

# KA431/KA431A/KA431L

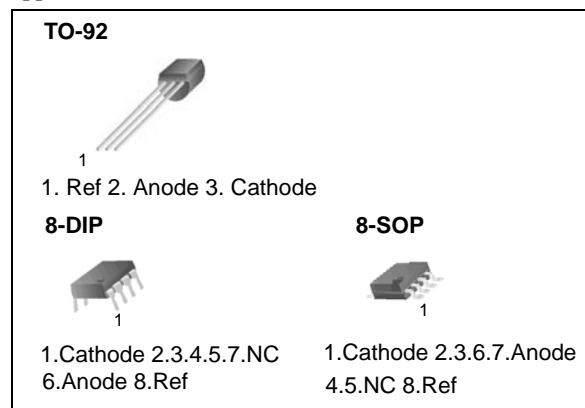
## Programmable Shunt Regulator

### Features

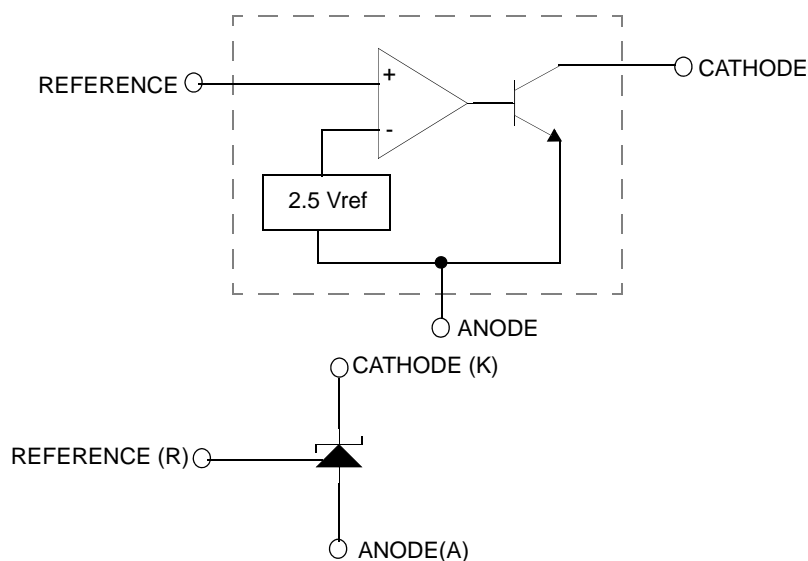
- Programmable Output Voltage to 36 Volts
- Low Dynamic Output Impedance 0.2Ω Typical
- Sink Current Capability of 1.0 to 100mA
- Equivalent Full-Range Temperature Coefficient of 50ppm/°C Typical
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn-on Response

### Description

The KA431/KA431A/KA431L are three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between VREF (approximately 2.5 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω. Active output circuitry provides a very sharp turn on characteristic, making these devices excellent replacement for zener diodes in many applications.



### Internal Block Diagram



## Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified.)

| Parameter   | Symbol           | Value       | Unit     |
|---|------------------|-------------|----------|
| Cathode Voltage   | V <sub>KA</sub>  | 37          | V        |
| Cathode Current Range (Continuous)                      | I <sub>KA</sub>  | -100 ~ +150 | mA       |
| Reference Input Current Range                           | I <sub>REF</sub> | -0.05 ~ +10 | mA       |
| Power Dissipation<br>D, Z Suffix Package<br>DIP Package | P <sub>D</sub>   | 770<br>1000 | mW<br>mW |
| Operating Temperature Range                             | T <sub>OPR</sub> | -25 ~ +85   | °C       |
| Junction Temperature                                    | T <sub>J</sub>   | 150         | °C       |
| Storage Temperature Range                               | T <sub>STG</sub> | -65 ~ +150  | °C       |

## Recommended Operating Conditions

| Parameter       | Symbol          | Min.             | Typ. | Max. | Unit |
|-----------------|-----------------|------------------|------|------|------|
| Cathode Voltage | V <sub>KA</sub> | V <sub>REF</sub> | -    | 36   | V    |
| Cathode Current | I <sub>KA</sub> | 1.0              | -    | 100  | mA   |

## Electrical Characteristics

(T<sub>A</sub> = +25°C, unless otherwise specified)

| Parameter   | Symbol                              | Conditions   | KA431                                  |       |       | KA431A |       |       | KA431L |       |       | Unit |      |
|---|-------------------------------------|--|--|-------|-------|--------|-------|-------|--------|-------|-------|------|------|
|   |                                     |  | Min.                                   | Typ.  | Max.  | Min.   | Typ.  | Max.  | Min.   | Typ.  | Max.  |      |      |
| Reference Input Voltage   | V <sub>REF</sub>                    | V <sub>KA</sub> =V <sub>REF</sub> ,<br>I <sub>KA</sub> =10mA   | 2.450                                  | 2.500 | 2.550 | 2.470  | 2.495 | 2.520 | 2.482  | 2.495 | 2.508 | V    |      |
| Deviation of Reference Input Voltage Over-Temperature                       | ΔV <sub>REF</sub> /ΔT               | V <sub>KA</sub> =V <sub>REF</sub> ,<br>I <sub>KA</sub> =10mA<br>T <sub>MIN</sub> ≤T <sub>A</sub> ≤T <sub>MAX</sub> | -                                      | 4.5   | 17    | -      | 4.5   | 17    | -      | 4.5   | 17    | mV   |      |
| Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage | ΔV <sub>REF</sub> /ΔV <sub>KA</sub> | I <sub>KA</sub> =10mA  | ΔV <sub>KA</sub> =10V-V <sub>REF</sub> | -     | -1.0  | -2.7   | -     | -1.0  | -2.7   | -     | -1.0  | -2.7 | mV/V |
|   |                                     |  | ΔV <sub>KA</sub> =36V-10V              | -     | -0.5  | -2.0   | -     | -0.5  | -2.0   | -     | -0.5  | -2.0 |      |
| Reference Input Current   | I <sub>REF</sub>                    | I <sub>KA</sub> =10mA,<br>R <sub>1</sub> =10kΩ,R <sub>2</sub> =∞   | -                                      | 1.5   | 4     | -      | 1.5   | 4     | -      | 1.5   | 4     | μA   |      |
| Deviation of Reference Input Current Over Full Temperature Range            | ΔI <sub>REF</sub> /ΔT               | I <sub>KA</sub> =10mA,<br>R <sub>1</sub> =10kΩ,R <sub>2</sub> =∞<br>T <sub>A</sub> =Full Range                     | -                                      | 0.4   | 1.2   | -      | 0.4   | 1.2   | -      | 0.4   | 1.2   | μA   |      |
| Minimum Cathode Current for Regulation                                      | I <sub>KA(MIN)</sub>                | V <sub>KA</sub> =V <sub>REF</sub>  | -                                      | 0.45  | 1.0   | -      | 0.45  | 1.0   | -      | 0.45  | 1.0   | mA   |      |
| Off - Stage Cathode Current   | I <sub>KA(OFF)</sub>                | V <sub>KA</sub> =36V,<br>V <sub>REF</sub> =0   | -                                      | 0.05  | 1.0   | -      | 0.05  | 1.0   | -      | 0.05  | 1.0   | μA   |      |
| Dynamic Impedance   | Z <sub>KA</sub>                     | V <sub>KA</sub> =V <sub>REF</sub> ,<br>I <sub>KA</sub> =1 to 100mA<br>f ≥1.0kHz                                    | -                                      | 0.15  | 0.5   | -      | 0.15  | 0.5   | -      | 0.15  | 0.5   | Ω    |      |

- T<sub>MIN</sub> = -25°C, T<sub>MAX</sub> = +85°C

## Test Circuits

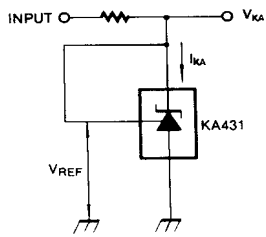


Figure 1. Test Circuit for  $V_{KA} = V_{REF}$

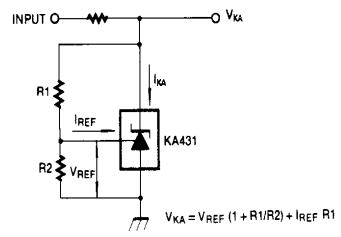


Figure 2. Test Circuit for  $V_{KA} \geq V_{REF}$

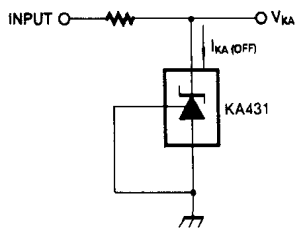


Figure 3. Test Circuit for  $I_{KA(OFF)}$

## Typical Performance Characteristics

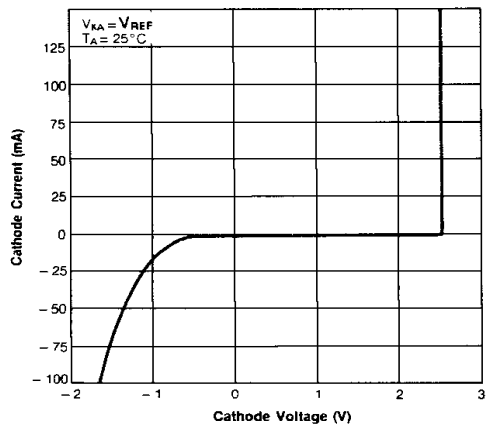


Figure 4. Cathode Current vs. Cathode Voltage

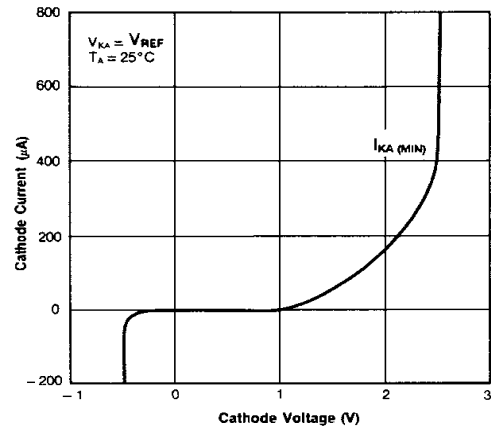


Figure 5. Cathode Current vs. Cathode Voltage

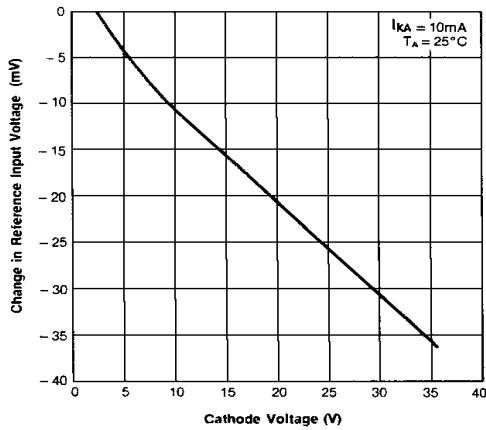


Figure 6. Change In Reference Input Voltage vs. Cathode Voltage

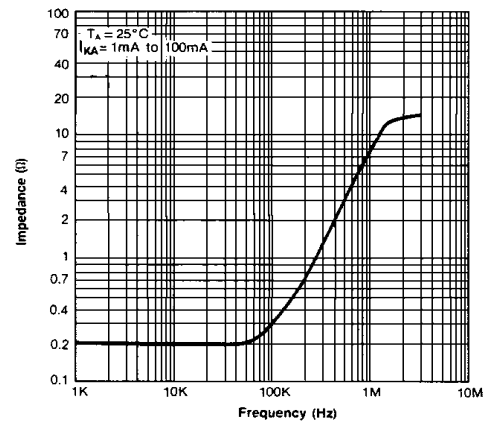


Figure 7. Dynamic Impedance Frequency

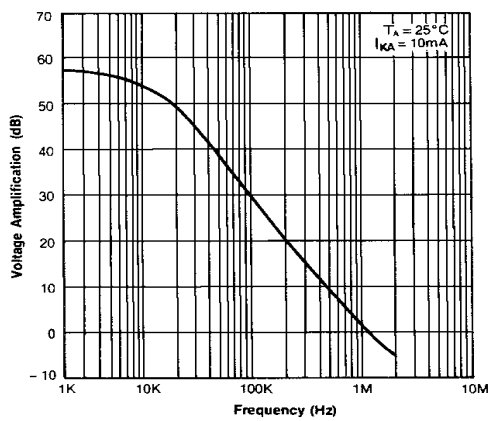


Figure 8. Small Signal Voltage Amplification vs. Frequency

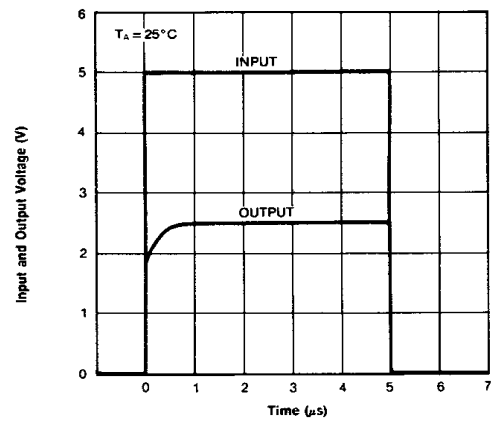


Figure 9. Pulse Response

Typical Performance Characteristics (Continued)

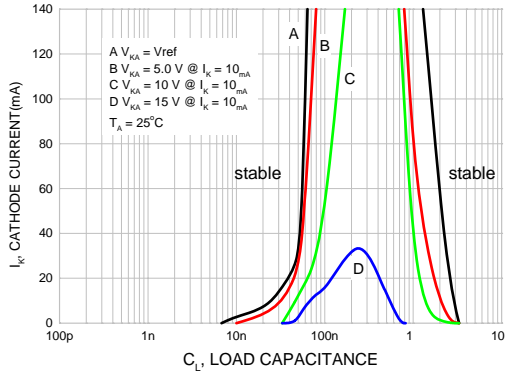


Figure 10. Stability Boundary Conditions

## Typical Application

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

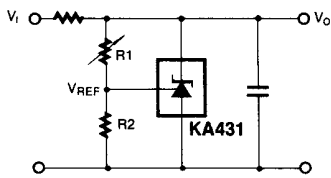


Figure 11. Shunt Regulator

$$V_O = V_{ref} \left(1 + \frac{R_1}{R_2}\right)$$

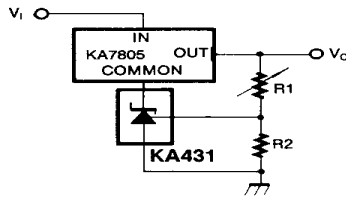


Figure 12. Output Control for Three-Terminal Fixed Regulator

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

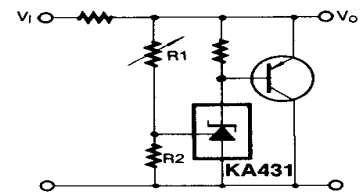


Figure 13. High Current Shunt Regulator

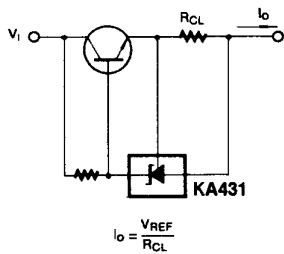


Figure 14. Current Limit or Current Source

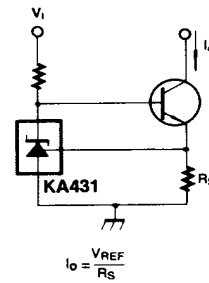


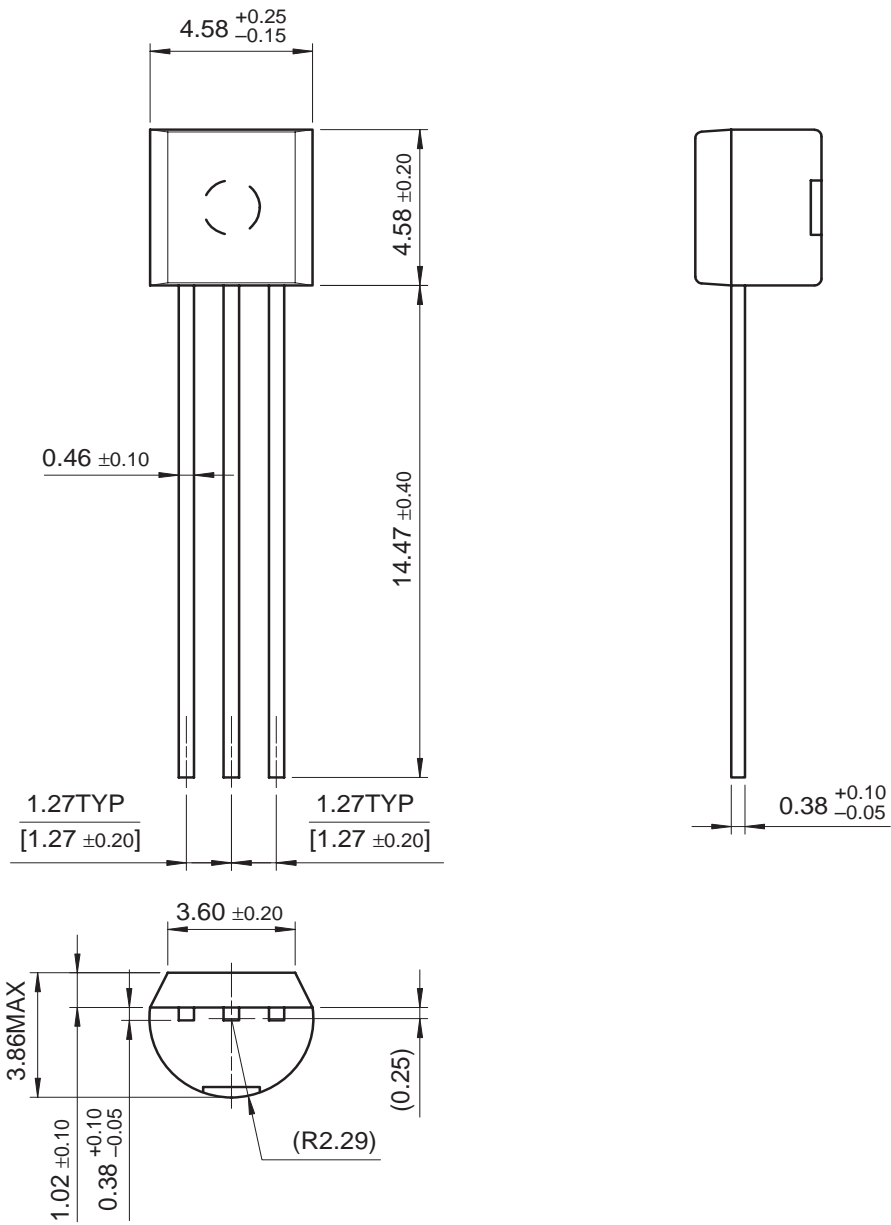
Figure 15. Constant-Current Sink

# Mechanical Dimensions

Package

Dimensions in millimeters

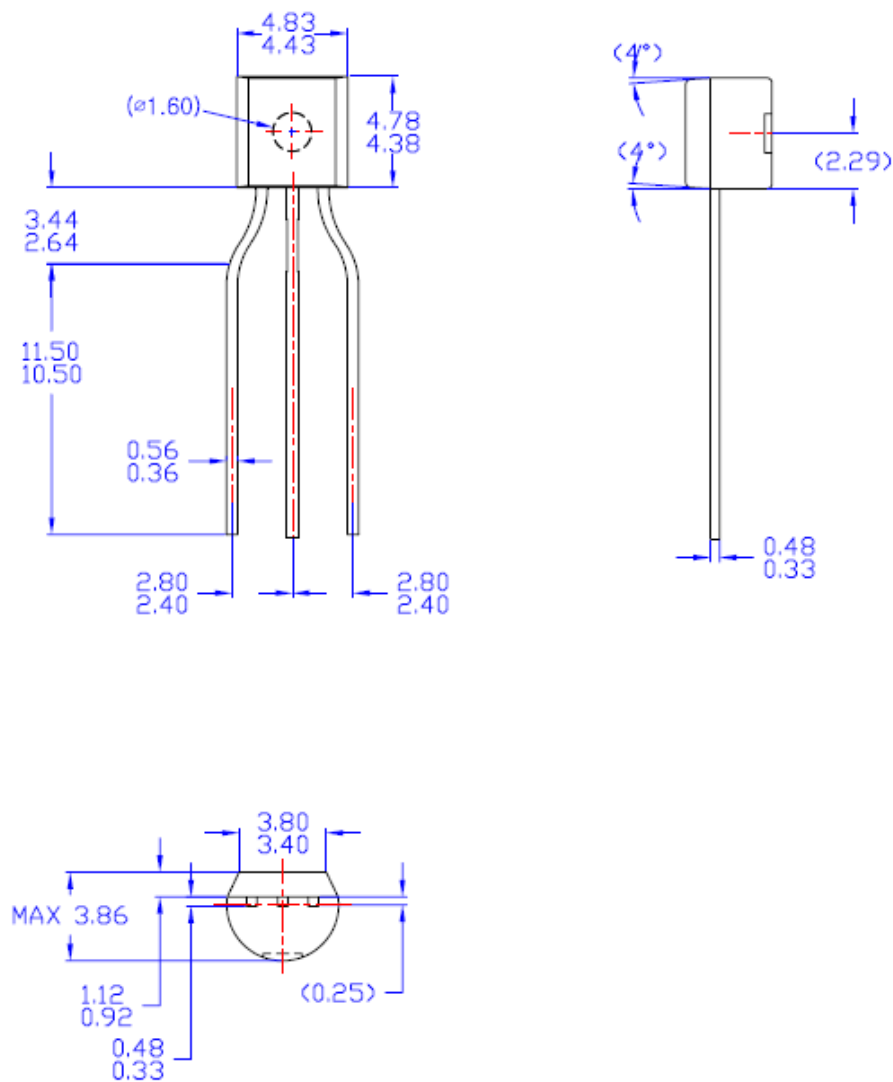
## TO-92 Bulk Type





**Mechanical Dimensions** (Continued)**Package**

Dimensions in millimeters

**TO-92 Ammo Type & Tape And Reel Type****NOTES:**

- A) THIS PACKAGE DOES NOT COMPLY TO ANY CURRENT PACKAGING STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DRAWING CONFORMS TO ASME Y14.5M-1994
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

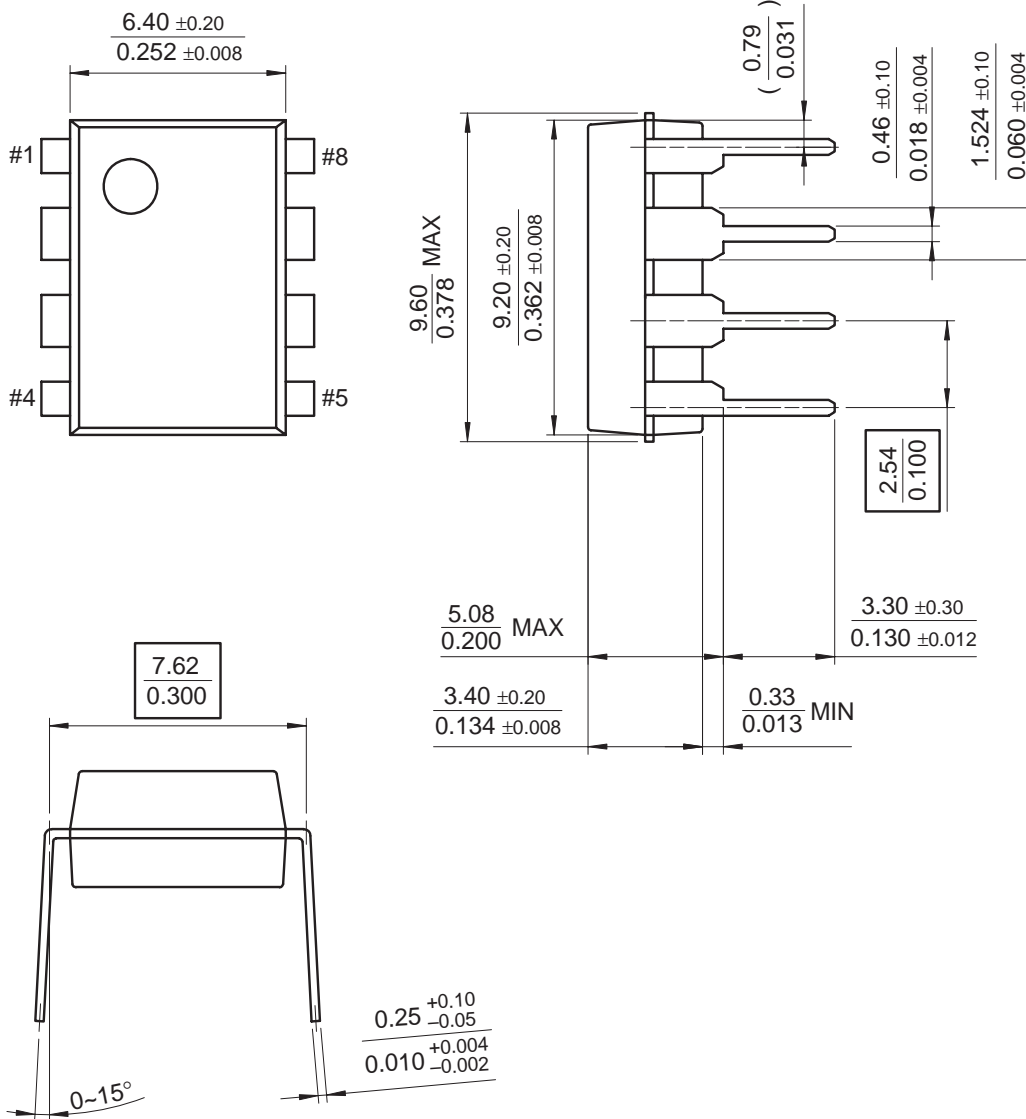
FILE NAME:MKT-TO-92J61Z

**Mechanical Dimensions** (Continued)

**Package**

Dimensions in millimeters

**8-DIP**

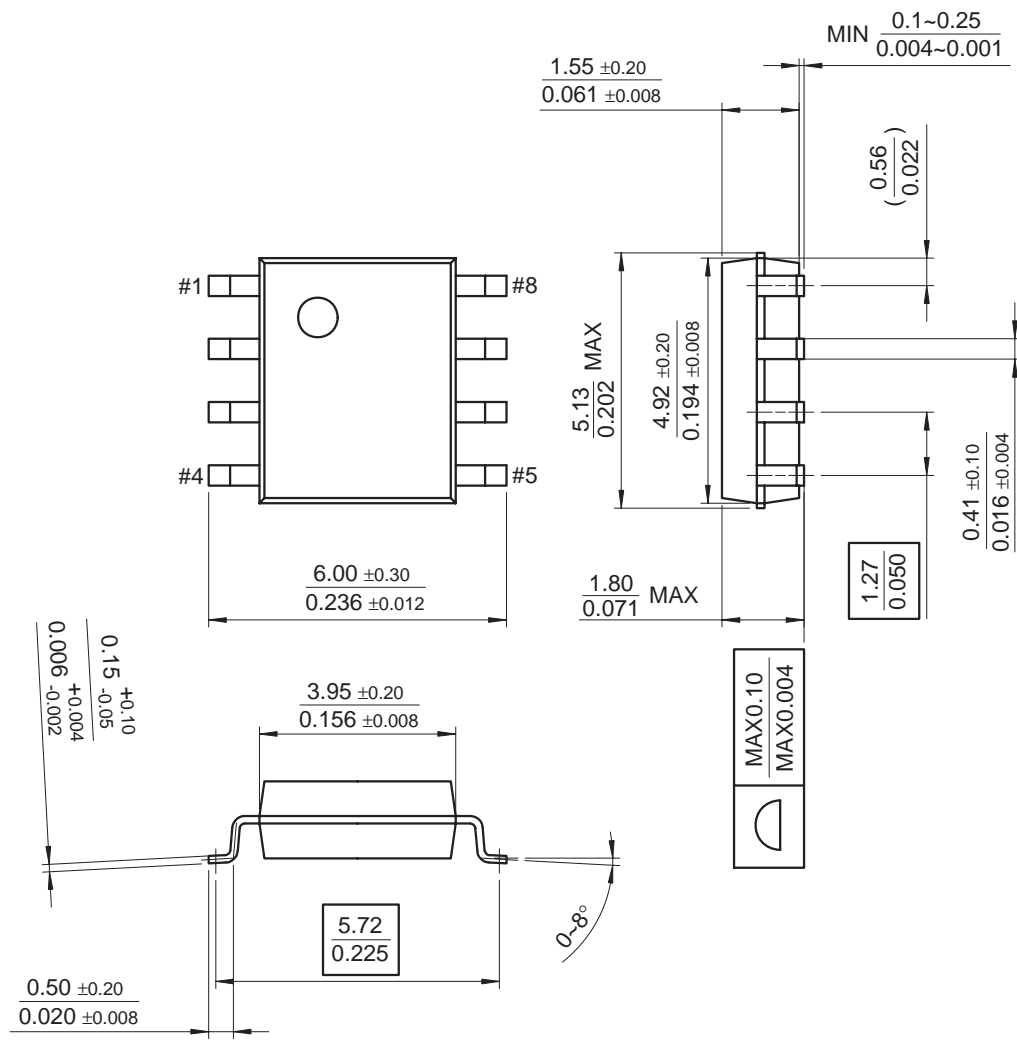


Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-SOP



## Ordering Information

| Product Number | Output Voltage Tolerance | Package     | Operating Temperature | Shipping |
|----------------|--------------------------|-------------|-----------------------|----------|
| KA431LZ        | 0.5%                     | TO-92       | -25 ~ +85°C           |          |
| KA431LD        |                          | 8-SOP       |                       |          |
| KA431AZ        | 1%                       | TO-92       |                       |          |
| KA431AD        |                          | 8-SOP       |                       |          |
| KA431          | 2%                       | 8-DIP       |                       |          |
| KA431Z         |                          | TO-92       |                       |          |
| KA431D         |                          | 8-SOP       |                       |          |
| KA431AZMTA     |                          | 1%          |                       | TO-92    |
| KA431AZTA      | Tape & Reel              |             |                       |          |
| KA431AZTF      |                          |             |                       |          |
| KA431LZMTA     | 0.5%                     | Ammo Pack   |                       |          |
| KA431LZTA      |                          | Tape & Reel |                       |          |
| KA431LZTF      |                          |             |                       |          |
| KA431ZMTA      | 2%                       | Ammo Pack   |                       |          |
| KA431ZTA       |                          | Tape & Reel |                       |          |
| KA431ZTF       |                          |             |                       |          |

- For information on tape & reel and ammo pack specifications, including part orientation and tape sizes, please refer to our tape and reel data, <http://www.fairchildsemi.com/products/analog/packaging/to92r.html>

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- A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.