

# LH5116/H

## CMOS 16K (2K × 8) Static RAM

### FEATURES

- 2,048 × 8 bit organization
- Access time: 100 ns (MAX.)
- Power consumption:
  - Operating: 220 mW (MAX.)
  - Standby: 5.5 μW (MAX.)
- Single +5 V power supply
- Fully-static operation
- TTL compatible I/O
- Three-state outputs
- Wide temperature range available
  - LH5116H: -40 to +85°C
- Packages:
  - 24-pin, 600-mil DIP
  - 24-pin, 300-mil SK-DIP
  - 24-pin, 450-mil SOP

### DESCRIPTION

The LH5116/H are static RAMs organized as 2,048 × 8 bits. It is fabricated using silicon-gate CMOS process technology. It features high speed access in read mode using output enable ( $t_{OE}$ ).

### PIN CONNECTIONS

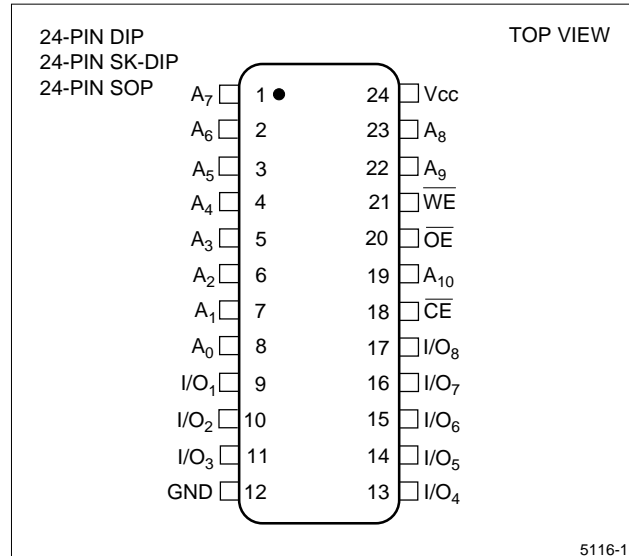


Figure 1. Pin Connections for DIP, SK-DIP, and SOP Packages

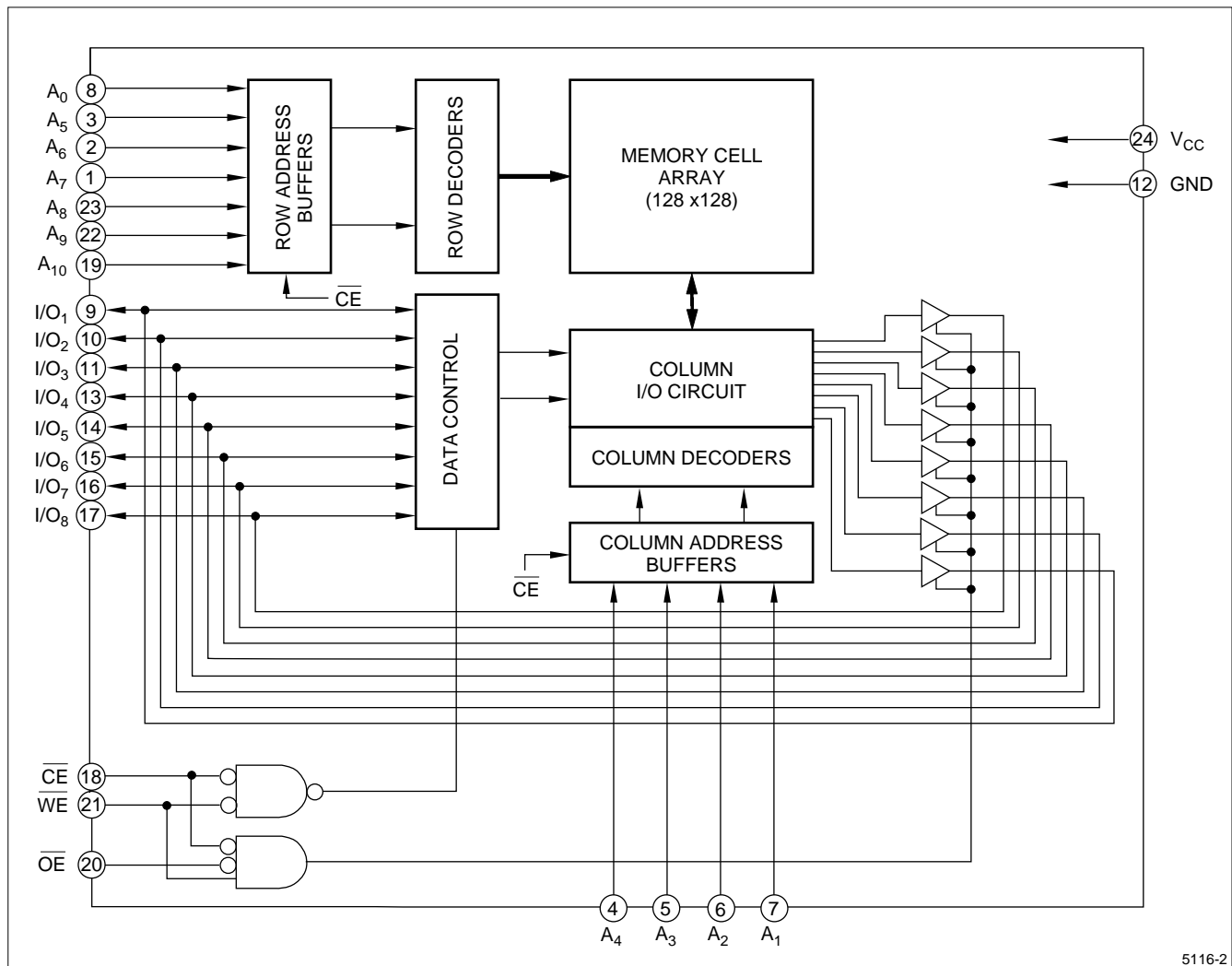


Figure 2. LH5116/H Block Diagram

## PIN DESCRIPTION

| SIGNAL                           | PIN NAME            |
|----------------------------------|---------------------|
| A <sub>0</sub> - A <sub>10</sub> | Address input       |
| $\overline{CE}$                  | Chip Enable input   |
| $\overline{OE}$                  | Output Enable input |
| $\overline{WE}$                  | Write Enable input  |

| SIGNAL                              | PIN NAME          |
|-------------------------------------|-------------------|
| I/O <sub>1</sub> - I/O <sub>8</sub> | Data input/output |
| V <sub>CC</sub>                     | Power supply      |
| GND                                 | Ground            |

## TRUTH TABLE

| $\overline{CE}$ | $\overline{OE}$ | $\overline{WE}$ | MODE            | I/O <sub>1</sub> - I/O <sub>8</sub> | SUPPLY CURRENT               | NOTE |
|-----------------|-----------------|-----------------|-----------------|-------------------------------------|------------------------------|------|
| L               | X               | L               | Write           | D <sub>IN</sub>                     | Operating (I <sub>CC</sub> ) | 1    |
| L               | L               | H               | Read            | D <sub>OUT</sub>                    | Operating (I <sub>CC</sub> ) |      |
| H               | X               | X               | Deselect        | High-Z                              | Standby (I <sub>SB</sub> )   | 1    |
| L               | H               | X               | Outputs disable | High-Z                              | Operating (I <sub>CC</sub> ) | 1    |

## NOTE:

1. X = H or L

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER             | SYMBOL    | RATING                 | UNIT | NOTE |
|-----------------------|-----------|------------------------|------|------|
| Supply voltage        | $V_{CC}$  | -0.3 to +7.0           | V    | 1    |
| Input voltage         | $V_{IN}$  | -0.3 to $V_{CC} + 0.3$ | V    | 1    |
| Operating temperature | $T_{opr}$ | 0 to +70               | °C   | 2    |
|                       |           | -40 to +85             |      | 3    |
| Storage temperature   | $T_{stg}$ | -55 to +150            | °C   |      |

**NOTES:**

1. The maximum applicable voltage on any pin with respect to GND.
2. Applied to the LH5116/D/NA
3. Applied to the LH5116H/HD/HN

**RECOMMENDED OPERATING CONDITIONS <sup>1</sup>**

| PARAMETER      | SYMBOL   | MIN. | TYP. | MAX.           | UNIT |
|----------------|----------|------|------|----------------|------|
| Supply voltage | $V_{CC}$ | 4.5  | 5.0  | 5.5            | V    |
| Input voltage  | $V_{IH}$ | 2.2  |      | $V_{CC} + 0.3$ | V    |
|                | $V_{IL}$ | -0.3 |      | 0.8            | V    |

**NOTE:**

1.  $T_A = 0$  to 70°C (LH5116/D/NA),  $T_A = -40$  to +85°C (LH5116H/HD/HN)

**DC CHARACTERISTICS <sup>1</sup> ( $V_{CC} = 5\text{ V} \pm 10\%$ )**

| PARAMETER              | SYMBOL    | CONDITIONS   | MIN. | TYP. | MAX. | UNIT | NOTE |
|------------------------|-----------|--|------|------|------|------|------|
| Output 'LOW' voltage   | $V_{OL}$  | $I_{OL} = 2.1\text{ mA}$   |      |      | 0.4  | V    |      |
| Output 'HIGH' voltage  | $V_{OH}$  | $I_{OH} = -1.0\text{ mA}$  | 2.4  |      |      | V    |      |
| Input leakage current  | $I_{LI}$  | $V_{IN} = 0\text{ V to } V_{CC}$   | -1.0 |      | 1.0  | μA   |      |
| Output leakage current | $I_{LO}$  | $\overline{CE} = V_{IH}, V_{I/O} = 0\text{ V to } V_{CC}$                            | -1.0 |      | 1.0  | μA   |      |
| Operating current      | $I_{CC1}$ | Outputs open ( $\overline{OE} = V_{CC}$ )  |      | 25   | 30   | mA   | 2    |
|                        | $I_{CC2}$ | Outputs open ( $\overline{OE} = V_{IH}$ )  |      | 30   | 40   | mA   | 3    |
| Standby current        | $I_{SB}$  | $\overline{CE} \geq V_{CC} - 0.2\text{ V}$<br>All other input pins = 0 V to $V_{CC}$ |      |      | 1.0  | μA   | 4    |
|                        |           |  |      |      | 0.2  |      |      |

**NOTES:**

1.  $T_A = 0$  to 70°C (LH5116/D/NA),  $T_A = -40$  to +85°C (LH5116H/HD/HN)
2.  $\overline{CE} = 0\text{ V}$ ; all other input pins = 0 V to  $V_{CC}$
3.  $\overline{CE} = V_{IL}$ ; all other input pins =  $V_{IL}$  to  $V_{IH}$
4.  $T_A = 25^\circ\text{C}$

**AC CHARACTERISTICS <sup>1</sup>****(1) READ CYCLE ( $V_{CC} = 5\text{ V} \pm 10\%$ )**

| PARAMETER                            | SYMBOL    | MIN. | TYP. | MAX. | UNIT | NOTE |
|--------------------------------------|-----------|------|------|------|------|------|
| Read cycle time                      | $t_{RC}$  | 100  |      |      | ns   |      |
| Address access time                  | $t_{AA}$  |      |      | 100  | ns   |      |
| Chip enable access time              | $t_{ACE}$ |      |      | 100  | ns   |      |
| Chip enable Low to output in Low-Z   | $t_{CLZ}$ | 10   |      |      | ns   | 2    |
| Output enable access time            | $t_{OE}$  |      |      | 40   | ns   |      |
| Output enable Low to output in Low-Z | $t_{OLZ}$ | 10   |      |      | ns   | 2    |
| Chip disable to output in High-Z     | $t_{CHZ}$ | 0    |      | 40   | ns   | 2    |
| Output disable to output in High-Z   | $t_{OHZ}$ | 0    |      | 40   | ns   | 2    |
| Output hold time                     | $t_{OH}$  | 10   |      |      | ns   |      |

**NOTES:**

1.  $T_A = 0$  to 70°C (LH5116/NA/D),  $T_A = -40$  to 85°C (LH5116H/HD/HN).
2. Active output to high-impedance and high-impedance to output active tests specified for a  $\pm 200\text{ mV}$  transition from steady state levels into the test load.

**(2) WRITE CYCLE <sup>1</sup> ( $V_{CC} = 5\text{ V} \pm 10\%$ )**

| PARAMETER                               | SYMBOL    | MIN. | TYP. | MAX. | UNIT | NOTE |
|---|-----------|------|------|------|------|------|
| Write cycle time                        | $t_{WC}$  | 100  |      |      | ns   |      |
| Chip enable to end of write             | $t_{CW}$  | 80   |      |      | ns   |      |
| Address valid time                      | $t_{AW}$  | 80   |      |      | ns   |      |
| Address setup time                      | $t_{AS}$  | 0    |      |      | ns   |      |
| Write pulse width                       | $t_{WP}$  | 60   |      |      | ns   |      |
| Write recovery time                     | $t_{WR}$  | 10   |      |      | ns   |      |
| Output active from end of write         | $t_{OW}$  | 10   |      |      | ns   | 2    |
| $\overline{WE}$ Low to output in High-Z | $t_{WHZ}$ | 0    |      | 30   | ns   | 2    |
| Data valid to end of write              | $t_{DW}$  | 30   |      |      | ns   |      |
| Data hold time                          | $t_{DH}$  | 10   |      |      | ns   |      |
| Output enable to output in High-Z       | $t_{OHZ}$ | 0    |      | 40   | ns   | 2    |
| Output active from end of write         | $t_{OW}$  | 10   |      |      | ns   | 2    |

**NOTES:**

- $T_A = 0$  to  $+70^\circ\text{C}$  (LH5116/D/NA),  $T_A = -40$  to  $+85^\circ\text{C}$  (LH5116H/HD/HN)
- Active output to high-impedance and high-impedance to output active tests specified for a  $\pm 200$  mV transition from steady state levels into the test load.

**AC TEST CONDITIONS**

| PARAMETER               | MODE                  | NOTE |
|-------------------------|-----------------------|------|
| Input voltage amplitude | 0.8 V to 2.2 V        |      |
| Input rise/fall time    | 10 ns                 |      |
| Timing reference level  | 1.5 V                 |      |
| Output load condition   | 1TTL + $C_L$ (100 pF) | 1    |

**NOTE:**

- Includes scope and jig capacitance.

**DATA RETENTION CHARACTERISTICS <sup>1</sup>**

| PARAMETER                      | SYMBOL     | CONDITIONS  | MIN.     | TYP. | MAX.       | UNIT          | NOTE |
|--------------------------------|------------|---|----------|------|------------|---------------|------|
| Data retention voltage         | $V_{CCDR}$ | $\overline{CE} \geq V_{CCRC} - 0.2\text{ V}$                                | 2.0      |      | 5.5        | V             |      |
| Data retention current         | $I_{CCDR}$ | $\overline{CE} \geq V_{CCDR} - 0.2\text{ V}$ ,<br>$V_{CCDR} = 2.0\text{ V}$ |          |      | 1.0<br>0.2 | $\mu\text{A}$ | 2    |
| Chip disable to data retention | $t_{CDR}$  |   | 0        |      |            | ns            |      |
| Recovery time                  | $t_R$      |   | $t_{RC}$ |      |            | ns            | 3    |

**NOTES:**

- $T_A = 0$  to  $+70^\circ\text{C}$  (LH5116/D/NA),  $T_A = -40$  to  $+85^\circ\text{C}$  (LH5116H/HD/HN)
- $T_A = 25^\circ\text{C}$
- $t_{RC}$  = Read cycle time

**CAPACITANCE <sup>1</sup> ( $f = 1\text{ MHz}$ ,  $T_A = 25^\circ\text{C}$ )**

| PARAMETER                | SYMBOL    | CONDITIONS             | MIN. | TYP. | MAX. | UNIT |
|--------------------------|-----------|------------------------|------|------|------|------|
| Input capacitance        | $C_{IN}$  | $V_{IN} = 0\text{ V}$  |      |      | 7    | pF   |
| Input/output capacitance | $C_{I/O}$ | $V_{I/O} = 0\text{ V}$ |      |      | 10   | pF   |

**NOTE:**

- This parameter is sampled and not production tested.

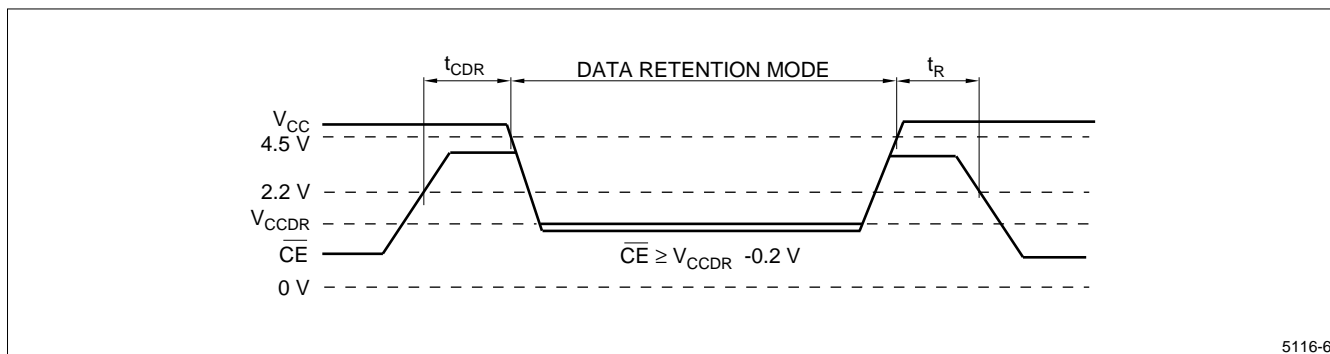


Figure 3. Low Voltage Data Retention

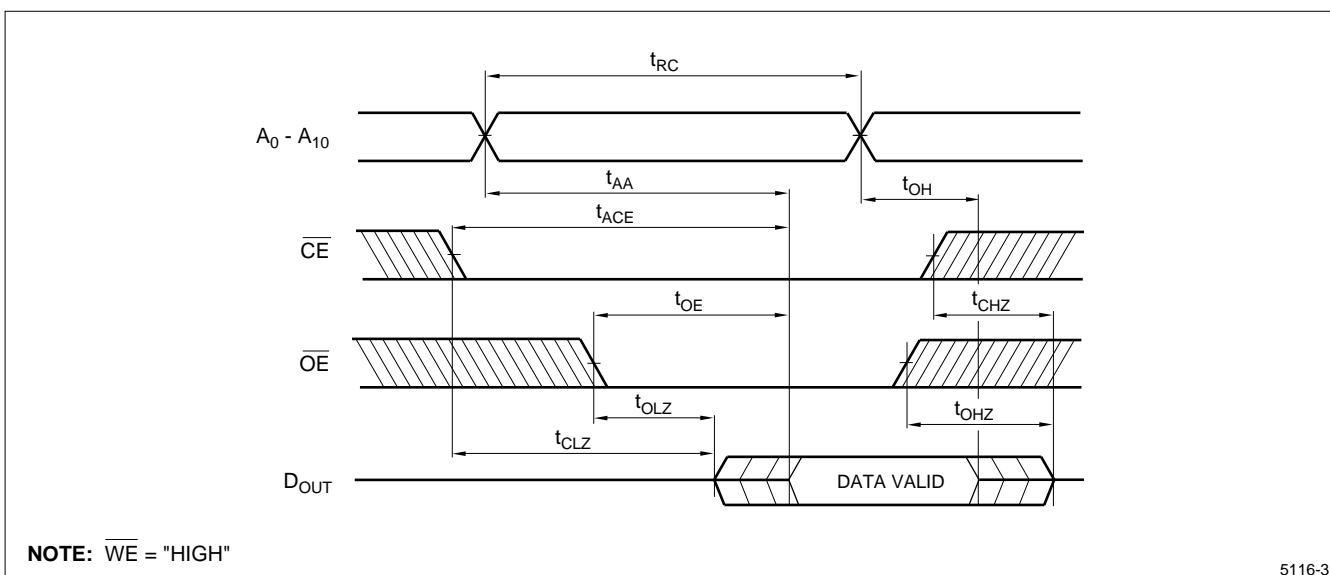
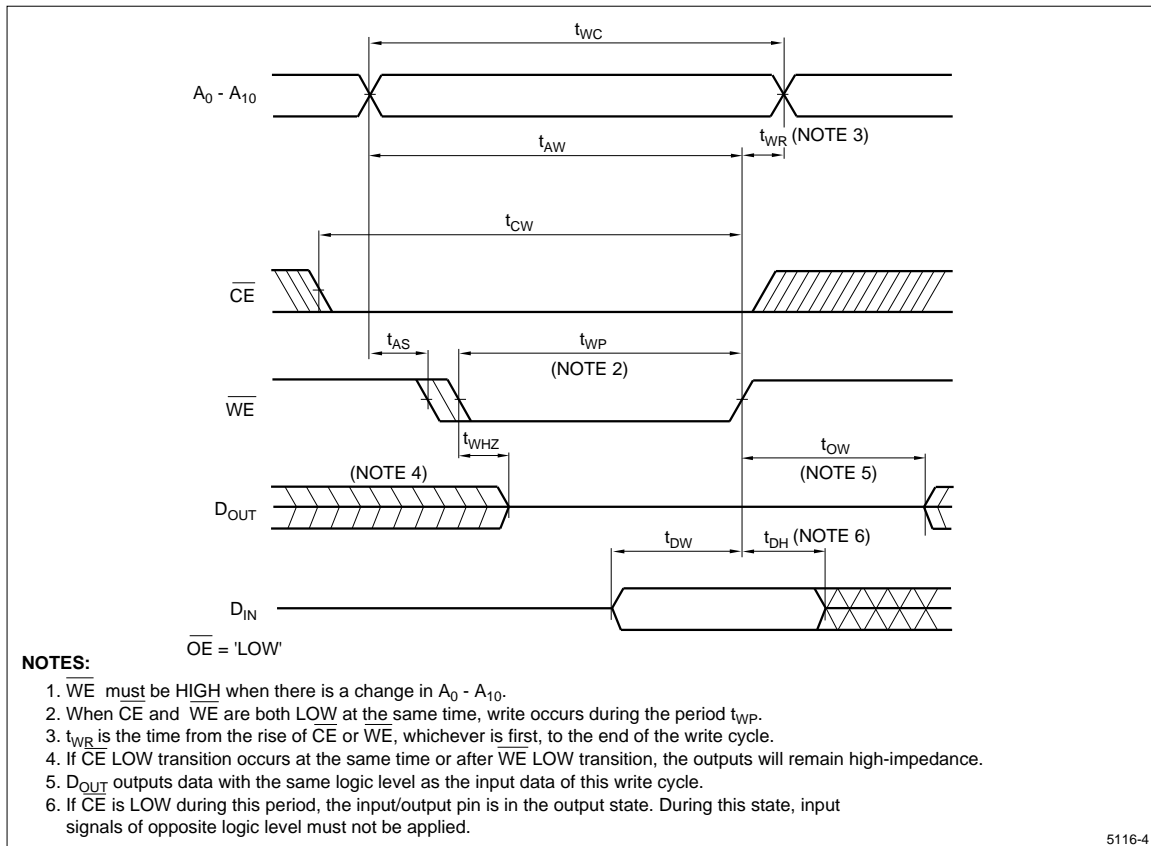
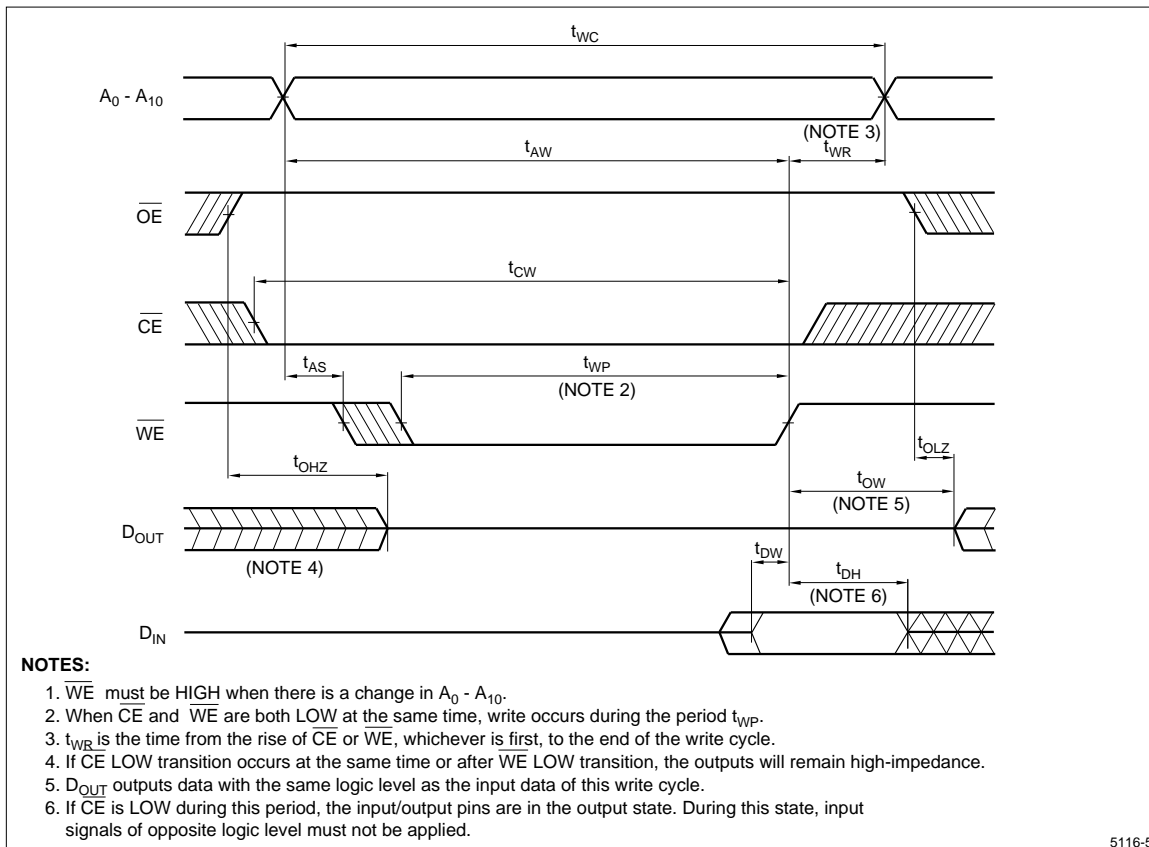


Figure 4. Read Cycle



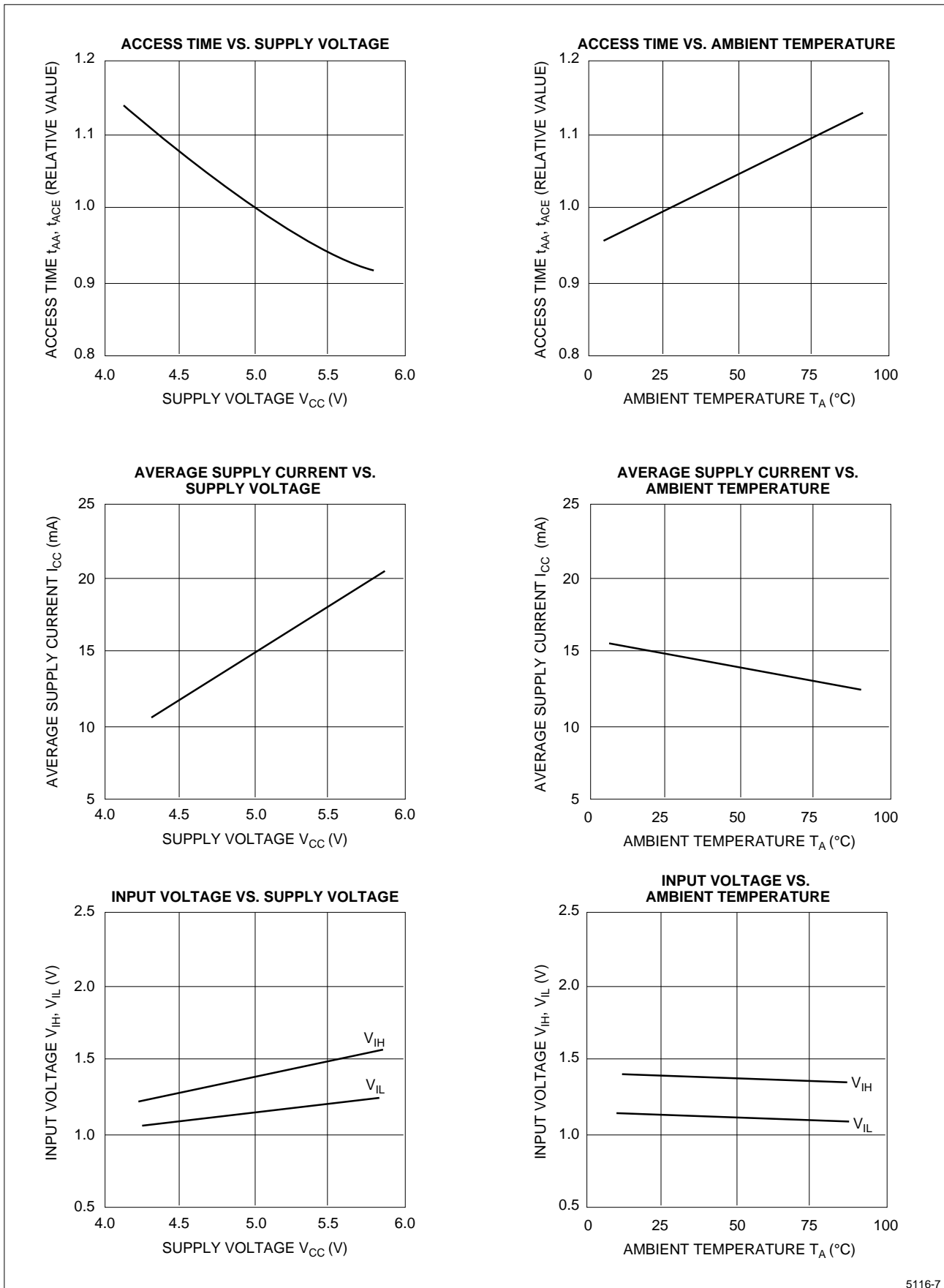
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Figure 5. Write Cycle 1 (Note 1)



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Figure 6. Write Cycle 2 (Note 1)



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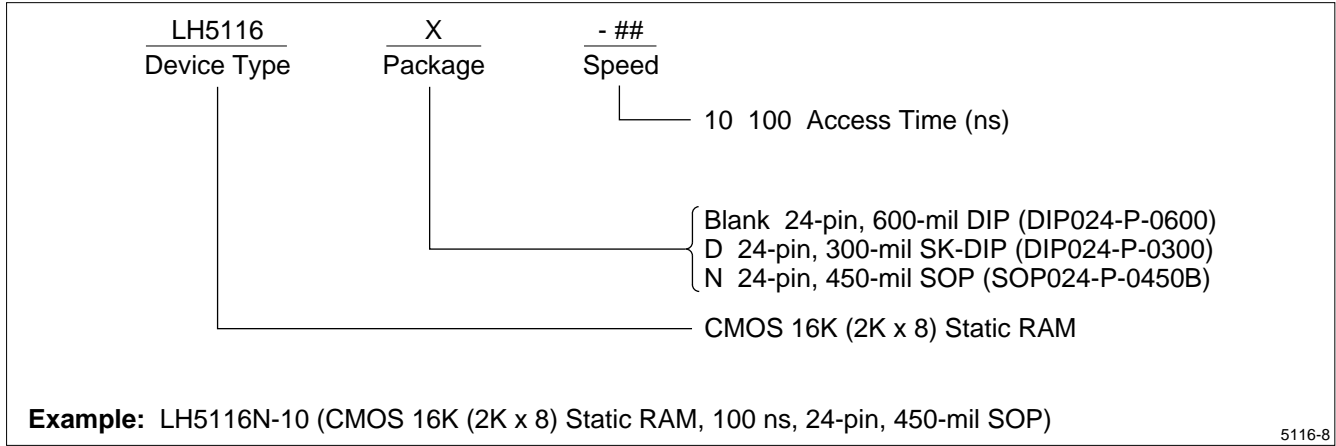
**Figure 7. Electrical Characteristic Curves**  
 ( $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified)







**ORDERING INFORMATION (T<sub>A</sub> = 0°C to 70°C)**



**ORDERING INFORMATION (T<sub>A</sub> = -40°C to +85°C)**

