

DATA SHEET

LM111/211/311/311B

Voltage comparator

Product data
Supersedes data of 1994 Aug 31
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2001 Aug 03

Voltage comparator

LM111/211/311/311B

DESCRIPTION

The LM111 series are voltage comparators that have input currents approximately a hundred times lower than devices like the μ A710. They are designed to operate over a wider range of supply voltages; from standard ± 15 V op amp supplies down to a single 3 V supply. Their output is compatible with RTL, DTL, and TTL as well as MOS circuits. Further, they can drive lamps or relays, switching voltages up to 50 V at currents as high as 50mA.

Both the inputs and the outputs of the LM111 series can be isolated from system ground, and the output can drive loads referred to ground, the positive supply, or the negative supply. Offset balancing and strobe capability are provided and outputs can be wire-ORed.

Although slower than the μ A710 (200 ns response time versus 40 ns), the devices are also much less prone to spurious oscillations. The LM111 series has the same pin configuration as the μ A710 series.

FEATURES

- Operates from single 3 V supply (LM311B)
- Maximum input bias current: 150 nA (LM311: 250 nA)
- Maximum offset current: 20 nA (LM311: 50 nA)
- Differential input voltage range: ± 30 V
- Power consumption: 135 mW at ± 15 V
- High sensitivity: 200 V/mV
- Zero crossing detector

ORDERING INFORMATION

| DESCRIPTION | TEMPERATURE RANGE | ORDER CODE | DWG # |
|--|---|------------|---------|
| 8-Pin Plastic Small Outline Package (SO) | -55°C to $+125^{\circ}\text{C}$ | LM111D | SOT96-1 |
| 8-Pin Plastic Dual In-Line Package (DIP) | -55°C to $+125^{\circ}\text{C}$ | LM111N | SOT97-1 |
| 8-Pin Plastic Small Outline Package (SO) | -25°C to $+85^{\circ}\text{C}$ | LM211D | SOT96-1 |
| 8-Pin Plastic Dual In-Line Package (DIP) | -25°C to $+85^{\circ}\text{C}$ | LM211N | SOT97-1 |
| 8-Pin Plastic Small Outline Package (SO) | 0°C to $+70^{\circ}\text{C}$ | LM311D | SOT96-1 |
| 8-Pin Plastic Dual In-Line Package (DIP) | 0°C to $+70^{\circ}\text{C}$ | LM311N | SOT97-1 |
| 8-Pin Plastic Small Outline Package (SO) | 0°C to $+70^{\circ}\text{C}$ | LM311BD | SOT96-1 |
| 8-Pin Plastic Dual In-Line Package (DIP) | 0°C to $+70^{\circ}\text{C}$ | LM311BN | SOT97-1 |

PIN CONFIGURATION

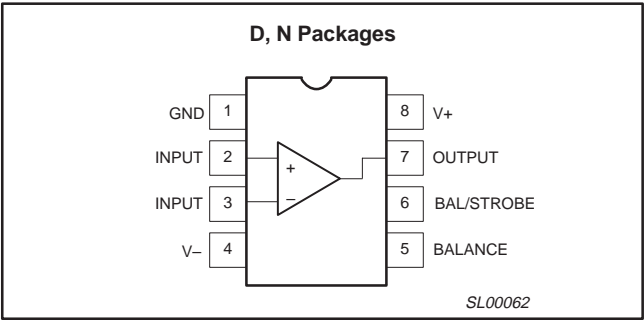


Figure 1. Pin Configuration

APPLICATIONS

- Precision squarer
- Positive/negative peak detector
- Low voltage adjustable reference supply
- Switching power amplifier

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EQUIVALENT SCHEMATIC

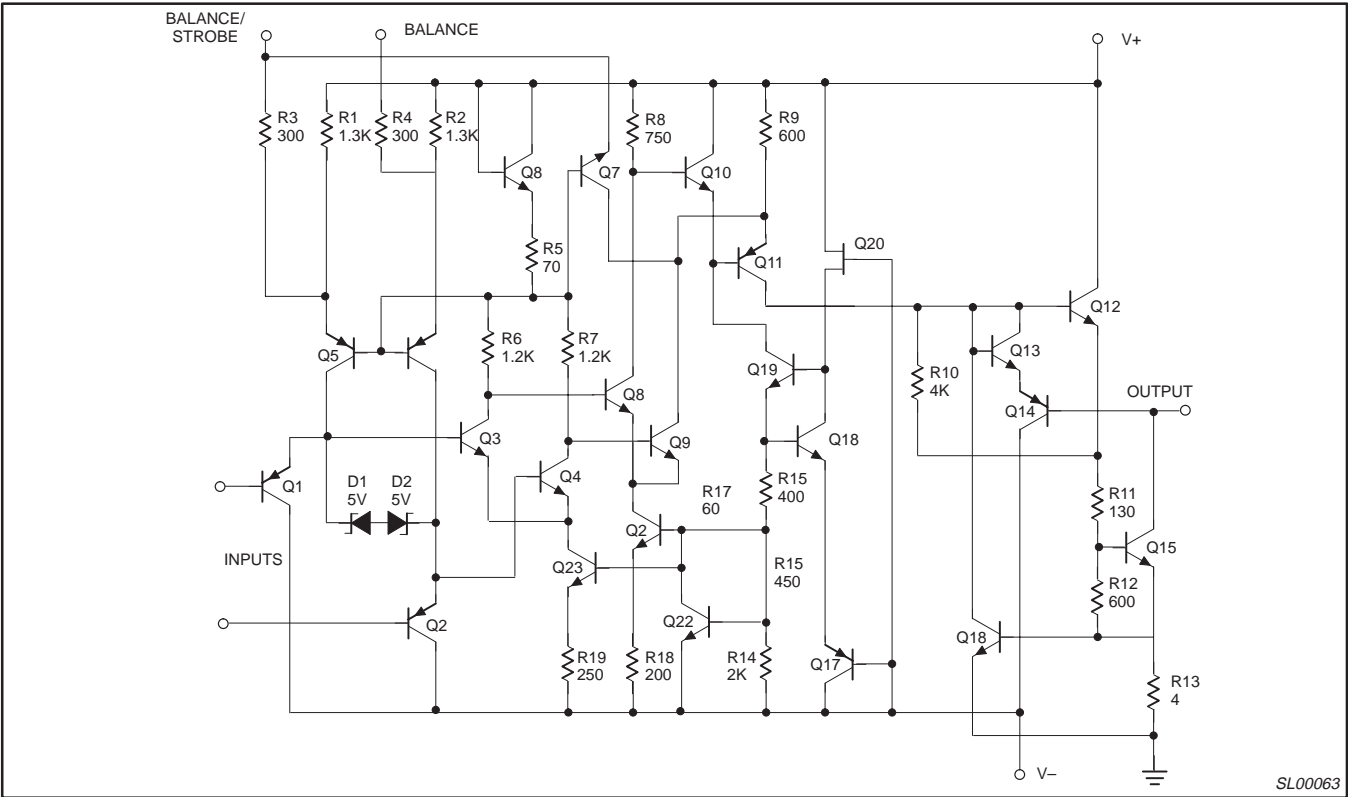


Figure 2. Equivalent Schematic

ABSOLUTE MAXIMUM RATINGS

| SYMBOL | PARAMETER | RATING | UNIT |
|--------------|--|-------------|------------------|
| V_S | Total supply voltage | 36 | V |
| | Output to negative supply voltage: | | |
| | LM111/LM211 | 50 | V |
| | LM311/LM311B | 40 | V |
| | Ground to negative supply voltage | 30 | V |
| | Differential input voltage | ± 30 | V |
| V_{IN} | Input voltage ¹ | ± 15 | V |
| $P_{D\ MAX}$ | Maximum power dissipation, $T_{amb} = 25\ ^\circ\text{C}$ (still-air) ² | | |
| | N package | 1190 | mW |
| | D package | 780 | mW |
| I | Output short-circuit duration | 10 | sec |
| T_{amb} | Operating ambient temperature range | | |
| | LM111 | -55 to +125 | $^\circ\text{C}$ |
| | LM211 | -25 to +85 | $^\circ\text{C}$ |
| | LM311/LM311B | 0 to +70 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature range | -65 to +150 | $^\circ\text{C}$ |
| T_{sld} | Lead soldering temperature (10 sec max) | 230 | $^\circ\text{C}$ |

NOTES:

1. This rating applies for $\pm 15\text{ V}$ supplies. The positive input voltage limit is 30 V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30 V below the positive supply, whichever is less.
2. Derate above 25 $^\circ\text{C}$, at the following rates:
 N package at 9.5 mW/ $^\circ\text{C}$
 D package at 6.2 mW/ $^\circ\text{C}$

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DC ELECTRICAL CHARACTERISTICS^{1, 2, 3, 6}

Over temperature range unless otherwise specified.

| SYMBOL | PARAMETER | TEST CONDITIONS | LM111/LM211 | | | LM311 | | | LM311B | | | UNIT |
|----------------------|-------------------------------------|--|-------------|---------------|------|-------|---------------|------|---------|------|---------|------|
| | | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| V _{OS} | Input offset voltage ³ | T _{amb} = 25 °C; R _S ≤ 50 kΩ | | 0.7 | 3.0 | | 2.0 | 7.5 | | 2.0 | 7.5 | mV |
| I _{OS} | Input offset current ³ | T _{amb} = 25 °C | | 4.0 | 10 | | 6.0 | 50 | | 6 | 25 | nA |
| I _{BIAS} | Input bias current | T _{amb} = 25 °C | | 60 | 100 | | 100 | 250 | | 100 | 200 | nA |
| A _V | Voltage gain | T _{amb} = 25 °C | | 200 | | | 200 | | | 200 | | V/mV |
| | Response time ⁴ | T _{amb} = 25 °C | | 200 | | | 200 | | | 500 | | ns |
| V _{SAT} | Saturation voltage | LM111/211 V _{IN} ≤ -5 mV; I _{OUT} = 50 mA LM311/B V _{IN} ≤ -10 mV; I _{OUT} = 50 mA T _{amb} = 25 °C | | 0.75 | 1.5 | | 0.75 | 1.5 | | 0.75 | 1.5 | V |
| I _{BAL/STR} | Strobe on current | T _{amb} = 25 °C | | 3.0 | | | 3.0 | | | 3.0 | | mA |
| I _{LEAKAGE} | Output leakage current ⁶ | LM111/211 V _{IN} ≥ 5 mV; V _{OUT} = 35 V LM311/B V _{IN} ≥ 10 mV; V _{OUT} = 35 V T _{amb} = 25 °C, I _{STROBE} = 3 mA (V- = V _{GND} = -5 V) | | 0.2 | 10 | | 0.2 | 50 | | 0.2 | 50 | nA |
| V _{OS} | Input offset voltage ³ | R _S ≤ 50 kΩ | | | 4.0 | | | 10 | | | 10 | mV |
| I _{OS} | Input offset current ³ | | | | 20 | | | 70 | | | 50 | nA |
| I _{BIAS} | Input bias current | | | | 150 | | | 300 | | | 250 | nA |
| V _{IN} | Input voltage range | V = ±15 V (Pin 7 may go to 5 V) | -14.5 | 13.8 to -14.7 | 13.0 | -14.5 | 13.8 to -14.7 | 13.0 | V- +0.5 | | V+ -1.5 | V |
| V _{OL} | Saturation voltage ⁶ | V+ ≥ 4.5 V, V- = 0 V LM111/211 V _{IN} ≤ -6 mV; I _{SINK} ≤ 8 mA LM311/B V _{IN} ≤ -10 mV; I _{SINK} ≤ 8 mA | | 0.23 | 0.4 | | 0.23 | 0.4 | | 0.23 | 0.4 | V |
| I _{OH} | Output leakage current | V _{IN} ≥ 5 mV; V _{OUT} = 35 V | | 0.1 | 0.5 | | | | | | | μA |
| I _{CC} | Positive supply current | T _{amb} = 25 °C | | 5.1 | 6.0 | | 5.1 | 7.5 | | 1.6 | 3.5 | mA |
| I _{EE} | Negative supply voltage | T _{amb} = 25 °C | | 4.1 | 5.0 | | 4.1 | 5.0 | | | | mA |

NOTES:

1. This rating applies for ±15 V supplies. The positive input voltage limit is 30 V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30 V below the positive supply, whichever is less.
2. These specifications apply for V_S = ±15 V and 0 °C < T_{amb} < 70 °C unless otherwise specified. With the LM211, however, all temperature specifications are limited to -25 °C ≤ T_{amb} ≤ +85 °C, and for the LM111 is limited to -55 °C < T_{amb} < +125 °C. The offset voltage, offset current, and bias current specifications apply for any supply voltage from a single 5 V supply up to ±15 V supplies.
3. The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with 1 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
4. The response time specified is for a 100 mV input step with 5 mV over-drive.
5. Do not short the strobe pin to ground; it should be current driven at 3 mA to 5 mA.
6. LM311B, all parameters are at V+ = 3 V ±10%; V- = GND = 0 V.

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TYPICAL APPLICATIONS

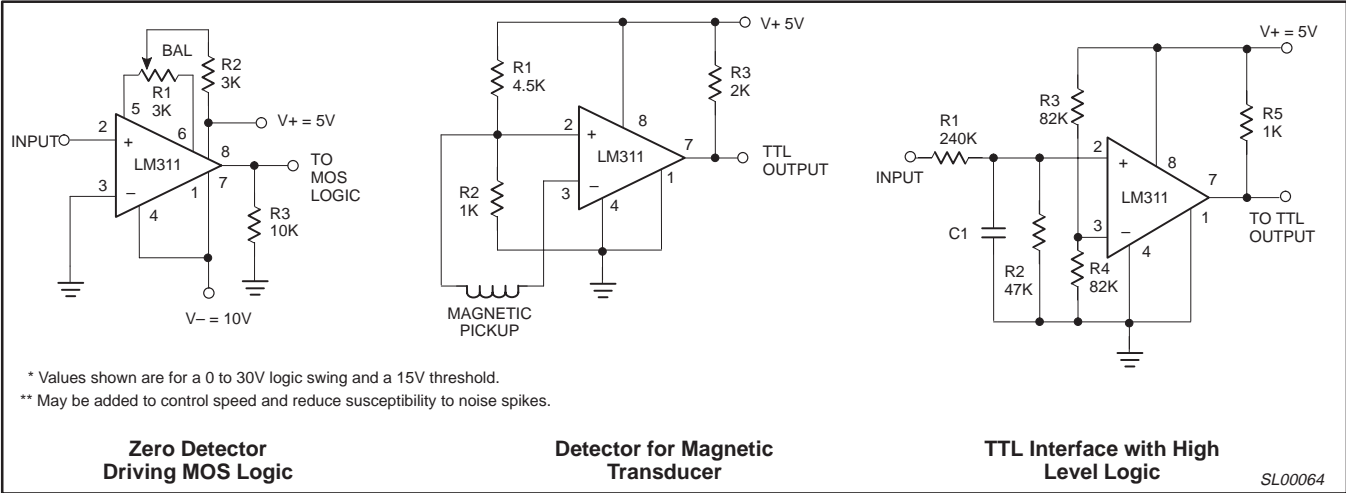


Figure 3. Typical Applications

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DIP8: plastic dual in-line package; 8 leads (300 mil)

SOT97-1

Technical drawing of the SOT97-1 package showing top, side, and end views with dimensions A, A1, A2, b, b1, b2, c, D, E, L, ME, MH, w, Z, e, and pin 1 index.

0 5 10 mm

scale

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 1.14 | 0.53 0.38 | 1.07 0.89 | 0.36 0.23 | 9.8 9.2 | 6.48 6.20 | 2.54 | 7.62 | 3.60 3.05 | 8.25 7.80 | 10.0 8.3 | 0.254 | 1.15 |
| inches | 0.17 | 0.020 | 0.13 | 0.068 0.045 | 0.021 0.015 | 0.042 0.035 | 0.014 0.009 | 0.39 0.36 | 0.26 0.24 | 0.10 | 0.30 | 0.14 0.12 | 0.32 0.31 | 0.39 0.33 | 0.01 | 0.045 |

Note

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

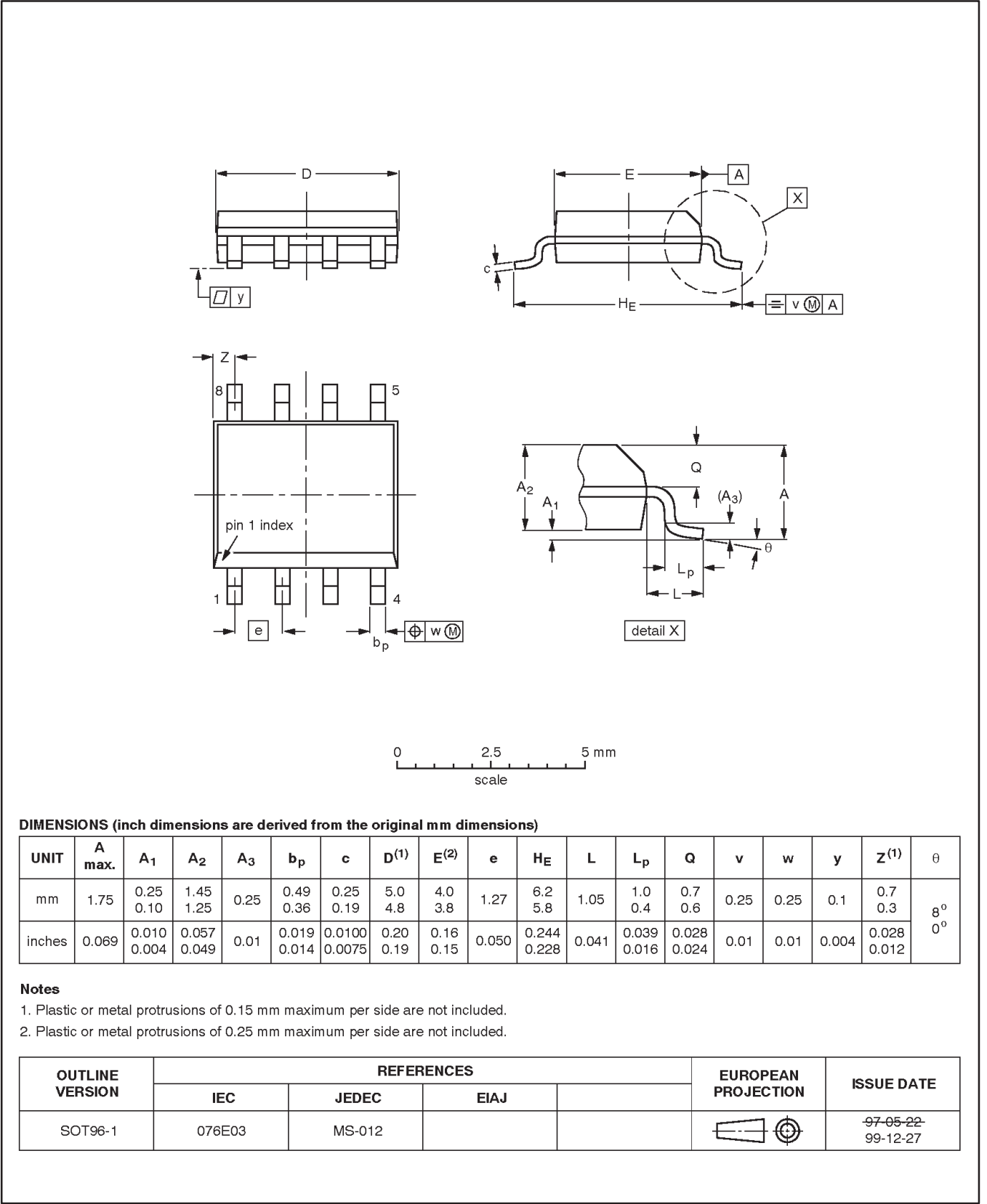
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|--------|----------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT97-1 | 050G01 | MO-001 | SC-504-8 | | | 95-02-04 99-12-27 |

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SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1



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Data sheet status

| Data sheet status ^[1] | Product status ^[2] | Definitions |
|----------------------------------|-------------------------------|--|
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