup> | —    | 0.8                   | V    |

3089 tbl 06

### NOTES:

- V<sub>IL</sub> (min.) = -3.0V for pulse width less than 20ns, once per cycle.
- V<sub>IN</sub> must not exceed V<sub>CC</sub> + 0.5V.

## DC Electrical Characteristics (V<sub>CC</sub> = 5.0V ± 10%)

| Symbol          | Parameter              | Test Conditions                                                                                          | IDT6116SA |         | IDT6116LA |        | Unit |
|-----------------|------------------------|----------------------------------------------------------------------------------------------------------|-----------|---------|-----------|--------|------|
|                 |                        |                                                                                                          | Min.      | Max.    | Min.      | Max.   |      |
| I <sub>IL</sub> | Input Leakage Current  | V <sub>CC</sub> = Max.,<br>V <sub>IN</sub> = GND to V <sub>CC</sub>                                      | —         | 10<br>5 | —         | 5<br>2 | μA   |
| I <sub>LO</sub> | Output Leakage Current | V <sub>CC</sub> = Max., $\overline{CS}$ = V <sub>IH</sub> ,<br>V <sub>OUT</sub> = GND to V <sub>CC</sub> | —         | 10<br>5 | —         | 5<br>2 | μA   |
| V <sub>OL</sub> | Output Low Voltage     | I <sub>OL</sub> = 8mA, V <sub>CC</sub> = Min.                                                            | —         | 0.4     | —         | 0.4    | V    |
| V <sub>OH</sub> | Output High Voltage    | I <sub>OH</sub> = -4mA, V <sub>CC</sub> = Min.                                                           | 2.4       | —       | 2.4       | —      | V    |

3089 tbl 07

## DC Electrical Characteristics<sup>(1)</sup> (V<sub>CC</sub> = 5.0V ± 10%, V<sub>LC</sub> = 0.2V, V<sub>HC</sub> = V<sub>CC</sub> - 0.2V)

| Symbol           | Parameter                                                                                                                                                                             | Power | 6116SA15   | 6116SA20<br>6116LA20 |     | 6116SA25<br>6116LA25 |     | Unit |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|----------------------|-----|----------------------|-----|------|
|                  |                                                                                                                                                                                       |       | Com'l Only | Com'l & Ind          | Mil | Com'l & Ind          | Mil |      |
| I <sub>CC1</sub> | Operating Power Supply Current<br>CS ≤ V <sub>IL</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = 0                                                                                | SA    | 105        | 105                  | 130 | 100                  | 90  | mA   |
|                  |                                                                                                                                                                                       | LA    | —          | 95                   | 120 | 95                   | 85  |      |
| I <sub>CC2</sub> | Dynamic Operating Current<br>CS ≤ V <sub>IL</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = f <sub>MAX</sub> <sup>(2)</sup>                                                       | SA    | 150        | 130                  | 150 | 120                  | 135 | mA   |
|                  |                                                                                                                                                                                       | LA    | —          | 120                  | 140 | 110                  | 125 |      |
| I <sub>SB</sub>  | Standby Power Supply Current<br>(TTL Level)<br>CS ≥ V <sub>IH</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = f <sub>MAX</sub> <sup>(2)</sup>                                     | SA    | 40         | 40                   | 50  | 40                   | 45  | mA   |
|                  |                                                                                                                                                                                       | LA    | —          | 35                   | 45  | 35                   | 40  |      |
| I <sub>SB1</sub> | Full Standby Power Supply Current<br>(CMOS Level)<br>CS ≥ V <sub>HC</sub> , V <sub>CC</sub> = Max.,<br>V <sub>IN</sub> ≤ V <sub>LC</sub> or V <sub>IN</sub> ≥ V <sub>HC</sub> , f = 0 | SA    | 2          | 2                    | 10  | 2                    | 10  | mA   |
|                  |                                                                                                                                                                                       | LA    | —          | 0.1                  | 0.9 | 0.1                  | 0.9 |      |

3089 tbl 08

### NOTES:

- All values are maximum guaranteed values.
- f<sub>MAX</sub> = 1/t<sub>RC</sub>, only address inputs are cycling at f<sub>MAX</sub>, f = 0 means address inputs are not changing.

## DC Electrical Characteristics<sup>(1)</sup> (continued)

(V<sub>CC</sub> = 5.0V ± 10%, V<sub>LC</sub> = 0.2V, V<sub>HC</sub> = V<sub>CC</sub> - 0.2V)

| Symbol | Parameter                                                                                                                                                                     | Power | 6116SA35<br>6116LA35 | 6116SA45<br>6116LA45 | 6116SA55<br>6116LA55 | 6116SA70<br>6116LA70 | 6116SA90<br>6116LA90 | 6116SA120<br>6116LA120 | 6116SA150<br>6116LA150 | Unit |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|----------------------|----------------------|----------------------|----------------------|------------------------|------------------------|------|
|        |                                                                                                                                                                               |       | Mil Only             | Mil Only             | Mil Only             | Mil Only             | Mil Only             | Mil Only               | Mil Only               |      |
| ICC1   | Operating Power Supply Current, CS ≤ V <sub>IL</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = 0                                                                          | SA    | 90                   | 90                   | 90                   | 90                   | 90                   | 90                     | 90                     | mA   |
|        |                                                                                                                                                                               | LA    | 85                   | 85                   | 85                   | 85                   | 85                   | 85                     | 85                     |      |
| ICC2   | Dynamic Operating Current, CS ≤ V <sub>IL</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = f <sub>MAX</sub> <sup>(2)</sup>                                                 | SA    | 115                  | 100                  | 100                  | 100                  | 100                  | 100                    | 90                     | mA   |
|        |                                                                                                                                                                               | LA    | 105                  | 95                   | 90                   | 90                   | 85                   | 85                     | 85                     |      |
| ISB    | Standby Power Supply Current (TTL Level)<br>CS ≥ V <sub>IH</sub> , Outputs Open<br>V <sub>CC</sub> = Max., f = f <sub>MAX</sub> <sup>(2)</sup>                                | SA    | 35                   | 25                   | 25                   | 25                   | 25                   | 25                     | 25                     | mA   |
|        |                                                                                                                                                                               | LA    | 30                   | 20                   | 20                   | 20                   | 25                   | 15                     | 15                     |      |
| ISB1   | Full Standby Power Supply Current (CMOS Level), CS ≥ V <sub>HC</sub> , V <sub>CC</sub> = Max., V <sub>IN</sub> ≤ V <sub>LC</sub> or V <sub>IN</sub> ≥ V <sub>HC</sub> , f = 0 | SA    | 10                   | 10                   | 10                   | 10                   | 10                   | 10                     | 10                     | mA   |
|        |                                                                                                                                                                               | LA    | 0.9                  | 0.9                  | 0.9                  | 0.9                  | 0.9                  | 0.9                    | 0.9                    |      |

3089 tbl 09

### NOTES:

- All values are maximum guaranteed values.
- f<sub>MAX</sub> = 1/trc, only address inputs are toggling at f<sub>MAX</sub>, f = 0 means address inputs are not changing.

## Data Retention Characteristics Over All Temperature Ranges (LA Version Only) (V<sub>LC</sub> = 0.2V, V<sub>HC</sub> = V<sub>CC</sub> - 0.2V)

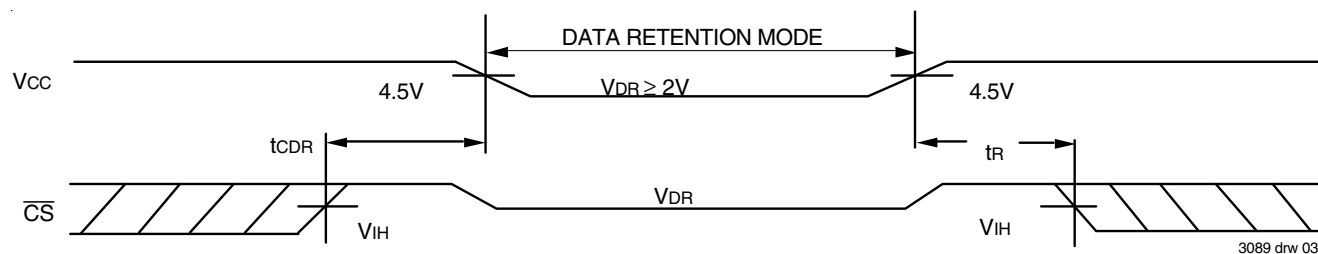
| Symbol                          | Parameter                            | Test Condition                                                                 | Min.                           | Typ. <sup>(1)</sup><br>V <sub>CC</sub> @ |            | Max.<br>V <sub>CC</sub> @ |           | Unit |
|---------------------------------|--------------------------------------|--------------------------------------------------------------------------------|--------------------------------|------------------------------------------|------------|---------------------------|-----------|------|
|                                 |                                      |                                                                                |                                | 2.0V                                     | 3.0V       | 2.0V                      | 3.0V      |      |
| V <sub>DR</sub>                 | V <sub>CC</sub> for Data Retention   | —                                                                              | 2.0                            | —                                        | —          | —                         | —         | V    |
| ICCDR                           | Data Retention Current               | MIL.<br>COM'L.                                                                 | —<br>—                         | 0.5<br>0.5                               | 1.5<br>1.5 | 200<br>20                 | 300<br>30 | μA   |
| t <sub>CDR</sub> <sup>(3)</sup> | Chip Deselect to Data Retention Time | CS ≥ V <sub>HC</sub><br>V <sub>IN</sub> ≥ V <sub>HC</sub> or ≤ V <sub>LC</sub> | —                              | 0                                        | —          | —                         | —         | ns   |
| t <sub>r</sub> <sup>(2)</sup>   | Operation Recovery Time              |                                                                                | t <sub>rc</sub> <sup>(2)</sup> | —                                        | —          | —                         | —         | ns   |
| I <sub>IL</sub>                 | Input Leakage Current                |                                                                                | —                              | —                                        | —          | 2                         | 2         | μA   |

3089 tbl 10

### NOTES:

- T<sub>A</sub> = + 25°C
- t<sub>rc</sub> = Read Cycle Time.
- This parameter is guaranteed by device characterization, but is not production tested.

## Low Vcc Data Retention Waveform



## AC Test Conditions

|                               |                     |
|-------------------------------|---------------------|
| Input Pulse Levels            | GND to 3.0V         |
| Input Rise/Fall Times         | 5ns                 |
| Input Timing Reference Levels | 1.5V                |
| Output Reference Levels       | 1.5V                |
| AC Test Load                  | See Figures 1 and 2 |

3089 tbl 11

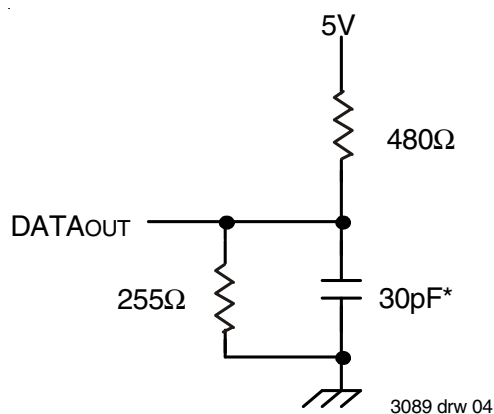


Figure 1. AC Test Load

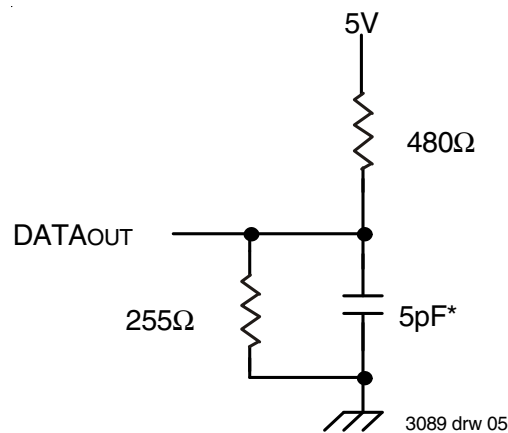


Figure 2. AC Test Load  
(for tOLZ, tCLZ, tOHZ, tWHZ, tCHZ & tOW)

\*Including scope and jig.

**AC Electrical Characteristics (V<sub>CC</sub> = 5V ± 10%, All Temperature Ranges)**

| Symbol                          | Parameter                          | 6116SA15 <sup>(1)</sup> |      | 6116SA20<br>6116LA20 |      | 6116SA25<br>6116LA25 |      | 6116SA35 <sup>(2)</sup><br>6116LA35 <sup>(2)</sup> |      | Unit |
|---------------------------------|------------------------------------|-------------------------|------|----------------------|------|----------------------|------|----------------------------------------------------|------|------|
|                                 |                                    | Min.                    | Max. | Min.                 | Max. | Min.                 | Max. | Min.                                               | Max. |      |
| Read Cycle                      |                                    |                         |      |                      |      |                      |      |                                                    |      |      |
| t <sub>RC</sub>                 | Read Cycle Time                    | 15                      | —    | 20                   | —    | 25                   | —    | 35                                                 | —    | ns   |
| t <sub>AA</sub>                 | Address Access Time                | —                       | 15   | —                    | 19   | —                    | 25   | —                                                  | 35   | ns   |
| t <sub>ACS</sub>                | Chip Select Access Time            | —                       | 15   | —                    | 20   | —                    | 25   | —                                                  | 35   | ns   |
| t <sub>CLZ</sub> <sup>(3)</sup> | Chip Select to Output in Low-Z     | 5                       | —    | 5                    | —    | 5                    | —    | 5                                                  | —    | ns   |
| t <sub>OE</sub>                 | Output Enable to Output Valid      | —                       | 10   | —                    | 10   | —                    | 13   | —                                                  | 20   | ns   |
| t <sub>OLZ</sub> <sup>(3)</sup> | Output Enable to Output in Low-Z   | 0                       | —    | 0                    | —    | 5                    | —    | 5                                                  | —    | ns   |
| t <sub>CHZ</sub> <sup>(3)</sup> | Chip Deselect to Output in High-Z  | —                       | 10   | —                    | 11   | —                    | 12   | —                                                  | 15   | ns   |
| t <sub>OHZ</sub> <sup>(3)</sup> | Output Disable to Output in High-Z | —                       | 8    | —                    | 8    | —                    | 10   | —                                                  | 13   | ns   |
| t <sub>OH</sub>                 | Output Hold from Address Change    | 5                       | —    | 5                    | —    | 5                    | —    | 5                                                  | —    | ns   |
| t <sub>PU</sub> <sup>(3)</sup>  | Chip Select to Power Up Time       | 0                       | —    | 0                    | —    | 0                    | —    | 0                                                  | —    | ns   |
| t <sub>PD</sub> <sup>(3)</sup>  | Chip Deselect to Power Down Time   | —                       | 15   | —                    | 20   | —                    | 25   | —                                                  | 35   | ns   |

3089 tbl 12

**AC Electrical Characteristics (V<sub>CC</sub> = 5V ± 10%, All Temperature Ranges) (continued)**

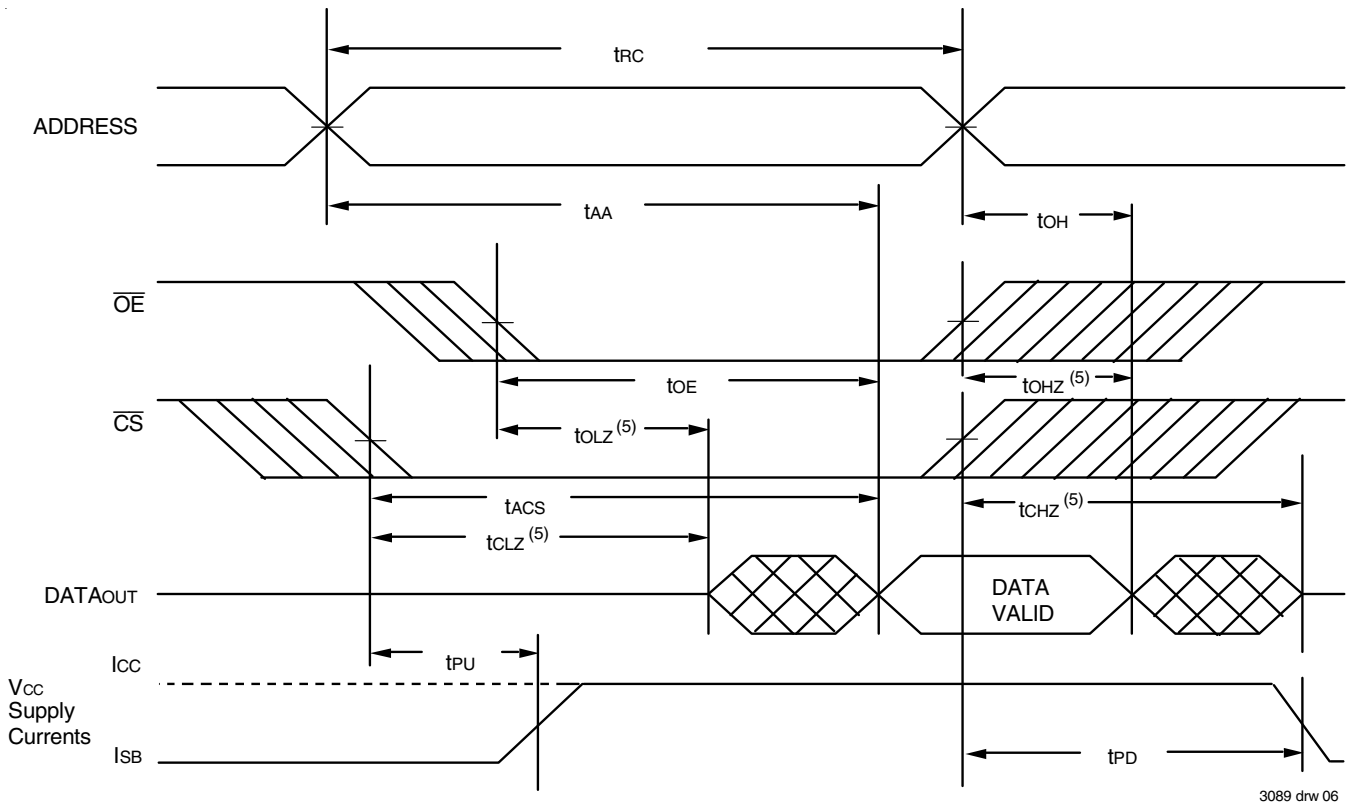
| Symbol              | Parameter                          | 6116SA45 <sup>(2)</sup><br>6116LA45 <sup>(2)</sup> |      | 6116SA55 <sup>(2)</sup><br>6116LA55 <sup>(2)</sup> |      | 6116SA70 <sup>(2)</sup><br>6116LA70 <sup>(2)</sup> |      | 6116SA90 <sup>(2)</sup><br>6116LA90 <sup>(2)</sup> |      | 6116SA120 <sup>(2)</sup><br>6116LA120 <sup>(2)</sup> |      | 6116SA150 <sup>(2)</sup><br>6116LA150 <sup>(2)</sup> |      | Unit |
|---------------------|------------------------------------|----------------------------------------------------|------|----------------------------------------------------|------|----------------------------------------------------|------|----------------------------------------------------|------|------------------------------------------------------|------|------------------------------------------------------|------|------|
|                     |                                    | Min.                                               | Max. | Min.                                               | Max. | Min.                                               | Max. | Min.                                               | Max. | Min.                                                 | Max. | Min.                                                 | Max. |      |
| Read Cycle          |                                    |                                                    |      |                                                    |      |                                                    |      |                                                    |      |                                                      |      |                                                      |      |      |
| tRC                 | Read Cycle Time                    | 45                                                 | —    | 55                                                 | —    | 70                                                 | —    | 90                                                 | —    | 120                                                  | —    | 150                                                  | —    | ns   |
| tAA                 | Address Access Time                | —                                                  | 45   | —                                                  | 55   | —                                                  | 70   | —                                                  | 90   | —                                                    | 120  | —                                                    | 150  | ns   |
| tACS                | Chip Select Access Time            | —                                                  | 45   | —                                                  | 50   | —                                                  | 65   | —                                                  | 90   | —                                                    | 120  | —                                                    | 150  | ns   |
| tCLZ <sup>(3)</sup> | Chip Select to Output in Low-Z     | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                    | —    | 5                                                    | —    | ns   |
| tOE                 | Output Enable to Output Valid      | —                                                  | 25   | —                                                  | 40   | —                                                  | 50   | —                                                  | 60   | —                                                    | 80   | —                                                    | 100  | ns   |
| tOLZ <sup>(3)</sup> | Output Enable to Output in Low-Z   | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                    | —    | 5                                                    | —    | ns   |
| tCHZ <sup>(3)</sup> | Chip Deselect to Output in High-Z  | —                                                  | 20   | —                                                  | 30   | —                                                  | 35   | —                                                  | 40   | —                                                    | 40   | —                                                    | 40   | ns   |
| tOHZ <sup>(3)</sup> | Output Disable to Output in High-Z | —                                                  | 15   | —                                                  | 30   | —                                                  | 35   | —                                                  | 40   | —                                                    | 40   | —                                                    | 40   | ns   |
| tOH                 | Output Hold from Address Change    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                    | —    | 5                                                    | —    | ns   |

3089 tbl 13

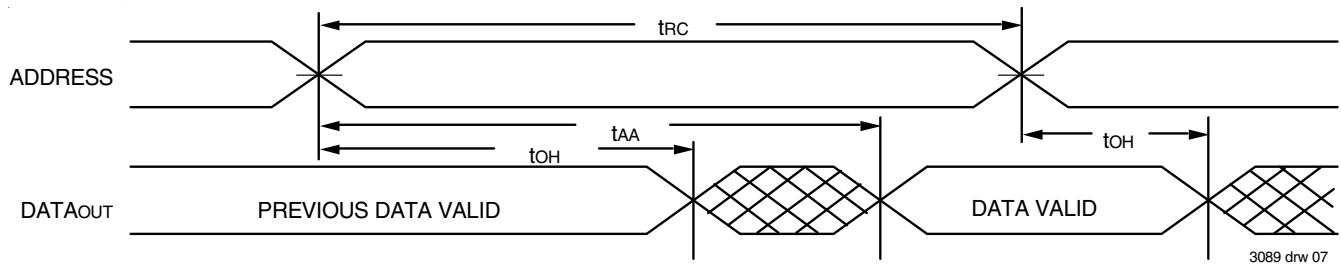
**NOTES:**

- 0°C to +70°C temperature range only.
- 55°C to +125°C temperature range only.
- This parameter guaranteed with the AC Load (Figure 2) by device characterization, but is not production tested.

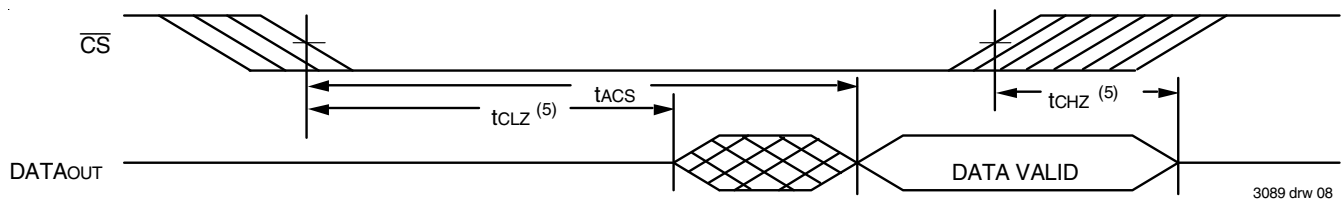
## Timing Waveform of Read Cycle No. 1<sup>(1,3)</sup>



## Timing Waveform of Read Cycle No. 2<sup>(1,2,4)</sup>



## Timing Waveform of Read Cycle No. 3<sup>(1,3,4)</sup>



### NOTES:

1.  $\overline{WE}$  is HIGH for Read cycle.
2. Device is continuously selected,  $\overline{CS}$  is LOW.
3. Address valid prior to or coincident with  $\overline{CS}$  transition LOW.
4.  $\overline{OE}$  is LOW.
5. Transition is measured  $\pm 500\text{mV}$  from steady state.

## AC Electrical Characteristics ( $V_{CC} = 5V \pm 10\%$ , All Temperature Ranges)

| Symbol               | Parameter                       | 6116SA15 <sup>(1)</sup> |      | 6116SA20<br>6116LA20 |      | 6116SA25<br>6116LA25 |      | 6116SA35 <sup>(2)</sup><br>6116LA35 <sup>(2)</sup> |      | Unit |
|----------------------|---------------------------------|-------------------------|------|----------------------|------|----------------------|------|----------------------------------------------------|------|------|
|                      |                                 | Min.                    | Max. | Min.                 | Max. | Min.                 | Max. | Min.                                               | Max. |      |
| Write Cycle          |                                 |                         |      |                      |      |                      |      |                                                    |      |      |
| tWC                  | Write Cycle Time                | 15                      | —    | 20                   | —    | 25                   | —    | 35                                                 | —    | ns   |
| tCW                  | Chip Select to End-of-Write     | 13                      | —    | 15                   | —    | 17                   | —    | 25                                                 | —    | ns   |
| tAW                  | Address Valid to End-of-Write   | 14                      | —    | 15                   | —    | 17                   | —    | 25                                                 | —    | ns   |
| tAS                  | Address Set-up Time             | 0                       | —    | 0                    | —    | 0                    | —    | 0                                                  | —    | ns   |
| tWP                  | Write Pulse Width               | 12                      | —    | 12                   | —    | 15                   | —    | 20                                                 | —    | ns   |
| tWR                  | Write Recovery Time             | 0                       | —    | 0                    | —    | 0                    | —    | 0                                                  | —    | ns   |
| tWHZ <sup>(3)</sup>  | Write to Output in High-Z       | —                       | 7    | —                    | 8    | —                    | 16   | —                                                  | 20   | ns   |
| tDW                  | Data to Write Time Overlap      | 12                      | —    | 12                   | —    | 13                   | —    | 15                                                 | —    | ns   |
| tDH <sup>(4)</sup>   | Data Hold from Write Time       | 0                       | —    | 0                    | —    | 0                    | —    | 0                                                  | —    | ns   |
| tOW <sup>(3,4)</sup> | Output Active from End-of-Write | 0                       | —    | 0                    | —    | 0                    | —    | 0                                                  | —    | ns   |

3089 tbl 14

## AC Electrical Characteristics ( $V_{CC} = 5V \pm 10\%$ , All Temperature Ranges)(con't)

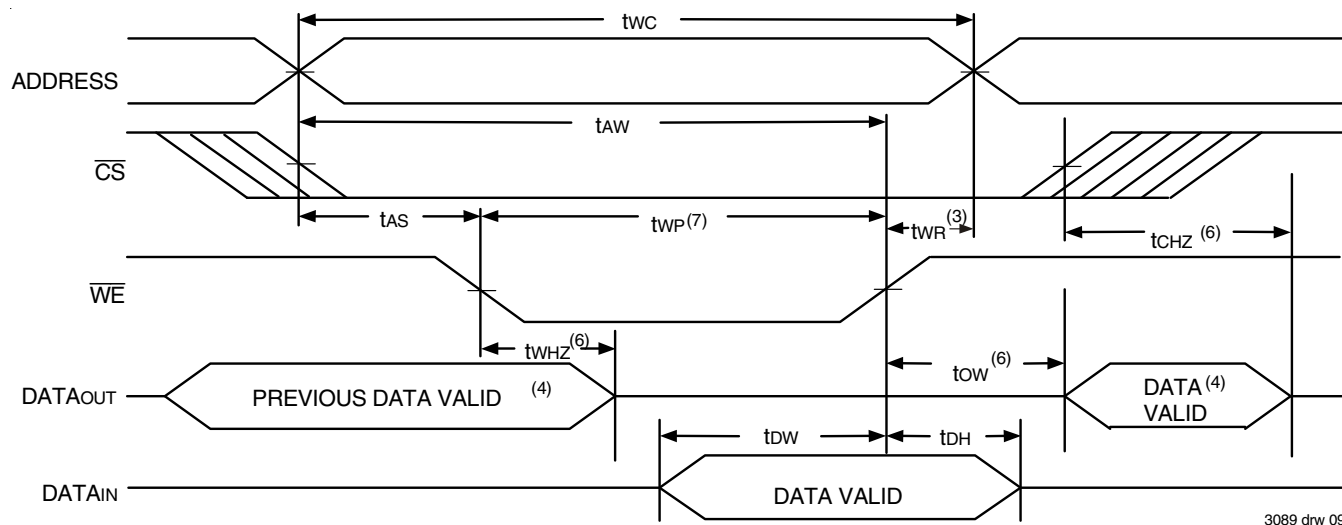
| Symbol                           | Parameter                       | 6116SA45 <sup>(2)</sup><br>6116LA45 <sup>(2)</sup> |      | 6116SA55 <sup>(2)</sup><br>6116LA55 <sup>(2)</sup> |      | 6116SA70 <sup>(2)</sup><br>6116LA70 <sup>(2)</sup> |      | 6116SA90 <sup>(2)</sup><br>6116LA90 <sup>(2)</sup> |      | 6116SA120 <sup>(2)</sup><br>6116LA120 <sup>(2)</sup> |      | 6116SA150 <sup>(2)</sup><br>6116LA150 <sup>(2)</sup> |      | Unit |
|----------------------------------|---------------------------------|----------------------------------------------------|------|----------------------------------------------------|------|----------------------------------------------------|------|----------------------------------------------------|------|------------------------------------------------------|------|------------------------------------------------------|------|------|
|                                  |                                 | Min.                                               | Max. | Min.                                               | Max. | Min.                                               | Max. | Min.                                               | Max. | Min.                                                 | Max. | Min.                                                 | Max. |      |
| Write Cycle                      |                                 |                                                    |      |                                                    |      |                                                    |      |                                                    |      |                                                      |      |                                                      |      |      |
| t <sub>WC</sub>                  | Write Cycle Time                | 45                                                 | —    | 55                                                 | —    | 70                                                 | —    | 90                                                 | —    | 120                                                  | —    | 150                                                  | —    | ns   |
| t <sub>CW</sub>                  | Chip Select to End-of-Write     | 30                                                 | —    | 40                                                 | —    | 40                                                 | —    | 55                                                 | —    | 70                                                   | —    | 90                                                   | —    | ns   |
| t <sub>AW</sub>                  | Address Valid to End-of-Write   | 30                                                 | —    | 45                                                 | —    | 65                                                 | —    | 80                                                 | —    | 105                                                  | —    | 120                                                  | —    | ns   |
| t <sub>AS</sub>                  | Address Set-up Time             | 0                                                  | —    | 5                                                  | —    | 15                                                 | —    | 15                                                 | —    | 20                                                   | —    | 20                                                   | —    | ns   |
| t <sub>WP</sub>                  | Write Pulse Width               | 25                                                 | —    | 40                                                 | —    | 40                                                 | —    | 55                                                 | —    | 70                                                   | —    | 90                                                   | —    | ns   |
| t <sub>WR</sub>                  | Write Recovery Time             | 0                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                    | —    | 10                                                   | —    | ns   |
| t <sub>WHZ</sub> <sup>(3)</sup>  | Write to Output in High-Z       | —                                                  | 25   | —                                                  | 30   | —                                                  | 35   | —                                                  | 40   | —                                                    | 40   | —                                                    | 40   | ns   |
| t <sub>DW</sub>                  | Data to Write Time Overlap      | 20                                                 | —    | 25                                                 | —    | 30                                                 | —    | 30                                                 | —    | 35                                                   | —    | 40                                                   | —    | ns   |
| t <sub>DH</sub> <sup>(4)</sup>   | Data Hold from Write Time       | 0                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                  | —    | 5                                                    | —    | 10                                                   | —    | ns   |
| t <sub>OW</sub> <sup>(3,4)</sup> | Output Active from End-of-Write | 0                                                  | —    | 0                                                  | —    | 0                                                  | —    | 0                                                  | —    | 0                                                    | —    | 0                                                    | —    | ns   |

3089 tbl 15

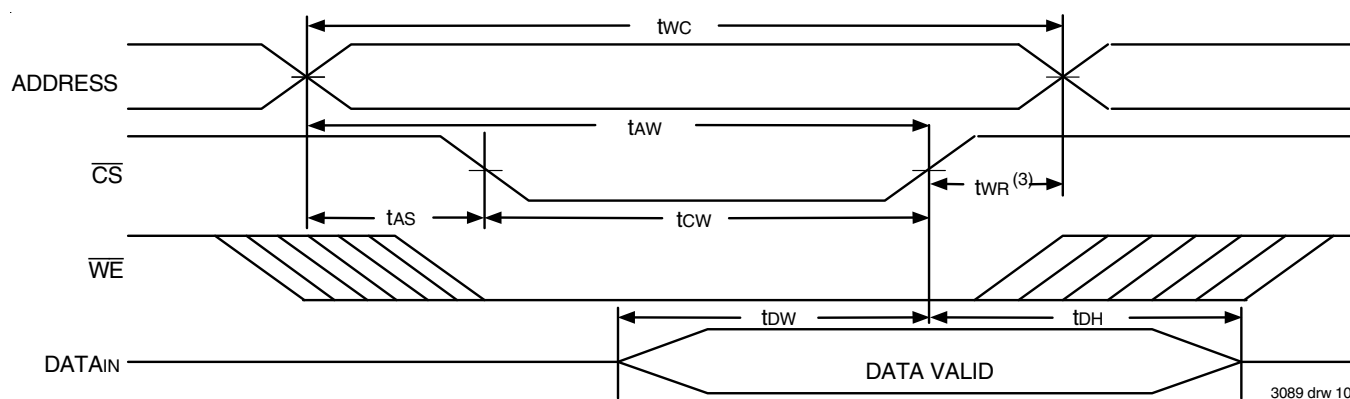
### NOTES:

- 0°C to +70°C temperature range only.
- 55°C to +125°C temperature range only.
- This parameter guaranteed with AC Load (Figure 2) by device characterization, but is not production tested.
- The specification for t<sub>DH</sub> must be met by the device supplying write data to the RAM under all operation conditions. Although t<sub>DH</sub> and t<sub>OW</sub> values will vary over voltage and temperature, the actual t<sub>DH</sub> will always be smaller than the actual t<sub>OW</sub>.

## Timing Waveform of Write Cycle No. 1 ( $\overline{WE}$ Controlled Timing)<sup>(1,2,5,7)</sup>



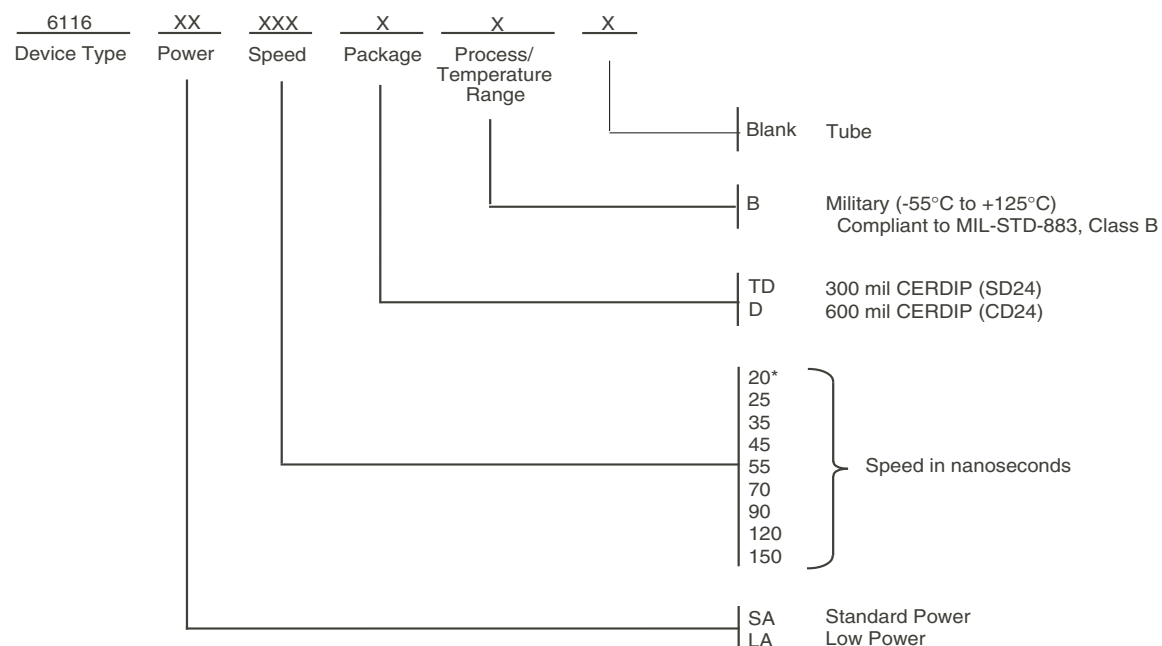
## Timing Waveform of Write Cycle No. 2 ( $\overline{CS}$ Controlled Timing)<sup>(1,2,3,5,7)</sup>



### NOTES:

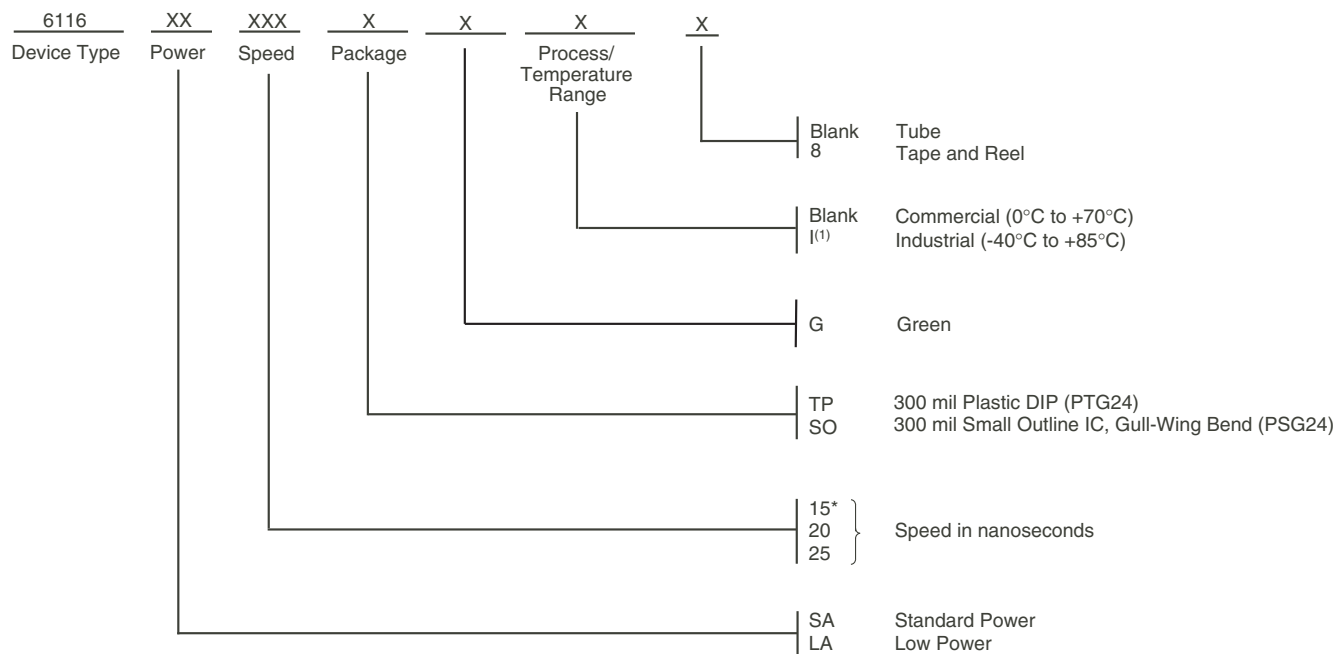
1.  $\overline{WE}$  or  $\overline{CS}$  must be HIGH during all address transitions.
2. A write occurs during the overlap of a LOW  $\overline{CS}$  and a LOW  $\overline{WE}$ .
3.  $t_{WR}$  is measured from the earlier of  $\overline{CS}$  or  $\overline{WE}$  going HIGH to the end of the write cycle.
4. During this period, the I/O pins are in the output state and the input signals must not be applied.
5. If the  $\overline{CS}$  LOW transition occurs simultaneously with or after the  $\overline{WE}$  LOW transition, the outputs remain in the high-impedance state.
6. Transition is measured  $\pm 500\text{mV}$  from steady state.
7.  $\overline{OE}$  is continuously HIGH. If  $\overline{OE}$  is LOW during a  $\overline{WE}$  controlled write cycle, the write pulse width must be the larger of  $t_{WP}$  or  $(t_{WHZ} + t_{DW})$  to allow the I/O drivers to turn off and data to be placed on the bus for the required  $t_{DW}$ . If  $\overline{OE}$  is HIGH during a  $\overline{WE}$  controlled write cycle, this requirement does not apply and the write pulse is the specified  $t_{WP}$ . For a  $\overline{CS}$  controlled write cycle,  $\overline{OE}$  may be LOW with no degradation to  $t_{CW}$ .

## Ordering Information — Military



3089 drw 11

## Ordering Information — Commercial & Industrial



\*Available in commercial temperature range and standard power only.

### NOTE:

1. Contact your local sales office for industrial temp range for other speeds, packages and powers.

3089 drw 12

## Orderable Part Information

| Speed (ns) | Orderable Part ID | Pkg. Code | Pkg. Type | Temp. Grade |
|------------|-------------------|-----------|-----------|-------------|
| 20         | 6116LA20SOG       | PSG24     | SOIC      | C           |
|            | 6116LA20SOG8      | PSG24     | SOIC      | C           |
|            | 6116LA20SOGI      | PSG24     | SOIC      | I           |
|            | 6116LA20SOG8      | PSG24     | SOIC      | I           |
|            | 6116LA20TDB       | SD24      | CDIP      | M           |
|            | 6116LA20TPG       | PTG24     | PDIP      | C           |
|            | 6116LA20TPGI      | PTG24     | PDIP      | I           |
| 25         | 6116LA25DB        | CD24      | CDIP      | M           |
|            | 6116LA25SOG       | PSG24     | SOIC      | C           |
|            | 6116LA25SOG8      | PSG24     | SOIC      | C           |
|            | 6116LA25SOGI      | PSG24     | SOIC      | I           |
|            | 6116LA25SOG8      | PSG24     | SOIC      | I           |
|            | 6116LA25TDB       | SD24      | CDIP      | M           |
|            | 6116LA25TPG       | PTG24     | PDIP      | C           |
| 35         | 6116LA35DB        | CD24      | CDIP      | M           |
|            | 6116LA35TDB       | SD24      | CDIP      | M           |
| 45         | 6116LA45DB        | CD24      | CDIP      | M           |
|            | 6116LA45TDB       | SD24      | CDIP      | M           |
| 55         | 6116LA55DB        | CD24      | CDIP      | M           |
|            | 6116LA55TDB       | SD24      | CDIP      | M           |
| 70         | 6116LA70DB        | CD24      | CDIP      | M           |
|            | 6116LA70TDB       | SD24      | CDIP      | M           |
| 90         | 6116LA90DB        | CD24      | CDIP      | M           |
|            | 6116LA90TDB       | SD24      | CDIP      | M           |
| 120        | 6116LA120DB       | CD24      | CDIP      | M           |
|            | 6116LA120TDB      | SD24      | CDIP      | M           |
| 150        | 6116LA150DB       | CD24      | CDIP      | M           |
|            | 6116LA150TDB      | SD24      | CDIP      | M           |

| Speed (ns) | Orderable Part ID | Pkg. Code | Pkg. Type | Temp. Grade |
|------------|-------------------|-----------|-----------|-------------|
| 15         | 6116SA15SOG       | PSG24     | SOIC      | C           |
|            | 6116SA15SOG8      | PSG24     | SOIC      | C           |
|            | 6116SA15TPG       | PTG24     | PDIP      | C           |
| 20         | 6116SA20DB        | CD24      | CDIP      | M           |
|            | 6116SA20SOG       | PSG24     | SOIC      | C           |
|            | 6116SA20SOG8      | PSG24     | SOIC      | C           |
|            | 6116SA20TDB       | SD24      | CDIP      | M           |
|            | 6116SA20TPG       | PTG24     | PDIP      | C           |
|            | 6116SA20TPGI      | PTG24     | PDIP      | I           |
| 25         | 6116SA25SOG       | PSG24     | SOIC      | C           |
|            | 6116SA25SOG8      | PSG24     | SOIC      | C           |
|            | 6116SA25SOGI      | PSG24     | SOIC      | I           |
|            | 6116SA25SOG8      | PSG24     | SOIC      | I           |
|            | 6116SA25TDB       | SD24      | CDIP      | M           |
|            | 6116SA25TPG       | PTG24     | PDIP      | C           |
|            | 6116SA25TPGI      | PTG24     | PDIP      | I           |
|            | 6116SA35TDB       | SD24      | CDIP      | M           |
|            | 6116SA45DB        | CD24      | CDIP      | M           |
| 45         | 6116SA45DB        | CD24      | CDIP      | M           |
|            | 6116SA45TDB       | SD24      | CDIP      | M           |
| 55         | 6116SA55DB        | CD24      | CDIP      | M           |
|            | 6116SA55TDB       | SD24      | CDIP      | M           |
| 70         | 6116SA70DB        | CD24      | CDIP      | M           |
|            | 6116SA70TDB       | SD24      | CDIP      | M           |
| 90         | 6116SA90DB        | CD24      | CDIP      | M           |
|            | 6116SA90TDB       | SD24      | CDIP      | M           |
| 120        | 6116SA120DB       | CD24      | CDIP      | M           |
|            | 6116SA120TDB      | SD24      | CDIP      | M           |
| 150        | 6116SA150DB       | CD24      | CDIP      | M           |
|            | 6116SA150TDB      | SD24      | CDIP      | M           |

## Datasheet Document History

|          |                 |                                                                                                                                                                                                                                                                                        |
|----------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01/07/00 |                 | Updated to new format                                                                                                                                                                                                                                                                  |
|          | Pg. 1, 3, 4, 10 | Added Industrial Temperature range offerings                                                                                                                                                                                                                                           |
|          | Pg. 9, 10       | Separated ordering information into military, commercial, and industrial temperature range offerings                                                                                                                                                                                   |
|          | Pg. 11          | Added Datasheet Document History                                                                                                                                                                                                                                                       |
| 08/09/00 |                 | Not recommended for new designs                                                                                                                                                                                                                                                        |
| 02/01/01 |                 | Removed "Not recommended for new designs"                                                                                                                                                                                                                                              |
| 12/30/03 | Pg. 3,10        | Corrected Industrial temp from -45C to -40C.                                                                                                                                                                                                                                           |
| 03/31/05 | Pg. 10          | Added "Restricted hazardous substance device" to ordering information.                                                                                                                                                                                                                 |
| 11/15/06 | Pg. 3           | Changed power limits for commercial and industrial on speed grades 25ns and 35ns.                                                                                                                                                                                                      |
|          | Pg.4            | Changed power limits for commercial and industrial on speed grade 45ns. Refer to PCN SR-0602-02.                                                                                                                                                                                       |
| 04/26/11 | Pg.1,2,3,4,6,10 | Updated "Restricted hazardous substance device" to "Green". Obsoleted 24-pin SOJ, 24-pin 600 mil and 35ns, 45ns for Industrial & Commercial.                                                                                                                                           |
| 05/01/13 | Pg. 1           | Description paragraph 4, package information. Changed text to read "The IDT6116SA/LA is packaged in 24-pin 300mil plastic DIP, 24-pin 600mil and 300mil ceramic DIP, or 24-lead gull-wing SOIC providing high board-level packing densities". Removed IDT in reference to fabrication. |
|          | Pg. 3           | Updated DC Elec Chars ( $V_{CC} = 5.0V \pm 10\%$ ) table by adding industrial to the Test Conditions.<br>Updated DC Elec Chars ( $V_{CC} = 5.0V \pm 10\%$ , $V_{LC} = 0.2V$ , $V_{HC} + V_{CC} - 0.2V$ ) table by removing the LA power for the 15ns speed.                            |
|          | Pg. 10          | Removed footnote "*Available in 300mil packaging only" from the Military ordering information.                                                                                                                                                                                         |
| 07/17/20 | Pg. 1 - 13      | Rebranded as Renesas datasheet                                                                                                                                                                                                                                                         |
|          | Pg. 2 & 10      | Updated package codes.                                                                                                                                                                                                                                                                 |
|          | Pg. 10          | Updated Ordering Information.                                                                                                                                                                                                                                                          |
|          | Pg. 11          | Added Orderable Part Information tables.                                                                                                                                                                                                                                               |

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:  
[www.renesas.com/contact/](http://www.renesas.com/contact/)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.