

# 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

## **HEF4104B** **MSI**

Quadruple low to high voltage translator with 3-state outputs

Product specification  
File under Integrated Circuits, IC04

January 1995

Quadruple low to high voltage translator  
with 3-state outputs

HEF4104B  
MSI

DESCRIPTION

The HEF4104B quadruple low voltage to high voltage translator with 3-state outputs provides the capability of interfacing low voltage circuits to high voltage circuits, such as low voltage LOCMOS and TTL to high voltage LOCMOS. It has four data inputs ( $I_0$  to  $I_3$ ), an active HIGH output enable input (EO), four data outputs ( $O_0$  to  $O_3$ ) and their complements ( $\bar{O}_0$  to  $\bar{O}_3$ ).

With EO HIGH,  $O_0$  to  $O_3$  and  $\bar{O}_0$  to  $\bar{O}_3$  are in the low impedance ON-state, either HIGH or LOW as determined by  $I_0$  to  $I_3$ ; with EO LOW,  $O_0$  to  $O_3$  and  $\bar{O}_0$  to  $\bar{O}_3$  are in the high impedance OFF-state.

The device uses a common negative supply ( $V_{SS}$ ) and separate positive supplies for inputs ( $V_{DDI}$ ) and outputs ( $V_{DDO}$ ).  $V_{DDI}$  must always be less than or equal to  $V_{DDO}$ , even during power turn-on and turn-off. For the permissible operating range of  $V_{DDI}$  and  $V_{DDO}$  see graph Fig.4.

Each input protection circuit is terminated between  $V_{DDO}$  and  $V_{SS}$ . This allows the input signals to be driven from any potential between  $V_{DDO}$  and  $V_{SS}$ , without regard to current limiting. When driving from potentials greater than  $V_{DDO}$  or less than  $V_{SS}$ , the current at each input must be limited to 10 mA.

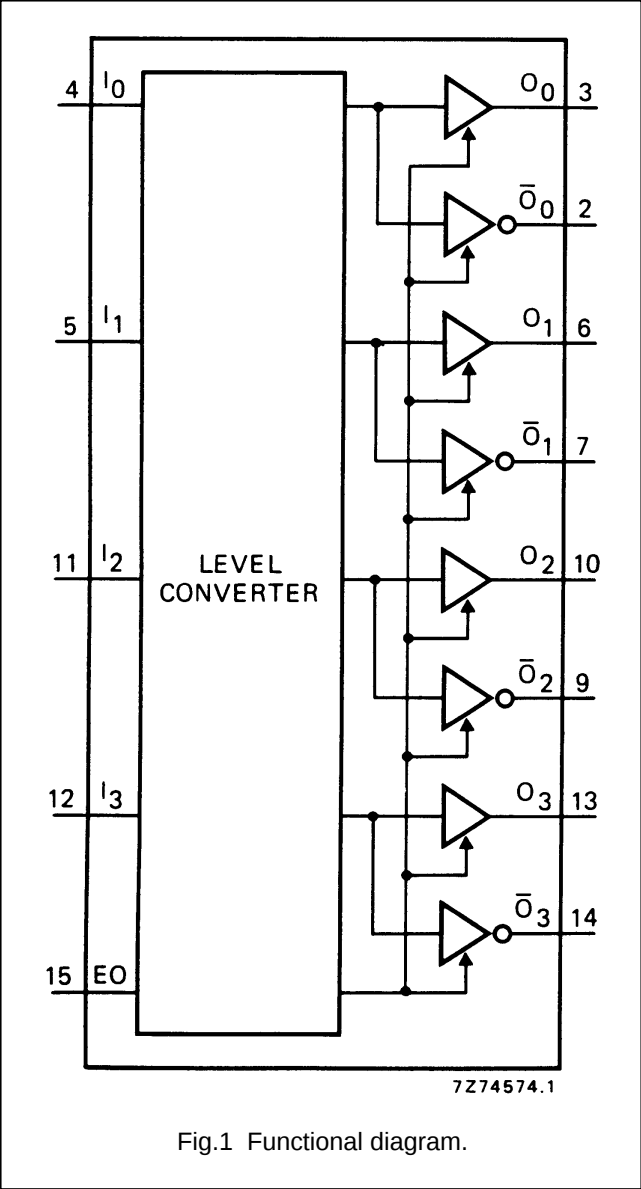
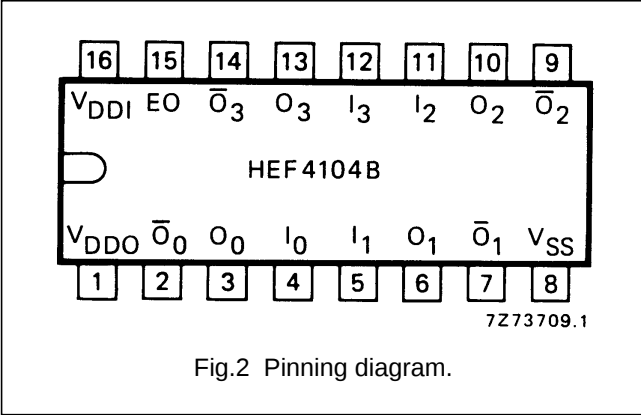


Fig.1 Functional diagram.



- HEF4104BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF4104BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF4104BT(D): 16-lead SO; plastic (SOT109-1)
- ( ): Package Designator North America

PINNING

- $I_0$  to  $I_3$  data inputs
- EO output enable input
- $O_0$  to  $O_3$  data outputs
- $\bar{O}_0$  to  $\bar{O}_3$  complementary data outputs

FAMILY DATA,  $I_{DD}$  LIMITS category MSI

See Family Specifications

# Quadruple low to high voltage translator with 3-state outputs

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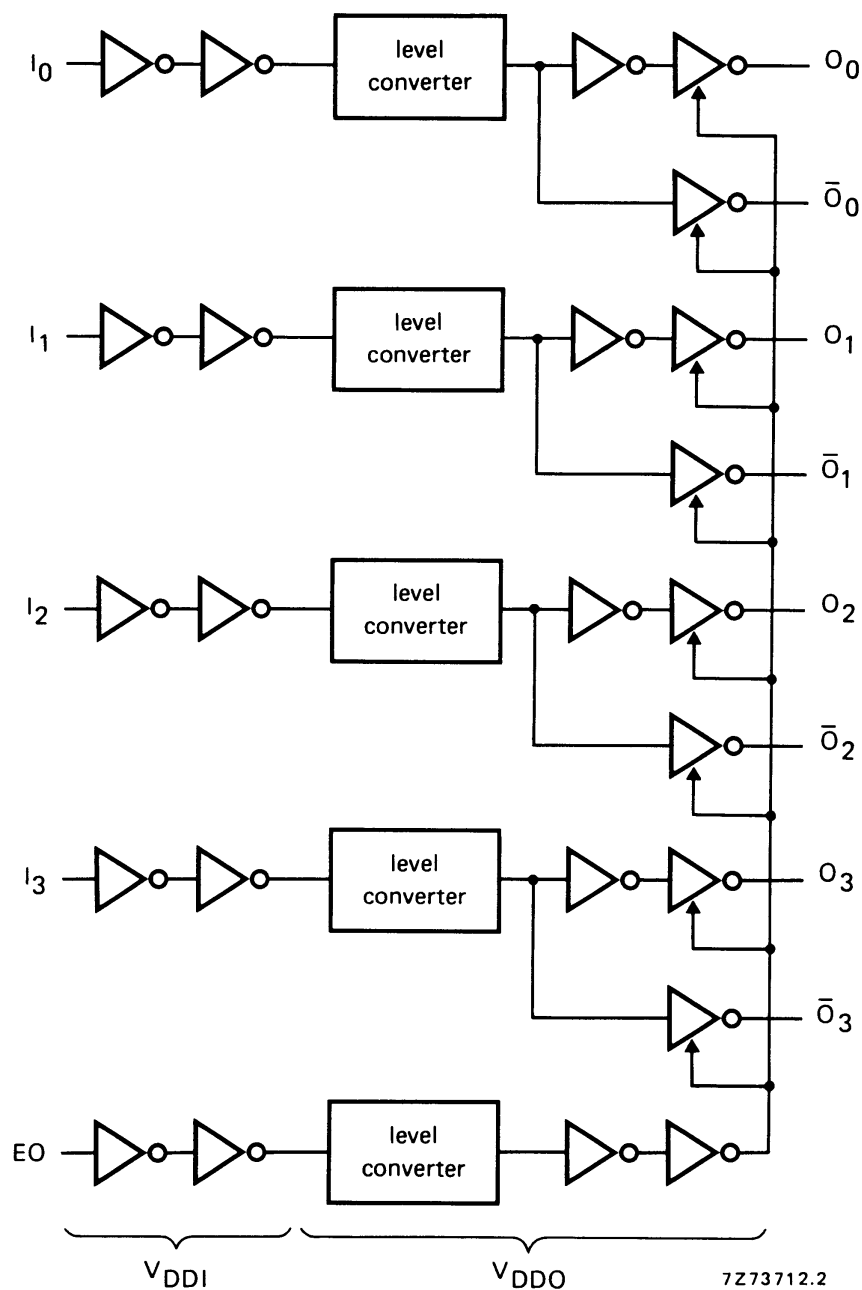


Fig.3 Logic diagram.

# Quadruple low to high voltage translator with 3-state outputs

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## AC CHARACTERISTICS

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

|                                                                                                                                                                                                        | $V_{DD}$<br>V | SYMBOL    | TYP. | MAX. |    | TYPICAL EXTRAPOLATION<br>FORMULA |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------|------|------|----|----------------------------------|
| Propagation delays<br>$I_n \rightarrow O_n, \overline{O}_n$<br>HIGH to LOW                                                                                                                             | 5             | $t_{PHL}$ | 170  | 340  | ns | 143 ns + (0,55 ns/pF) $C_L$      |
|                                                                                                                                                                                                        | 10            |           | 80   | 160  | ns | 69 ns + (0,23 ns/pF) $C_L$       |
|                                                                                                                                                                                                        | 15            |           | 65   | 135  | ns | 57 ns + (0,16 ns/pF) $C_L$       |
|                                                                                                                                                                                                        | 5             | $t_{PLH}$ | 170  | 340  | ns | 143 ns + (0,55 ns/pF) $C_L$      |
|                                                                                                                                                                                                        | 10            |           | 80   | 160  | ns | 69 ns + (0,23 ns/pF) $C_L$       |
|                                                                                                                                                                                                        | 15            |           | 70   | 140  | ns | 62 ns + (0,16 ns/pF) $C_L$       |
| Output transition times<br>HIGH to LOW                                                                                                                                                                 | 5             | $t_{THL}$ | 60   | 120  | ns | 10 ns + (1,0 ns/pF) $C_L$        |
|                                                                                                                                                                                                        | 10            |           | 30   | 60   | ns | 9 ns + (0,42 ns/pF) $C_L$        |
|                                                                                                                                                                                                        | 15            |           | 20   | 40   | ns | 6 ns + (0,28 ns/pF) $C_L$        |
|                                                                                                                                                                                                        | 5             | $t_{TLH}$ | 60   | 120  | ns | 10 ns + (1,0 ns/pF) $C_L$        |
|                                                                                                                                                                                                        | 10            |           | 30   | 60   | ns | 9 ns + (0,42 ns/pF) $C_L$        |
|                                                                                                                                                                                                        | 15            |           | 20   | 40   | ns | 6 ns + (0,28 ns/pF) $C_L$        |
| 3-state propagation<br>delays<br>Output disable times<br>$EO \rightarrow O_n, \overline{O}_n$<br>HIGH<br><br>LOW<br><br>Output enable times<br>$EO \rightarrow O_n, \overline{O}_n$<br>HIGH<br><br>LOW | 5             | $t_{PHZ}$ | 70   | 135  | ns |                                  |
|                                                                                                                                                                                                        | 10            |           | 55   | 110  | ns |                                  |
|                                                                                                                                                                                                        | 15            |           | 60   | 120  | ns |                                  |
|                                                                                                                                                                                                        | 5             | $t_{PLZ}$ | 70   | 135  | ns |                                  |
|                                                                                                                                                                                                        | 10            |           | 55   | 105  | ns |                                  |
|                                                                                                                                                                                                        | 15            |           | 55   | 110  | ns |                                  |
|                                                                                                                                                                                                        | 5             | $t_{PZH}$ | 195  | 395  | ns |                                  |
|                                                                                                                                                                                                        | 10            |           | 95   | 195  | ns |                                  |
|                                                                                                                                                                                                        | 15            |           | 80   | 165  | ns |                                  |
|                                                                                                                                                                                                        | 5             | $t_{PZL}$ | 195  | 395  | ns |                                  |
|                                                                                                                                                                                                        | 10            |           | 95   | 190  | ns |                                  |
|                                                                                                                                                                                                        | 15            |           | 80   | 160  | ns |                                  |

|                                                 | $V_{DD}$<br>V | TYPICAL FORMULA FOR P ( $\mu$ W)               |                                                                                                                                                                         |
|-------------------------------------------------|---------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dynamic power<br>dissipation per<br>package (P) | 5             | $3\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$  | where<br>$f_i$ = input freq. (MHz)<br>$f_o$ = output freq. (MHz)<br>$C_L$ = load capacitance (pF)<br>$\sum (f_o C_L)$ = sum of outputs<br>$V_{DD}$ = supply voltage (V) |
|                                                 | 10            | $12\,200 f_i + \sum (f_o C_L) \times V_{DD}^2$ |                                                                                                                                                                         |
|                                                 | 15            | $31\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$ |                                                                                                                                                                         |

# Quadruple low to high voltage translator with 3-state outputs

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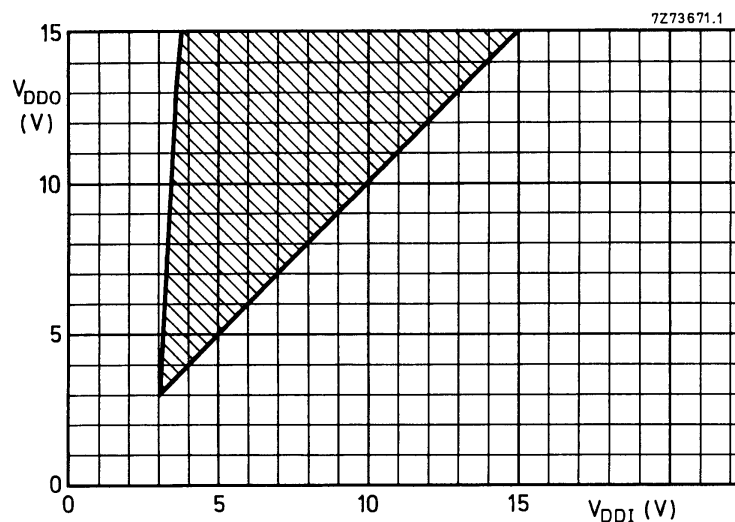


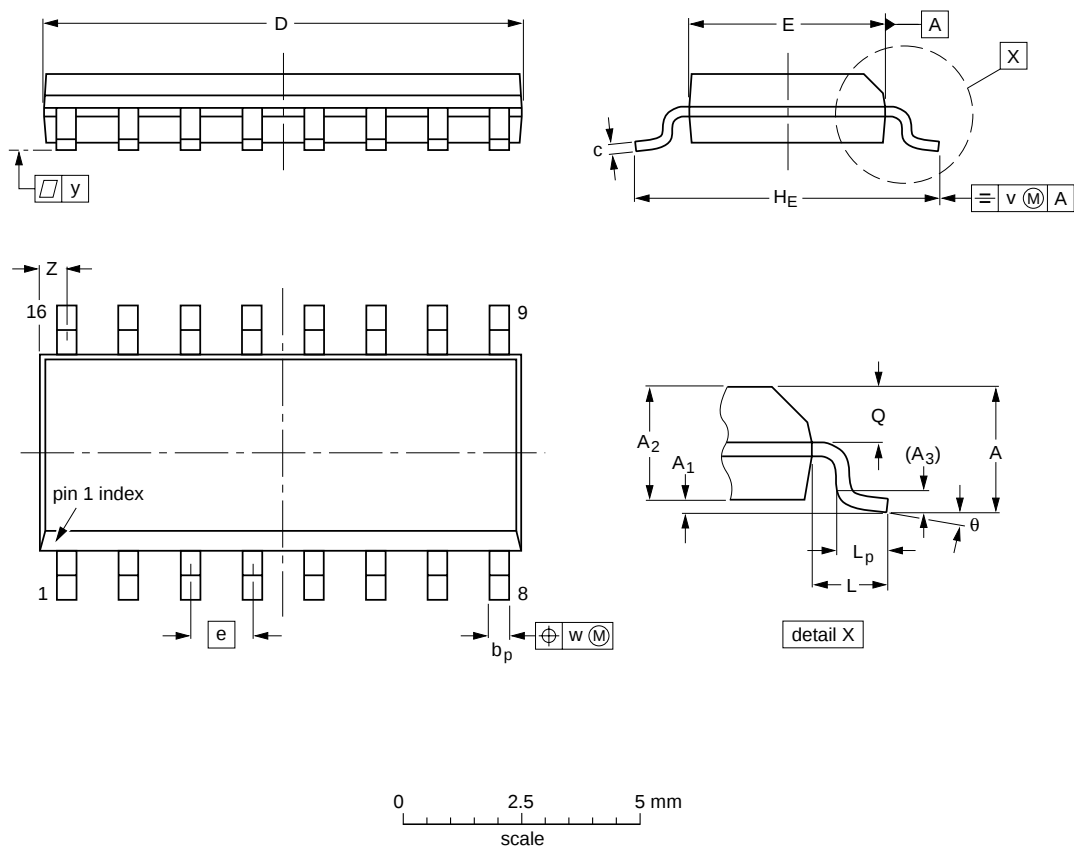
Fig.4  $V_{DDO}$  as a function of  $V_{DDI}$ ; the shaded area shows the permissible operating range.

Package information

Package outlines

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 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.

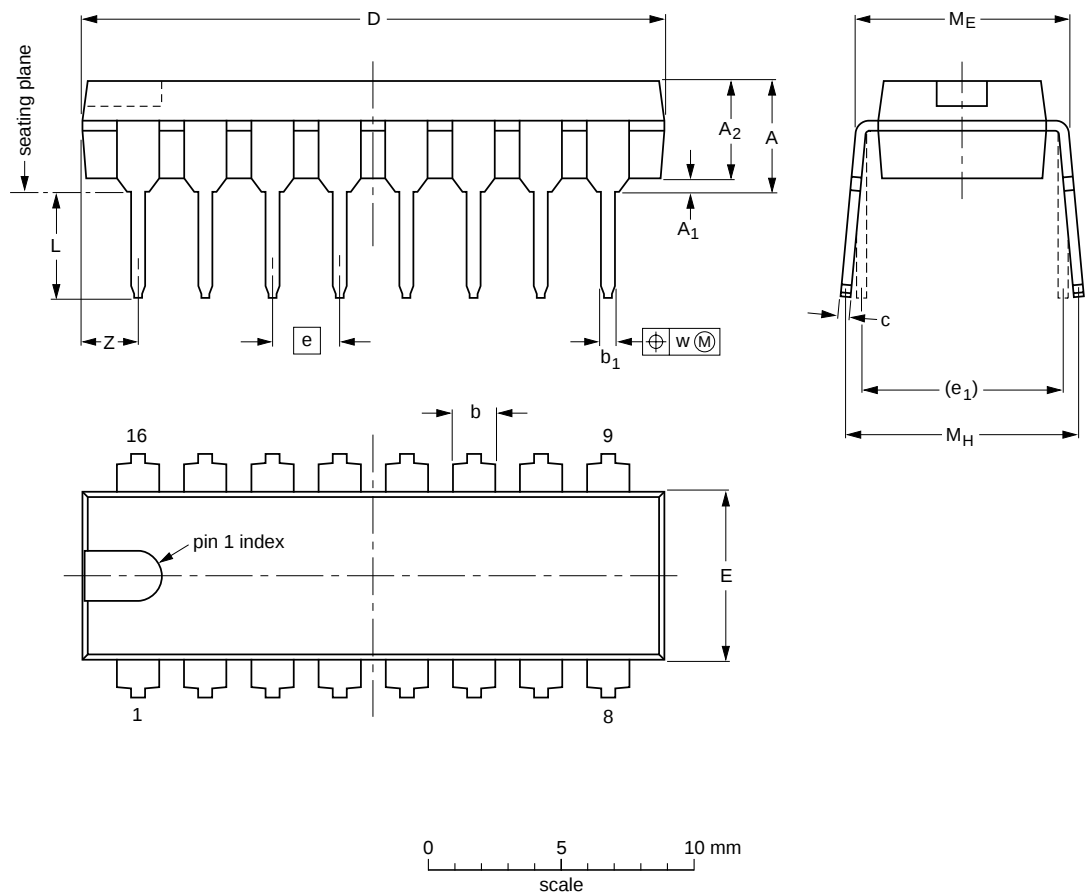
| OUTLINE<br>VERSION | REFERENCES |          |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|----------|------|--|------------------------|----------------------|
|                    | IEC        | JEDEC    | EIAJ |  |                        |         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

Package information

Package outlines

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

SOT38-1



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     | 4.7       | 0.51                   | 3.7                    | 1.40<br>1.14   | 0.53<br>0.38   | 0.32<br>0.23   | 21.8<br>21.4     | 6.48<br>6.20     | 2.54 | 7.62           | 3.9<br>3.4   | 8.25<br>7.80   | 9.5<br>8.3     | 0.254 | 2.2                      |
| inches | 0.19      | 0.020                  | 0.15                   | 0.055<br>0.045 | 0.021<br>0.015 | 0.013<br>0.009 | 0.86<br>0.84     | 0.26<br>0.24     | 0.10 | 0.30           | 0.15<br>0.13 | 0.32<br>0.31   | 0.37<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 |  |                                                                                       |                       |
| SOT38-1            | 050G09     | MO-001AE |      |  |  | 92-10-02-<br>95-01-19 |