

# DATA SHEET

## **74F189A**

64-bit TTL bipolar RAM, inverting  
(3-State)

Product specification

1990 Feb 23

IC15 Data Handbook

64-bit TTL bipolar RAM, inverting (3-State)

74F189A

FEATURES

- High speed performance
- Replaces 74F189
- Address access time: 8ns max vs 28ns for 74F189
- Power dissipation: 4.3mW/bit
- Schottky clamp TTL
- One chip enable
- Inverting outputs (for non-inverting outputs see 74F219A)
- 3-State outputs
- 74F189A in 150 mil wide SO is preferred options for new designs

are fully decoded on chip. The outputs are in high impedance state whenever the chip enable ( $\overline{CE}$ ) is high. The outputs are active only in the READ mode ( $\overline{WE}$  = high) and the output data is the complement of the stored data.

| TYPE    | TYPICAL ACCESS TIME | TYPICAL SUPPLY CURRENT ( TOTAL) |
|---------|---------------------|---------------------------------|
| 74F189A | 5.0ns               | 55mA                            |

DESCRIPTION

The 74F189A is a high speed, 64-bit RAM organized as a 16-word by 4-bit array. Address inputs are buffered to minimize loading and

ORDERING INFORMATION

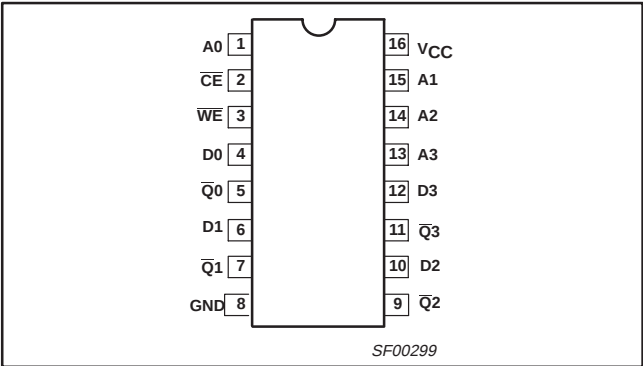
| DESCRIPTION                           | ORDER CODE                                                                            | DRAWING NUMBER |
|---------------------------------------|---------------------------------------------------------------------------------------|----------------|
|                                       | COMMERCIAL RANGE<br>$V_{CC} = 5V \pm 10\%$ , $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$ |                |
| 16-pin plastic Dual In-line Package   | N74F189AN                                                                             | SOT38-4        |
| 16-pin plastic Small Outline (150mil) | N74F189AD                                                                             | SOT109-1       |

INPUT AND OUTPUT LOADING AND FAN OUT TABLE

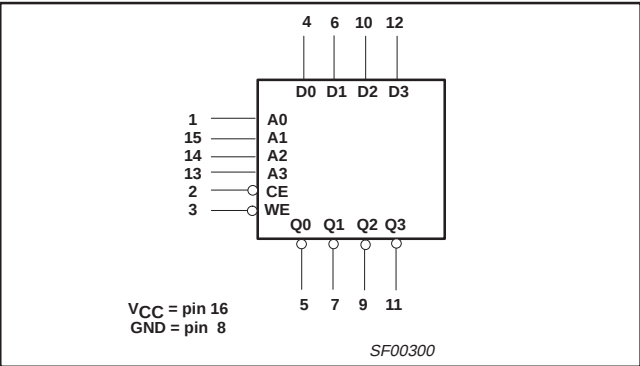
| PINS                            | DESCRIPTION                     | 74F (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|---------------------------------|---------------------------------|---------------------|---------------------|
| D0 – D3                         | Data inputs                     | 1.0/1.0             | 20 $\mu$ A/0.6mA    |
| A0 – A3                         | Address inputs                  | 1.0/1.0             | 20 $\mu$ A/0.6mA    |
| $\overline{CE}$                 | Chip enable input (active low)  | 1.0/2.0             | 20 $\mu$ A/1.2mA    |
| $\overline{WE}$                 | Write enable input (active low) | 1.0/2.0             | 20 $\mu$ A/1.2mA    |
| $\overline{Q0} - \overline{Q3}$ | Data outputs                    | 150/40              | 3mA/24mA            |

NOTE: One (1.0) FAST unit load is defined as: 20 $\mu$ A in the high state and 0.6mA in the low state.

PIN CONFIGURATION



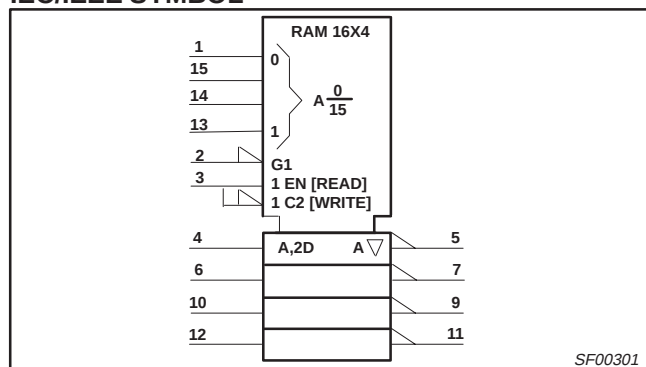
LOGIC SYMBOL



## 64-bit TTL bipolar RAM, inverting (3-State)

74F189A

### IEC/IEEE SYMBOL



## FUNCTION TABLE

| INPUTS |    |    | OUTPUT                    | OPERATING MODE |
|--------|----|----|---------------------------|----------------|
| CE     | WE | Dn | $\overline{Q}_n$          |                |
| L      | H  | X  | Complement of stored data | Read           |
| L      | L  | L  | High impedance            | Write "0"      |
| H      | L  | H  | High impedance            | Write "1"      |
| H      | X  | X  | High impedance            | Disable input  |

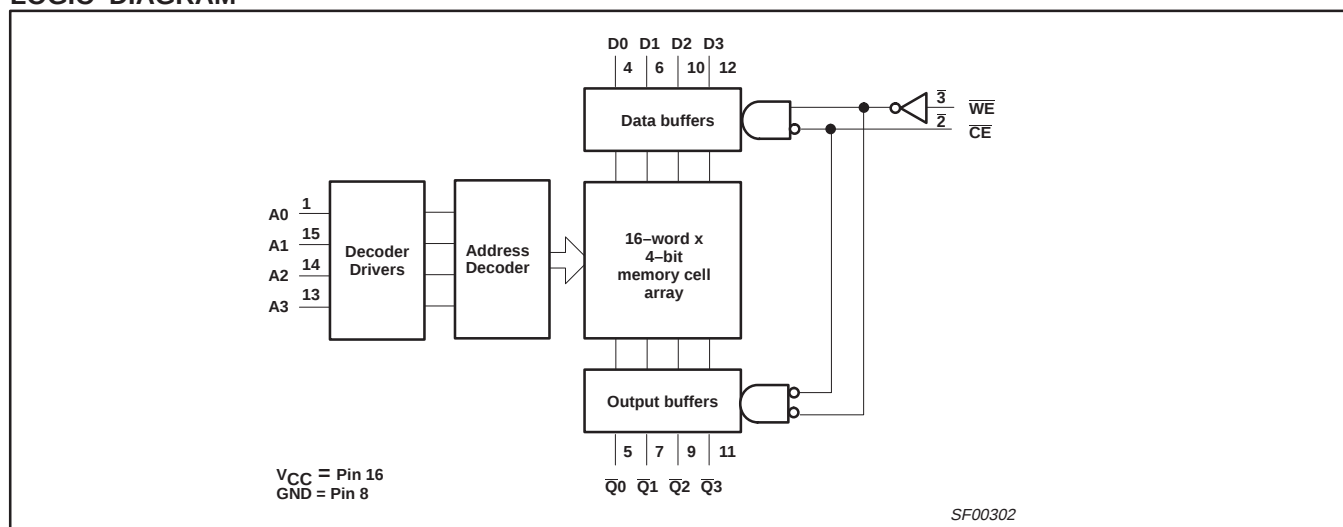
NOTES:

H = High voltage level

L = Low voltage level

X = Don't care

### LOGIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free air temperature range.)

| SYMBOL           | PARAMETER                                      | RATING                  | UNIT |
|------------------|------------------------------------------------|-------------------------|------|
| V <sub>CC</sub>  | Supply voltage                                 | −0.5 to +7.0            | V    |
| V <sub>IN</sub>  | Input voltage                                  | −0.5 to +7.0            | V    |
| I <sub>IN</sub>  | Input current                                  | −30 to +5               | mA   |
| V <sub>OUT</sub> | Voltage applied to output in high output state | −0.5 to V <sub>CC</sub> | V    |
| I <sub>OUT</sub> | Current applied to output in low output state  | 48                      | mA   |
| T <sub>amb</sub> | Operating free air temperature range           | 0 to +70                | °C   |
| T <sub>stg</sub> | Storage temperature range                      | −65 to +150             | °C   |

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## RECOMMENDED OPERATING CONDITIONS

| SYMBOL    | PARAMETER                            | LIMITS |     |     | UNIT |
|-----------|--------------------------------------|--------|-----|-----|------|
|           |                                      | MIN    | NOM | MAX |      |
| $V_{CC}$  | Supply voltage                       | 4.5    | 5.0 | 5.5 | V    |
| $V_{IH}$  | High-level input voltage             | 2.0    |     |     | V    |
| $V_{IL}$  | Low-level input voltage              |        |     | 0.8 | V    |
| $I_{IK}$  | Input clamp current                  |        |     | -18 | mA   |
| $I_{OH}$  | High-level output current            |        |     | -3  | mA   |
| $I_{OL}$  | Low-level output current             |        |     | 24  | mA   |
| $T_{amb}$ | Operating free air temperature range | 0      |     | +70 | °C   |

## DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

Over recommended operating free air temperature range unless otherwise noted.

| SYMBOL           | PARAMETER                                         |        | TEST CONDITIONS <sup>1</sup>                            |                     | LIMITS |                  |      | UNIT |
|------------------|---------------------------------------------------|--------|---------------------------------------------------------|---------------------|--------|------------------|------|------|
|                  |                                                   |        |                                                         |                     | MIN    | TYP <sup>2</sup> | MAX  |      |
| V <sub>OH</sub>  | High-level output voltage                         |        | V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX            | ±10%V <sub>CC</sub> | 2.4    |                  |      | V    |
|                  |                                                   |        | V <sub>IH</sub> = MIN, I <sub>OH</sub> = MAX            | ±5%V <sub>CC</sub>  | 2.7    | 3.4              |      | V    |
| V <sub>OL</sub>  | Low-level output voltage                          |        | V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX            | ±10%V <sub>CC</sub> |        | 0.35             | 0.50 | V    |
|                  |                                                   |        | V <sub>IH</sub> = MIN, I <sub>OL</sub> = MAX            | ±5%V <sub>CC</sub>  |        | 0.35             | 0.50 | V    |
| V <sub>IK</sub>  | Input clamp voltage                               |        | V <sub>CC</sub> = MIN, I <sub>I</sub> = I <sub>IK</sub> |                     |        | -0.73            | -1.2 | V    |
| I <sub>I</sub>   | Input current at maximum input voltage            |        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7.0V            |                     |        |                  | 100  | μA   |
| I <sub>IH</sub>  | High-level input current                          |        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7V            |                     |        |                  | 20   | μA   |
| I <sub>IL</sub>  | Low-level input current                           | others | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5V            |                     |        |                  | -0.6 | mA   |
|                  |                                                   | CE, WE |                                                         |                     |        |                  | -1.2 | mA   |
| I <sub>OZH</sub> | Offset output current, high-level voltage applied |        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7V            |                     |        |                  | 50   | μA   |
| I <sub>OZL</sub> | Offset output current, low-level voltage applied  |        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5V            |                     |        |                  | -50  | μA   |
| I <sub>OS</sub>  | Short-circuit output current <sup>3</sup>         |        | V <sub>CC</sub> = MAX                                   |                     | -60    |                  | -150 | mA   |
| I <sub>CC</sub>  | Supply current (total)                            |        | V <sub>CC</sub> = MAX, CE = WE = GND                    |                     |        | 55               | 80   | mA   |
| C <sub>IN</sub>  | Input capacitance                                 |        | V <sub>CC</sub> = 5V, V <sub>IN</sub> = 2.0V            |                     |        | 4                |      | pF   |
| C <sub>OUT</sub> | Output capacitance                                |        | V <sub>CC</sub> = 5V, V <sub>OUT</sub> = 2.0V           |                     |        | 7                |      | pF   |

## NOTES:

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_{amb} = 25^\circ\text{C}$ .
- Not more than one output should be shorted at a time. For testing  $I_{OS}$ , the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests,  $I_{OS}$  tests should be performed last.

## 64-bit TTL bipolar RAM, inverting (3-State)

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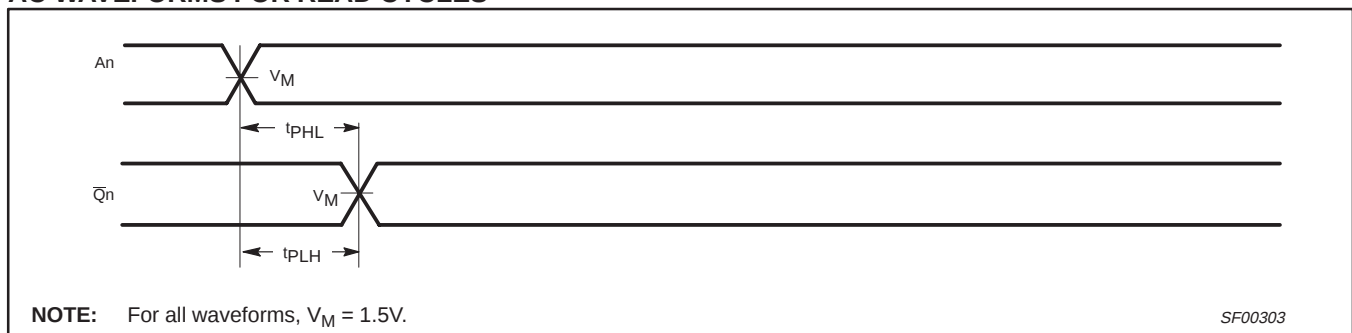
## AC ELECTRICAL CHARACTERISTICS

| SYMBOL                               | PARAMETER                            |                                           | TEST<br>CONDITION | LIMITS                                                                                              |            |            |                                                                                                                  |            | UNIT |
|--------------------------------------|--------------------------------------|-------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------|------------|------------|------------------------------------------------------------------------------------------------------------------|------------|------|
|                                      |                                      |                                           |                   | T <sub>amb</sub> = +25°C<br>V <sub>CC</sub> = +5.0V<br>C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω |            |            | T <sub>amb</sub> = 0°C to +70°C<br>V <sub>CC</sub> = +5.0V ± 10%<br>C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω |            |      |
|                                      |                                      |                                           |                   | MIN                                                                                                 | TYP        | MAX        | MIN                                                                                                              | MAX        |      |
|                                      |                                      |                                           |                   |                                                                                                     |            |            |                                                                                                                  |            |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Access time                          | Propagation delay<br>An to Q <sub>n</sub> | Waveform 1        | 2.5<br>2.0                                                                                          | 5.0<br>4.5 | 8.0<br>8.0 | 2.5<br>2.0                                                                                                       | 8.0<br>8.0 | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> |                                      | Enable time<br>CE to Q <sub>n</sub>       | Waveform 2        | 2.0<br>2.0                                                                                          | 3.5<br>4.0 | 6.0<br>7.0 | 1.5<br>2.0                                                                                                       | 7.0<br>7.5 | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Disable time<br>CE to Q <sub>n</sub> |                                           | Waveform 3        | 2.5<br>1.5                                                                                          | 4.5<br>3.0 | 7.0<br>5.5 | 2.0<br>1.5                                                                                                       | 8.0<br>6.0 | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Write recovery time                  | Enable time<br>WE to Q <sub>n</sub>       | Waveform 4        | 2.0<br>2.5                                                                                          | 4.0<br>4.5 | 6.5<br>7.5 | 2.0<br>2.5                                                                                                       | 7.0<br>8.0 | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Disable time<br>WE to Q <sub>n</sub> |                                           | Waveform 4        | 3.5<br>1.5                                                                                          | 5.5<br>3.5 | 8.5<br>6.5 | 3.0<br>1.5                                                                                                       | 9.0<br>7.0 | ns   |

## AC SETUP REQUIREMENT

| SYMBOL                                     | PARAMETER                                                 | TEST<br>CONDITION | LIMITS                                                                                              |     |     |                                                                                                                  |     | UNIT |
|--------------------------------------------|-----------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------|-----|-----|------------------------------------------------------------------------------------------------------------------|-----|------|
|                                            |                                                           |                   | T <sub>amb</sub> = +25°C<br>V <sub>CC</sub> = +5.0V<br>C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω |     |     | T <sub>amb</sub> = 0°C to +70°C<br>V <sub>CC</sub> = +5.0V ± 10%<br>C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω |     |      |
|                                            |                                                           |                   | MIN                                                                                                 | TYP | MAX | MIN                                                                                                              | MAX |      |
|                                            |                                                           |                   |                                                                                                     |     |     |                                                                                                                  |     |      |
| t <sub>SU</sub> (H)<br>t <sub>SU</sub> (L) | Setup time, high or low<br>An to WE                       | Waveform 4        | 4.5<br>4.5                                                                                          |     |     | 5.0<br>5.0                                                                                                       |     | ns   |
| t <sub>H</sub> (H)<br>t <sub>H</sub> (L)   | Hold time, high or low<br>An to WE                        | Waveform 4        | 0<br>0                                                                                              |     |     | 0<br>0                                                                                                           |     | ns   |
| t <sub>SU</sub> (H)<br>t <sub>SU</sub> (L) | Setup time, high or low<br>Dn to WE                       | Waveform 4        | 7.5<br>6.5                                                                                          |     |     | 9.0<br>8.0                                                                                                       |     | ns   |
| t <sub>H</sub> (H)<br>t <sub>H</sub> (L)   | Hold time, high or low<br>Dn to WE                        | Waveform 4        | 0<br>0                                                                                              |     |     | 0<br>0                                                                                                           |     | ns   |
| t <sub>SU</sub> (L)                        | Setup time, low<br>CE (falling edge) to WE (falling edge) | Waveform 4        | 0                                                                                                   |     |     | 0                                                                                                                |     | ns   |
| t <sub>H</sub> (L)                         | Hold time, low<br>WE (falling edge) to WE (rising edge)   | Waveform 4        | 6.5                                                                                                 |     |     | 7.5                                                                                                              |     | ns   |
| t <sub>W</sub> (L)                         | Pulse width, low<br>WE                                    | Waveform 4        | 7.0                                                                                                 |     |     | 8.0                                                                                                              |     | ns   |

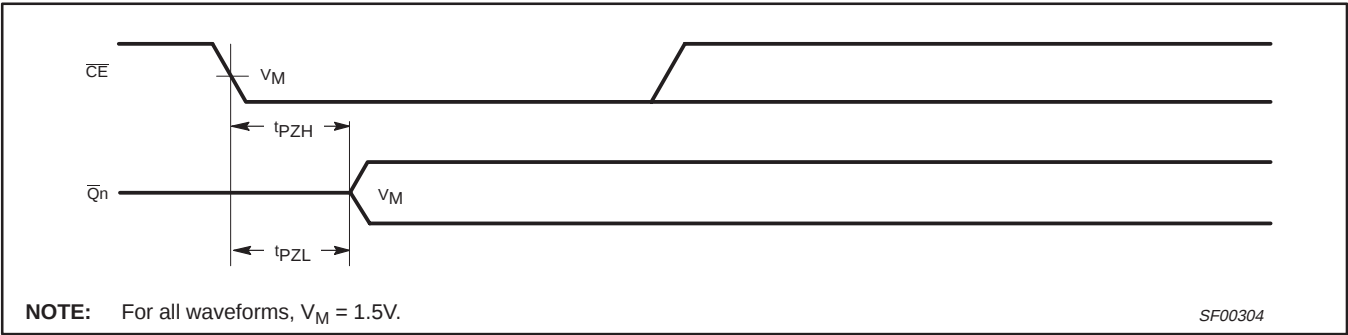
## AC WAVEFORMS FOR READ CYCLES



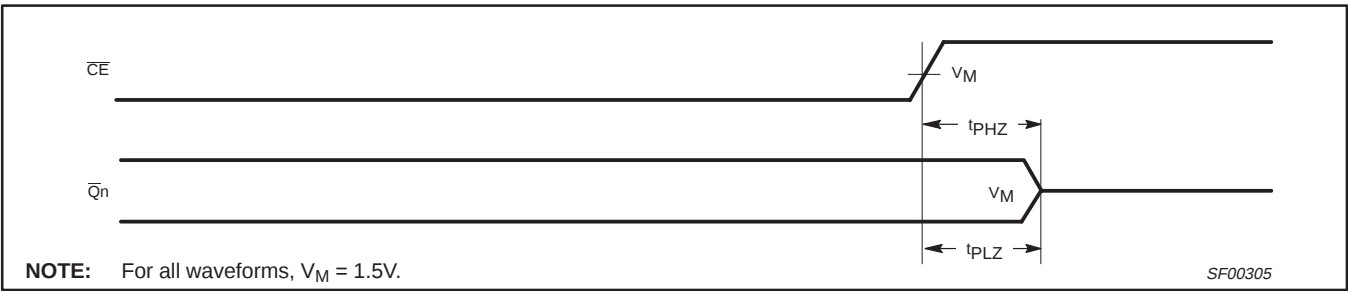
Waveform 1. Read cycle, address access time

64-bit TTL bipolar RAM, inverting (3-State)

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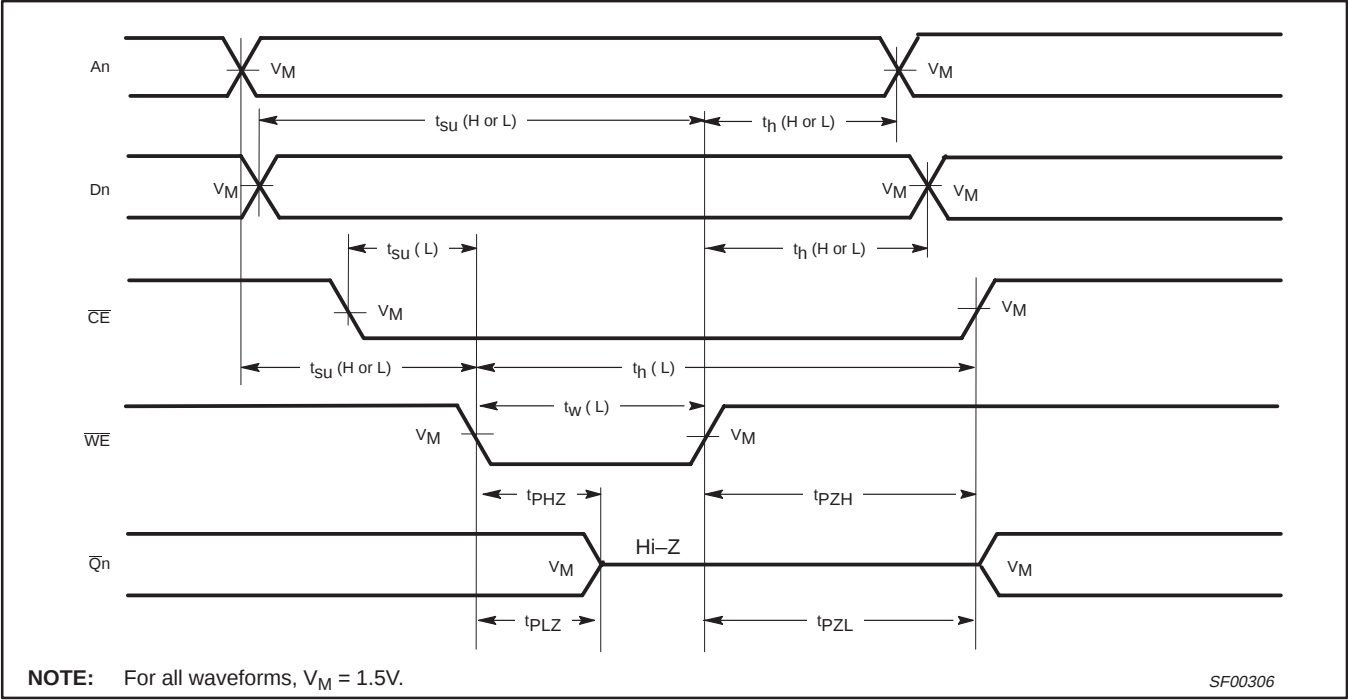


Waveform 2. Read cycle, chip enable access time



Waveform 3. Read cycle, chip disable time

AC WAVEFORMS FOR WRITE CYCLE

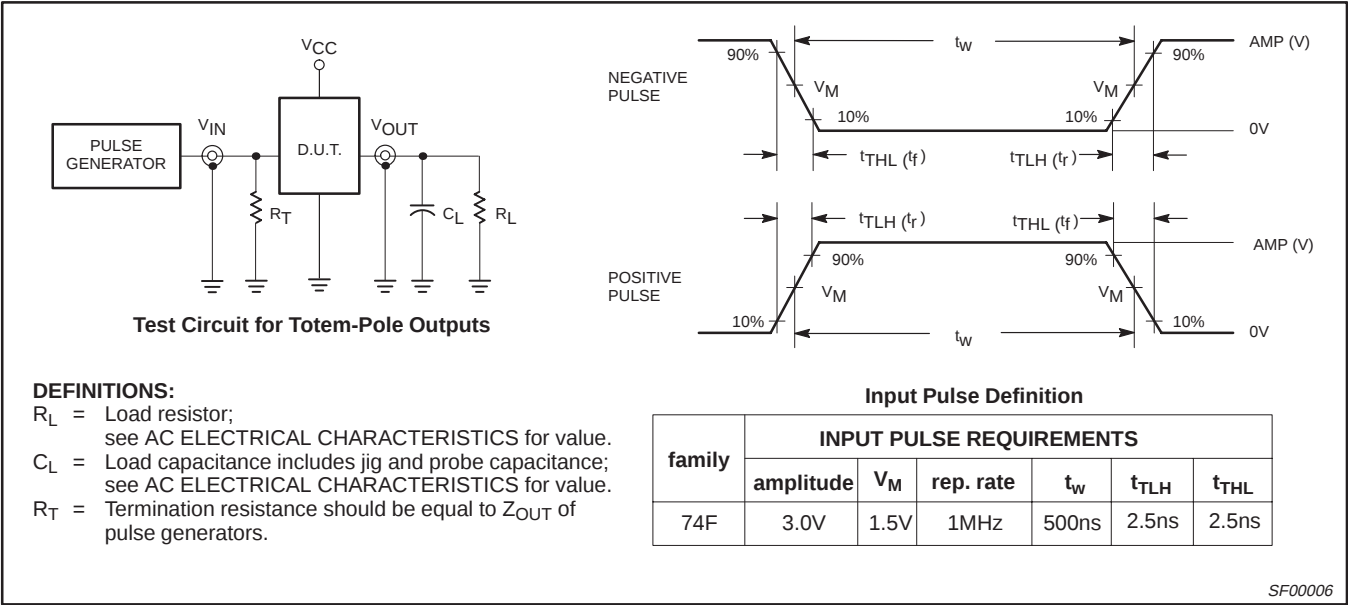


Waveform 4. Write cycle

64-bit TTL bipolar RAM, inverting (3-State)

74F189A

TEST CIRCUIT AND WAVEFORM

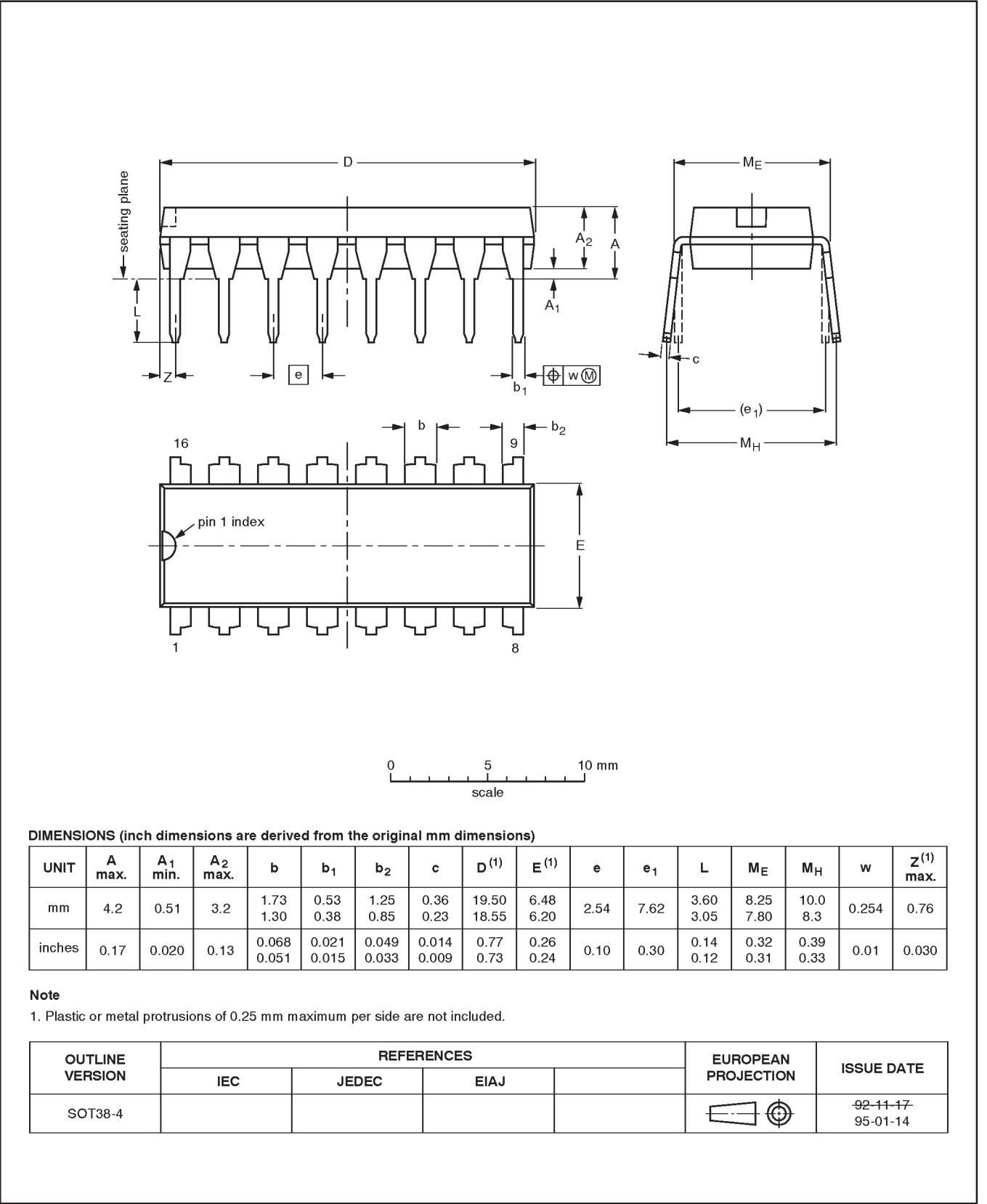


64-bit TTL bipolar RAM, inverting (3-State)

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DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4

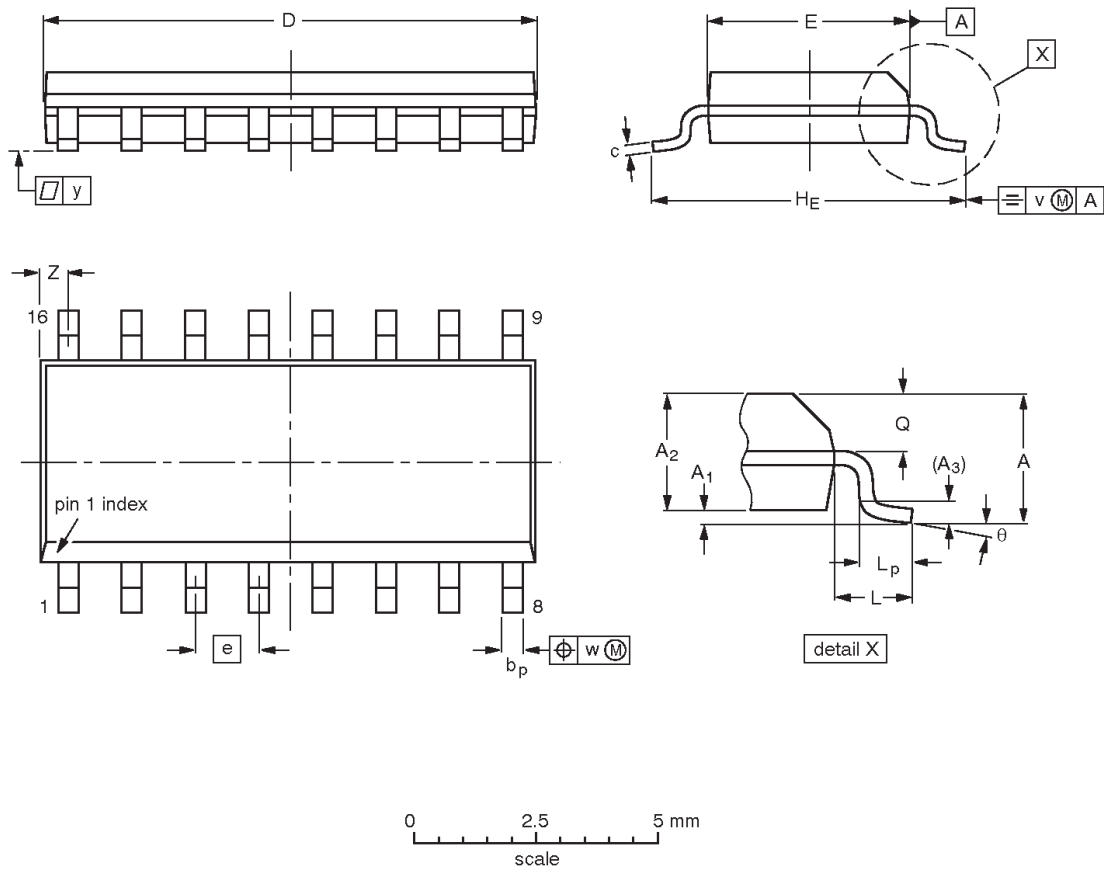


64-bit TTL bipolar RAM, inverting (3-State)

74F189A

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e     | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75      | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 10.0<br>9.8      | 4.0<br>3.8       | 1.27  | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069     | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38     | 0.16<br>0.15     | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |          |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|----------|------|--|------------------------|----------------------|
|                    | IEC        | JEDEC    | EIAJ |  |                        |                      |
| SOT109-1           | 076E07S    | MS-012AC |      |  |                        | 95-01-23<br>97-05-22 |

## 64-bit TTL bipolar RAM, inverting (3-State)

74F189A

## Data sheet status

| Data sheet status         | Product status | Definition [1]                                                                                                                                                                                                                                             |
|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.                                                                                                          |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.                                                       |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

## Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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Philips Semiconductors  
811 East Arques Avenue  
P.O. Box 3409  
Sunnyvale, California 94088-3409  
Telephone 800-234-7381

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print code

Date of release: 10-98

Document order number:

9397-750-05092

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