# DATA SHEET

**74LV139**

## Dual 2-to-4 line decoder/demultiplexer

**Philips**
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## Dual 2-to-4 line decoder/demultiplexer                                                    74LV139

### FEATURES

- Wide operating voltage: 1.0 to 5.5 V
- Optimized for low voltage applications: 1.0 to 3.6 V
- Accepts TTL input levels between $V_{CC}$ = 2.7 V and $V_{CC}$ = 3.6 V
- Typical $V_{OLP}$ (output ground bounce) < 0.8 V at $V_{CC}$ = 3.3 V, $T_{amb}$ = 25°C
- Typical $V_{OHV}$ (output $V_{OH}$ undershoot) > 2 V at $V_{CC}$ = 3.3 V, $T_{amb}$ = 25°C
- Demultiplexing capability
- Two independent 2-to-4 decoders
- Multifunction capability
- Active LOW mutually exclusive outputs
- Output capability: standard
- $I_{CC}$ category: MSI

### APPLICATIONS

- Memory decoding or data-routing
- Code conversion

### DESCRIPTION

The 74LV139 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC/HCT139.

The 74LV139 is a dual 2-to-4 line decoder/demultiplexer. This device has two independent decoders, each accepting two binary weighted inputs ($nA_0$ and $nA_1$) and providing four mutually exclusive active LOW outputs ($n\overline{Y}_0$ to $n\overline{Y}_3$). Each decoder has an active LOW enable input ($n\overline{E}$).

When $n\overline{E}$ is HIGH, every output is forced HIGH. The enable can be used as the data input for a 1-to-4 demultiplexer application.

### QUICK REFERENCE DATA

GND = 0 V; $T_{amb}$ = 25°C; $t_r$ = $t_f$ $\leq$ 2.5 ns

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | UNIT |
|---|---|---|---|---|
| $t_{PHL}/t_{PLH}$ | Propagation delay $nA_n$ to $n\overline{Y}_n$, $n\overline{E}$ to $n\overline{Y}_n$ | $C_L$ = 15 pF; $V_{CC}$ = 3.3 V | 11 10 | ns |
| $C_I$ | Input capacitance | | 3.5 | pF |
| $C_{PD}$ | Power dissipation capacitance per multiplexer | $V_{CC}$ = 3.3 V $V_I$ = GND to $V_{CC}$[1] | 42 | pF |

**NOTES:**
1. $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in $\mu$W)
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:
   $f_i$ = input frequency in MHz; $C_L$ = output load capacitance in pF;
   $f_o$ = output frequency in MHz; $V_{CC}$ = supply voltage in V;
   $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

### ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | PKG. DWG. # |
|---|---|---|---|---|
| 16-Pin Plastic DIL | −40°C to +125°C | 74LV139 N | 74LV139 N | SOT38-4 |
| 16-Pin Plastic SO | −40°C to +125°C | 74LV139 D | 74LV139 D | SOT109-1 |
| 16-Pin Plastic SSOP Type II | −40°C to +125°C | 74LV139 DB | 74LV139 DB | SOT338-1 |
| 16-Pin Plastic TSSOP Type I | −40°C to +125°C | 74LV139 PW | 74LV139PW DH | SOT403-1 |

### PIN CONFIGURATION



SV00530
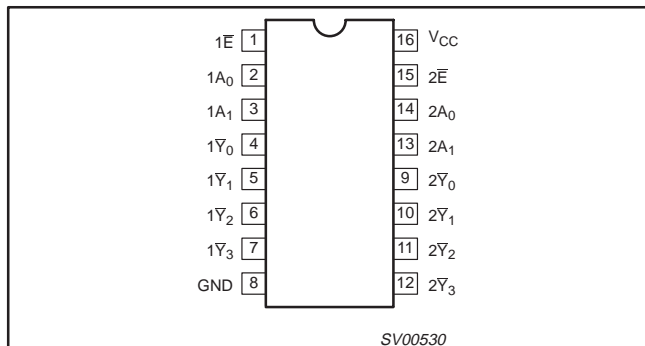
### PIN DESCRIPTION

| PIN NUMBER | SYMBOL | FUNCTION |
|---|---|---|
| 1, 15 | $1\overline{E}$, $2\overline{E}$ | Enable inputs (active LOW) |
| 2, 3 | $1A_0$, $1A_1$ | Address inputs |
| 4, 5, 6, 7 | $1\overline{Y}_0$ to $1\overline{Y}_3$ | Outputs (active LOW) |
| 8 | GND | Ground (0 V) |
| 12, 11, 10, 9 | $2\overline{Y}_0$ to $2\overline{Y}_3$ | Outputs (active LOW) |
| 14, 13 | $2A_0$, $2A_1$ | Address inputs |
| 16 | $V_{CC}$ | Positive supply voltage |

## Dual 2-to-4 line decoder/demultiplexer

## 74LV139

## LOGIC DIAGRAM



SV00531
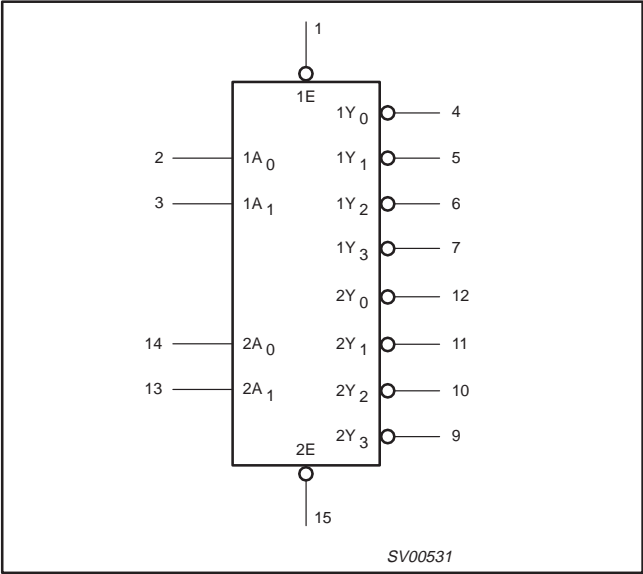
## FUNCTIONAL DIAGRAM



SV00534
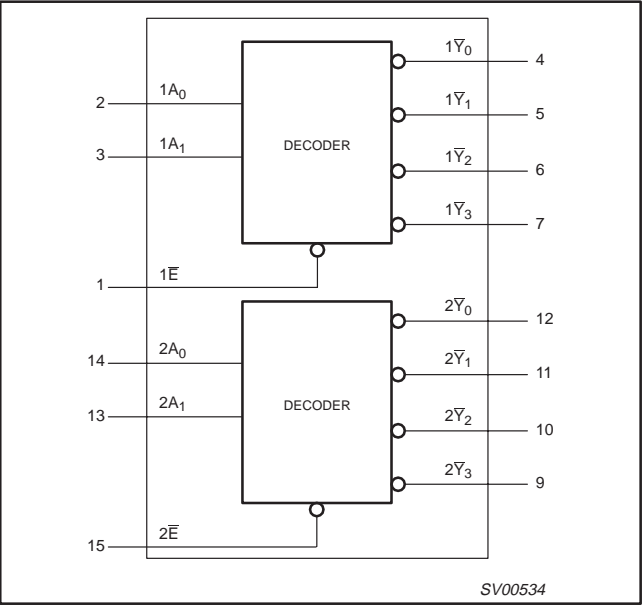
## LOGIC SYMBOL (IEEE/IEC)



(a)                    (b)

SV00532
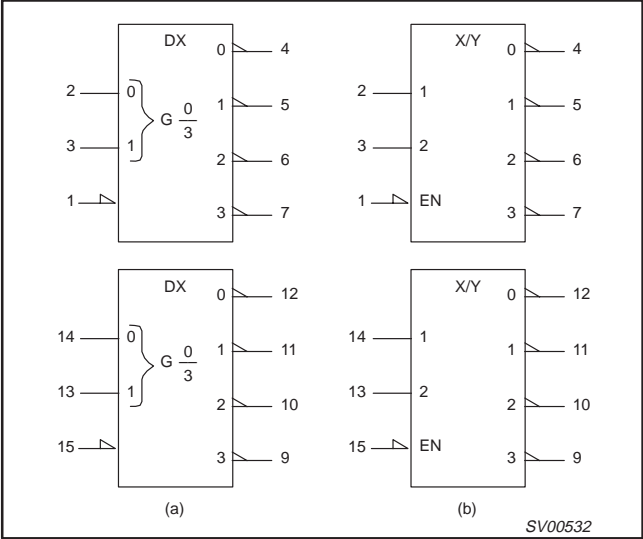
## FUNCTION TABLE

| INPUTS | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|
| $n\overline{E}$ | $nA_0$ | $nA_1$ | $n\overline{Y}_0$ | $n\overline{Y}_1$ | $n\overline{Y}_2$ | $n\overline{Y}_3$ |
| H | X | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | H | L | H | L | H | H |
| L | L | H | H | H | L | H |
| L | H | H | H | H | H | L |

**NOTES:**
H = HIGH voltage level
L = LOW voltage level
X = don't care

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | DC supply voltage | See Note 1 | 1.0 | 3.3 | 5.5 | V |
| $V_I$ | Input voltage | | 0 | – | $V_{CC}$ | V |
| $V_O$ | Output voltage | | 0 | – | $V_{CC}$ | V |
| $T_{amb}$ | Operating ambient temperature range in free air | See DC and AC characteristics | –40<br>–40 | | +85<br>+125 | °C |
| $t_r$, $t_f$ | Input rise and fall times | $V_{CC}$ = 1.0V to 2.0V<br>$V_{CC}$ = 2.0V to 2.7V<br>$V_{CC}$ = 2.7V to 3.6V<br>$V_{CC}$ = 3.6V to 5.5V | –<br>–<br>–<br>– | –<br>–<br>–<br>– | 500<br>200<br>100<br>50 | ns/V |

**NOTE:**
1. The LV is guaranteed to function down to $V_{CC}$ = 1.0V (input levels GND or $V_{CC}$); DC characteristics are guaranteed from $V_{CC}$ = 1.2V to $V_{CC}$ = 5.5V.

## ABSOLUTE MAXIMUM RATINGS[1, 2]

In accordance with the Absolute Maximum Rating System (IEC 134).
Voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | CONDITIONS | RATING | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | DC supply voltage | | –0.5 to +7.0 | V |
| $\pm I_{IK}$ | DC input diode current | $V_I$ < –0.5 or $V_I$ > $V_{CC}$ + 0.5V | 20 | mA |
| $\pm I_{OK}$ | DC output diode current | $V_O$ < –0.5 or $V_O$ > $V_{CC}$ + 0.5V | 50 | mA |
| $\pm I_O$ | DC output source or sink current<br>– standard outputs | –0.5V < $V_O$ < $V_{CC}$ + 0.5V | 25 | mA |
| $\pm I_{GND}$, $\pm I_{CC}$ | DC $V_{CC}$ or GND current for types with<br>– standard outputs | | 50 | mA |
| $T_{stg}$ | Storage temperature range | | –65 to +150 | °C |
| $P_{TOT}$ | Power dissipation per package<br>– plastic DIL<br>– plastic mini-pack (SO)<br>– plastic shrink mini-pack (SSOP and TSSOP) | for temperature range: –40 to +125°C<br>above +70°C derate linearly with 12 mW/K<br>above +70°C derate linearly with 8 mW/K<br>above +60°C derate linearly with 5.5 mW/K | 750<br>500<br>400 | mW |

**NOTES:**
1. Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## Dual 2-to-4 line decoder/demultiplexer

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### DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | -40°C to +85°C | | | -40°C to +125°C | | |
| | | | MIN | TYP[1] | MAX | MIN | MAX | |
| $V_{IH}$ | HIGH level Input voltage | $V_{CC}$ = 1.2 V | 0.9 | | | 0.9 | | V |
| | | $V_{CC}$ = 2.0 V | 1.4 | | | 1.4 | | |
| | | $V_{CC}$ = 2.7 to 3.6 V | 2.0 | | | 2.0 | | |
| | | $V_{CC}$ = 4.5 to 5.5 V | $0.7 * V_{CC}$ | | | $0.7 * V_{CC}$ | | |
| $V_{IL}$ | LOW level Input voltage | $V_{CC}$ = 1.2 V | | | 0.3 | | 0.3 | V |
| | | $V_{CC}$ = 2.0 V | | | 0.6 | | 0.6 | |
| | | $V_{CC}$ = 2.7 to 3.6 V | | | 0.8 | | 0.8 | |
| | | $V_{CC}$ = 4.5 to 5.5 | | | $0.3 * V_{CC}$ | | $0.3 * V_{CC}$ | |
| $V_{OH}$ | HIGH level output voltage; all outputs | $V_{CC}$ = 1.2 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 100µA | | 1.2 | | | | V |
| | | $V_{CC}$ = 2.0 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 100µA | 1.8 | 2.0 | | 1.8 | | |
| | | $V_{CC}$ = 2.7 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 100µA | 2.5 | 2.7 | | 2.5 | | |
| | | $V_{CC}$ = 3.0 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 100µA | 2.8 | 3.0 | | 2.8 | | |
| | | $V_{CC}$ = 4.5 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 100µA | 4.3 | 4.5 | | 4.3 | | |
| $V_{OH}$ | HIGH level output voltage; STANDARD outputs | $V_{CC}$ = 3.0 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 6mA | 2.40 | 2.82 | | 2.20 | | V |
| | | $V_{CC}$ = 4.5 V; $V_I = V_{IH}$ or $V_{IL}$; $-I_O$ = 12mA | 3.60 | 4.20 | | 3.50 | | |
| $V_{OL}$ | LOW level output voltage; all outputs | $V_{CC}$ = 1.2 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | 0 | | | | V |
| | | $V_{CC}$ = 2.0 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | 0 | 0.2 | | 0.2 | |
| | | $V_{CC}$ = 2.7 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | 0 | 0.2 | | 0.2 | |
| | | $V_{CC}$ = 3.0 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | 0 | 0.2 | | 0.2 | |
| | | $V_{CC}$ = 4.5 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | 0 | 0.2 | | 0.2 | |
| $V_{OL}$ | LOW level output voltage; STANDARD outputs | $V_{CC}$ = 3.0 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 6mA | | 0.25 | 0.40 | | 0.50 | V |
| | | $V_{CC}$ = 4.5 V; $V_I = V_{IH}$ or $V_{IL}$; $I_O$ = 12mA | | 0.35 | 0.55 | | 0.65 | |
| $I_I$ | Input leakage current | $V_{CC}$ = 5.5 V; $V_I = V_{CC}$ or GND | | | 1.0 | | 1.0 | µA |
| $I_{CC}$ | Quiescent supply current; MSI | $V_{CC}$ = 5.5 V; $V_I = V_{CC}$ or GND; $I_O$ = 0 | | | 20.0 | | 160 | µA |
| $\Delta I_{CC}$ | Additional quiescent supply current per input | $V_{CC}$ = 2.7 V to 3.6 V; $V_I = V_{CC} - 0.6$ V | | | 500 | | 850 | µA |

**NOTE:**
1. All typical values are measured at $T_{amb}$ = 25°C.

## Dual 2-to-4 line decoder/demultiplexer

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## AC CHARACTERISTICS

GND = 0V; $t_r = t_f \leq 2.5$ns; $C_L$ = 50pF; $R_L$ = 1K$\Omega$

| SYMBOL | PARAMETER | WAVEFORM | CONDITION | LIMITS | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | −40 to +85 °C | | | −40 to +125 °C | | |
| | | | $V_{CC}$(V) | MIN | TYP[1] | MAX | MIN | MAX | |
| $t_{PHL}/t_{PLH}$ | Propagation delay $nA_n$ to $\overline{Y}_n$ | Figures 1, 2 | 1.2 | | 70 | | | | ns |
| | | | 2.0 | | 24 | 31 | | 39 | |
| | | | 2.7 | | 18 | 23 | | 29 | |
| | | | 3.0 to 3.6 | | 13[2] | 18 | | 23 | |
| | | | 4.5 to 5.5 | | | 15 | | 19 | |
| $t_{PHL}/t_{PLH}$ | Propagation delay $n\overline{E}$ to $\overline{Y}_n$ | Figures 1, 2 | 1.2 | | 60 | | | | ns |
| | | | 2.0 | | 20 | 27 | | 34 | |
| | | | 2.7 | | 15 | 20 | | 25 | |
| | | | 3.0 to 3.6 | | 11[2] | 16 | | 20 | |
| | | | 4.5 to 5.5 | | | 13 | | 16 | |

**NOTES:**
1. Unless otherwise stated, all typical values are measured at $T_{amb}$ = 25°C
2. Typical values are measured at $V_{CC}$ = 3.3 V.

## AC WAVEFORMS

$V_M$ = 1.5 V at $V_{CC} \geq 2.7$ V and $\leq 3.6$ V;
$V_M$ = 0.5 V × $V_{CC}$ at $V_{CC} < 2.7$ V and $\geq 4.5$ V.
$V_{OL}$ and $V_{OH}$ are the typical output voltage drop that occur with the output load.



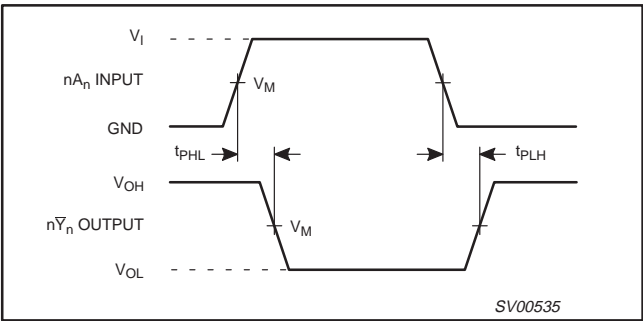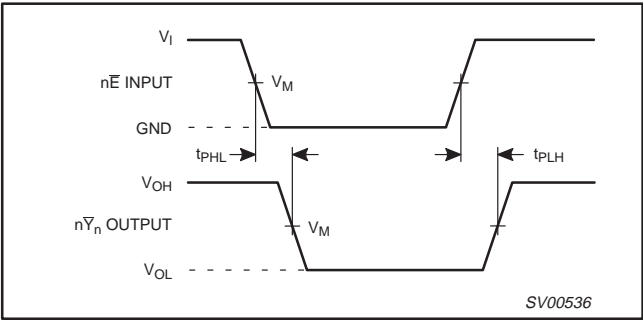**Figure 1. Address input ($nA_n$) to output ($n\overline{Y}$n) propagation delays.**



**Figure 2. Enable input ($n\overline{E}$) to output ($n\overline{Y}_n$) propagation delays.**

## TEST CIRCUIT



**Test Circuit for Outputs**

**DEFINITIONS**

$R_L$ = Load resistor

$C_L$ = Load capacitance includes jig and probe capacitiance

$R_T$ = Termination resistance should be equal to $Z_{OUT}$ of pulse generators.

| TEST | $V_{CC}$ | $V_I$ |
|---|---|---|
| $t_{PLH}/t_{PHL}$ | < 2.7V | $V_{CC}$ |
| | 2.7–3.6V | 2.7V |
| | ≥ 4.5 V | $V_{CC}$ |
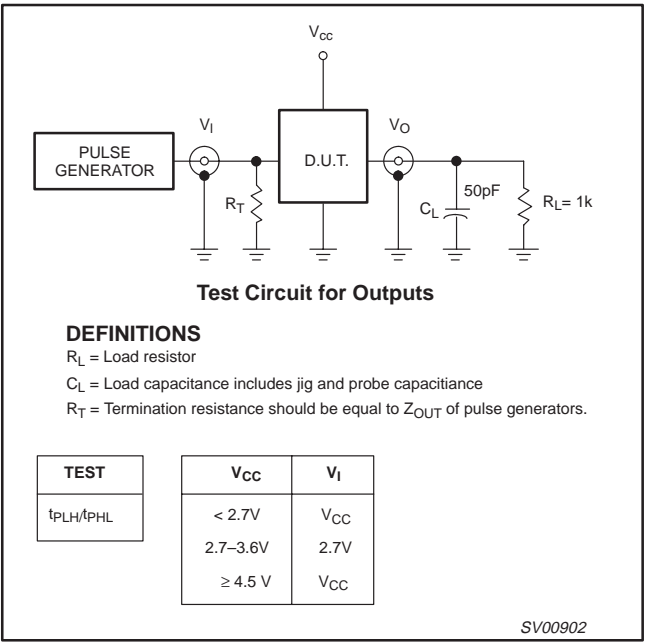
**Figure 3. Load circuitry for switching times.**

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

**SOT38-4**
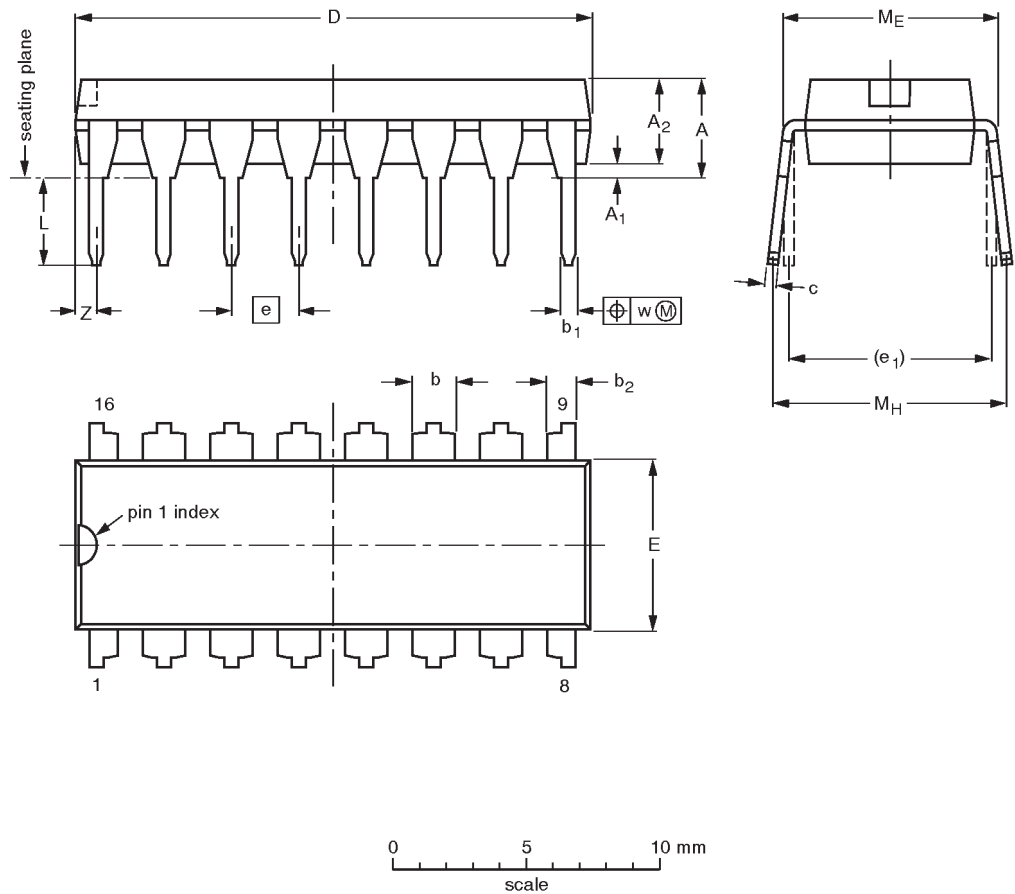


**DIMENSIONS** (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A$_1$ min. | A$_2$ max. | b | b$_1$ | b$_2$ | c | D$^{(1)}$ | E$^{(1)}$ | e | e$_1$ | L | M$_E$ | M$_H$ | w | Z$^{(1)}$ max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73 1.30 | 0.53 0.38 | 1.25 0.85 | 0.36 0.23 | 19.50 18.55 | 6.48 6.20 | 2.54 | 7.62 | 3.60 3.05 | 8.25 7.80 | 10.0 8.3 | 0.254 | 0.76 |
| inches | 0.17 | 0.020 | 0.13 | 0.068 0.051 | 0.021 0.015 | 0.049 0.033 | 0.014 0.009 | 0.77 0.73 | 0.26 0.24 | 0.10 | 0.30 | 0.14 0.12 | 0.32 0.31 | 0.39 0.33 | 0.01 | 0.030 |

**Note**

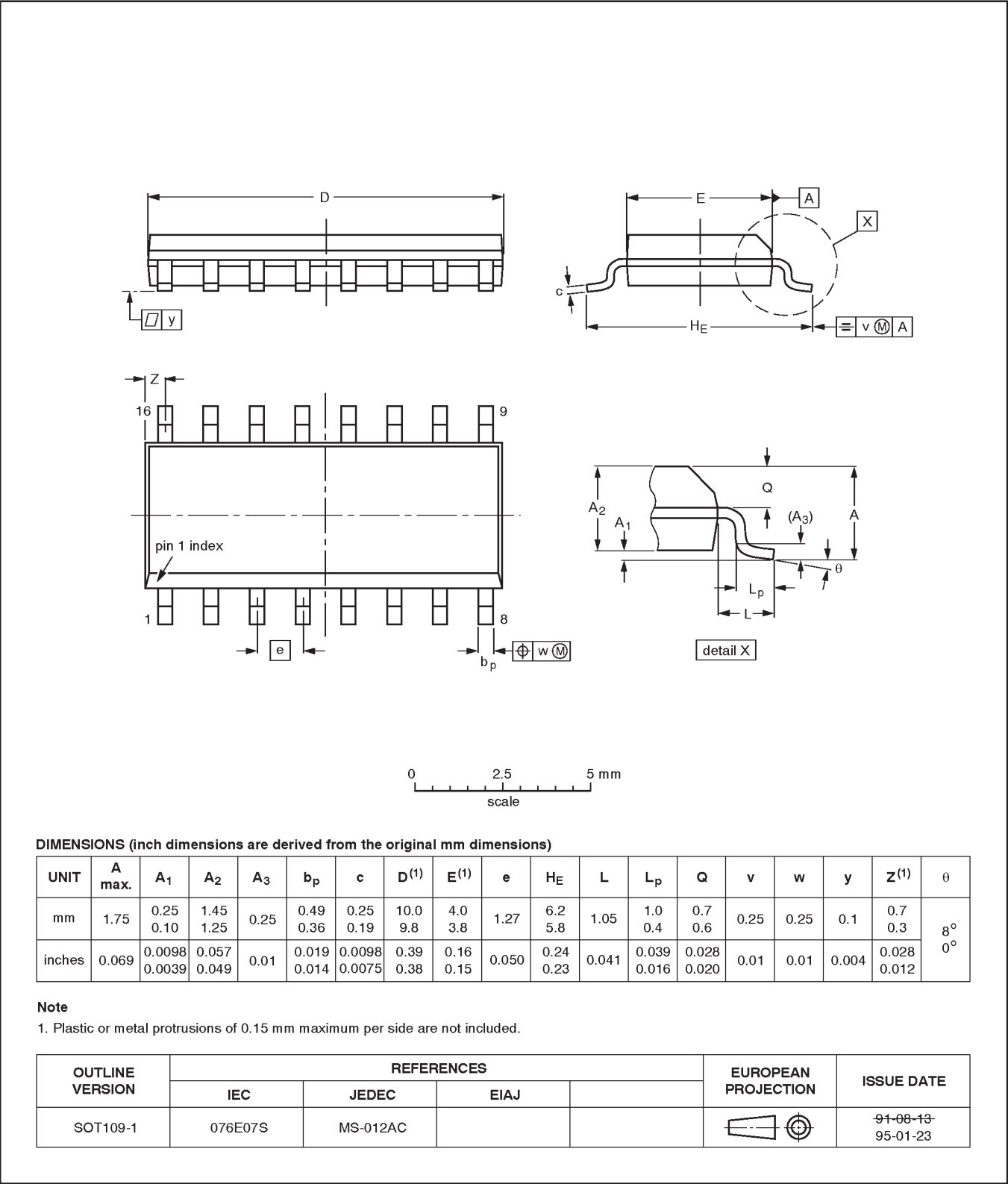1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT38-4 | | | | | | 92-11-17 95-01-14 |

Dual 2-to-4 line decoder/demultiplexer

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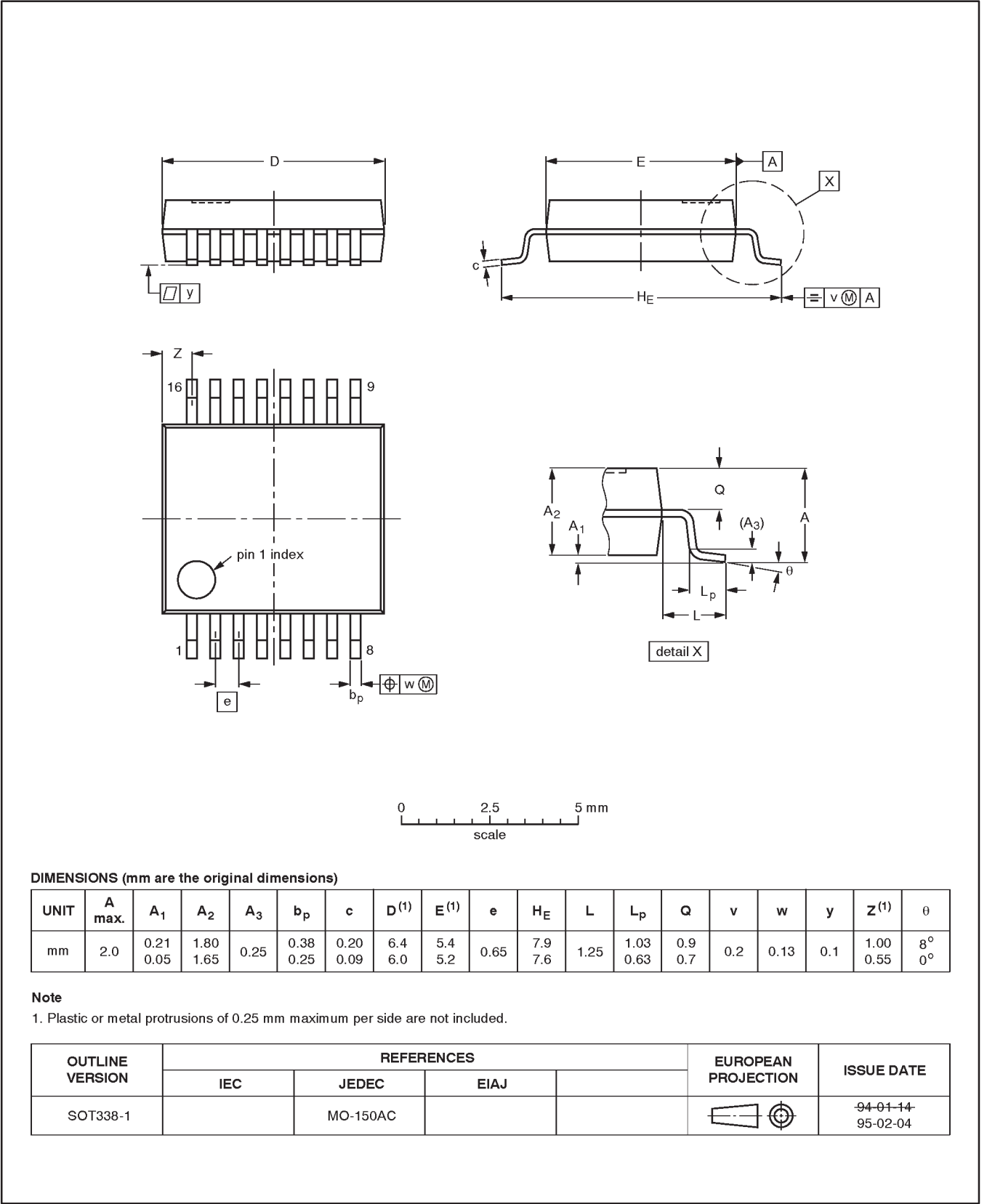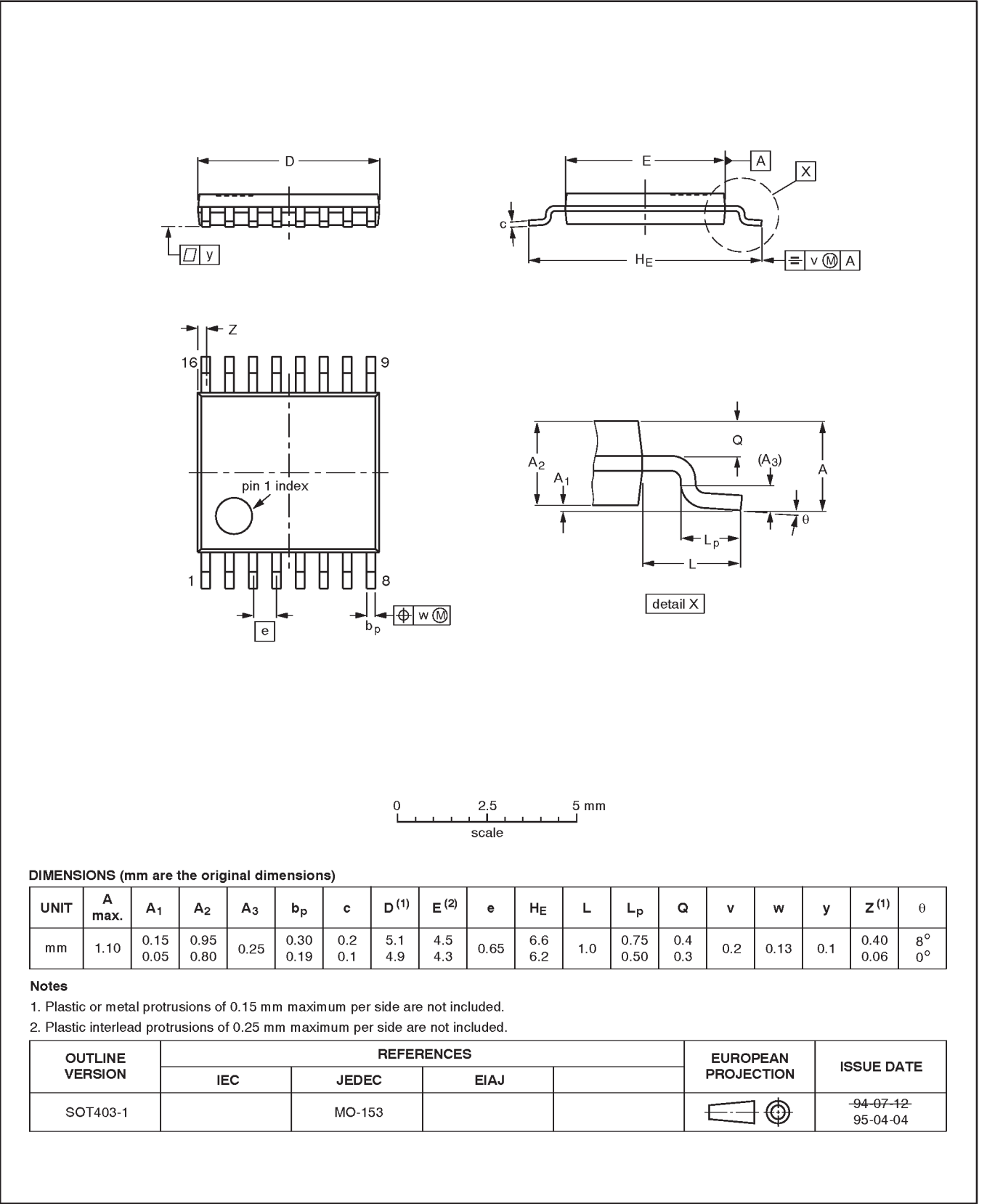SO16:   plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



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

| UNIT | A max. | A₁ | A₂ | A₃ | b_p | c | D[1] | E[1] | e | H_E | L | L_p | Q | v | w | y | Z[1] | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25 / 0.10 | 1.45 / 1.25 | 0.25 | 0.49 / 0.36 | 0.25 / 0.19 | 10.0 / 9.8 | 4.0 / 3.8 | 1.27 | 6.2 / 5.8 | 1.05 | 1.0 / 0.4 | 0.7 / 0.6 | 0.25 | 0.25 | 0.1 | 0.7 / 0.3 | 8° 0° |
| inches | 0.069 | 0.0098 / 0.0039 | 0.057 / 0.049 | 0.01 | 0.019 / 0.014 | 0.0098 / 0.0075 | 0.39 / 0.38 | 0.16 / 0.15 | 0.050 | 0.24 / 0.23 | 0.041 | 0.039 / 0.016 | 0.028 / 0.020 | 0.01 | 0.01 | 0.004 | 0.028 / 0.012 | |

Note

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

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT109-1 | 076E07S | MS-012AC | | | | ~~91-08-13~~ 95-01-23 |

## SSOP16:   plastic shrink small outline package; 16 leads; body width 5.3 mm                SOT338-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|------|--------|-------|-------|-------|-------|---|-----------|-----------|---|-------|---|-------|---|---|---|---|-----------|---|
| mm | 2.0 | 0.21 0.05 | 1.80 1.65 | 0.25 | 0.38 0.25 | 0.20 0.09 | 6.4 6.0 | 5.4 5.2 | 0.65 | 7.9 7.6 | 1.25 | 1.03 0.63 | 0.9 0.7 | 0.2 | 0.13 | 0.1 | 1.00 0.55 | 8° 0° |

**Note**

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

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|---|---|---|---------------------|------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT338-1 | | MO-150AC | | | | 94-01-14 95-02-04 |

Dual 2-to-4 line decoder/demultiplexer

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TSSOP16:   plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



detail X

```
0        2.5        5 mm
|__|__|__|__|__|__|__|__|__|__|
            scale
```

**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | A$_1$ | A$_2$ | A$_3$ | b$_p$ | c | D [1] | E [2] | e | H$_E$ | L | L$_p$ | Q | v | w | y | Z [1] | θ |
|------|--------|-------|-------|-------|-------|---|-------|-------|---|-------|---|-------|---|---|---|---|-------|---|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.40 0.06 | 8° 0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT403-1 | | MO-153 | | | | ~~94-07-12~~ 95-04-04 |

**NOTES**

## Dual 2-to-4 line decoder/demultiplexer                                                74LV139

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### DEFINITIONS

| Data Sheet Identification | Product Status | Definition |
|---|---|---|
| *Objective Specification* | **Formative or in Design** | This data sheet contains the design target or goal specifications for product development.  Specifications may change in any manner without notice. |
| *Preliminary Specification* | **Preproduction Product** | 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* | **Full 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. |

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