

# DATA SHEET

For a complete data sheet, please also download:

- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

## HEF4024B

### MSI

## 7-stage binary counter

Product specification  
File under Integrated Circuits, IC04

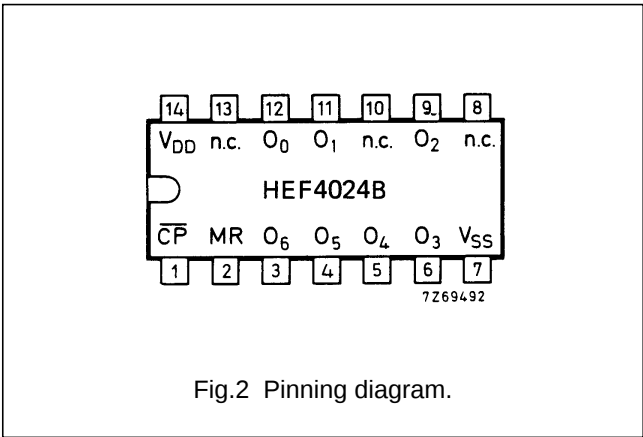
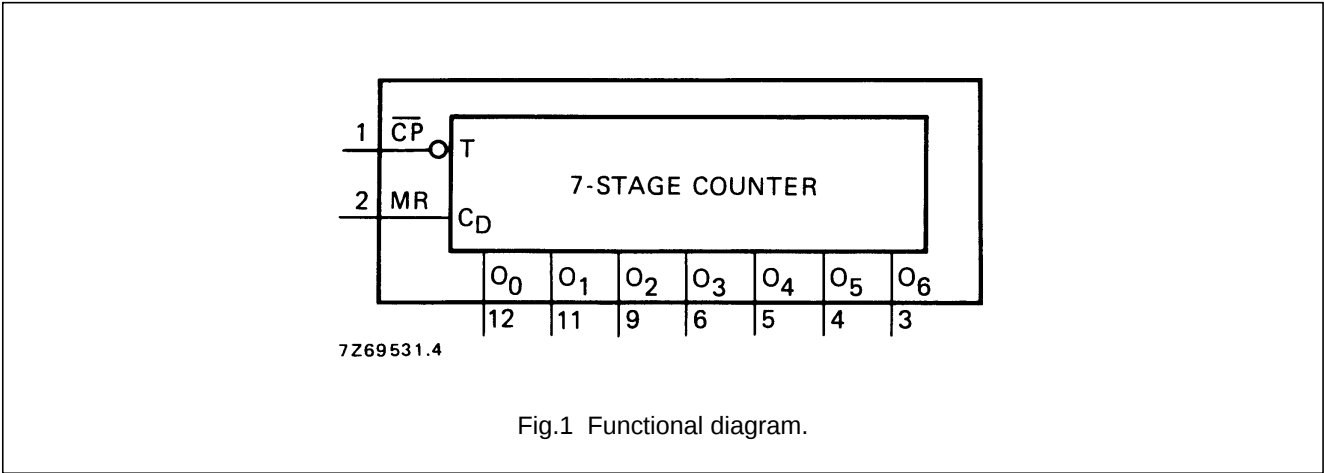
January 1995

7-stage binary counter

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DESCRIPTION

The HEF4024B is a 7-stage binary ripple counter with a clock input ( $\overline{CP}$ ), and overriding asynchronous master reset input (MR) and seven fully buffered parallel outputs ( $O_0$  to  $O_6$ ). The counter advances on the HIGH to LOW transition of  $\overline{CP}$ . A HIGH on MR clears all counter stages and forces all outputs LOW, independent of  $\overline{CP}$ . Each counter stage is a static toggle flip-flop.



PINNING

|                                  |                                     |
|----------------------------------|-------------------------------------|
| $\overline{CP}$                  | clock input (HIGH to LOW triggered) |
| MR                               | master reset input                  |
| O <sub>0</sub> to O <sub>6</sub> | buffered parallel outputs           |

APPLICATION INFORMATION

- Some examples of applications for the HEF4024B are:
- Frequency dividers
  - Time delay circuits

FAMILY DATA, I<sub>DD</sub> LIMITS category MSI

See Family Specifications

- HEF4024BP(N): 14-lead DIL; plastic  
(SOT27-1)
- HEF4024BD(F): 14-lead DIL; ceramic (cerdip)  
(SOT73)
- HEF4024BT(D): 14-lead SO; plastic  
(SOT108-1)
- ( ): Package Designator North America

## 7-stage binary counter

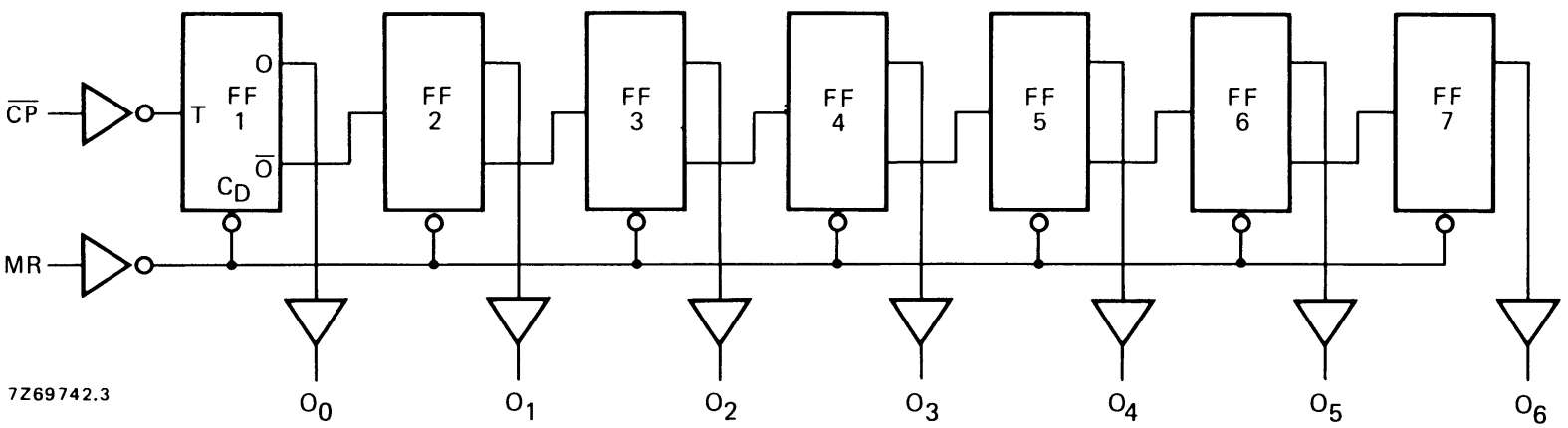
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Fig.3 Logic diagram.

## 7-stage binary counter

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## AC CHARACTERISTICS

$V_{SS} = 0$  V;  $T_{amb} = 25$  °C;  $C_L = 50$  pF; input transition times  $\leq 20$  ns; see also waveforms Fig.4

|                                     | V <sub>DD</sub><br>V | SYMBOL            | MIN. | TYP. | MAX. | TYPICAL<br>EXTRAPOLATION<br>FORMULA |                                     |
|-------------------------------------|----------------------|-------------------|------|------|------|-------------------------------------|-------------------------------------|
| Propagation delays                  |                      |                   |      |      |      |                                     |                                     |
| $\overline{CP} \rightarrow O_0$     | 5                    |                   |      | 100  | 200  | ns                                  | 73 ns + (0,55 ns/pF) C <sub>L</sub> |
| HIGH to LOW                         | 10                   | t <sub>PHL</sub>  |      | 40   | 75   | ns                                  | 29 ns + (0,23 ns/pF) C <sub>L</sub> |
|                                     | 15                   |                   |      | 25   | 50   | ns                                  | 17 ns + (0,16 ns/pF) C <sub>L</sub> |
| LOW to HIGH                         | 5                    | t <sub>PLH</sub>  |      | 105  | 210  | ns                                  | 78 ns + (0,55 ns/pF) C <sub>L</sub> |
|                                     | 10                   |                   |      | 45   | 85   | ns                                  | 34 ns + (0,23 ns/pF) C <sub>L</sub> |
|                                     | 15                   |                   |      | 30   | 60   | ns                                  | 22 ns + (0,16 ns/pF) C <sub>L</sub> |
| O <sub>n</sub> → O <sub>n</sub> + 1 | 5                    |                   |      | 60   | 120  | ns                                  | 33 ns + (0,55 ns/pF) C <sub>L</sub> |
| HIGH to LOW                         | 10                   | t <sub>PHL</sub>  |      | 25   | 50   | ns                                  | 14 ns + (0,23 ns/pF) C <sub>L</sub> |
|                                     | 15                   |                   |      | 20   | 40   | ns                                  | 12 ns + (0,16 ns/pF) C <sub>L</sub> |
| LOW to HIGH                         | 5                    | t <sub>PLH</sub>  |      | 50   | 100  | ns                                  | 23 ns + (0,55 ns/pF) C <sub>L</sub> |
|                                     | 10                   |                   |      | 20   | 40   | ns                                  | 9 ns + (0,23 ns/pF) C <sub>L</sub>  |
|                                     | 15                   |                   |      | 15   | 30   | ns                                  | 7 ns + (0,16 ns/pF) C <sub>L</sub>  |
| MR → O <sub>n</sub>                 | 5                    |                   |      | 120  | 240  | ns                                  | 93 ns + (0,55 ns/pF) C <sub>L</sub> |
| HIGH to LOW                         | 10                   | t <sub>PHL</sub>  |      | 45   | 90   | ns                                  | 34 ns + (0,23 ns/pF) C <sub>L</sub> |
|                                     | 15                   |                   |      | 30   | 60   | ns                                  | 22 ns + (0,16 ns/pF) C <sub>L</sub> |
| Output transition times             | 5                    |                   |      | 60   | 120  | ns                                  | 10 ns + (1,0 ns/pF) C <sub>L</sub>  |
| HIGH to LOW                         | 10                   | t <sub>THL</sub>  |      | 30   | 60   | ns                                  | 9 ns + (0,42 ns/pF) C <sub>L</sub>  |
|                                     | 15                   |                   |      | 20   | 40   | ns                                  | 6 ns + (0,28 ns/pF) C <sub>L</sub>  |
| LOW to HIGH                         | 5                    | t <sub>TLH</sub>  |      | 60   | 120  | ns                                  | 10 ns + (1,0 ns/pF) C <sub>L</sub>  |
|                                     | 10                   |                   |      | 30   | 60   | ns                                  | 9 ns + (0,42 ns/pF) C <sub>L</sub>  |
|                                     | 15                   |                   |      | 20   | 40   | ns                                  | 6 ns + (0,28 ns/pF) C <sub>L</sub>  |
| Minimum clock<br>pulse width; HIGH  | 5                    |                   | 60   | 30   |      | ns                                  |                                     |
|                                     | 10                   | t <sub>WCPH</sub> | 30   | 15   |      | ns                                  |                                     |
|                                     | 15                   |                   | 20   | 10   |      | ns                                  |                                     |
| Minimum MR<br>pulse width; HIGH     | 5                    |                   | 80   | 40   |      | ns                                  |                                     |
|                                     | 10                   | t <sub>WMRH</sub> | 35   | 20   |      | ns                                  |                                     |
|                                     | 15                   |                   | 25   | 15   |      | ns                                  |                                     |
| Recovery time<br>for MR             | 5                    |                   | 20   | 10   |      | ns                                  |                                     |
|                                     | 10                   | t <sub>RMR</sub>  | 15   | 5    |      | ns                                  |                                     |
|                                     | 15                   |                   | 15   | 5    |      | ns                                  |                                     |
| Maximum clock<br>pulse frequency    | 5                    |                   | 5    | 10   |      | MHz                                 |                                     |
|                                     | 10                   | f <sub>max</sub>  | 13   | 25   |      | MHz                                 |                                     |
|                                     | 15                   |                   | 18   | 35   |      | MHz                                 |                                     |

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|                                                 | $V_{DD}$<br>V | TYPICAL FORMULA FOR P ( $\mu$ W)            |                                                                                                                                                                  |
|-------------------------------------------------|---------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dynamic power<br>dissipation per<br>package (P) | 5             | $500 f_i + \sum (f_o C_L) \times V_{DD}^2$  | where<br>$f_i$ = input freq. (MHz)<br>$f_o$ = output freq. (MHz)<br>$C_L$ = load cap. (pF)<br>$\sum (f_o C_L)$ = sum of outputs<br>$V_{DD}$ = supply voltage (V) |
|                                                 | 10            | $2100 f_i + \sum (f_o C_L) \times V_{DD}^2$ |                                                                                                                                                                  |
|                                                 | 15            | $5200 f_i + \sum (f_o C_L) \times V_{DD}^2$ |                                                                                                                                                                  |

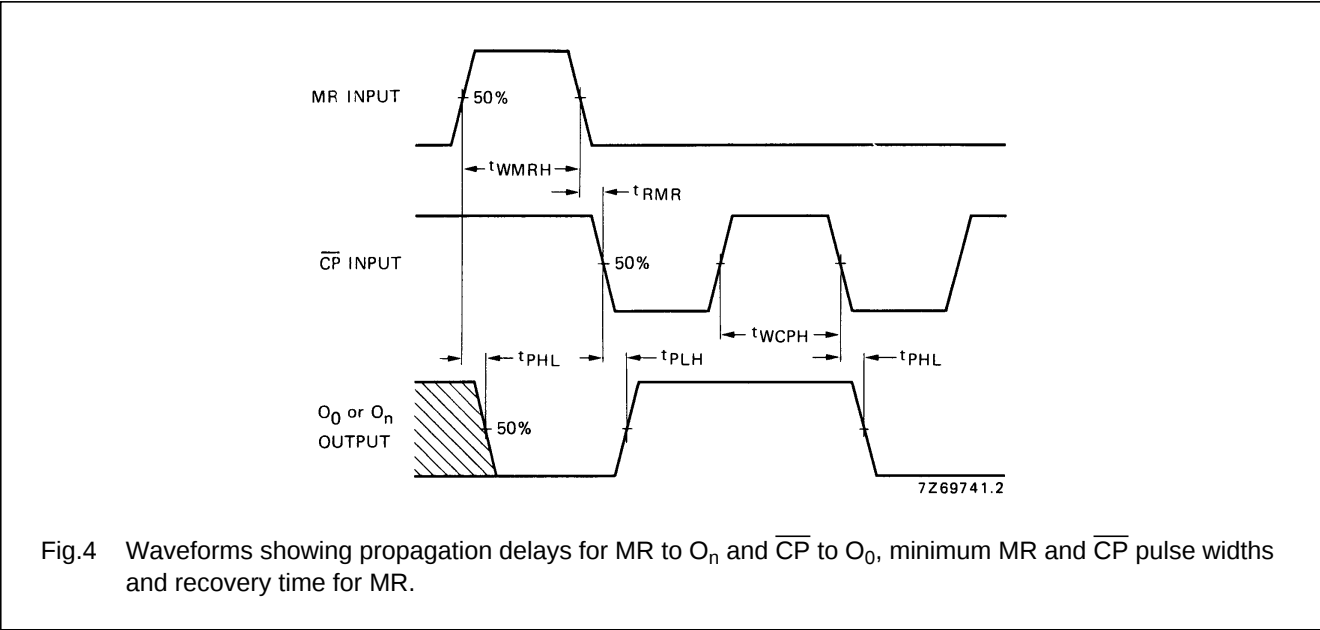


Fig.4 Waveforms showing propagation delays for MR to  $O_n$  and  $\overline{CP}$  to  $O_0$ , minimum MR and  $\overline{CP}$  pulse widths and recovery time for MR.

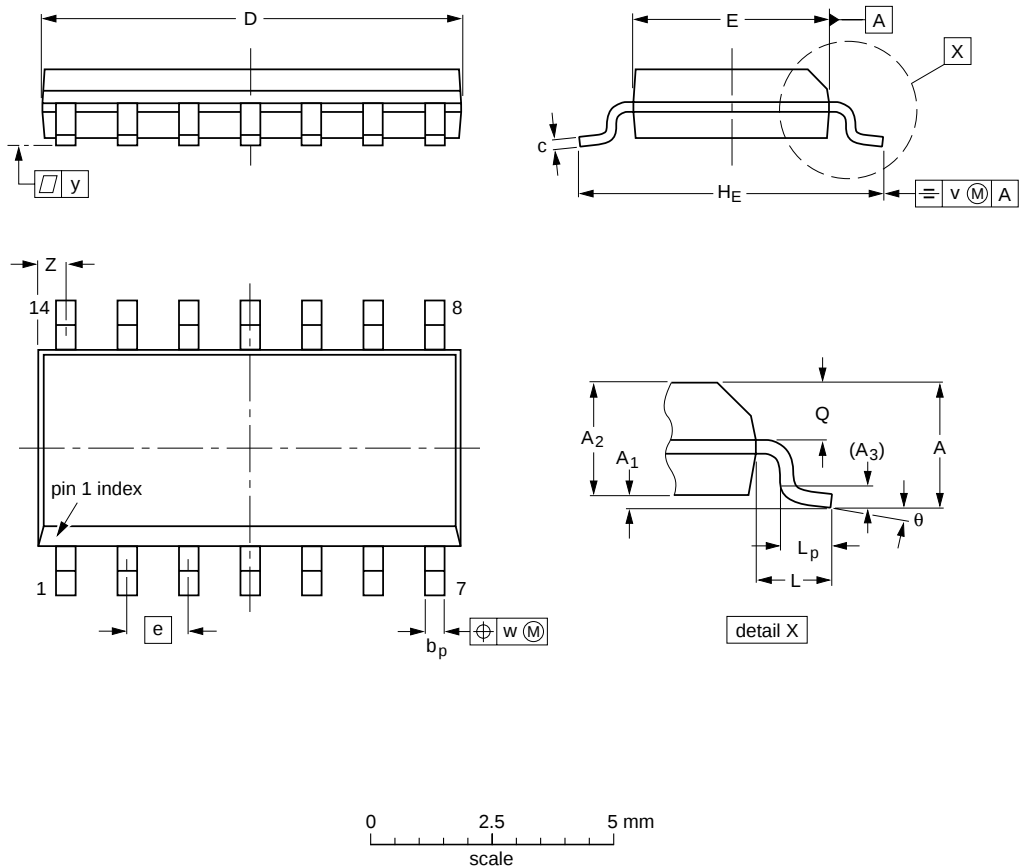
Package information

Package outlines

SO

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



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     | 8.75<br>8.55     | 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 | 0.35<br>0.34     | 0.16<br>0.15     | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 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 |  |                        |                      |
| SOT108-1           | 076E06S    | MS-012AB |      |  |                        | 95-01-23<br>97-05-22 |

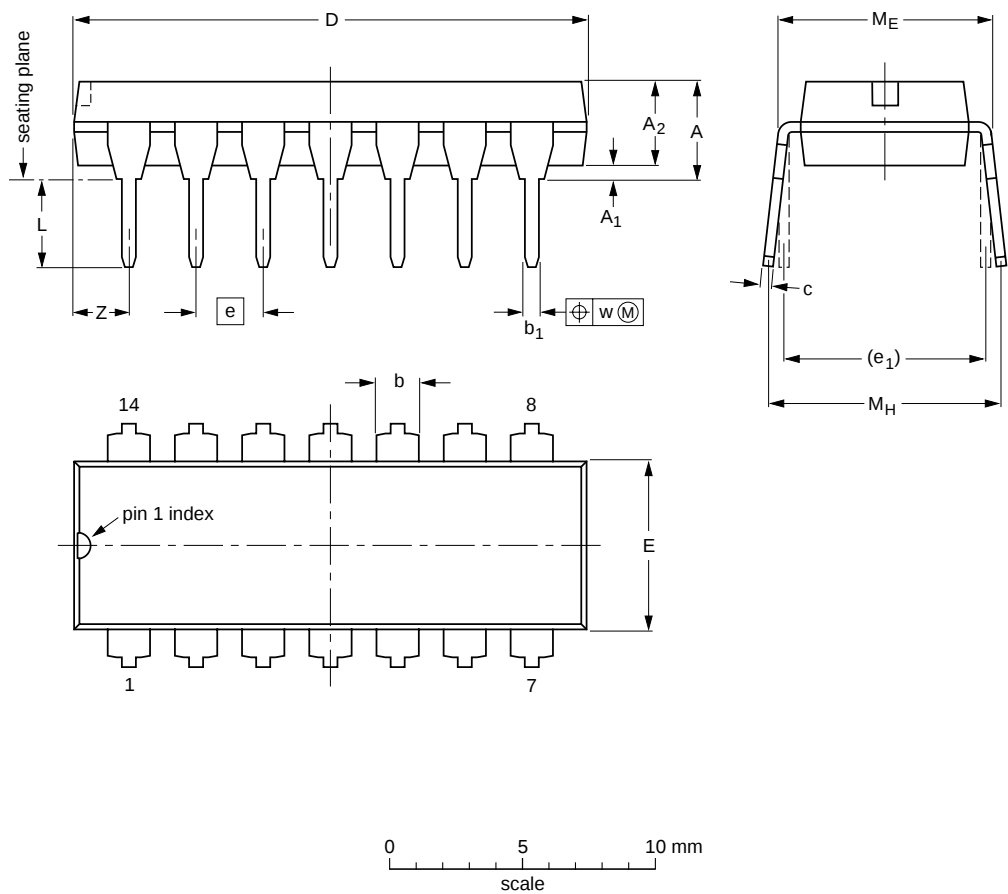
Package information

Package outlines

DIP

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



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

| UNIT   | A<br>max. | A <sub>1</sub><br>min. | A <sub>2</sub><br>max. | b              | b <sub>1</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup><br>max. |
|--------|-----------|------------------------|------------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| mm     | 4.2       | 0.51                   | 3.2                    | 1.73<br>1.13   | 0.53<br>0.38   | 0.36<br>0.23   | 19.50<br>18.55   | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 2.2                      |
| inches | 0.17      | 0.020                  | 0.13                   | 0.068<br>0.044 | 0.021<br>0.015 | 0.014<br>0.009 | 0.77<br>0.73     | 0.26<br>0.24     | 0.10 | 0.30           | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.087                    |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |          |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|----------|------|--|------------------------|----------------------|
|                    | IEC        | JEDEC    | EIAJ |  |                        |                      |
| SOT27-1            | 050G04     | MO-001AA |      |  |                        | 92-11-17<br>95-03-11 |