

DATA SHEET

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74ALS112A

Dual J-K negative edge-triggered flip-flop

Product specification

1996 June 27

IC05 Data Handbook

Dual J-K negative edge-triggered flip-flop

74ALS112A

DESCRIPTION

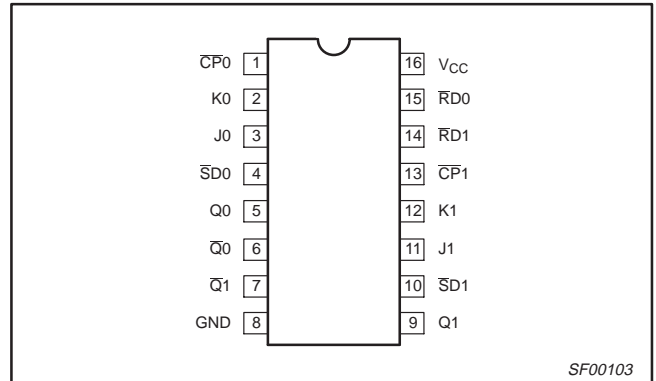
The 74ALS112A, dual negative edge-triggered JK-type flip-flop features individual J, K, clock (\overline{CPn}), set (\overline{SD}), and reset (\overline{RD}) inputs, true (Qn) and complementary (\overline{Qn}) outputs.

The \overline{SD} and \overline{RD} inputs, when Low, set or reset the outputs as shown in the function table regardless of the level at the other inputs.

A High level on the clock (\overline{CPn}) input enables the J and K inputs and data will be accepted. The logic levels at the J and K inputs may be allowed to change while the \overline{CPn} is High and the flip-flop will perform according to the function table as long as minimum setup and hold times are observed. Output changes are initiated by the High-to-Low transition of the \overline{CPn} .

| TYPE | TYPICAL f_{MAX} | TYPICAL SUPPLY CURRENT (TOTAL) |
|-----------|-------------------|--------------------------------|
| 74ALS112A | 50MHz | 3.0mA |

PIN CONFIGURATION



ORDERING INFORMATION

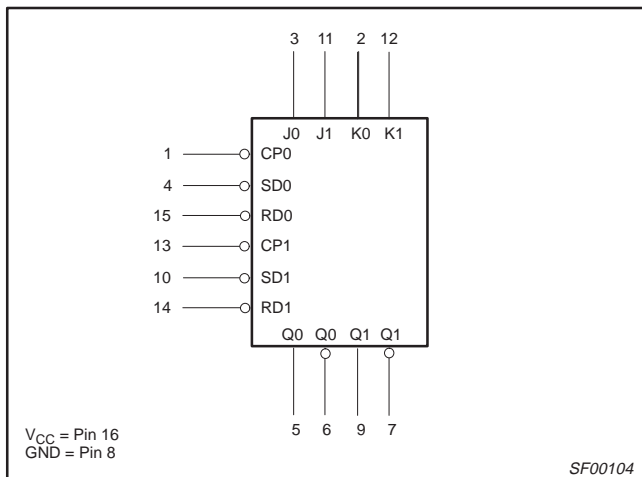
| DESCRIPTION | ORDER CODE | DRAWING NUMBER |
|--------------------|---|----------------|
| | COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$, $T_{amb} = 0^\circ C \text{ to } +70^\circ C$ | |
| 16-pin plastic DIP | 74ALS112AN | SOT38-4 |
| 16-pin plastic SO | 74ALS112AD | SOT109-1 |

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

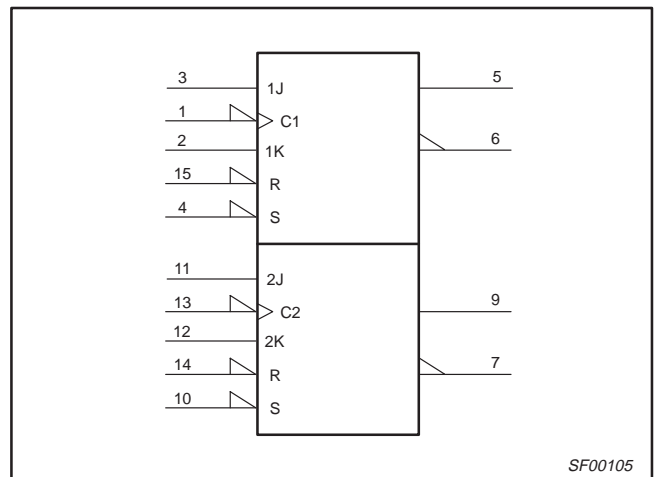
| PINS | DESCRIPTION | 74ALS (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|--|---|-----------------------|---------------------|
| $\overline{CP0}, \overline{CP1}$ | Clock Pulse input (active falling edge) | 1.0/1.0 | 20 μ A/0.1mA |
| J0, J1 | J inputs | 1.0/2.0 | 20 μ A/0.2mA |
| K0, K1 | K inputs | 1.0/2.0 | 20 μ A/0.2mA |
| $\overline{SD0}, \overline{SD1}$ | Set inputs (active-Low) | 1.0/2.0 | 20 μ A/0.2mA |
| $\overline{RD0}, \overline{RD1}$ | Reset inputs (active-Low) | 1.0/2.0 | 20 μ A/0.2mA |
| Q0, Q1, $\overline{Q0}, \overline{Q1}$ | Data outputs | 20/80 | 0.4mA/8mA |

NOTE: One (1.0) ALS unit load is defined as: 20 μ A in the High state and 0.1mA in the Low state.

LOGIC SYMBOL



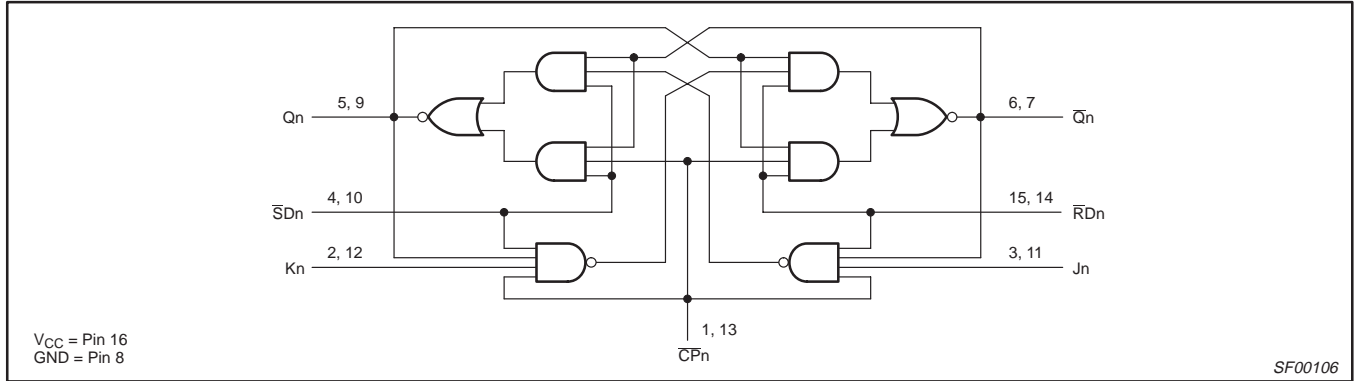
IEC/IEEE SYMBOL



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LOGIC DIAGRAM



FUNCTION TABLE

| INPUTS | | | | | OUTPUTS | | OPERATING MODE |
|-----------------|-----------------|-----------------|---|---|----------------|----------------|--------------------|
| \overline{SD} | \overline{RD} | \overline{CP} | J | K | Q | \overline{Q} | |
| L | H | X | X | X | H | L | Asynchronous Set |
| H | L | X | X | X | L | H | Asynchronous Reset |
| L | L | X | X | X | H* | H* | Undetermined * |
| H | H | ↓ | h | h | \overline{q} | q | Toggle |
| H | H | ↓ | h | l | H | L | Load "1" (Set) |
| H | H | ↓ | l | h | L | H | Load "0" (Reset) |
| H | H | ↓ | l | l | q | \overline{q} | Hold "no change" |
| H | H | H | X | X | q | \overline{q} | Hold "no change" |

H = High voltage level

h = High state must be present one setup time prior to High-to-Low clock transition

L = Low voltage level

l = Low state must be present one setup time prior to High-to-Low clock transition

q = Lower case indicate the state of the referenced output prior to the High-to-Low clock transition

X = Don't care

↓ = High-to-Low clock transition

* = Both outputs will be High while both \overline{SD} and \overline{RD} are Low, but the output states are unpredictable if \overline{SD} and \overline{RD} go High simultaneously

Asynchronous inputs: Low input to \overline{SD} sets Q to High level, Low input to \overline{RD} sets Q to Low level. Set and reset are independent of clock.

Simultaneous Low on both \overline{SD} and \overline{RD} makes both Q and \overline{Q} High.

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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 _{CC} | Supply voltage | -0.5 to +7.0 | V |
| V _{IN} | Input voltage | -0.5 to +7.0 | V |
| I _{IN} | Input current | -30 to +5 | mA |
| V _{OUT} | Voltage applied to output in High output state | -0.5 to V _{CC} | V |
| I _{OUT} | Current applied to output in Low output state | 16 | mA |
| T _{amb} | Operating free-air temperature range | 0 to +70 | °C |
| T _{stg} | Storage temperature range | -65 to +150 | °C |

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 | | | -0.4 | mA |
| I _{OL} | Low-level output current | | | 8 | mA |
| T _{amb} | Operating free-air temperature range | 0 | | +70 | °C |

DC ELECTRICAL CHARACTERISTICS

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

| SYMBOL | PARAMETER | TEST CONDITIONS ¹ | LIMITS | | | UNIT | |
|-----------------|--|---|--|---------------------|-------|------|----|
| | | | MIN | TYP ² | MAX | | |
| V _{OH} | High-level output voltage | V _{CC} = ±10%, V _{IL} = MAX, V _{IH} = MIN | I _{OH} = -0.4mA | V _{CC} - 2 | | V | |
| V _{OL} | Low-level output voltage | V _{CC} = MIN, V _{IL} = MAX, V _{IH} = MIN | I _{OL} = 4mA | | 0.25 | 0.40 | V |
| | | | I _{OL} = 8mA | | 0.35 | 0.50 | V |
| V _{IK} | Input clamp voltage | V _{CC} = MIN, I _I = I _{IK} | | | -0.73 | -1.5 | V |
| I _I | Input current at maximum input voltage | V _{CC} = MAX, V _I = 7.0V | | | | 0.1 | mA |
| I _{IH} | High-level input current | V _{CC} = MAX, V _I = 2.7V | | | | 20 | μA |
| I _{IL} | Low-level input current | CPn | V _{CC} = MAX, V _I = 0.4V | | | -0.1 | mA |
| | | SDn, RDn, Jn, Kn | | | | -0.2 | mA |
| I _O | Output current ³ | V _{CC} = MAX, V _O = 2.25V | | -30 | | -112 | mA |
| I _{CC} | Supply current (total) | V _{CC} = MAX | | | 2.5 | 4.5 | mA |

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} = 5V, T_{amb} = 25°C.
- The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

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AC ELECTRICAL CHARACTERISTICS

| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | UNIT |
|------------------------|---|----------------|---|--------------|------|
| | | | $T_{amb} = 0^{\circ}\text{C to } +70^{\circ}\text{C}$ $V_{CC} = +5.0\text{V} \pm 10\%$ $C_L = 50\text{pF}, R_L = 500\Omega$ | | |
| | | | MIN | MAX | |
| f_{MAX} | Maximum clock frequency | Waveform 1 | 35 | | MHz |
| t_{PLH} t_{PHL} | Propagation delay CPn to Qn or $\bar{Q}n$ | Waveform 1 | 2.0 4.0 | 10.0 10.5 | ns |
| t_{PLH} t_{PHL} | Propagation delay $\bar{S}Dn$ or $\bar{R}Dn$ to Qn or $\bar{Q}n$ | Waveform 2, 3 | 1.5 3.5 | 8.0 9.5 | ns |

AC SETUP REQUIREMENTS

| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | UNIT |
|----------------------------|---|----------------|---|-----|------|
| | | | $T_{amb} = 0^{\circ}\text{C to } +70^{\circ}\text{C}$ $V_{CC} = +5.0\text{V} \pm 10\%$ $C_L = 50\text{pF}, R_L = 500\Omega$ | | |
| | | | MIN | MAX | |
| $t_{su}(H)$ $t_{su}(L)$ | Setup time, High or Low Jn, Kn to $\bar{C}Pn$ | Waveform 1 | 8.0 8.0 | | ns |
| $t_h(H)$ $t_h(L)$ | Hold time, High or Low Jn, Kn to $\bar{C}Pn$ | Waveform 1 | 0.0 0.0 | | ns |
| $t_w(H)$ $t_w(L)$ | $\bar{C}Pn$ Pulse width high or Low | Waveform 1 | 11.0 8.0 | | ns |
| $t_w(L)$ | $\bar{S}Dn$ or $\bar{R}Dn$ Pulse width Low | Waveform 2, 3 | 6.0 | | ns |
| t_{REC} | Recovery time, $\bar{S}Dn$ or $\bar{R}Dn$ to $\bar{C}Pn$ | Waveform 2, 3 | 8.0 | | ns |

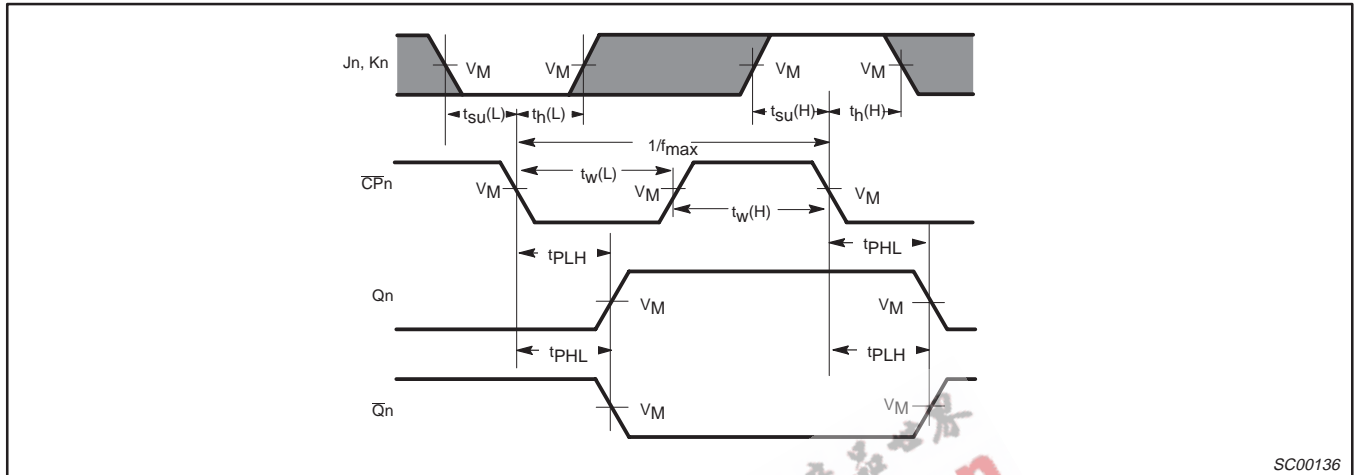
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AC WAVEFORMS

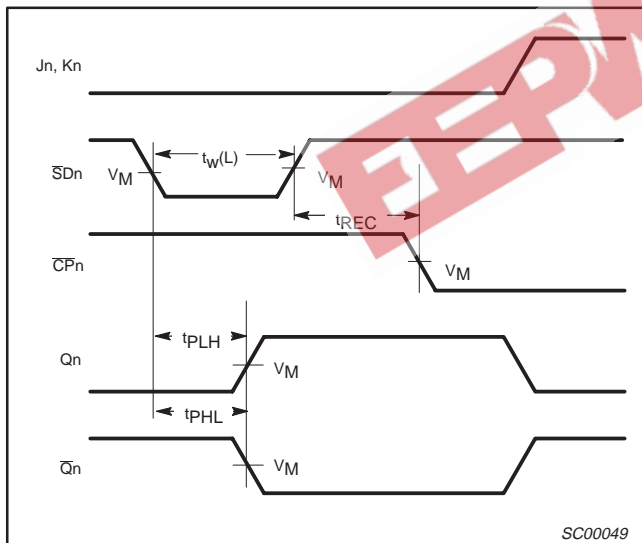
For all waveforms, $V_M = 1.3V$.

The shaded areas indicate when the input is permitted to change for predictable output performance.



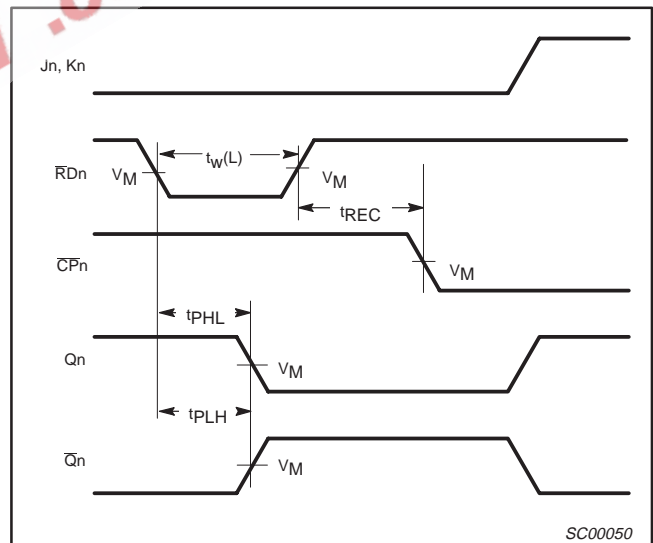
SC00136

Waveform 1. Propagation Delay for Data to Output, Data Setup Time and Hold Times, Clock Pulse Width, and Maximum Clock Frequency



SC00049

Waveform 2. Propagation Delay for Set to Output, Set Pulse Width, and Recovery Time for Set to Clock



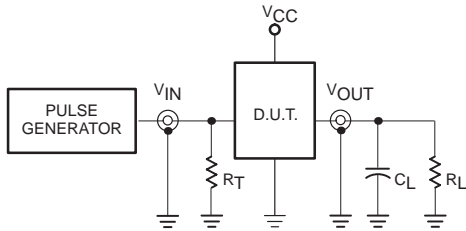
SC00050

Waveform 3. Propagation Delay for Reset to Output, Reset Pulse Width, and Recovery Time for Reset to Clock

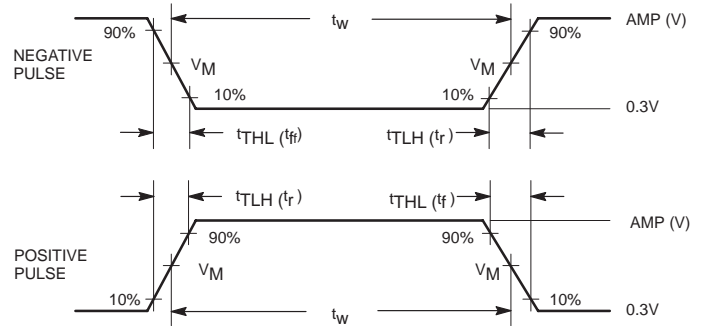
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TEST CIRCUIT AND WAVEFORMS



Test Circuit for Totem-pole Outputs



Input Pulse Definition

DEFINITIONS:

- R_L = Load resistor; see AC electrical characteristics for value.
- C_L = Load capacitance includes jig and probe capacitance; see AC electrical characteristics for value.
- R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

| Family | INPUT PULSE REQUIREMENTS | | | | | |
|--------|--------------------------|-------|----------|-------|-----------|-----------|
| | Amplitude | V_M | Rep.Rate | t_w | t_{TLH} | t_{THL} |
| 74ALS | 3.5V | 1.3V | 1MHz | 500ns | 2.0ns | 2.0ns |

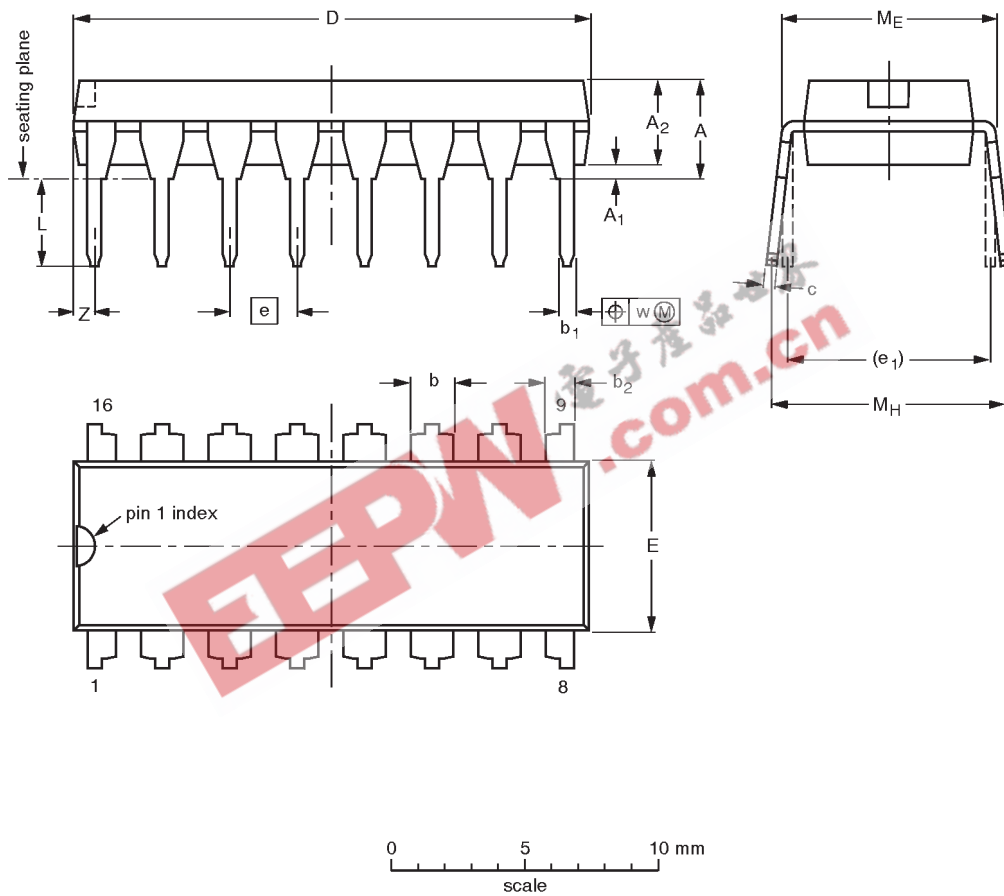
SC00005

Dual J-K negative edge-triggered flip-flop

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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.

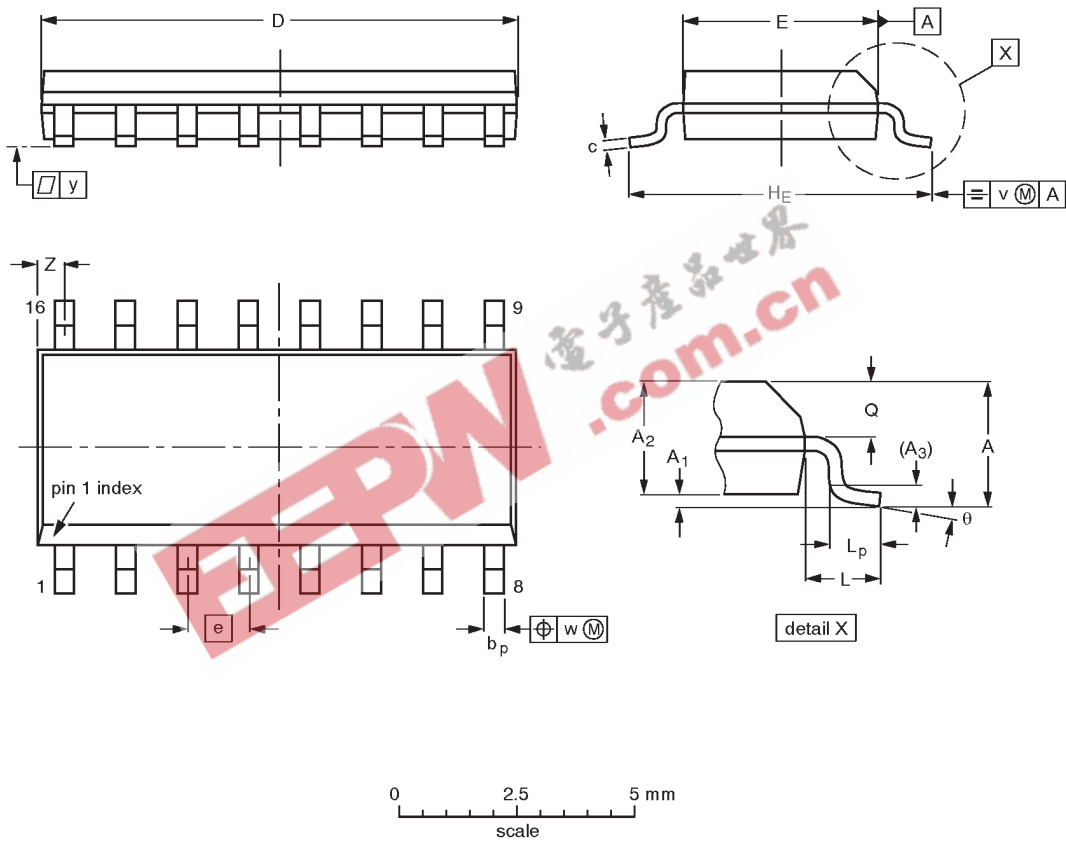
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT38-4 | | | | | | 92-11-17 95-01-14 |

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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. | 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 | 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 |

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DEFINITIONS

| Data Sheet Identification | Product Status | Definition |
|----------------------------------|-------------------------------|--|
| <i>Objective Specification</i> | 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. |
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