



# ME431

## Adjustable Precision Shunt Regulator

### General Description

The ME431 series ICs are three-terminal adjustable shunt regulators with guaranteed thermal stability over a full operation range. These ICs feature sharp turn-on characteristics, low temperature coefficient and low output impedance, which make them ideal substitutes for Zener diodes in applications such as switching power supply, charger and other adjustable regulators.

The ME431 voltage type is 40V. The output voltage can be set to any value between  $V_{REF}$  (2.5V) and the corresponding maximum cathode voltage.

The ME431 precision reference is offered in two band gap tolerance: 0.4% and 1.0%.

### Typical Application

- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

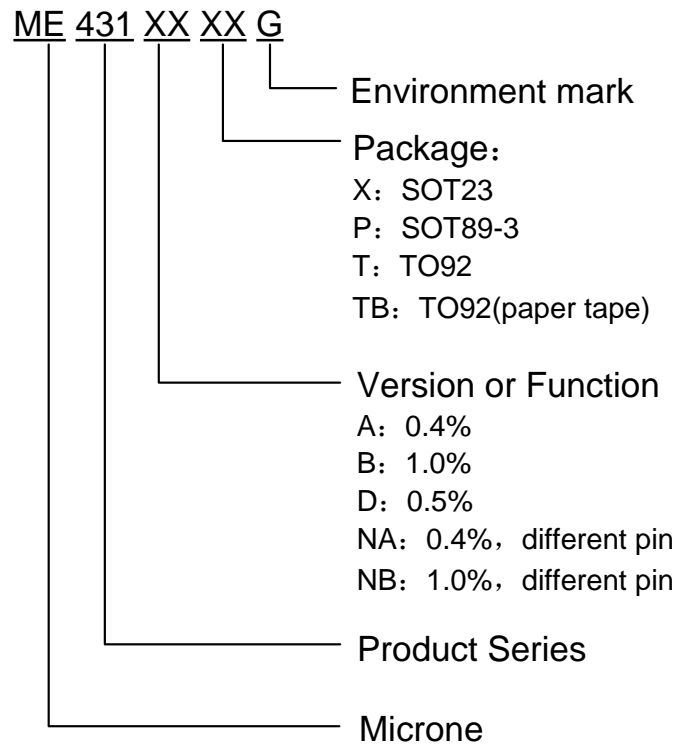
### Features

- Programmable Precise Output Voltage from 2.5V to 36V
- Very Accurate Reference Voltage: Typical 0.15%
- High Stability under Capacitive Load
- Low Temperature Deviation: Typical 4.5mV
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Low Dynamic Output Resistance: Typical 0.2Ω
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 150°C

### Package

- 3-pin SOT23、TO92、SOT89-3

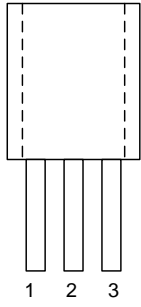
## Selection Guide



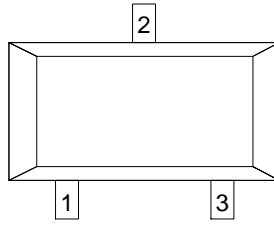
| product series | product description                                    |
|----------------|--|
| ME431AXG       | $V_{REF}=2.5V\pm0.4\%$ ; Package: SOT23                |
| ME431BXG       | $V_{REF}=2.5V\pm1.0\%$ ; Package: SOT23                |
| ME431DXG       | $V_{REF}=2.55V\pm0.5\%$ ; Package: SOT23               |
| ME431APG       | $V_{REF}=2.5V\pm0.4\%$ ; Package: SOT89-3              |
| ME431ATG       | $V_{REF}=2.5V\pm0.4\%$ ; Package: TO92                 |
| ME431BTG       | $V_{REF}=2.5V\pm1.0\%$ ; Package: TO92                 |
| ME431ATBG      | $V_{REF}=2.5V\pm0.4\%$ ; Package: TO92; paper tape     |
| ME431BTBG      | $V_{REF}=2.5V\pm1.0\%$ ; Package: TO92; paper tape     |
| ME431NAXG      | $V_{REF}=2.5V\pm0.4\%$ ; Package: SOT23; Different pin |
| ME431NBXG      | $V_{REF}=2.5V\pm1.0\%$ ; Package: SOT23; Different pin |

**NOTE:** If you need other voltage and package, please contact our sales staff.

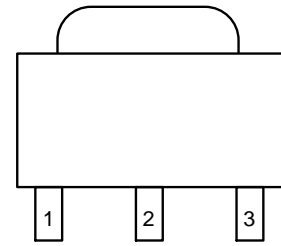
## PIN Configuration



TO92



SOT23

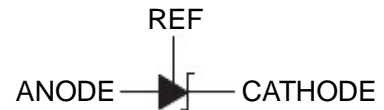
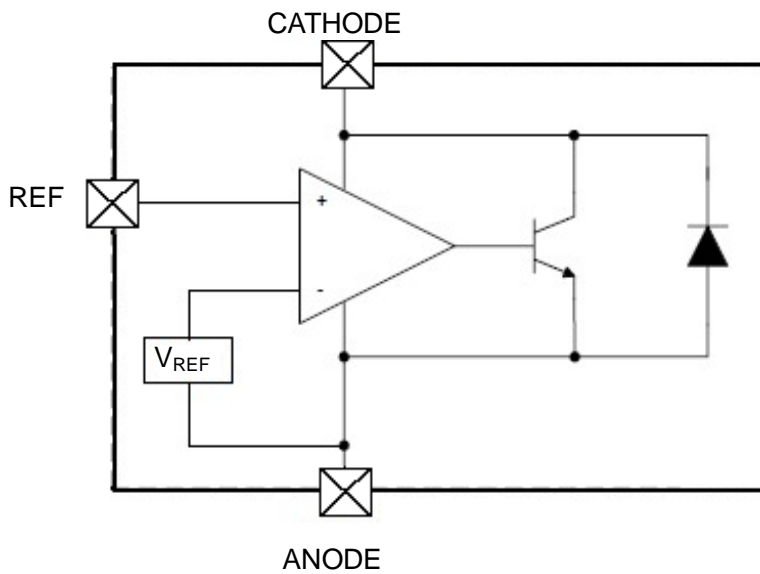


SOT89-3

## Pin Assignment

| Pin Number |        | Symbol | Functions |
|------------|--------|--------|-----------|
| ME431      | ME431N |        |           |
| 1          | 3      | R      | reference |
| 2          | 2      | A      | anode     |
| 3          | 1      | K      | cathode   |

## Block Diagram and symbol



## Absolute Maximum Ratings

| Parameter                          | Symbol        | Rating               | Unit |
|------------------------------------|---------------|----------------------|------|
| Cathode voltage                    | $V_{KA}$      | 40                   | V    |
| Cathode current range (continuous) | $I_{KA}$      | -100~+130            | mA   |
| Reference input current range      | $I_{REF}$     | 10                   | mA   |
| Power Dissipation                  | $P_D$         | TO-92 Package: 0.8   | W    |
|                                    |               | SOT23 Package:0.4    |      |
|                                    |               | SOT89-3 Package:1.25 |      |
| Junction temperature               | $T_J$         | -40~+150             | °C   |
| Storage Temperature range          | $T_{STG}$     | -55~+150             | °C   |
| Package thermal impedance          | $\theta_{JA}$ | TO-92 package:150    | °C/W |
|                                    |               | SOT23 package:330    |      |
|                                    |               | SOT89-3 Package:100  |      |

**Note:** Use this IC within the stated maximum ratings. Operation beyond these limits may cause degrading or permanent damage to the device.

## Recommended Operating Conditions

| Parameter                           | Symbol   | Min       | Max | Unit |
|-------------------------------------|----------|-----------|-----|------|
| Cathode Voltage                     | $V_{KA}$ | $V_{REF}$ | 36  | V    |
| Cathode Current                     | $I_{KA}$ | 1.0       | 100 | mA   |
| Operating Ambient Temperature Range |          | -40       | 85  | °C   |

## Electrical Characteristics ( $T_A=25^\circ\text{C}$ , unless otherwise noted)

| Parameter   | Symbol                                 | Conditions  | Min                                     | Typ. | Max   | Unit          | Test circuit |       |
|---|--|---|---|------|-------|---------------|--------------|-------|
| Reference voltage   | $V_{REF}$                              | $V_{KA}=V_{REF}, I_{KA}=10\text{mA}$                        | 2.490                                   | 2.50 | 2.510 | V             | Fig.1        |       |
|   |  |   | 2.475                                   | 2.50 | 2.525 |               |              |       |
|   |  |   | 2.537                                   | 2.55 | 2.562 |               |              |       |
| Deviation of reference voltage over-temperature                       | $\Delta V_{REF}$                       | $V_{KA}=V_{REF}, I_{KA}=10\text{mA}$                        | 0 to 70°C                               | -    | 7     | 10            | mV           | Fig.1 |
|   |  |   | -40 to 150°C                            | -    | 25    | 30            |              |       |
| Dynamic impedance   | $ Z_{KA} $                             | $V_{KA}=V_{REF}, I_{KA}=1$ to 100mA, $f \leq 1.0\text{KHz}$ | -                                       | 0.15 | 0.5   | $\Omega$      | Fig.1        |       |
| Minimum cathode current for regulation                                | $I_{KA}(\text{MIN})$                   | $V_{KA}=V_{REF}$  | -                                       | 0.4  | 1.0   | mA            | Fig.1        |       |
| Ratio of change in reference voltage to the change in cathode voltage | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $I_{KA}=10\text{mA}$  | $\Delta V_{KA}=10\text{V}$ to $V_{REF}$ | -    | -0.8  | -2.5          | mV/V         | Fig.2 |
|   |  |   | $\Delta V_{KA}=36\text{V}$ to 10V       | -    | -0.6  | -1.5          |              |       |
| Reference current   | $I_{REF}$                              | $I_{KA}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$        |   | 0.7  | 3     | $\mu\text{A}$ | Fig.2        |       |

|  |                        |  |      |     |         |       |
|--|------------------------|--|------|-----|---------|-------|
| Deviation of reference over full temperature range | $\Delta I_{REF}$       | $I_{KA}=10mA, R1=10K\Omega, R2=\infty, T_A=40 \text{ to } 150^\circ C$ | 0.1  | 1.2 | $\mu A$ | Fig.2 |
| Off-state cathode current                          | $I_{KA} \text{ (OFF)}$ | $V_{KA}=36V, V_{REF}=0$  | 0.03 | 0.3 | $\mu A$ | Fig.3 |

**Note:**The dynamic impedance is defined as:  $|Z_{KA}| = \Delta V_{KA} / \Delta I_{KA}$

## Test Circuit

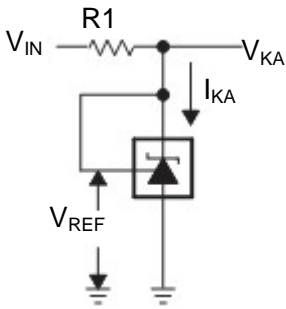
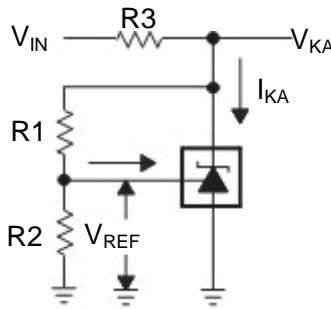


Fig.1: for  $V_{KA} = V_{REF}$



$$V_{KA} = V_{REF} (1 + R1/R2) + I_{REF} R1$$

Fig.2: for  $V_{KA} > V_{REF}$

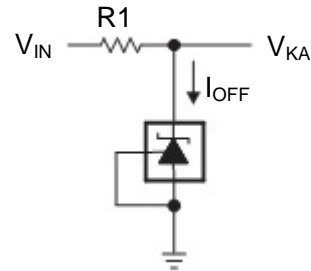
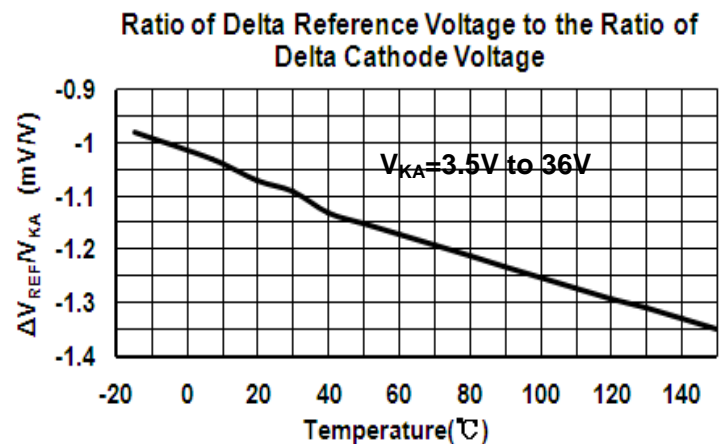
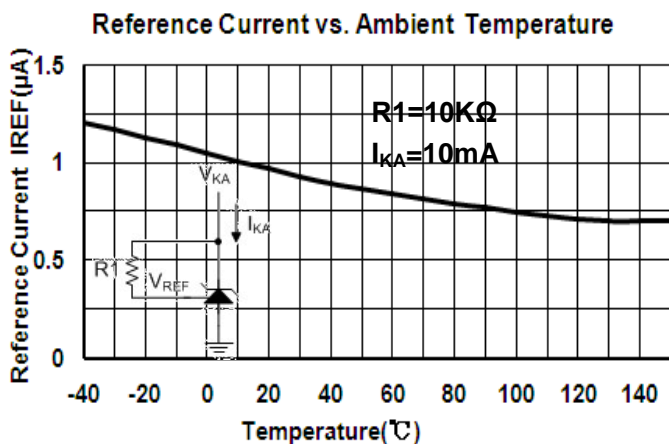
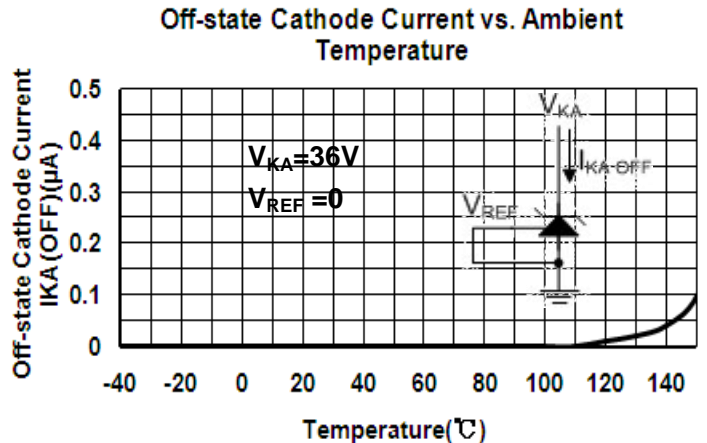
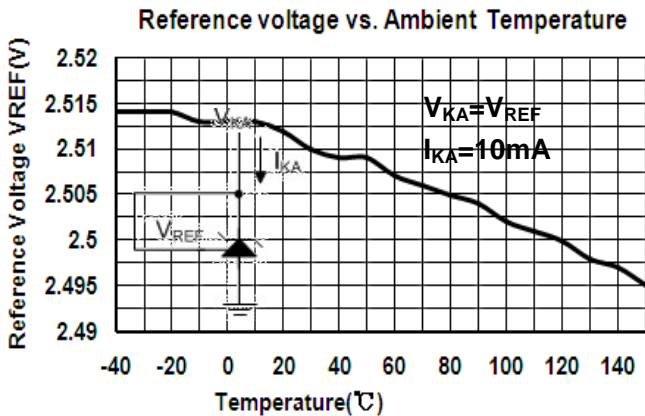
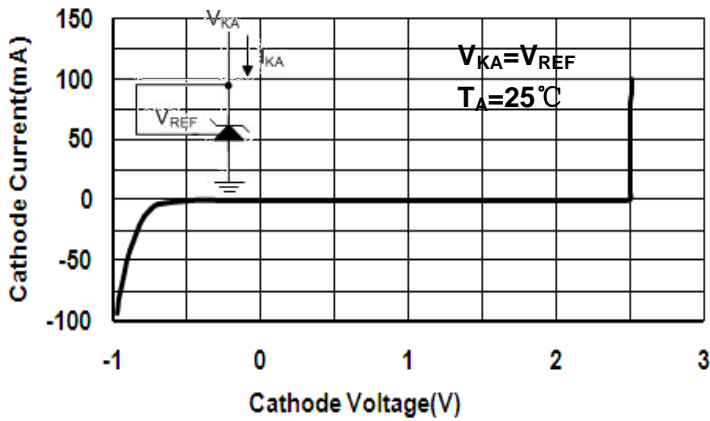


Fig.3: for  $I_{OFF}$

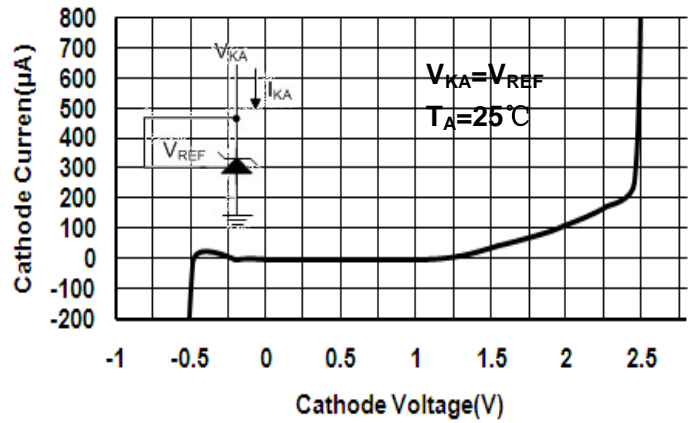
## Typical Performance Characteristics



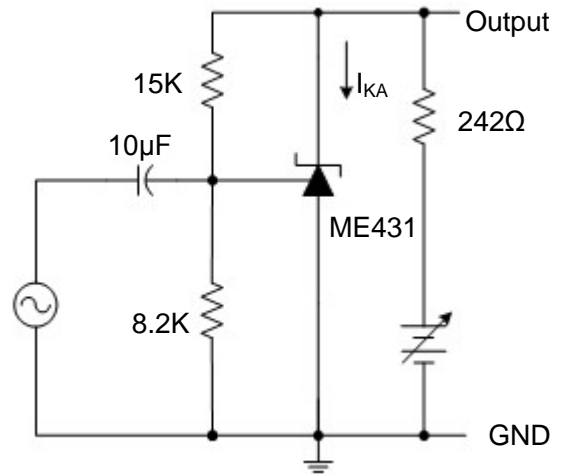
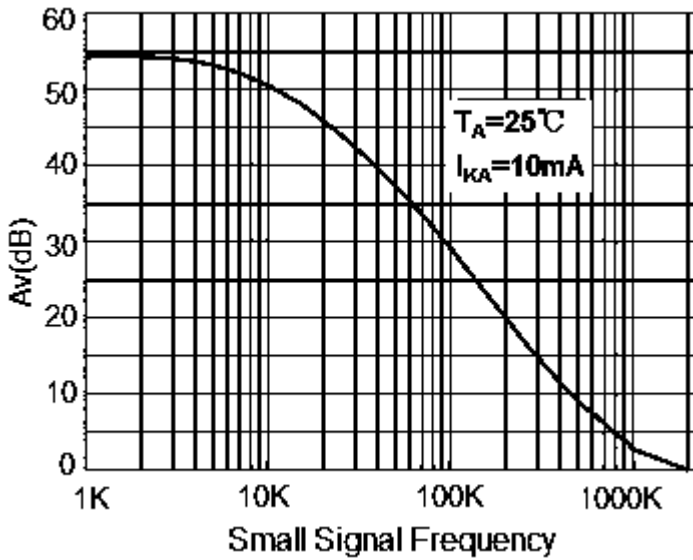
Cathode Current vs. Cathode Voltage



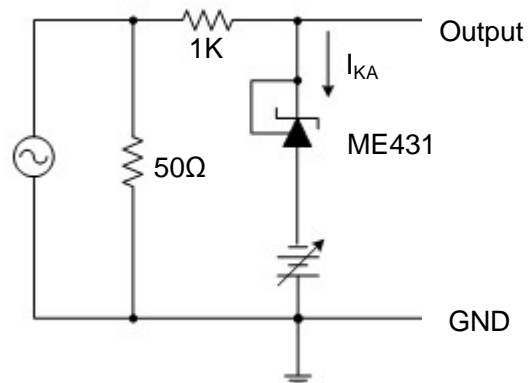
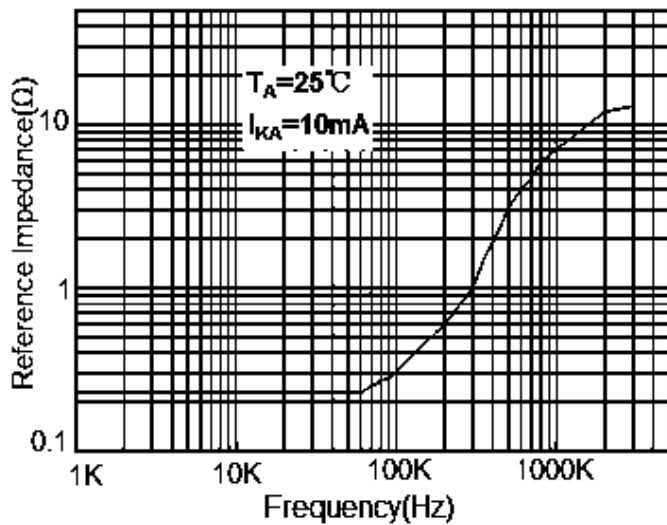
Cathode Current vs. Cathode Voltage



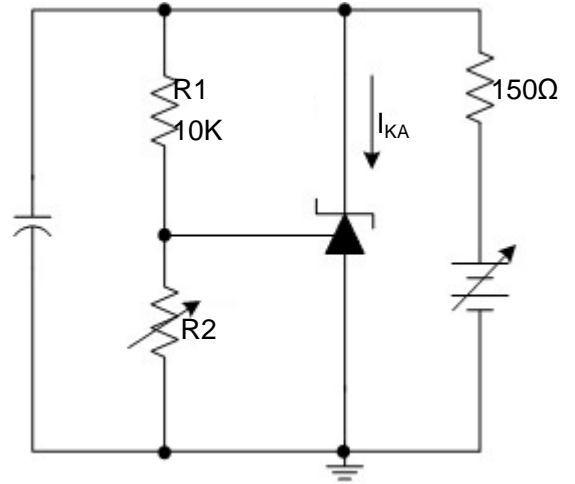
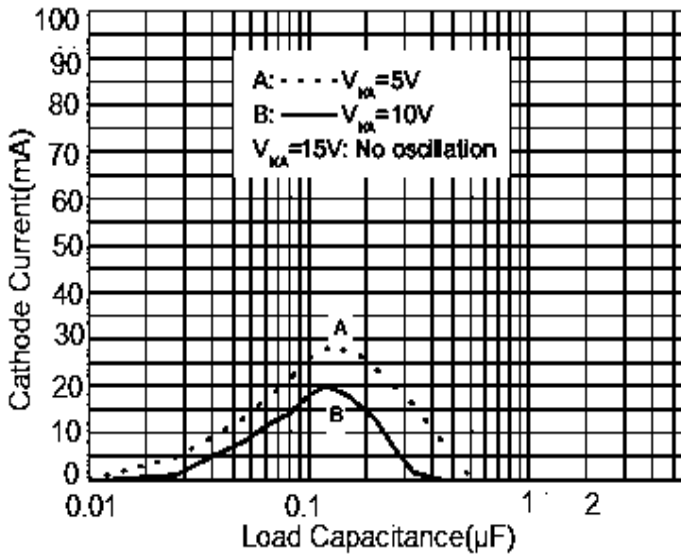
Small Signal Voltage Gain vs. Frequency



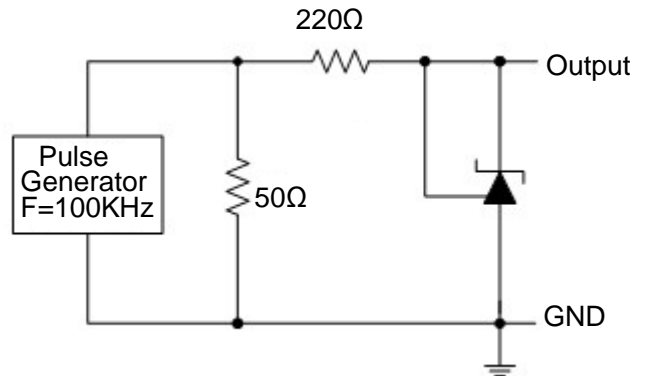
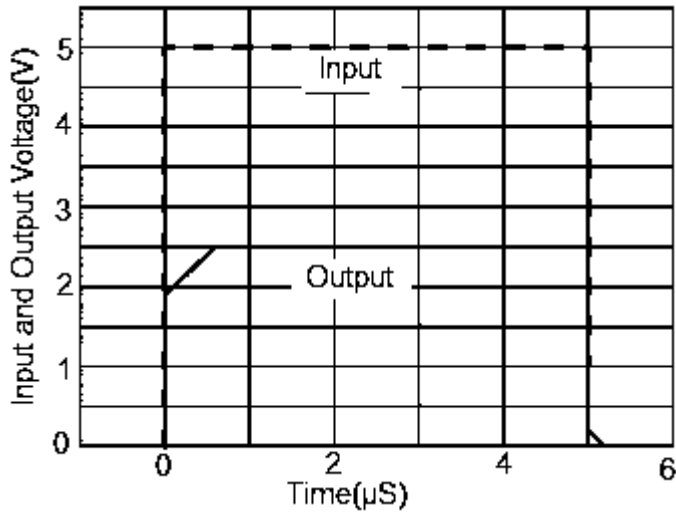
Reference Impedance vs. Frequency



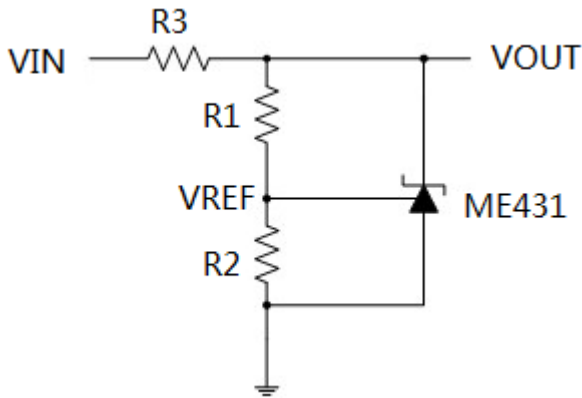
Stability Boundary Conditions vs. Load Capacitance



Pulse Response of Input and Output Voltage

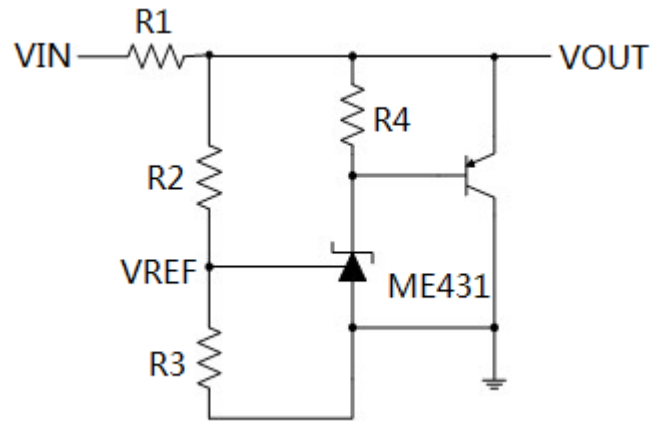


Typical Application



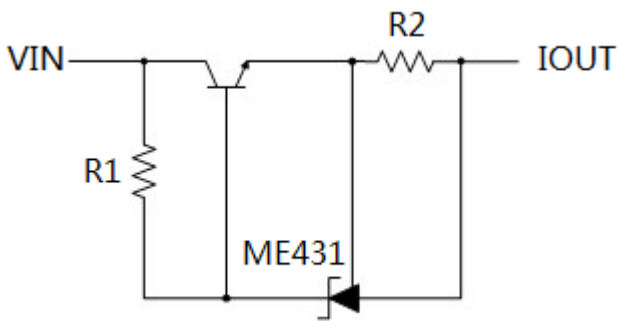
$$V_O = (1 + R1/R2)V_{REF}$$

Fig.4: Shunt Regulator



$$V_O = (1 + R2/R3)V_{REF}$$

Fig.5: High Current Shunt Regulator



$$I_{OUT} = V_{REF}/R2 + I_{KA}$$

Fig.6: Current Source or Current Limit

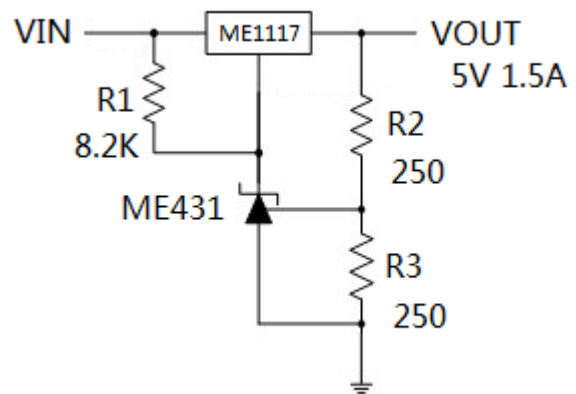
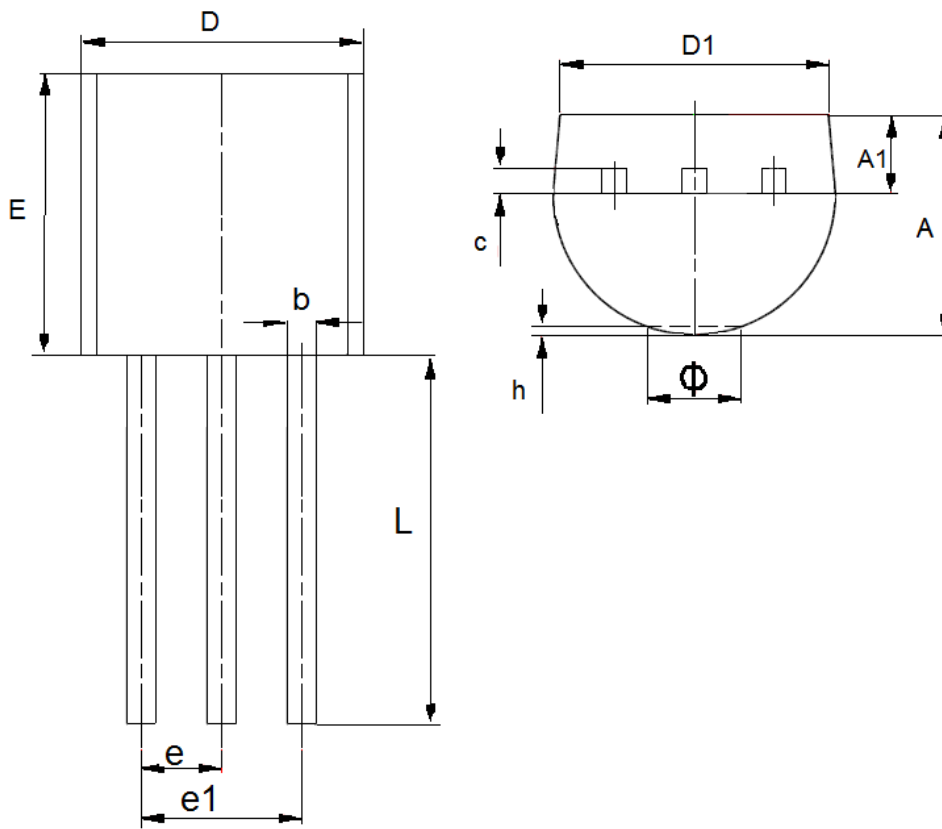


Fig.7: Precision 5V 1.5A Regulator



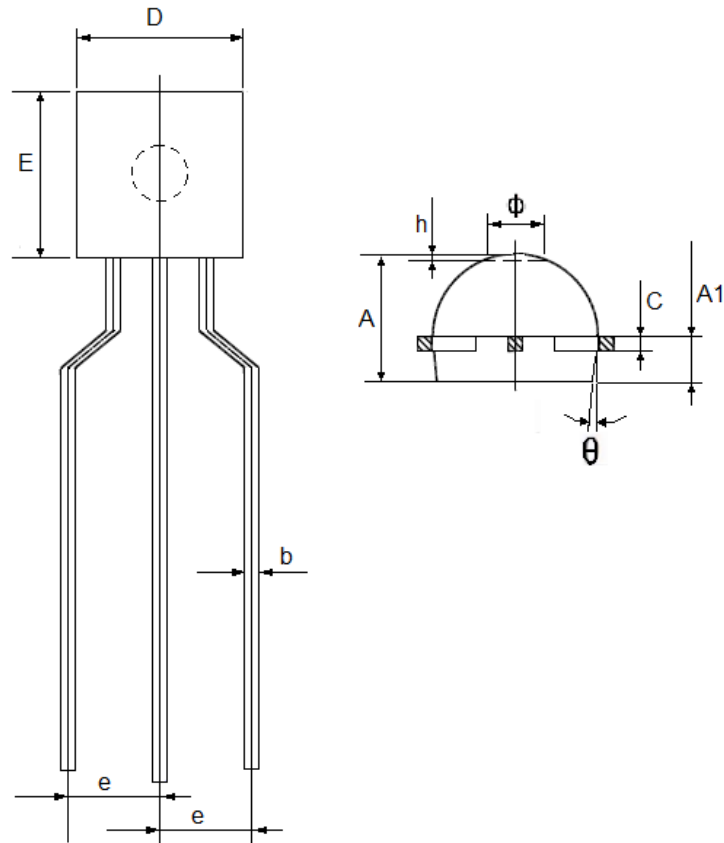
Packaging Type

- TO-92



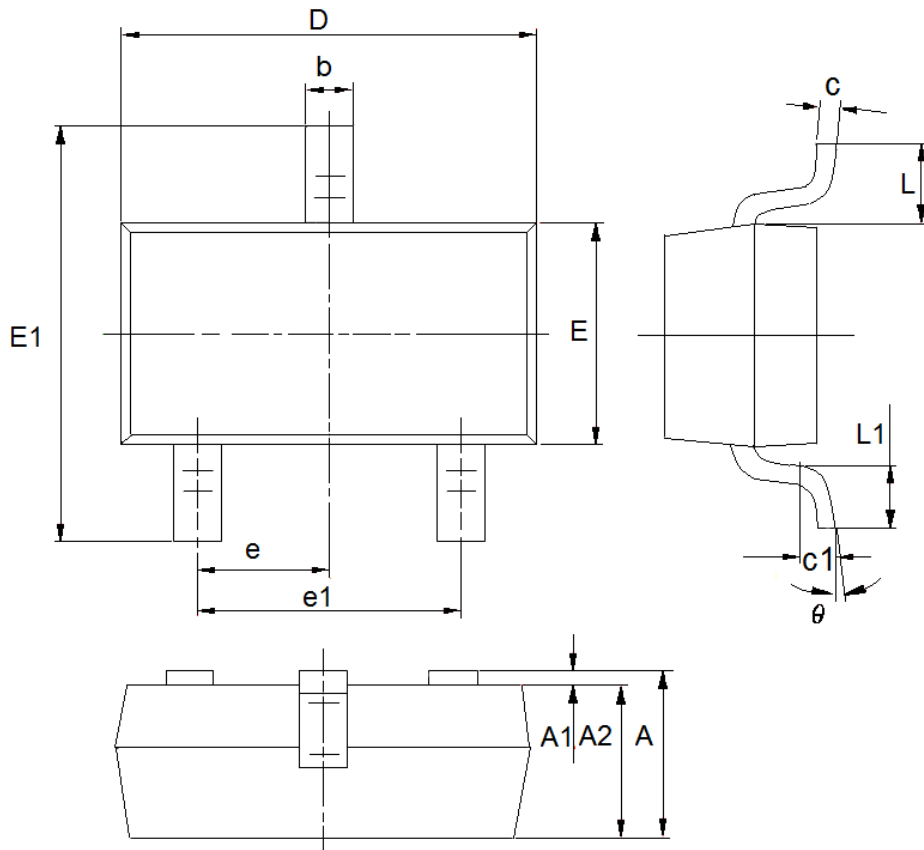
| DIM | Millimeters |      | Inches  |        |
|-----|-------------|------|---------|--------|
|     | Min         | Max  | Min     | Max    |
| A   | 3.3         | 3.7  | 0.1299  | 0.1457 |
| A1  | 1.1         | 1.4  | 0.0433  | 0.0551 |
| b   | 0.38        | 0.55 | 0.015   | 0.0217 |
| c   | 0.36        | 0.51 | 0.0142  | 0.0201 |
| D   | 4.3         | 4.7  | 0.1693  | 0.185  |
| D1  | 3.43        | —    | 0.135   | —      |
| E   | 4.3         | 4.7  | 0.1693  | 0.185  |
| e   | 1.27TYP     |      | 0.05TYP |        |
| e1  | 2.44        | 2.64 | 0.0961  | 0.1039 |
| L   | 14.1        | 14.5 | 0.5551  | 0.5709 |
| h   | 0           | 0.38 | 0       | 0.015  |
| Φ   | —           | 1.6  | —       | 0.063  |

● TO-92 (Paper Tape)



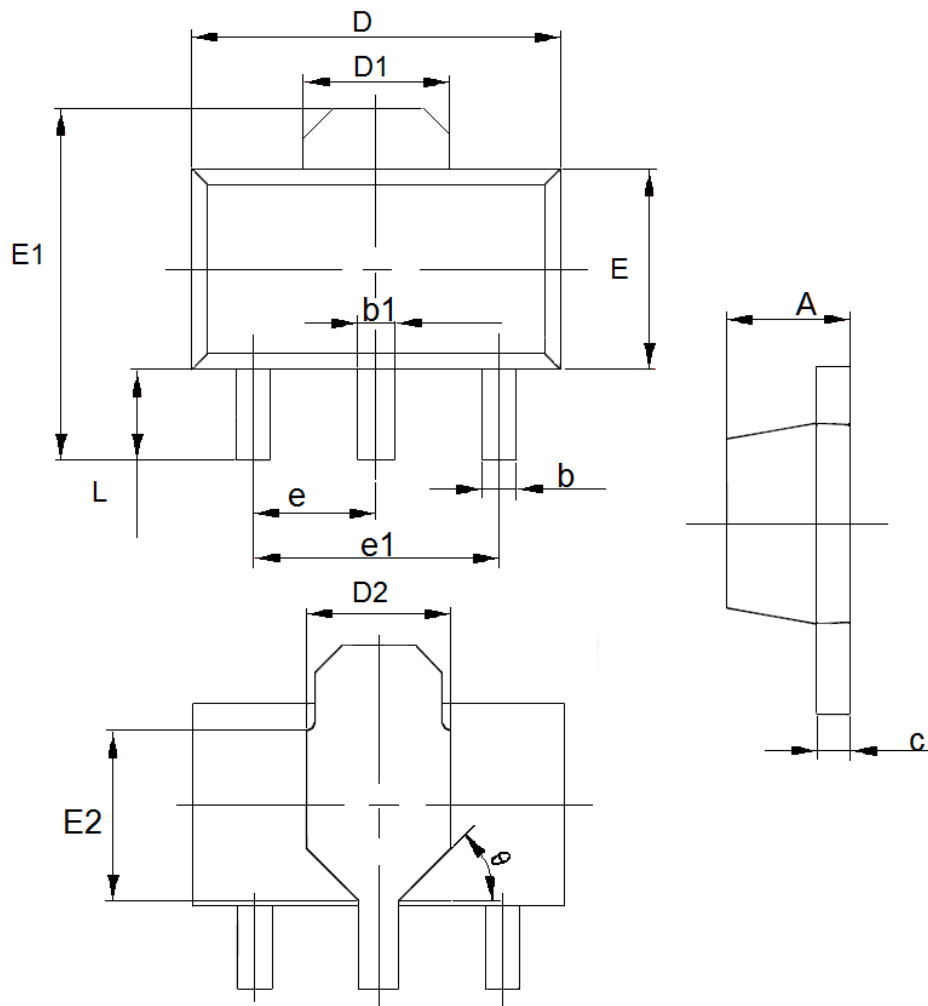
| DIM | Millimeters |     | Inches |        |
|-----|-------------|-----|--------|--------|
|     | Min         | Max | Min    | Max    |
| A   | 3.4         | 3.7 | 0.1339 | 0.1457 |
| A1  | 1.15        | 1.4 | 0.0453 | 0.0551 |
| b   | 0.36        | 0.5 | 0.0142 | 0.0197 |
| c   | 0.38        |     | 0.0150 |        |
| D   | 4.4         | 4.7 | 0.1732 | 0.1850 |
| E   | 4.4         | 4.7 | 0.1732 | 0.1850 |
| e   | 2.2         | 2.8 | 0.0866 | 0.1102 |
| Φ   | 1.5         |     | 0.0591 |        |
| θ   | 5°          |     | 5°     |        |
| h   | 0.2         |     | 0.0079 |        |

● SOT23



| DIM   | Millimeters |      | Inches      |        |
|-------|-------------|------|-------------|--------|
|       | Min         | Max  | Min         | Max    |
| A     | 0.9         | 1.15 | 0.0354      | 0.0453 |
| A1    | 0           | 0.14 | 0.0000      | 0.0055 |
| A2    | 0.9         | 1.05 | 0.0354      | 0.0413 |
| b     | 0.28        | 0.52 | 0.0110      | 0.0205 |
| c     | 0.07        | 0.23 | 0.0028      | 0.0091 |
| D     | 2.8         | 3.0  | 0.1102      | 0.1181 |
| e1    | 1.8         | 2.0  | 0.0709      | 0.0787 |
| E     | 1.2         | 1.4  | 0.0472      | 0.0551 |
| E1    | 2.2         | 2.6  | 0.0866      | 0.1024 |
| e     | 0.95(TYP)   |      | 0.0374(TYP) |        |
| L     | 0.55(TYP)   |      | 0.0217(TYP) |        |
| L1    | 0.25        | 0.55 | 0.0098      | 0.0217 |
| theta | 0           | 8°   | 0.0000      | 8°     |
| c1    | 0.25(TYP)   |      | 0.0098(TYP) |        |

● SOT89-3



| DIM | Millimeters |      | Inches      |        |
|-----|-------------|------|-------------|--------|
|     | Min         | Max  | Min         | Max    |
| A   | 1.4         | 1.6  | 0.0551      | 0.0630 |
| b   | 0.32        | 0.52 | 0.0126      | 0.0205 |
| b1  | 0.4         | 0.58 | 0.0157      | 0.0228 |
| c   | 0.35        | 0.45 | 0.0138      | 0.0177 |
| D   | 4.4         | 4.6  | 0.1732      | 0.1811 |
| D1  | 1.55(TYP)   |      | 0.061(TYP)  |        |
| D2  | 1.75(TYP)   |      | 0.0689(TYP) |        |
| e1  | 3.0(TYP)    |      | 0.1181(TYP) |        |
| E   | 2.3         | 2.6  | 0.0906      | 0.1023 |
| E1  | 3.94        | 4.4  | 0.1551      | 0.1732 |
| E2  | 1.9(TYP)    |      | 0.0748(TYP) |        |
| e   | 1.5(TYP)    |      | 0.0591(TYP) |        |
| L   | 0.8         | 1.2  | 0.0315      | 0.0472 |
| θ   | 45°         |      | 45°         |        |

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