

## Description

The LM236 and LM336 are precision 5.0V regulator diodes. These voltage reference monolithic ICs operate like 5.0V zener diodes with a low temperature coefficient and a dynamic impedance of  $0.6\ \Omega$ . A third pin enables adjusting the reference voltage and the temperature coefficient.

## Features

- Adjustable 4V to 6V
- Low temperature coefficient
- Wide operating current of 600  $\mu$ A to 10 mA
- $0.6\ \Omega$  dynamic impedance
- $\pm 1\%$  initial tolerance available
- Guaranteed temperature stability
- Easily trimmed for minimum temperature drift
- Fast turn-on
- Three lead transistor package



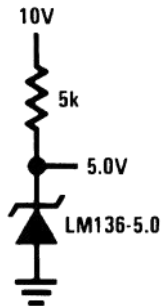
## Ordering Information

| DEVICE           | Package Type | MARKING             | Packing | Packing Qty   |
|------------------|--------------|---------------------|---------|---------------|
| LM236AM-5.0/TR   | SOP-8        | 236A-5.0            | REEL    | 2500pcs/reel  |
| LM236M-5.0/TR    | SOP-8        | 236-5.0             | REEL    | 2500pcs/reel  |
| LM336BM-5.0/TR   | SOP-8        | 336B-5.0            | REEL    | 2500pcs/reel  |
| LM336M-5.0/TR    | SOP-8        | 336-5.0             | REEL    | 2500pcs/reel  |
| LM236AZ-5.0      | TO-92        | LM236A-5.0,236A-5.0 | BAG     | 1000pcs/box   |
| LM236Z-5.0       | TO-92        | LM236-5.0,236-5.0   | BAG     | 1000pcs/box   |
| LM336BZ-5.0      | TO-92        | LM336B-5.0,336B-5.0 | BAG     | 1000pcs/box   |
| LM336Z-5.0       | TO-92        | LM336-5.0,336-5.0   | BAG     | 1000pcs/box   |
| LM236ADQ3-5.0/TR | DFN-8 3*3    | 236A-5.0            | REEL    | 5000pcs/reel  |
| LM236DQ3-5.0/TR  | DFN-8 3*3    | 236-5.0             | REEL    | 5000pcs/reel  |
| LM336BDQ3-5.0/TR | DFN-8 3*3    | 336B-5.0            | REEL    | 5000pcs/reel  |
| LM336DQ3-5.0/TR  | DFN-8 3*3    | 336-5.0             | REEL    | 5000pcs/reel  |
| LM236ADQ2-5.0/TR | DFN-8 2*2    | 236A-5.0            | REEL    | 5000pcs/reel* |
| LM236DQ2-5.0/TR  | DFN-8 2*2    | 236-5.0             | REEL    | 5000pcs/reel* |
| LM336BDQ2-5.0/TR | DFN-8 2*2    | 336B-5.0            | REEL    | 5000pcs/reel* |
| LM336DQ2-5.0/TR  | DFN-8 2*2    | 336-5.0             | REEL    | 5000pcs/reel* |

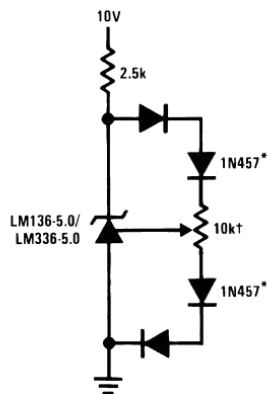
\* old:4000pcs/reel,New packaging quantity of 5000 pcs/reel after December 2025.

## Typical Applications

### 5.0V Reference



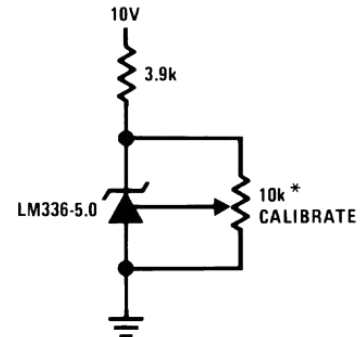
### 5.0V Reference with Minimum Temperature Coefficient



† Adjust to 5.00V

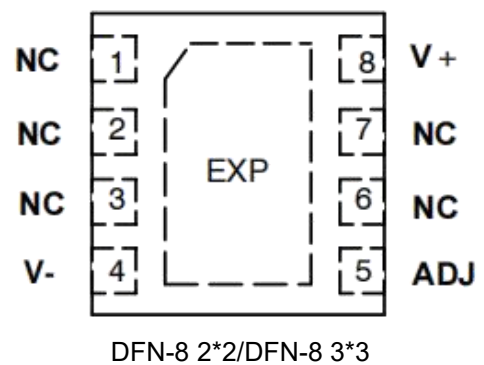
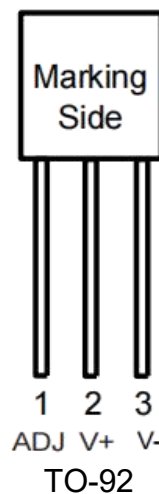
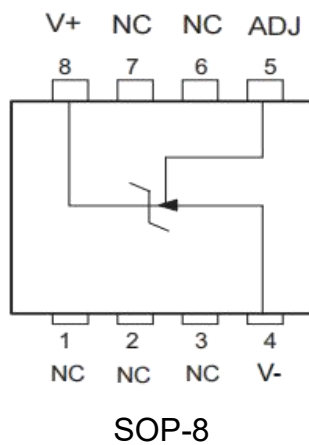
\* Any silicon signal diode

### Trimmed 4V to 6V Reference with Temperature Coefficient Independent of Breakdown Voltage



\* Does not affect temperature coefficient

## Pin Connections



## Absolute Maximum Ratings

| Symbol     | Parameter                                | LM336                                        | Unit     |
|------------|------------------------------------------|----------------------------------------------|----------|
| $I_{RIF}$  | Current<br>Reverse<br>Forward            | 15<br>10                                     | mA       |
| $T_{oper}$ | Operating Free-air Temperature Range     | LM336-5.0: 0 to +70<br>LM236-5.0: -40 to +85 | °C<br>°C |
| $T_{Stg}$  | Storage Temperature Range                | -65 to +150                                  | °C       |
| $T_L$      | Lead Temperature (Soldering, 10 seconds) | 260                                          | °C       |

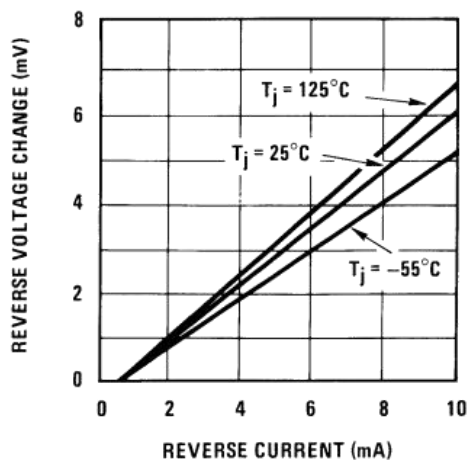
**Note:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.

## Electrical Characteristics

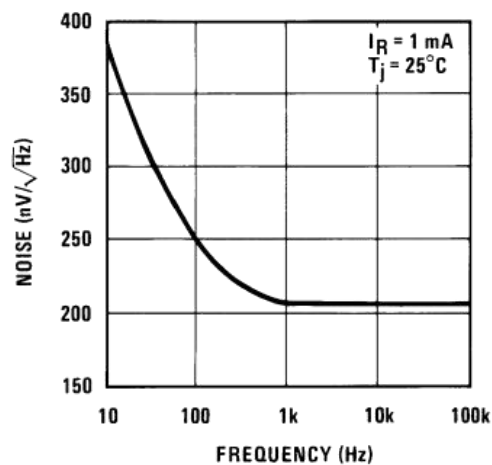
| Symbol       | Parameter                                                                                                                                           |                      | LM236/LM336 |      |      | Unit |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------|------|------|------|
|              |                                                                                                                                                     |                      | Min.        | Typ. | Max. |      |
| $V_R$        | Reference Breakdown Voltage<br>$T_{amb} = +25^{\circ}C, I_R = 1mA$                                                                                  | LM236A-5.0           | 4.95        | 5.0  | 5.05 | V    |
|              |                                                                                                                                                     | LM236-5.0/LM336B-5.0 | 4.90        | 5.0  | 5.10 |      |
|              |                                                                                                                                                     | LM336-5.0            | 4.98        | 5.0  | 5.20 |      |
| $\Delta V_R$ | Reverse Breakdown Voltage Change with Current<br>$600\mu A \leq I_R \leq 10mA$<br>$T_{amb} = +25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$ |                      | -           | 6    | 20   | mV   |
| $Z_D$        | Reverse Dynamic Impedance ( $I_R = 1mA$ )<br>$T_{amb} = +25^{\circ}C, f=100Hz$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                             |                      | -           | 0.6  | 2.0  |      |
| KVT          | Temperature Stability ( $V_R = 5.0V, I_R = 1mA$ )                                                                                                   |                      | -           | 4    | 12   | mV   |
| KVH          | Long Term Stability ( $T_{amb} = +25^{\circ}C \pm 0.1^{\circ}C, I_R = 1mA$ )                                                                        |                      | -           | 20   | -    | ppm  |

## Typical Performance Characteristics

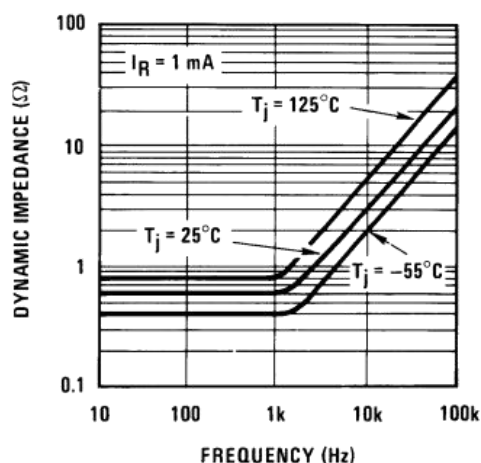
Reverse Voltage Change



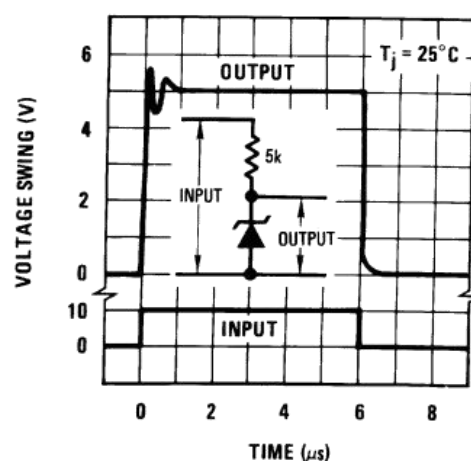
Zener Noise Voltage



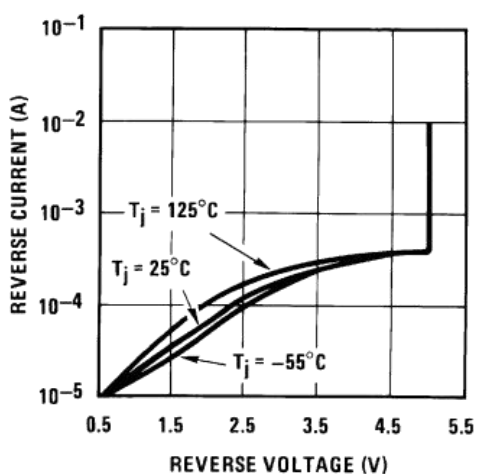
Dynamic Impedance



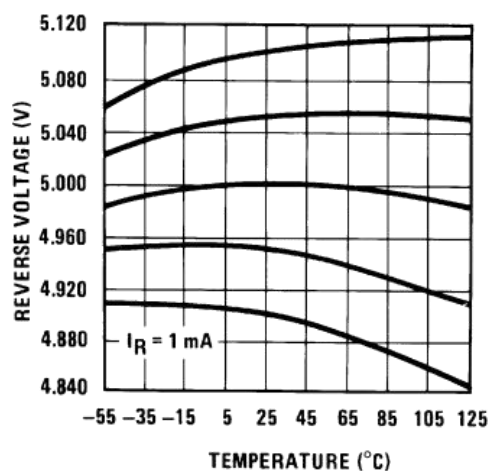
Response Time



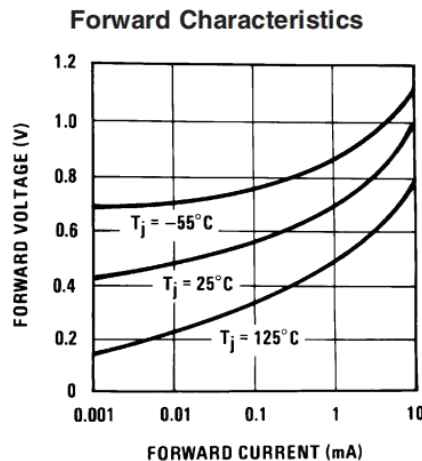
Reverse Characteristics



Temperature Drift



## Typical Performance Characteristics (Continued)



## Application Hints

The LMx36-5.0 series voltage references are much easier to use than ordinary zener diodes. Their low impedance and wide operating current range simplify biasing in almost any circuit. Further, either the breakdown voltage or the temperature coefficient can be adjusted to optimize circuit performance.

Figure 1 shows an LM336-5.0 with a 10k potentiometer for adjusting the reverse breakdown voltage. With the addition of R1 the breakdown voltage can be adjusted without affecting the temperature coefficient of the device. The adjustment range is usually sufficient to adjust for both the initial device tolerance and inaccuracies in buffer circuitry.

If minimum temperature coefficient is desired, four diodes can be added in series with the adjustment potentiometer as shown in Figure 2. When the device is adjusted to 5.00V the temperature coefficient is minimized. Almost any silicon signal diode can be used for this purpose such as a 1N914, 1N4148 or a 1N457. For proper temperature compensation the diodes should be in the same thermal environment as the LM336-5.0. It is usually sufficient to mount the diodes near the LM336-5.0 on the printed circuit board. The absolute resistance of the network is not critical and any value from 2k to 20k will work. Because of the wide adjustment range, fixed resistors should be connected in series with the pot to make pot setting less critical.

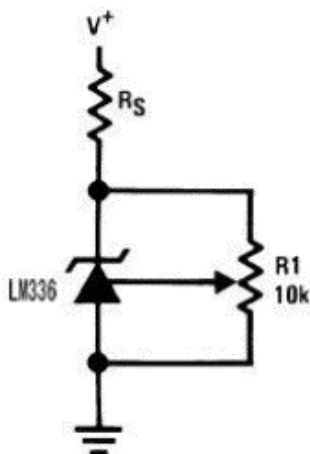


FIGURE 1. LM336-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range =  $\pm 1.0\text{V}$  Typical)

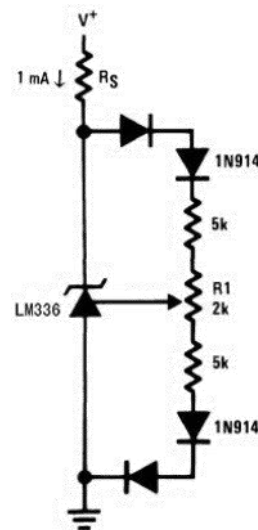
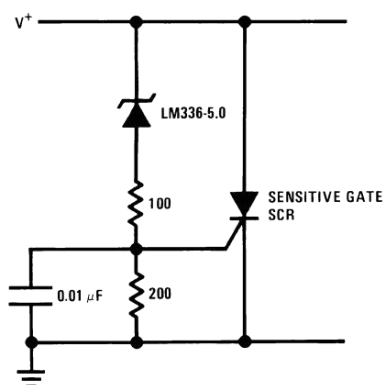


FIGURE 2. Temperature Coefficient Adjustment (Trim Range =  $\pm 0.5\text{V}$  Typical)

The circuit diagram shows an LM317 voltage regulator configured as a precision 5V reference. The **INPUT** pin of the LM317 is connected to  $V_{IN}$ . The **OUT** pin is connected to  $V_{OUT}$  and also to a 1.2k resistor. The **ADJ** pin is connected to the junction of the 1.2k resistor and the cathode of an LM336-5.0 Zener diode. The anode of the LM336-5.0 is connected to ground. A 10k\* resistor is connected between the LM336-5.0 and the junction of two 1N457 diodes. The cathode of the top 1N457 diode is connected to the  $V_{OUT}$  line, and its anode is connected to the junction of the 1.2k resistor and the LM336-5.0. The cathode of the bottom 1N457 diode is connected to ground, and its anode is connected to the junction of the 10k\* resistor and the LM336-5.0. A 625 resistor (R1) is connected between  $V_{OUT}$  and ground. A 2k potentiometer (R2) is connected between  $V_{OUT}$  and ground, with its wiper labeled **OUTPUT ADJUST**.

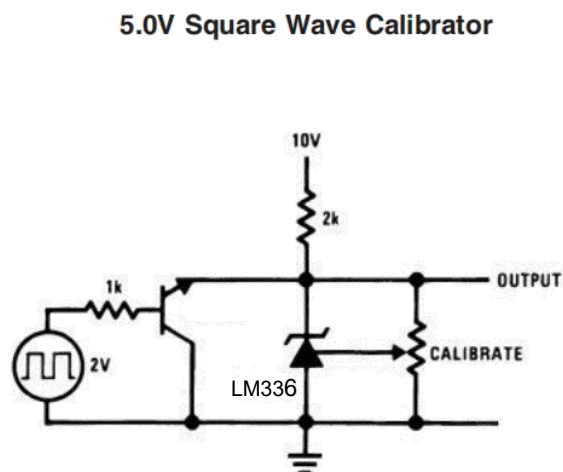
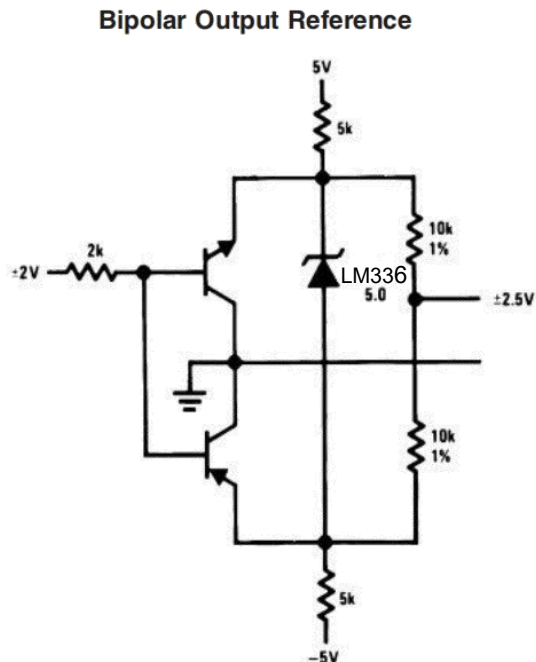
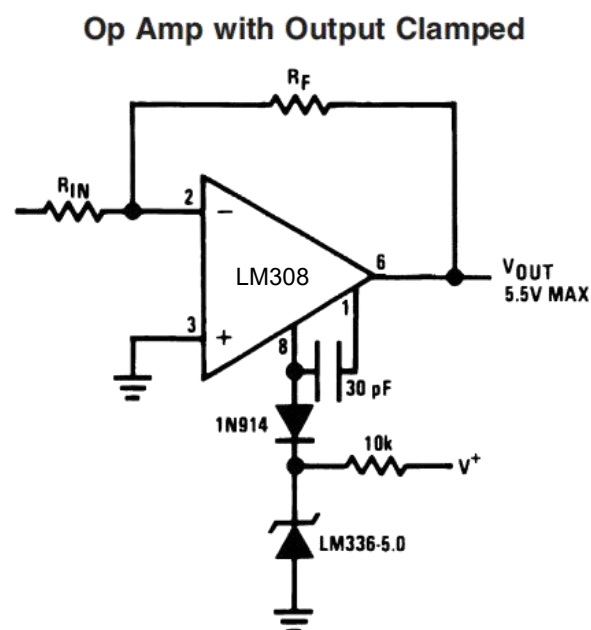
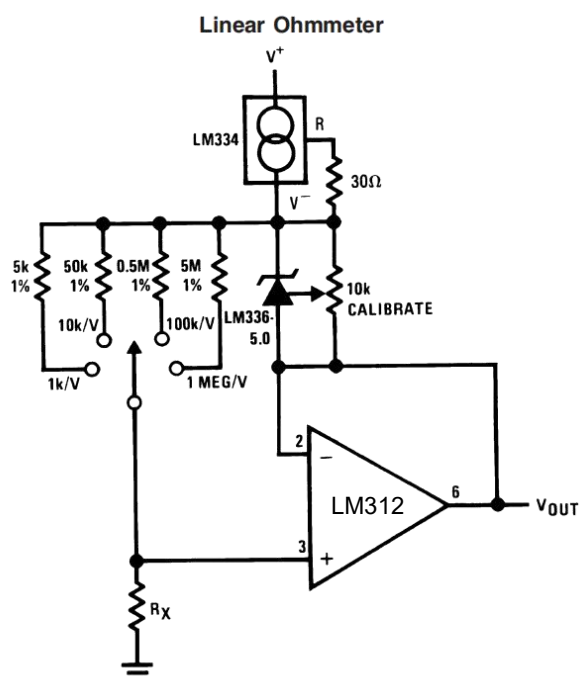
\* Adjust for 6.25V across R1



The circuit diagram shows a precision half-wave rectifier. The input  $V_{IN} > 2V + V_{OUT}$  is connected through a resistor  $R_S$  to the non-inverting input (pin 3) of the LM308A op-amp. The inverting input (pin 2) is connected to ground through a 20k resistor. The output of the op-amp (pin 6) is connected to the cathode of an LM336-5.0 diode. The anode of the diode is connected to the output of the circuit. The op-amp is configured with a 20k resistor between pins 1 and 8, and a 560 resistor between pins 7 and 8. A 100 pF capacitor is connected between pins 1 and 8. The output of the circuit is labeled "OUTPUT 10V TO 40V".

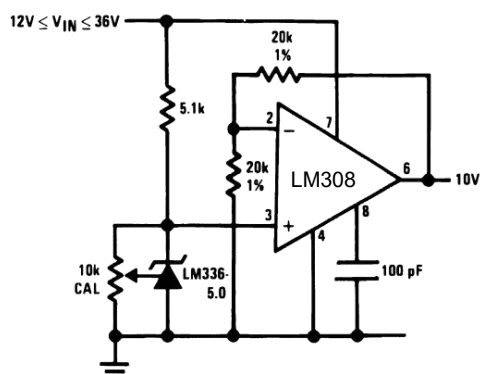
VER:V1.5

## Typical Applications (Continued)

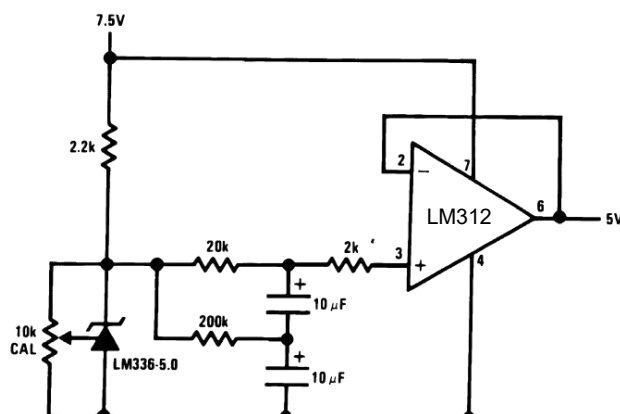


## Typical Applications (Continued)

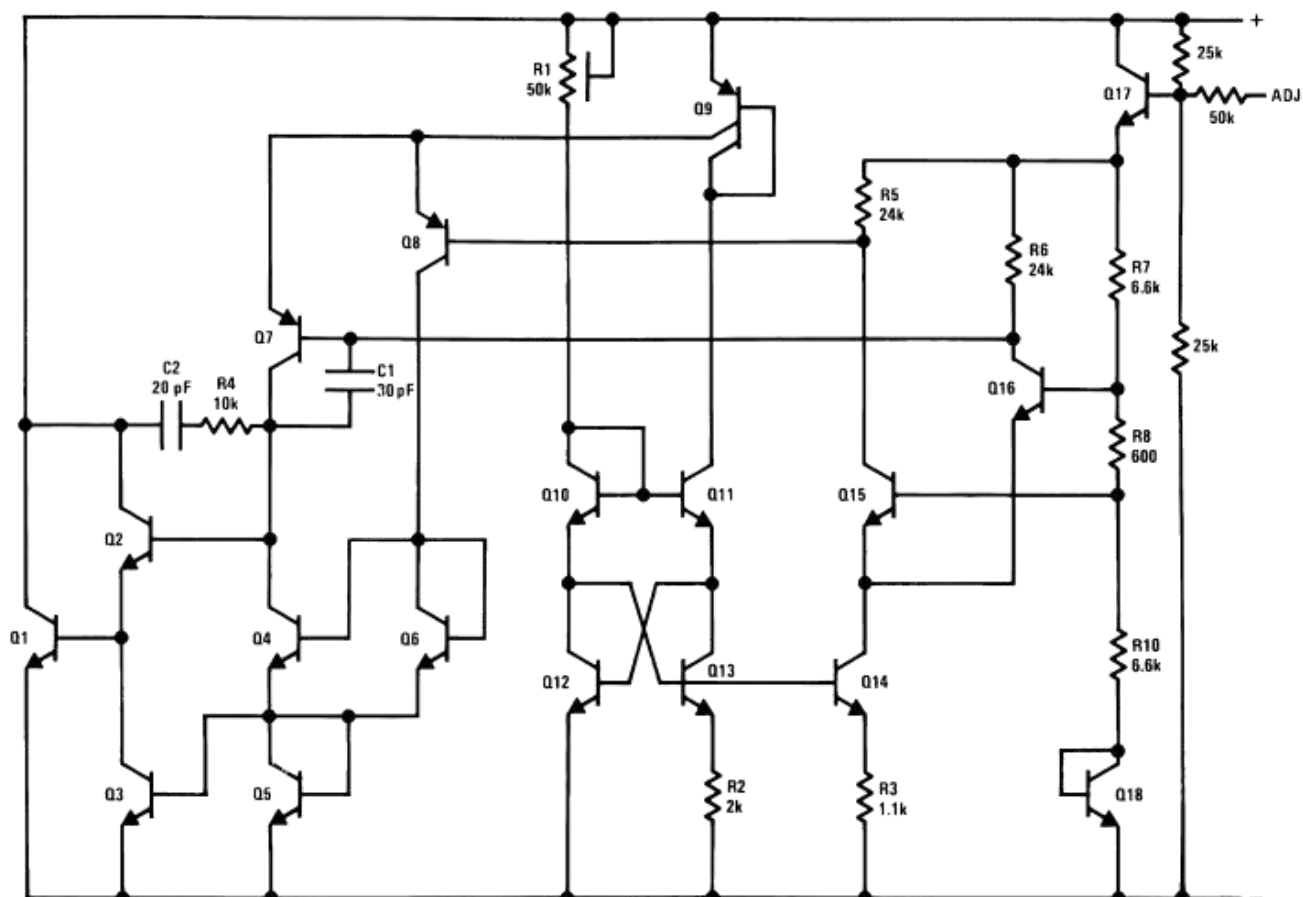
10V Buffered Reference



Low Noise Buffered Reference

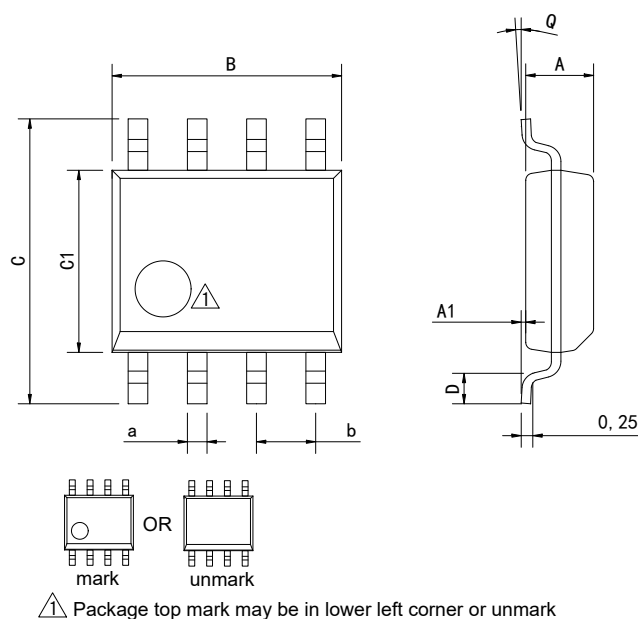


## Schematic Diagram



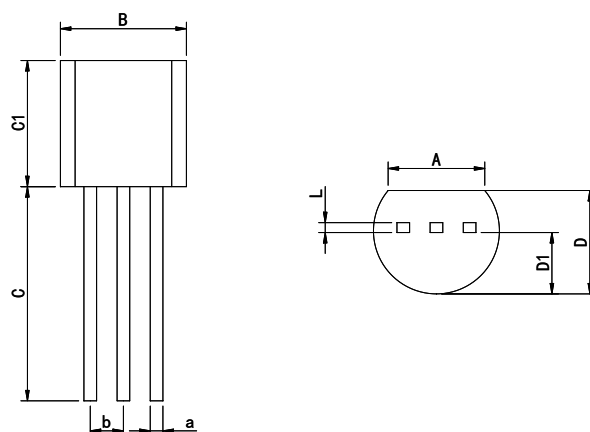
## Physical Dimensions

### SOP-8



| Dimensions In Millimeters(SOP-8) |      |      |      |      |      |      |    |      |          |
|----------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol:                          | A    | A1   | B    | C    | C1   | D    | Q  | a    | b        |
| Min:                             | 1.35 | 0.05 | 4.90 | 5.80 | 3.80 | 0.40 | 0° | 0.35 | 1.27 BSC |
| Max:                             | 1.55 | 0.20 | 5.10 | 6.20 | 4.00 | 0.80 | 8° | 0.45 |          |

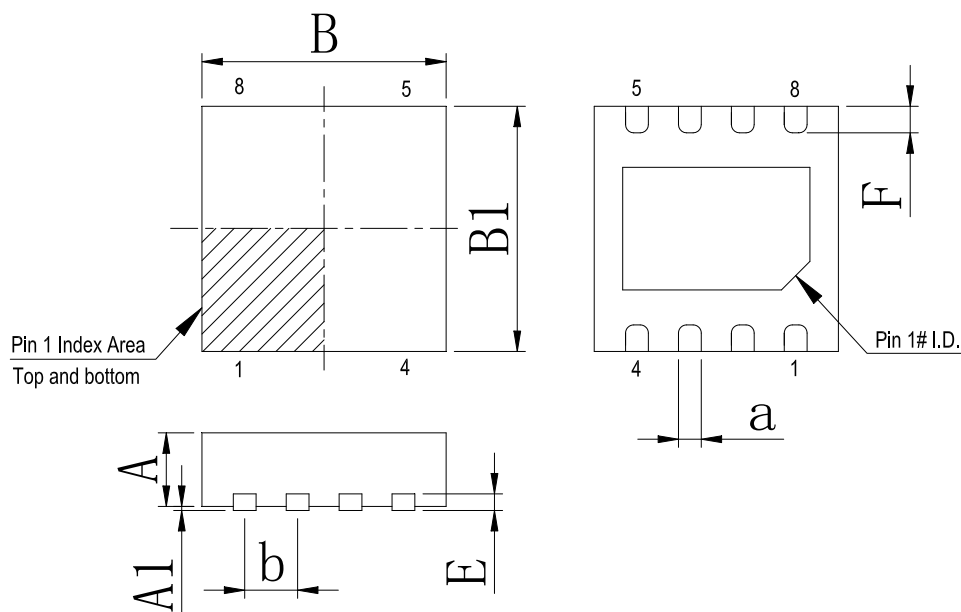
### TO-92



| Dimensions In Millimeters(TO-92) |      |      |      |      |      |      |      |      |         |
|----------------------------------|------|------|------|------|------|------|------|------|---------|
| Symbol:                          | A    | B    | C    | C1   | D    | D1   | L    | a    | b       |
| Min:                             | 3.43 | 4.44 | 13.5 | 4.32 | 3.17 | 2.03 | 0.33 | 0.40 | 1.27BSC |
| Max:                             | 4.13 | 5.21 | 15.3 | 5.34 | 4.19 | 2.67 | 0.42 | 0.52 |         |

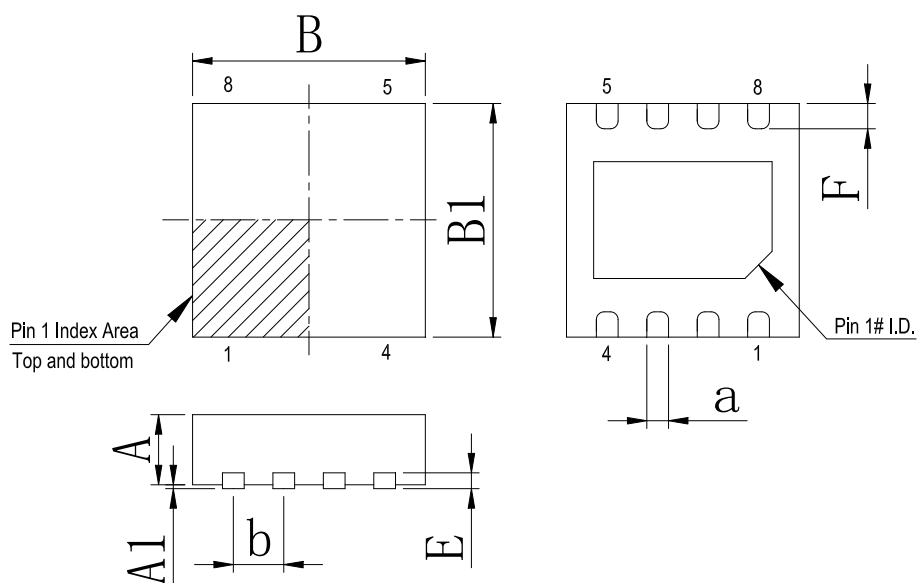
## Physical Dimensions

### DFN-8 3\*3



| Dimensions In Millimeters(DFN-8 3*3) |      |      |      |      |      |      |      |          |
|--------------------------------------|------|------|------|------|------|------|------|----------|
| Symbol:                              | A    | A1   | B    | B1   | E    | F    | a    | b        |
| Min:                                 | 0.85 | 0.00 | 2.90 | 2.90 | 0.20 | 0.30 | 0.20 | 0.65 BSC |
| Max:                                 | 0.95 | 0.05 | 3.10 | 3.10 | 0.25 | 0.50 | 0.34 |          |

### DFN-8 2\*2



| Dimensions In Millimeters(DFN-8 2*2) |      |      |      |      |      |      |      |         |
|--------------------------------------|------|------|------|------|------|------|------|---------|
| Symbol:                              | A    | A1   | B    | B1   | E    | F    | a    | b       |
| Min:                                 | 0.85 | 0    | 1.90 | 1.90 | 0.15 | 0.25 | 0.18 | 0.50TYP |
| Max:                                 | 0.95 | 0.05 | 2.10 | 2.10 | 0.25 | 0.45 | 0.30 |         |

## Revision History

| REVISION<br>NUMBER | DATE    | REVISION                                                     | PAGE  |
|--------------------|---------|--------------------------------------------------------------|-------|
| V1.0               | 2015-9  | New                                                          | 1-12  |
| V1.1               | 2017-9  | Add annotation for Maximum Ratings.                          | 2     |
| V1.2               | 2024-11 | Update TO-92 Physical Dimensions、 Update Lead Temperature    | 2、 8  |
| V1.3               | 2025-3  | Add DFN-8 package model                                      | 1     |
| V1.4               | 2025-4  | Add tiered models                                            | 1     |
| V1.5               | 2025-12 | Update important statements、 Update SOP-14 Dimension drawing | 9、 12 |

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