

March 1997

**2K x 8 CMOS PROM**

## Features

- Low Power Standby and Operating Power
  - ICCSB .....100 $\mu$ A
  - ICCOP .....20mA at 1MHz
- Fast Access Time ..... 90/120ns
- Industry Standard Pinout
- Single 5.0V Supply
- CMOS/TTL Compatible Inputs
- High Output Drive ..... 12 LSTTL Loads
- Synchronous Operation
- On-Chip Address Latches
- Separate Output Enable

## Ordering Information

| PACKAGE    | TEMP. RANGE     | 90ns           | 120ns          | PKG. NO. |
|------------|-----------------|----------------|----------------|----------|
| SBDIP      | -40°C to +85°C  | HM1-6617B-9    | HM1-6617-9     | D24.6    |
| SMD#       | -55°C to +125°C | 5962-8954002JA | 5962-8954001JA | D24.6    |
| SLIM SBDIP | -40°C to +85°C  | HM6-6617B-9    | HM6-6617-9     | D24.3    |
| SMD#       | -55°C to +125°C | 5962-8954002LA | 5962-8954001LA | D24.3    |
| CLCC       | -40°C to +85°C  | HM4-6617B-9    | HM4-6617-9     | J32.A    |
| SMD#       | -55°C to +125°C | 5962-8954002XA | 5962-8954001XA | J32.A    |

## Description

The HM-6617 is a 16,384 bit fuse link CMOS PROM in a 2K word by 8-bit/word format with "Three-State" outputs. This PROM is available in the standard 0.600 inch wide 24 pin SBDIP, the 0.300 inch wide slimline SBDIP, and the JEDEC standard 32 pad CLCC.

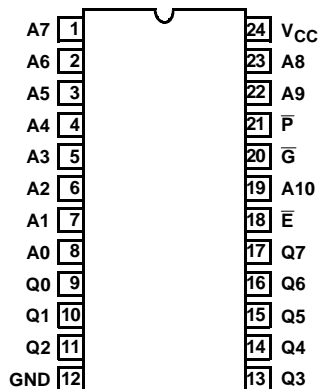
The HM-6617 utilizes a synchronous design technique. This includes on-chip address latches and a separate output enable control which makes this device ideal for applications utilizing recent generation microprocessors. This design technique, combined with the Intersil advanced self-aligned silicon gate CMOS process technology offers ultra-low standby current. Low ICCSB is ideal for battery applications or other systems with low power requirements.

The Intersil NiCr fuse link technology is utilized on this and other Intersil CMOS PROMs. This gives the user a PROM with permanent, stable storage characteristics over the full industrial and military temperature voltage ranges. NiCr fuse technology combined with the low power characteristics of CMOS provides an excellent alternative to standard bipolar PROMs or NMOS EPROMs.

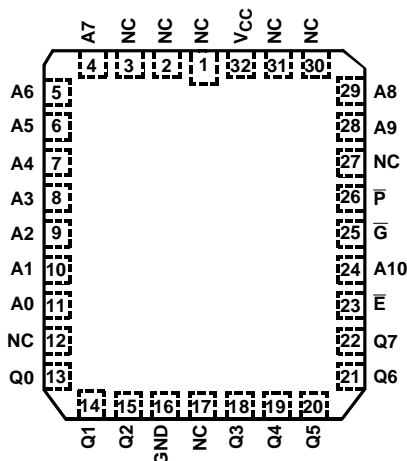
All bits are manufactured storing a logical "0" and can be selectively programmed for a logical "1" at any bit location.

## Pinouts

**HM-6617 (SBDIP)**  
TOP VIEW



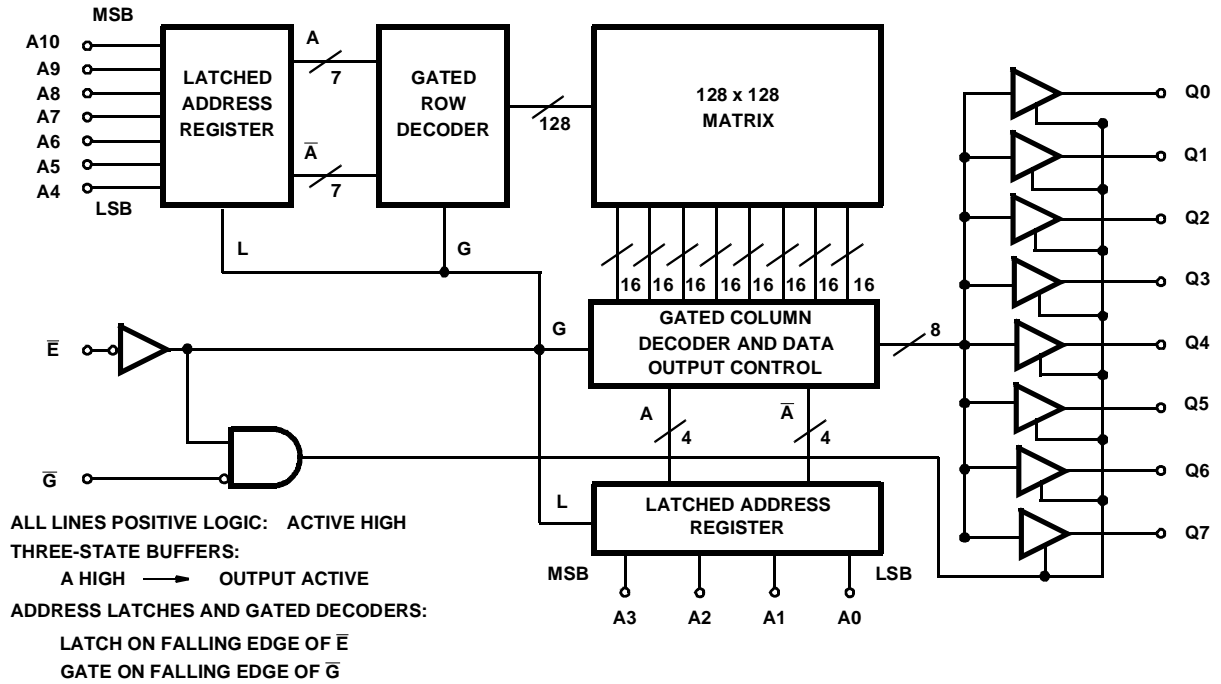
**HM-6617 (CLCC)**  
TOP VIEW



**PIN DESCRIPTION**

| PIN              | DESCRIPTION    |
|------------------|----------------|
| NC               | No Connect     |
| A0-A10           | Address Inputs |
| $\bar{E}$        | Chip Enable    |
| Q                | Data Output    |
| V <sub>CC</sub>  | Power (+5V)    |
| $\bar{G}$        | Output Enable  |
| $\bar{P}$ (Note) | Output Enable  |

NOTE:  $\bar{P}$  should be hardwired to V<sub>CC</sub> except during programming.

**Functional Diagram**

## Background Information Programming Algorithm

The HM-6617 CMOS PROM is manufactured with all bits containing a logical zero (output low). Any bit can be programmed selectively to a logical one (output high) state by following the procedure shown below. To accomplish this, a programmer can be built that meets the specifications shown, or any of the approved commercial programmers can be used.

### Programming Sequence Of Events

1. Apply a voltage of  $V_{CC1}$  to  $V_{CC}$  of the PROM.
2. Read all fuse locations to verify that the PROM is blank (output low).
3. Place the PROM in the initial state for programming:  $\bar{E} = V_{IH}$ ,  $\bar{P} = V_{IH}$ ,  $\bar{G} = V_{IL}$ .
4. Apply the correct binary address for the word to be programmed. No inputs should be left open circuit.
5. After a delay of  $t_D$ , apply voltage of  $V_{IL}$  to  $\bar{E}$  (pin 18) to access the addressed word.
6. The address may be held through the cycle, but must be held valid at least for a time equal to  $t_D$  after the falling edge of  $\bar{E}$ . None of the inputs should be allowed to float to an invalid logic level.
7. After a delay of  $t_D$ , disable the outputs by applying a voltage of  $V_{IH}$  to  $\bar{G}$  (pin 20).
8. After a delay of  $t_D$ , apply voltage of  $V_{IL}$  to  $\bar{P}$  (pin 21).
9. After delay of  $t_D$ , raise  $V_{CC}$  (pin 24) to  $V_{CCPROG}$  with a rise time of  $t_R$ . All outputs at  $V_{IH}$  should track  $V_{CC}$  with  $V_{CC} - 2.0V$  to  $V_{CC} + 0.3V$ . This could be accomplished by pulling outputs at  $V_{IH}$  to  $V_{CC}$  through pull-up resistors of value  $R_n$ .
10. After a delay of  $t_D$ , pull the output which corresponds to the bit to be programmed to  $V_{IL}$ . Only one bit should be programmed at a time.
11. After a delay of  $t_{PW}$ , allow the output to be pulled to  $V_{IH}$  through pull-up resistor  $R_n$ .
12. After a delay of  $t_D$ , reduce  $V_{CC}$  (pin 24) to  $V_{CC1}$  with a fall time of  $t_F$ . All outputs at  $V_{IH}$  should track  $V_{CC}$  with  $V_{CC} - 2.0V$  to  $V_{CC} + 0.3V$ . This could be accomplished by pulling outputs at  $V_{IH}$  to  $V_{CC}$  through pull-up resistors of value  $R_n$ .
13. Apply a voltage of  $V_{IH}$  to  $\bar{P}$  (pin 21).
14. After a delay of  $t_D$ , apply a voltage of  $V_{IL}$  to  $\bar{G}$  (pin 20).
15. After a delay of  $t_D$ , examine the outputs for correct data. If any location verifies incorrectly, repeat steps 4 through 14 (attempting to program only those bits in the word which verified incorrectly) up to a maximum of eight attempts for a given word. If a word does not program within eight attempts, it should be considered a programming reject.
16. Repeat steps 3 through 15 for all other bits to be programmed in the PROM.

### Post-Programming Verification

17. Place the PROM in the post-programming verification mode:  $\bar{E} = V_{IH}$ ,  $\bar{G} = V_{IL}$ ,  $\bar{P} = V_{IH}$ ,  $V_{CC}$  (pin 24) =  $V_{CC1}$ .
18. Apply the correct binary address of the word to be verified to the PROM.
19. After a delay of  $t_D$ , apply a voltage of  $V_{IL}$  to  $\bar{E}$  (pin 18).
20. After a delay of  $t_D$ , examine the outputs for correct data. If any location fails to verify correctly, the PROM should be considered a programming reject.
21. Repeat steps 17 through 20 for all possible programming locations

### Post-Programming Read

22. Apply a voltage of  $V_{CC2} = 4.0V$  to  $V_{CC}$  (pin 24).
23. After a delay of  $t_D$ , apply a voltage of  $V_{IH}$  to  $\bar{E}$  (pin 18).
24. Apply the correct binary address of the word to be read.
25. After a delay of  $T_{AVEL}$ , apply a voltage of  $V_{IL}$  to  $\bar{E}$  (pin 18).
26. After a delay of  $T_{ELQV}$ , examine the outputs for correct data. If any location fails to verify correctly, the PROM should be considered a programming reject.
27. Repeat steps 23 through 26 for all address locations.
28. Apply a voltage of  $V_{CC2} = 6.0V$  to  $V_{CC}$  (pin 24).
29. Repeat steps 23 through 26 for all address locations.

# Programming Cycle

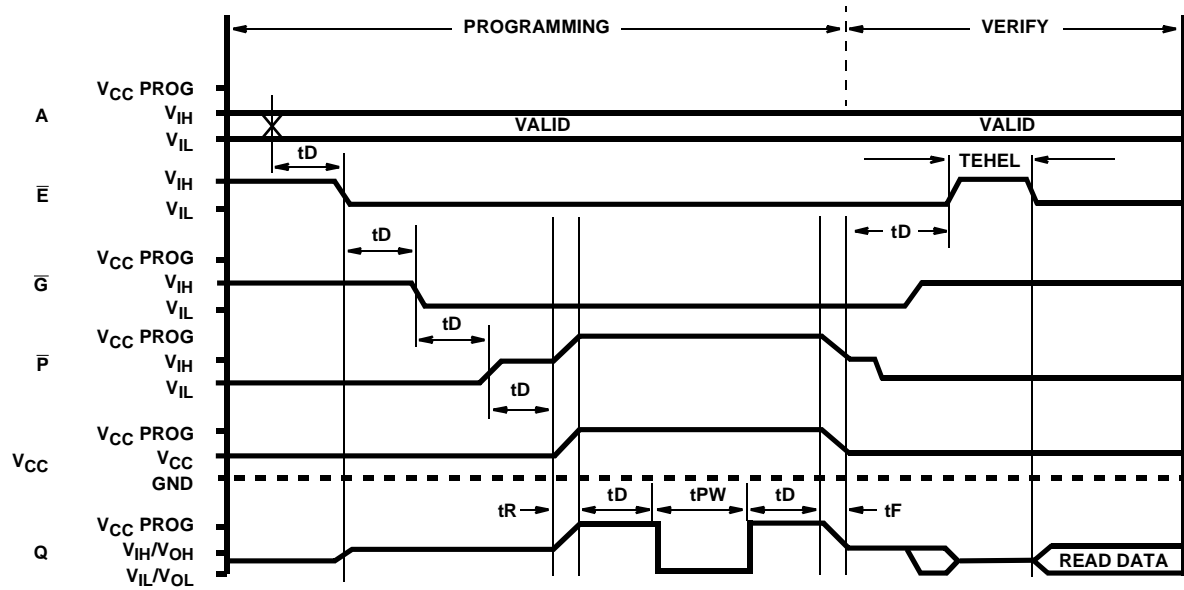


FIGURE 1. HM-6617 PROGRAMMING CYCLE

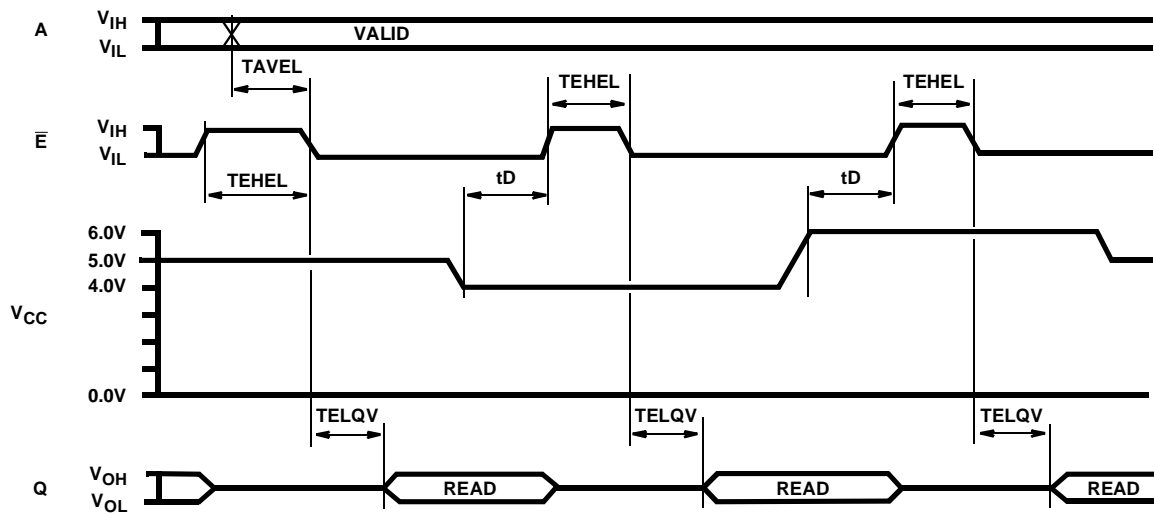


FIGURE 2. HM-6617 POST PROGRAMMING VERIFY CYCLE

**Background Information HM-6617 Programming****Programming Specifications**

| SYMBOL               | PARAMETER   | MIN                | TYP             | MAX                  | UNITS |
|----------------------|---|--------------------|-----------------|----------------------|-------|
| V <sub>IL</sub>      | Input "0"   | 0.0                | 0.2             | 0.8                  | V     |
| V <sub>IH</sub>      | Voltage "1" (Note 6)  | V <sub>CC</sub> -2 | V <sub>CC</sub> | V <sub>CC</sub> +0.3 | V     |
| V <sub>CC</sub> PROG | Programming V <sub>CC</sub> (Note 2)                          | 12.0               | 12.0            | 12.5                 | V     |
| V <sub>CC</sub> 1    | Operating V <sub>CC</sub>                                     | 4.5                | 5.5             | 5.5                  | V     |
| V <sub>CC</sub> 2    | Special Verify V <sub>CC</sub> (Note 3)                       | 4.0                | -               | 6.0                  | V     |
| t <sub>D</sub>       | Delay Time  | 1.0                | 1.0             | -                    | μs    |
| t <sub>R</sub>       | Rise Time   | 1.0                | 10.0            | 10.0                 | μs    |
| t <sub>F</sub>       | Fall Time   | 1.0                | 10.0            | 10.0                 | μs    |
| TEHEL                | Chip Enable Pulse Width                                       | 50                 | -               | -                    | ns    |
| TAVEL                | Address Valid to Chip Enable Low Time                         | 20                 | -               | -                    | ns    |
| TELQV                | Chip Enable Low to Output Valid Time                          | -                  | -               | 120                  | ns    |
| t <sub>PW</sub>      | Programming Pulse Width (Note 4)                              | 90                 | 100             | 110                  | μs    |
| t <sub>IP</sub>      | Input Leakage at V <sub>CC</sub> = V <sub>CC</sub> PROG       | -10                | +1.0            | 10                   | μA    |
| I <sub>OP</sub>      | Data Output Current at V <sub>CC</sub> = V <sub>CC</sub> PROG | -                  | -5.0            | -10                  | mA    |
| R <sub>n</sub>       | Output Pull-Up Resistor (Note 5)                              | 5                  | 10              | 15                   | kΩ    |
| T <sub>A</sub>       | Ambient Temperature   | -                  | 25              | -                    | °C    |

**NOTES:**

1. All inputs must track V<sub>CC</sub> (pin 24) within these limits.
2. V<sub>CC</sub>PROG must be capable of supplying 500mA.
3. See Steps 22 through 29 of the Programming Algorithm.
4. See Step 11 of the Programming Algorithm.
5. All outputs should be pulled up to V<sub>CC</sub> through a resistor of value R<sub>n</sub>.
6. Except during programming (See Programming Cycle Waveforms).

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# HM-6617

## Absolute Maximum Ratings

Supply Voltage (All Voltages Reference to Device GND) . . . . +7.0V  
 Input or Output Voltage Applied for All Grades . . . . . GND -0.3V to  $V_{CC} + 0.3V$   
 Typical Derating Factor . . . . . 5mA/MHz Increase in ICCOP  
 ESD Classification . . . . . Class 1

## Operating Conditions

Operating Voltage Range . . . . . +4.5V to +5.5V  
 Operating Temperature Range: HM-6617-9, B-9 . . -40°C to +85°C

## Thermal Information

Thermal Resistance (Typical)  
 SBDIP Package . . . . .  $\theta_{JA}$  48°C/W  $\theta_{JC}$  9°C/W  
 Slim SBDIP . . . . . 65°C/W 14°C/W  
 CLCC Package . . . . . 58°C/W 19°C/W  
 Maximum Storage Temperature Range . . . . . -65°C to +150°C  
 Maximum Junction Temperature . . . . . +175°C  
 Maximum Lead Temperature (Soldering 10s) . . . . . +300°C

## Die Characteristics

Gate Count . . . . . 5473 Gates

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

## DC Electrical Specifications $V_{CC} = 5V \pm 10\%$ ; (HM-6617B-9, HM-6617-9)

| SYMBOL   | PARAMETER                               | MIN            | MAX            | UNITS   | TEST CONDITIONS   |
|----------|---|----------------|----------------|---------|---|
| $V_{IH}$ | Logical One Input Voltage               | 2.4            | $V_{CC} + 0.3$ | V       | $V_{CC} = 5.5V$   |
| $V_{IL}$ | Logical Zero Input Voltage              | -0.3           | 0.8            | V       | $V_{CC} = 4.5V$   |
| $VOH1$   | Logical One Output Voltage              | 2.4            | -              | V       | $I_{OH} = -2.0mA$ , $V_{CC} = 4.5V$                                 |
| $VOH2$   | Logical One Output Voltage (Note 2)     | $V_{CC} - 1.0$ | -              | V       | $I_{OH} = -100\mu A$ , $V_{CC} = 4.5V$                              |
| $VOL$    | Logical Zero Output Voltage             | -              | 0.4            | V       | $I_{OL} = +4.8mA$ , $V_{CC} = 4.5V$                                 |
| $I_I$    | Input Leakage                           | -1.0           | +1.0           | $\mu A$ | $V_{IN} = V_{CC}$ or GND, $V_{CC} = 5.5V$                           |
| $IOZ$    | Output Leakage                          | -1.0           | +1.0           | $\mu A$ | $V_O = V_{CC}$ or GND, $\bar{G} = V_{CC}$ , $V_{CC} = 5.5V$         |
| ICCSB    | Standby Power Supply Current            | -              | 100            | $\mu A$ | $V_{IN} = V_{CC}$ or GND, $V_{CC} = 5.5V$ , $I_O = 0$               |
| ICCOP    | Operating Power Supply Current (Note 3) | -              | 20             | mA      | $f = 1MHz$ , $V_{CC} = 5.5V$ , $I_O = 0$ , $V_{IN} = V_{CC}$ or GND |

## AC Electrical Specifications

| SYMBOL     | PARAMETER                | HM-6617B-9 |     | HM-6617-9 |     | UNITS | TEST CONDITIONS |
|------------|--------------------------|------------|-----|-----------|-----|-------|-----------------|
|            |                          | MIN        | MAX | MIN       | MAX |       |                 |
| (1) TAVQV  | Address Access Time      | -          | 105 | -         | 140 | ns    | (Notes 1, 4)    |
| (2) TELQV  | Chip Enable Access Time  | -          | 90  | -         | 120 | ns    | (Notes 1, 4)    |
| (3) TELQX  | Chip Enable Time         | 5          | -   | 5         | -   | ns    | (Notes 2, 4)    |
| (4) TAVEL  | Address Setup Time       | 15         | -   | 20        | -   | ns    | (Notes 1, 4)    |
| (5) TELAX  | Address Hold Time        | 20         | -   | 25        | -   | ns    | (Notes 1, 4)    |
| (6) TELEH  | Chip Enable Low Width    | 95         | -   | 120       | -   | ns    | (Notes 1, 4)    |
| (7) TEHEL  | Chip Enable High Width   | 40         | -   | 40        | -   | ns    | (Notes 1, 4)    |
| (8) TELEL  | Cycle Time               | 136        | -   | 160       | -   | ns    | (Notes 1, 4)    |
| (9) TGLQV  | Output Access Time       | -          | 40  | -         | 50  | ns    | (Notes 1, 4)    |
| (10) TGLQX | Output Enable Time       | 5          | -   | 5         | -   | ns    | (Notes 2, 4)    |
| (11) TGHQZ | Output Disable Time      | -          | 40  | -         | 50  | ns    | (Notes 2, 4)    |
| (12) TEHQZ | Chip Enable Disable Time | -          | 45  | -         | 50  | ns    | (Notes 2, 4)    |

**Capacitance**  $T_A = +25^\circ\text{C}$

| SYMBOL | PARAMETER                   | MAX | UNITS | TEST CONDITIONS  |
|--------|-----------------------------|-----|-------|--|
| CIN    | Input Capacitance (Note 2)  | 10  | pF    | $f = 1\text{MHz}$ , All Measurement are Referenced to Device GND |
| COU    | Output Capacitance (Note 2) | 12  | pF    | $f = 1\text{MHz}$ , All Measurement are Referenced to Device GND |

**NOTES:**

1. Input pulse levels: 0 to 3.0V; Input rise and fall times: 5ns (max); Input and output timing reference level: 1.5V; Output load: 1 TTL gate equivalent  $C_L = 50\text{pF}$  (min) - for  $C_L$  greater than 50pF, access time is derated by 0.15ns per pF.
2. Tested at initial design and after major design changes.
3. Typical derating 5mA/MHz increase in ICCOP.
4.  $V_{CC} = 4.5\text{V}$  and 5.5V.

**Switching Waveforms**

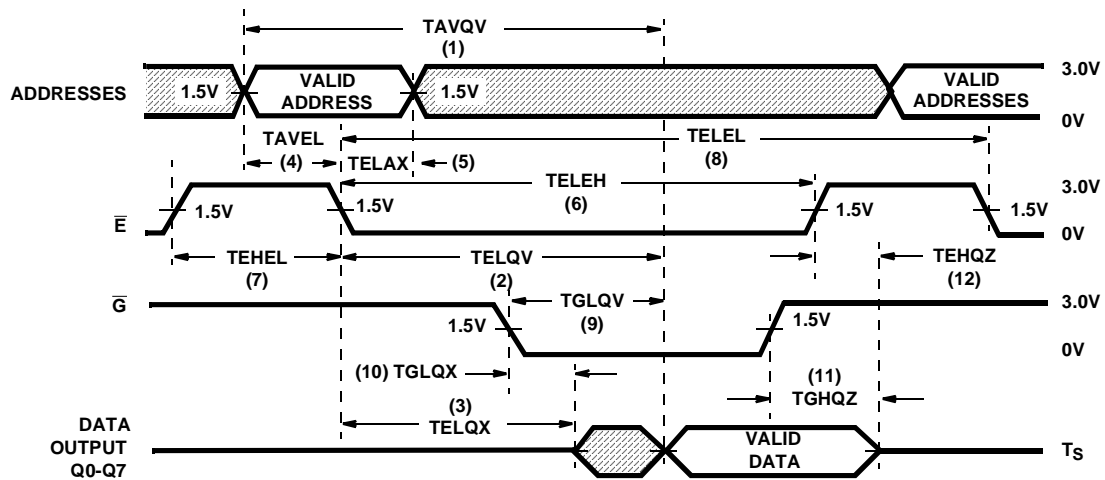


FIGURE 3. READ CYCLE

**Test Circuit**

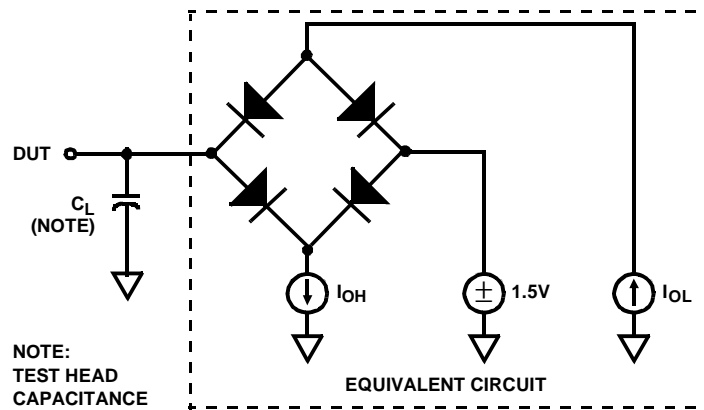


FIGURE 4. TEST CIRCUIT