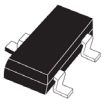
# TL431
# TL432

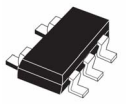
## Automotive adjustable voltage reference

**Datasheet - production data**

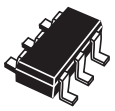
**Z**
**TO-92**
(Plastic package)



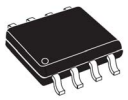
**L**
**SOT23-3**



**L**
**SOT23-5**



**C**
**SOT323-6**



**D**
**SO-8**
(Batwing plastic micropackage)

## Features

- AEC-Q100 qualified
- Adjustable output voltage: 2.5 to 36 V
- Sink current capability: 1 to 100 mA
- Typical output impedance: 0.22 Ω
- 1% and 2% voltage precision
- Automotive temp. range -40 °C to +125 °C

## Applications

- Power supply
- Industrial
- Automotive

## Description

The TL431 and TL432 are adjustable shunt voltage references with guaranteed temperature stability over the entire operating temperature range. The device temperature range is extended for the automotive version from -40 °C up to +125 °C. The output voltage can be set to any value between 2.5 and 36 V with two external resistors. The TL431 and TL432 operate with a wide current range from 1 to 100 mA with a typical dynamic impedance of 0.22 Ω.

# Contents

# 1 Schematic diagrams

**Figure 1. TO-92 pin connections (top view)**

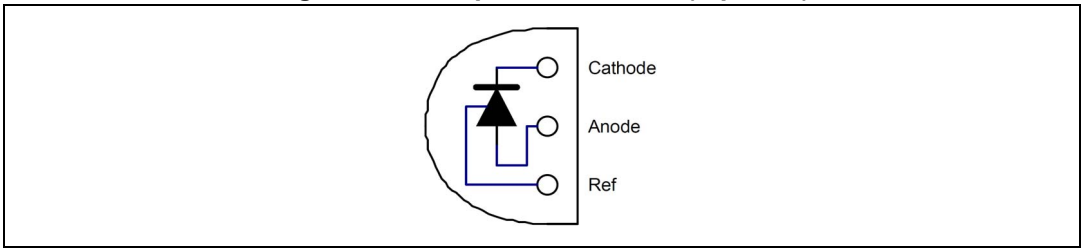



**Figure 2. SO-8 batwing pin connections (top view)**

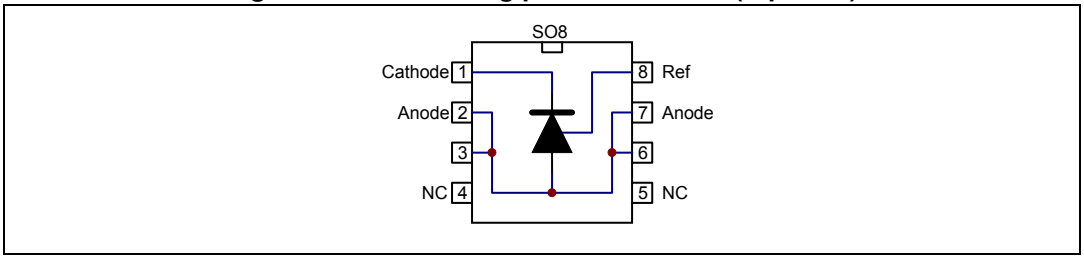



**Figure 3. SOT23-5 and SOT23-3 pin connections (top view)**

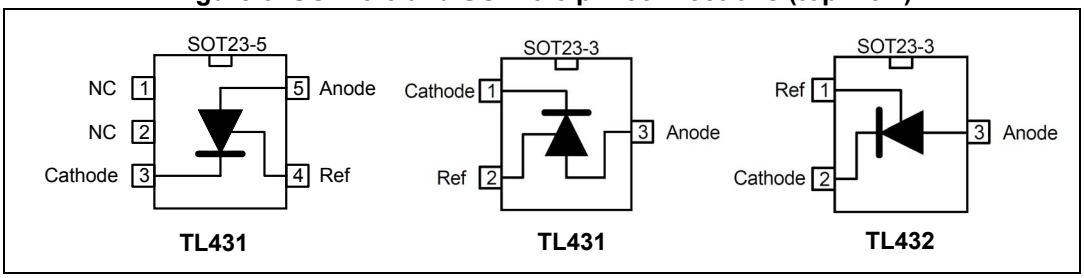



**Figure 4. SOT323-6 pin connections (top view)**

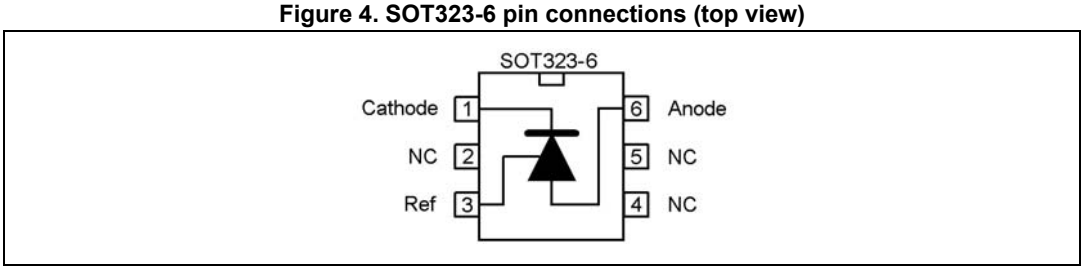
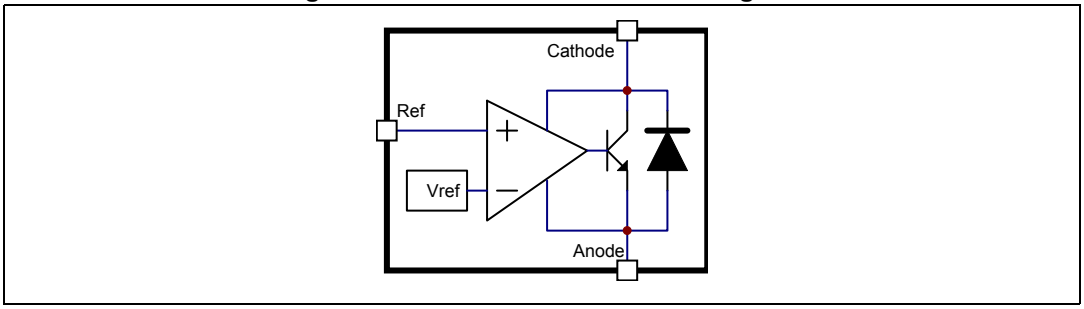



**Figure 5. TL431 and TL432 block diagram**



# 2 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{KA}$ | Cathode to anode voltage | 37 | V |
| $I_k$ | Continuous cathode current range | -100 to +150 | mA |
| $I_{ref}$ | Reference input current range | -0.05 to +10 | mA |
| $R_{thjc}$ | Thermal resistance junction to case<br>TO-92<br>SO-8 batwing<br>SOT23-3L<br>SOT23-5L<br>SOT323-6L | <br>57<br>30<br>136<br>67<br>110 | °C/W |
| $R_{thja}$ | Thermal resistance junction to ambient<br>TO-92<br>SO-8 batwing<br>SOT23-3L<br>SOT23-5L<br>SOT323-6L | <br>200<br>85<br>248<br>157<br>221 | °C/W |
| $T_{stg}$ | Storage temperature range | -65 to +150 | °C |
| $T_J$ | Junction temperature | 150 | °C |
| ESD | TL431IY, TL431AIY-T: HBM (human body model)(1)<br>TL431-TL432: HBM (human body model)<br>MM: machine model(2)<br>CDM: charged device model(3) | 3000<br>2000<br>200<br>1500 | V |

1. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
2. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
3. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

**Table 2. Operating conditions**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{KA}$ | Cathode to anode voltage | $V_{ref}$ to 36 | V |
| $I_k$ | Cathode current | 1 to 100 | mA |
| $T_{oper}$ | Operating free-air temperature range<br>TL431C/AC<br>TL431I/AI - TL432I/AI<br>TL431IY/AIY | <br>0 to +70<br>-40 to +105<br>-40 to +125 | °C |

# 3 Electrical characteristics

**Table 3. TL431C ($T_{amb}$ = 25 °C unless otherwise specified)**

| Symbol | Parameter | TL431C | | | TL431AC | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{ref}$ | Reference input voltage<br>$V_{KA} = V_{ref}$, $I_k$ = 10 mA, $T_{amb}$ = 25 °C<br>$T_{min} \leq T_{amb} \leq T_{max}$ | 2.44<br>2.423 | 2.495<br>- | 2.55<br>2.567 | 2.47<br>2.453 | 2.495<br>- | 2.52<br>2.537 | V |
| $\Delta V_{ref}$ | Reference input voltage deviation overtemperature range (1)<br>$V_{KA} = V_{ref}$, $I_k$ = 10 mA, $T_{min} \leq T_{amb} \leq T_{max}$ | - | 3 | 17 | - | 3 | 15 | mV |
| $\frac{\Delta Vref}{\Delta Vka}$ | Ratio of change in reference input voltage to change in cathode to anode voltage<br>$I_k$ = 10 mA - $\Delta V_{KA}$ = 10 V to $V_{ref}$<br>$\Delta V_{KA}$ = 36 V to 10 V | -2.7<br>-2 | -1.4<br>-1 | -<br>- | -2.7<br>-2 | -1.4<br>-1 | -<br>- | mV/V |
| $I_{ref}$ | Reference input current<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 = ∞<br>$T_{amb}$ = 25 °C<br>$T_{min} \leq T_{amb} \leq T_{max}$ | -<br>- | 1.8<br>- | 4<br>5.2 | -<br>- | 1.8<br>- | 4<br>5.2 | µA |
| $\Delta I_{ref}$ | Reference input current deviation overtemperature range<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 =∞<br>$T_{min} \leq T_{amb} \leq T_{max}$ | - | 0.4 | 1.2 | - | 0.4 | 1.2 | µA |
| $I_{min}$ | Minimum cathode current for regulation<br>$V_{KA} = V_{ref}$ | - | 0.5 | 1 | - | 0.5 | 0.6 | mA |
| $I_{off}$ | Off-state cathode current | - | 2.6 | 1000 | - | 2.6 | 1000 | nA |
| $\lvert ZKA \rvert$ | Dynamic impedance(2)<br>$V_{KA} = V_{ref}$, $\Delta I_k$ = 1 to 100 mA, f ≤ 1 kHZ | - | 0.22 | 0.5 | - | 0.22 | 0.5 | Ω |

1. See definition of *Section : Reference input voltage deviation overtemperature range*.
2. The dynamic impedance is defined as $\lvert ZKA \rvert = \frac{\Delta V_{KA}}{\Delta I_k}$

**Table 4. TL431I/TL432I ($T_{amb}$ = 25 °C unless otherwise specified)**

| Symbol | Parameter | TL431I/TL432I | | | TL431AI/TL432AI | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{ref}$ | Reference input voltage<br>$V_{KA} = V_{ref}$, $I_k$ = 10 mA, $T_{amb}$ = 25 °C<br>$T_{min} \leq T_{amb} \leq T_{max}$ | 2.44<br>2.41 | 2.495<br>- | 2.55<br>2.58 | 2.47<br>2.44 | 2.495<br>- | 2.52<br>2.55 | V |
| $\Delta V_{ref}$ | Reference input voltage deviation overtemperature range (1)<br>$V_{KA} = V_{ref}$, $I_k$ =10 mA, $T_{min} \leq T_{amb} \leq T_{max}$ | - | 7 | 30 | - | 7 | 30 | mV |
| $\frac{\Delta Vref}{\Delta Vka}$ | Ratio of change in reference input voltage to change in cathode to anode voltage<br>$I_k$ = 10 mA, $\Delta V_{KA}$ = 10 V to $V_{ref}$<br>$\Delta V_{KA}$ = 36 V to 10 V | -2.7<br>-2 | -1.4<br>-1 | -<br>- | -2.7<br>-2 | -1.4<br>-1 | -<br>- | mV/V |
| $I_{ref}$ | Reference input current<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 = ∞<br>$T_{amb}$ = 25 °C<br>$T_{min} \leq T_{amb} \leq T_{max}$ | -<br>- | 1.8<br>- | 4<br>6.5 | -<br>- | 1.8<br>- | 4<br>6.5 | µA |
| $\Delta I_{ref}$ | Reference input current deviation overtemperature range<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 = ∞<br>$T_{min} \leq T_{amb} \leq T_{max}$ | - | 0.8 | 2.5 | - | 0.8 | 1.2 | µA |
| $I_{min}$ | Minimum cathode current for regulation<br>$V_{KA} = V_{ref}$ | - | 0.5 | 1 | - | 0.5 | 0.7 | mA |
| $I_{off}$ | Off-state cathode current | - | 2.6 | 1000 | - | 2.6 | 1000 | nA |
| $\lvert ZKA \rvert$ | Dynamic impedance(2)<br>$V_{KA} = V_{ref}$, $\Delta I_k$ = 1 to 100 mA, f ≤ 1 kHZ | - | 0.22 | 0.5 | - | 0.22 | 0.5 | Ω |

1. See definition of *Section : Reference input voltage deviation overtemperature range* below.
2. The dynamic impedance is defined as $\lvert ZKA \rvert = \frac{\Delta V_{KA}}{\Delta I_k}$

**Table 5. TL431IY ($T_{amb}$ = 25 °C unless otherwise specified)**

| Symbol | Parameter | TL431IY | | | TL431AIY | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{ref}$ | Reference input voltage<br>$V_{KA} = V_{ref}$, $I_k$ = 10 mA<br>$T_{min} \leq T_{amb} \leq T_{max}$ | 2.44<br>2.41 | 2.495<br>- | 2.55<br>2.58 | 2.47<br>2.44 | 2.495<br>- | 2.52<br>2.55 | V |
| $\Delta V_{ref}$ | Reference input voltage deviation overtemperature range(1)<br>$V_{KA} = V_{ref}$, $I_k$ = 10 mA, $T_{min} \leq T_{amb} \leq T_{max}$ | - | 7 | 30 | - | 7 | 30 | mV |
| $\frac{\Delta Vref}{\Delta Vka}$ | Ratio of change in reference input voltage to change in cathode to anode voltage<br>$I_k$ = 10 mA, $\Delta V_{KA}$ = 10 V to $V_{ref}$<br>$I_k$ = 10 mA, $\Delta V_{KA}$ = 36 V to 10 V | -2.7<br>-2 | -1.4<br>-1 | -<br>- | -2.7<br>-2 | -1.4<br>-1 | -<br>- | mV/V |
| $I_{ref}$ | Reference input current<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 = ∞<br>$T_{min} \leq T_{amb} \leq T_{max}$ | -<br>- | 1.8<br>- | 4<br>6.5 | -<br>- | 1.8<br>- | 4<br>6.5 | µA |
| $\Delta I_{ref}$ | Reference input current deviation overtemperature range<br>$I_k$ = 10 mA, R1 = 10 kΩ, R2 = ∞, $T_{min} \leq T_{amb} \leq T_{max}$ | - | 0.8 | 2.5 | - | 0.8 | 1.2 | µA |
| $I_{min}$ | Minimum cathode current for regulation<br>$V_{KA} = V_{ref}$ | - | 0.5 | 1 | - | 0.5 | 0.6 | mA |
| $I_{off}$ | Off-state cathode current<br>$T_{min} \leq T_{amb} \leq T_{max}$ | -<br>- | 2.6 | 1000<br>3000 | -<br>- | 2.6 | 1000<br>3000 | nA |
| $\lvert ZKA \rvert$ | Dynamic impedance(2)<br>$V_{KA} = V_{ref}$, $\Delta I_k$ = 1 to 100 mA, F ≤ 1 kHz | - | 0.22 | 0.5 | - | 0.22 | 0.5 | Ω |

1. See definition of *Section : Reference input voltage deviation overtemperature range* below.
2. The dynamic impedance is defined as $\lvert ZKA \rvert = \frac{\Delta V_{KA}}{\Delta I_k}$

## Reference input voltage deviation overtemperature range

$\Delta V_{ref}$ is defined as the difference between the maximum and minimum values obtained over the full temperature range.

$$\Delta V_{ref} = V_{ref\ max} - V_{ref\ min}$$

**Figure 6. Reference input voltage deviation overtemperature range**

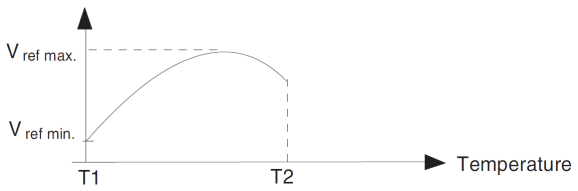


**Figure 7. Test circuit for $V_{KA} = V_{ref}$**

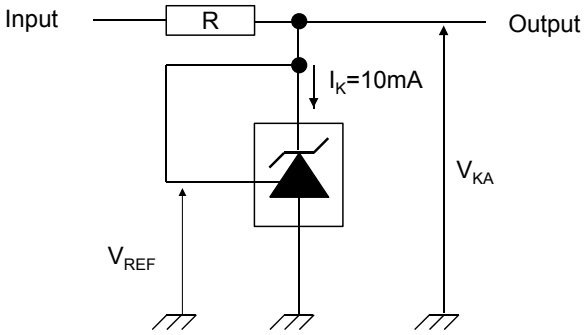
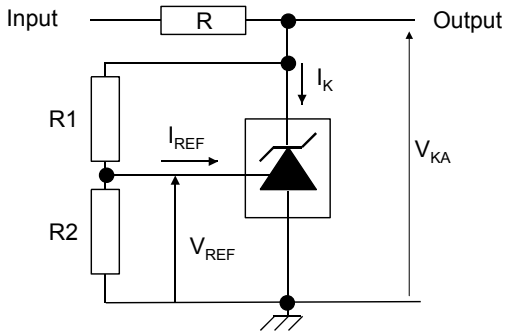



**Figure 8. Test circuit for programming mode**




$$V_{KA} = V_{REF}\left(1 + \frac{R1}{R2}\right) + R1 \times I_{REF}$$

**Figure 9. Test circuit for $I_{off}$**

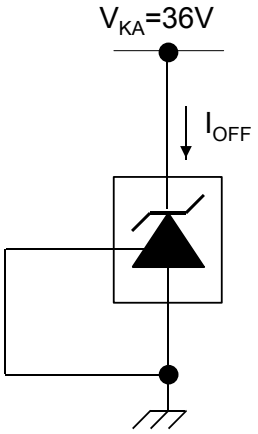



**Figure 10. Test circuit for phase margin and voltage gain**

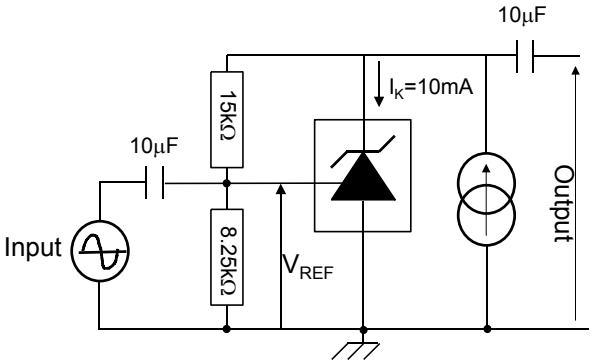



**Figure 11. Test circuit for response time**

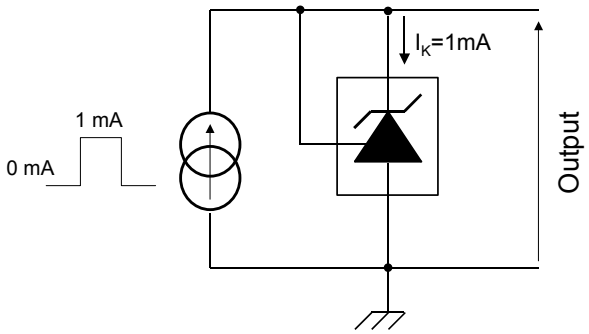



**Figure 12. Reference voltage vs. temperature**

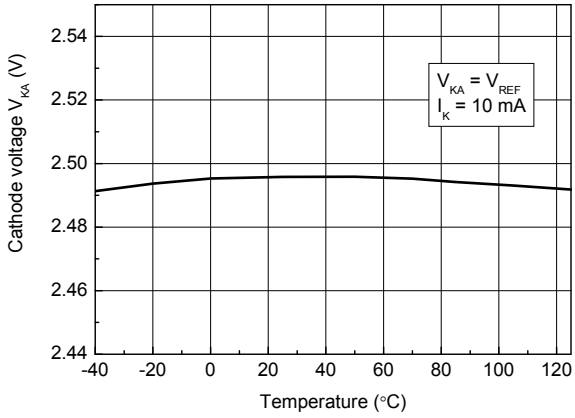


**Figure 13. Reference voltage vs. cathode current**

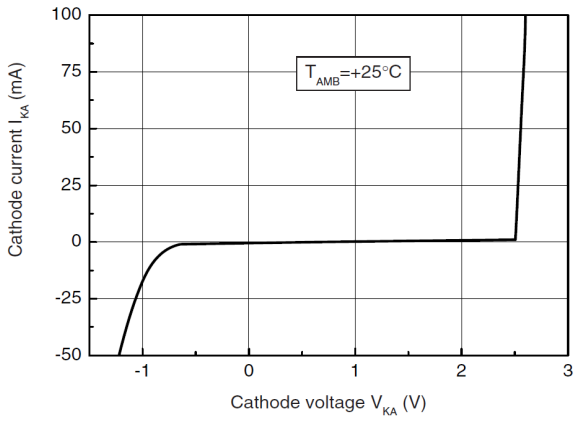



**Figure 14. Zoom on reference voltage vs. cathode current**

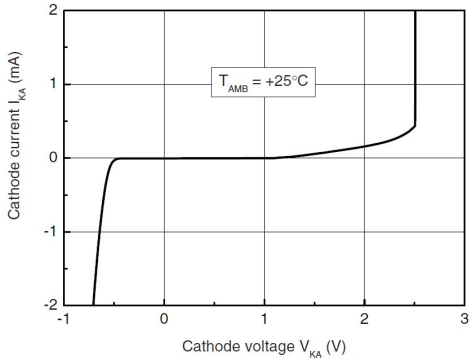



**Figure 15. Reference current vs. temperature**

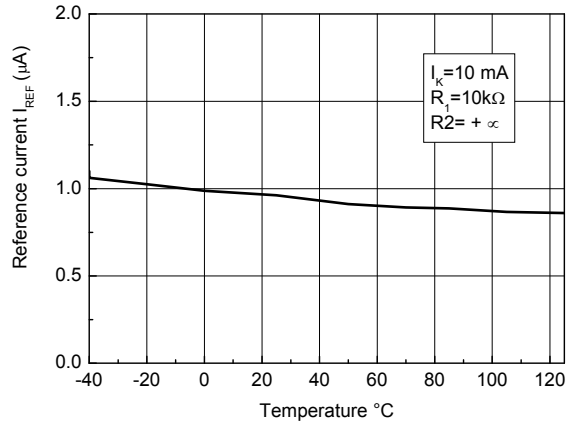



**Figure 16. Off-state cathode current vs. temperature**

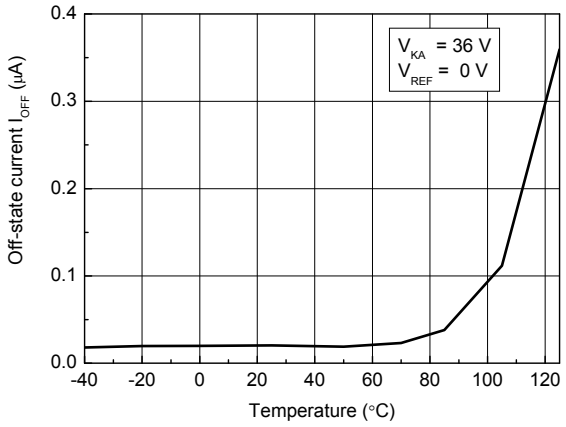



**Figure 17. Ratio of change in $V_{ref}$ to change in $V_{KA}$ vs. temperature**

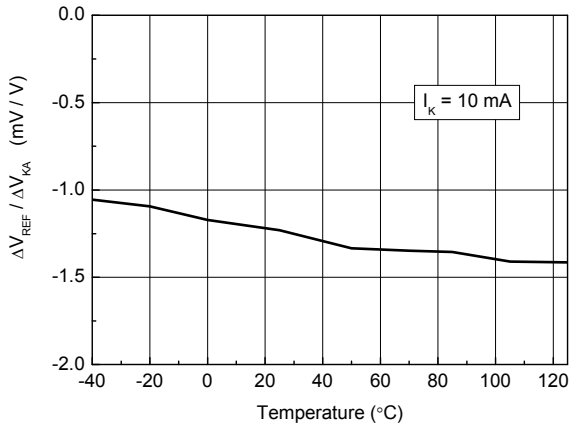



**Figure 18. Static impedance $R_{KA}$ vs. temperature**

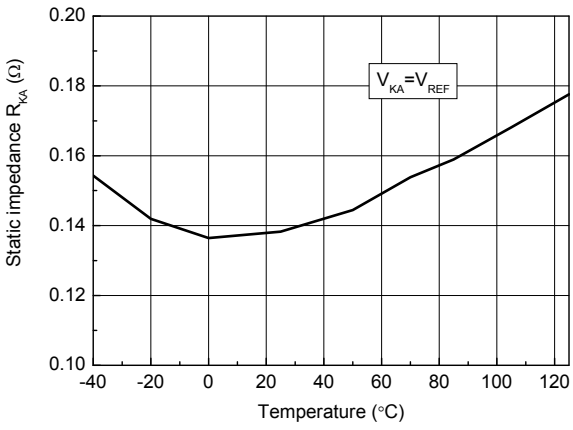


**Figure 19. Minimum operating current vs. temperature**

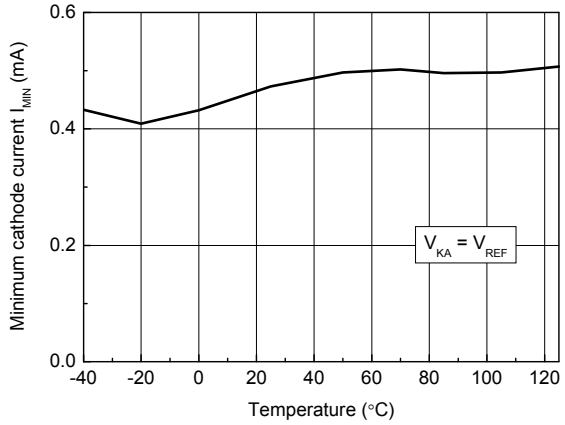



**Figure 20. Gain and phase vs. frequency**

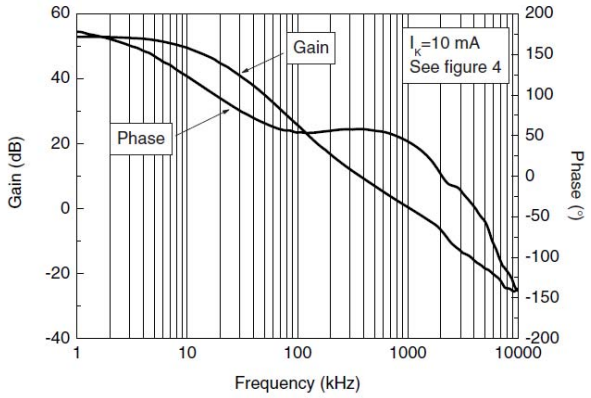



**Figure 21. Stability behavior with capacitive loads**

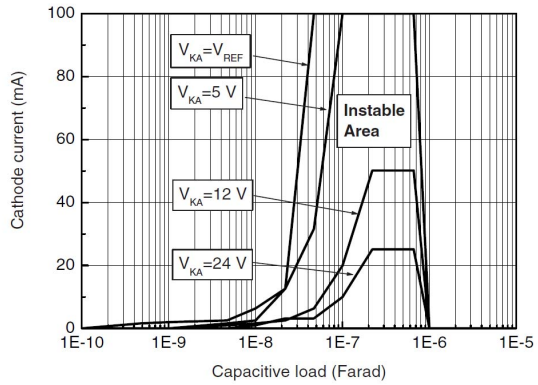



**Figure 22. Maximum power dissipation**

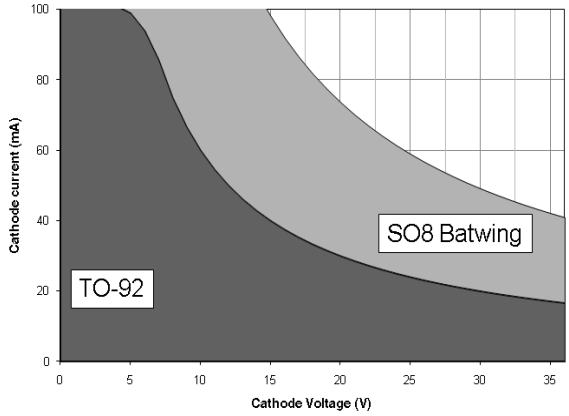
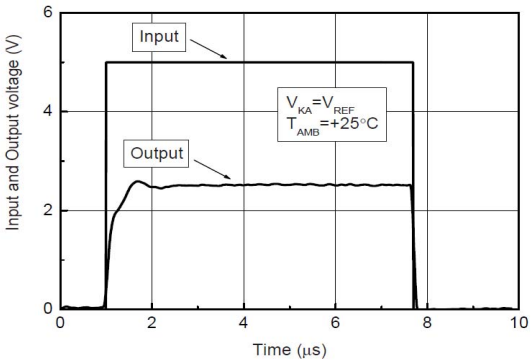



**Figure 23. Pulse response for $I_k$ = 1 mA**



# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.
ECOPACK® is an ST trademark.

## 4.1 SO-8 package information

**Figure 24. SO-8 package outline**

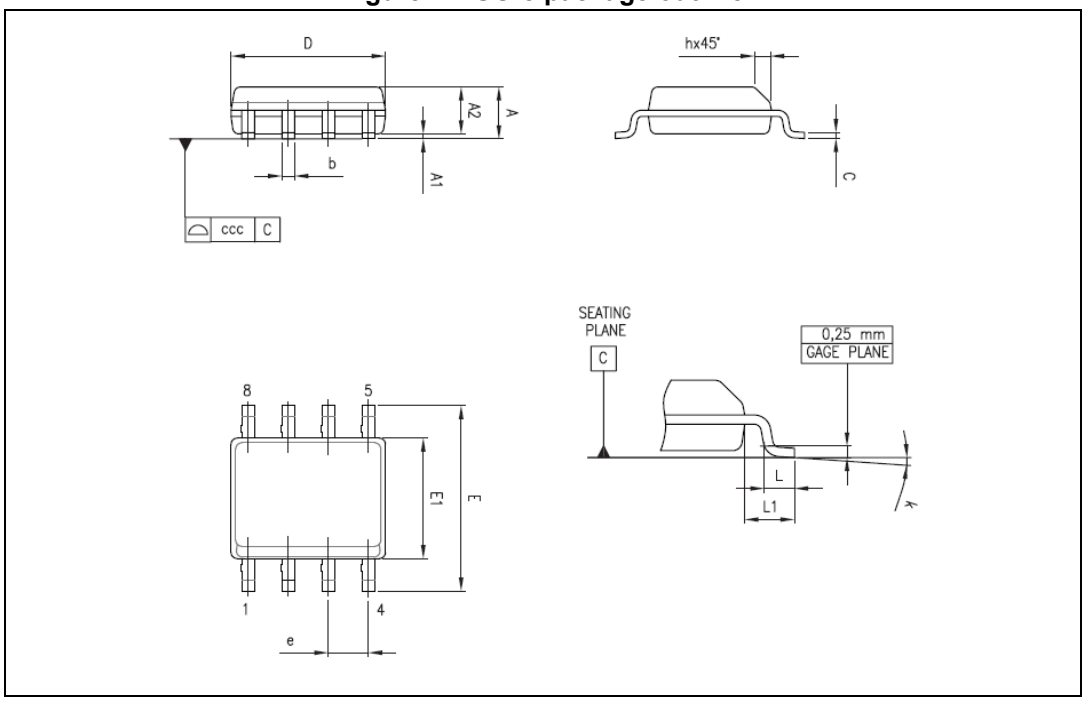



**Table 6. SO-8 package mechanical data**

| Symbol | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | - | 1.75 | - | - | 0.069 |
| A1 | 0.10 | - | 0.25 | 0.004 | - | 0.010 |
| A2 | 1.25 | - | - | 0.049 | - | - |
| b | 0.28 | - | 0.48 | 0.011 | - | 0.019 |
| c | 0.17 | - | 0.23 | 0.007 | - | 0.010 |
| D | 4.80 | 4.90 | 5.00 | 0.189 | 0.193 | 0.197 |
| E | 5.80 | 6.00 | 6.20 | 0.228 | 0.236 | 0.244 |
| E1 | 3.80 | 3.90 | 4.00 | 0.150 | 0.154 | 0.157 |
| e | - | 1.27 | - | - | 0.050 | - |
| h | 0.25 | - | 0.50 | 0.010 | - | 0.020 |
| L | 0.40 | - | 1.27 | 0.016 | - | 0.050 |
| L1 | - | 1.04 | - | - | 0.040 | - |
| k | 0° | - | 8° | 0° | - | 8° |
| ccc | - | - | 0.10 | - | - | 0.004 |

## 4.2 TO-92 ammopack and tape and reel package information

**Figure 25. TO-92 ammopack and tape and reel package outline**

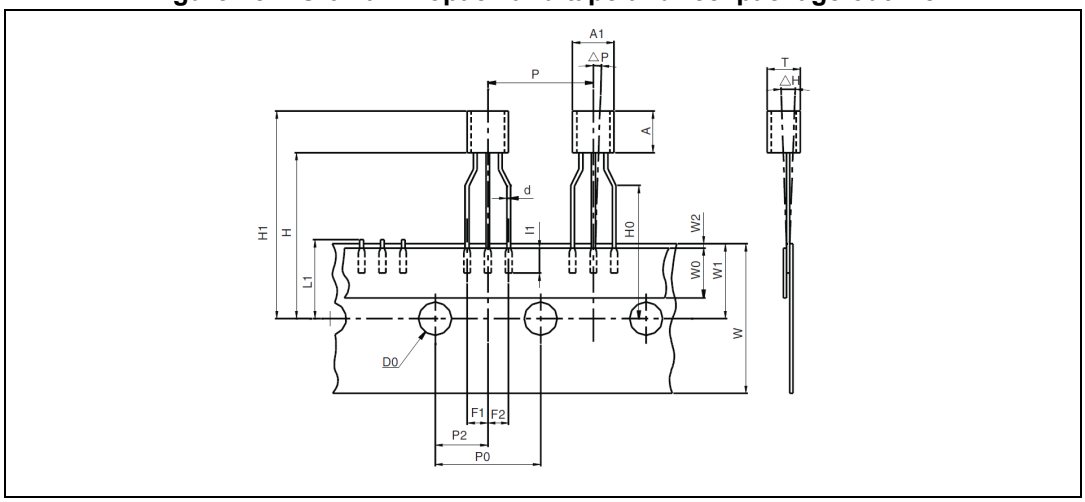



**Table 7. TO-92 ammopack and tape and reel package mechanical data**

| Symbol | Dimension (millimeters) | | | Dimension (Inches) | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A1 | - | - | 5.0 | - | - | 0.197 |
| A | - | - | 5.0 | - | - | 0.197 |
| T | - | - | 4.0 | - | - | 0.157 |
| d | - | 0.45 | - | - | 0.018 | - |
| I1 | 2.5 | - | - | 0.098 | - | - |
| P | 11.7 | 12.7 | 13.7 | 0.461 | 0.500 | 0.539 |
| PO | 12.4 | 12.7 | 13 | 0.488 | 0.500 | 0.512 |
| P2 | 5.95 | 6.35 | 6.75 | 0.234 | 0.250 | 0.266 |
| F1/F2 | 2.4 | 2.5 | 2.8 | 0.094 | 0.098 | 0.110 |
| Δh | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| ΔP | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| W | 17.5 | 18.0 | 19.0 | 0.689 | 0.709 | 0.748 |
| W0 | 5.7 | 6 | 6.3 | 0.224 | 0.236 | 0.248 |
| W1 | 8.5 | 9 | 9.75 | 0.335 | 0.354 | 0.384 |
| W2 | - | - | 0.5 | - | - | 0.020 |
| H | - | - | 20 | - | - | 0.787 |
| H0 | 15.5 | 16 | 16.5 | 0.610 | 0.630 | 0.650 |
| H1 | - | - | 25 | - | - | 0.984 |
| DO | 3.8 | 4.0 | 4.2 | 0.150 | 0.157 | 0.165 |
| L1 | - | - | 11 | - | - | 0.433 |

## 4.3 TO-92 (bulk) package information

Figure 26. TO-92 bulk package outline

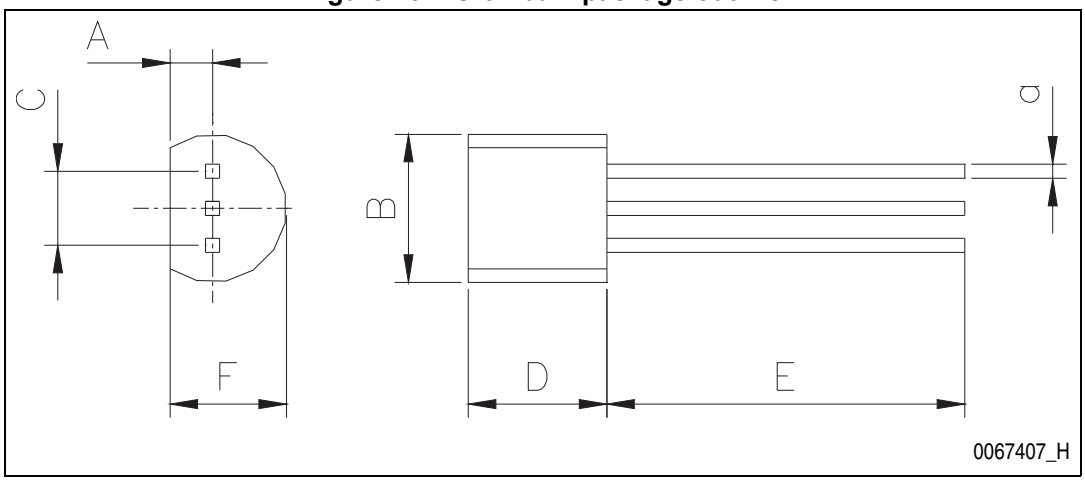



Table 8. TO-92 bulk package mechanical data

| Symbol | Dimension (millimeters) | | | Dimension (Inches) | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | - | 1.35 | - | - | 0.053 | - |
| B | - | - | 4.70 | - | - | 0.185 |
| C | - | 2.54 | - | - | 0.100 | - |
| D | 4.40 | - | - | 0.173 | - | - |
| E | 12.70 | - | - | 0.500 | - | - |
| F | - | - | 3.70 | - | - | 0.146 |
| a | - | - | 0.5 | - | - | 0.019 |

## 4.4 SOT23-3 package information

**Figure 27. SOT23-3 package outline**

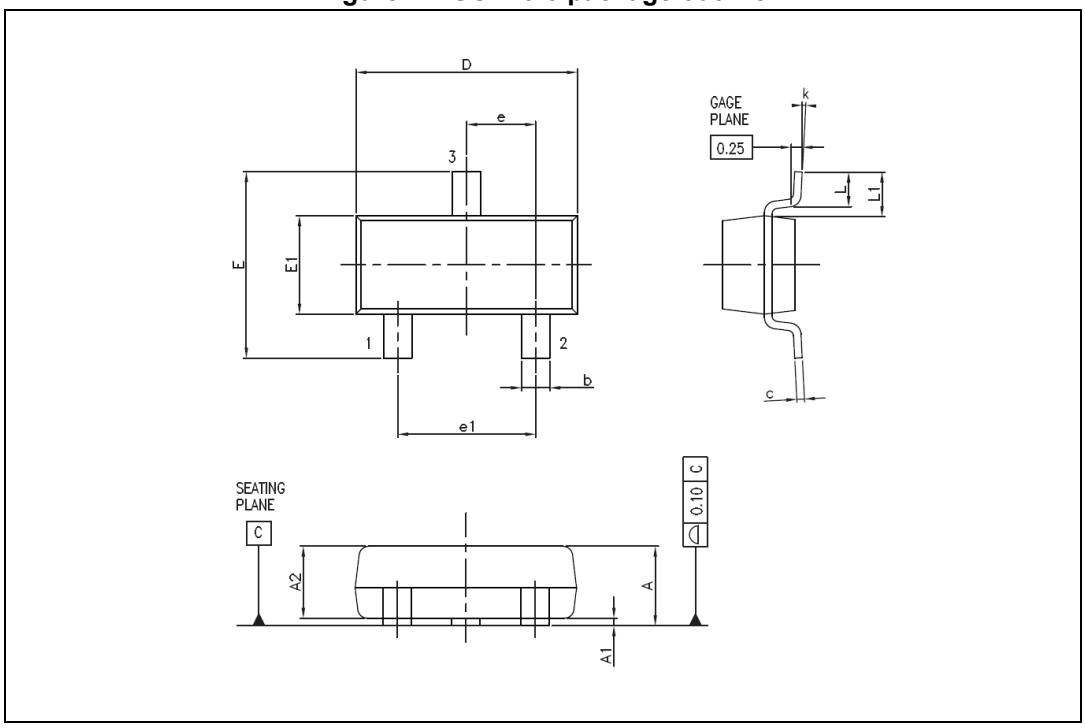



**Table 9. SOT23-3 package mechanical data**

| Symbol | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.89 | - | 1.12 | 0.035 | - | 0.044 |
| A1 | 0.01 | - | 0.10 | 0.0004 | - | 0.004 |
| A2 | 0.88 | 0.95 | 1.02 | 0.035 | 0.037 | 0.040 |
| b | 0.30 | - | 0.50 | 0.012 | - | 0.020 |
| c | 0.08 | - | 0.20 | 0.003 | - | 0.008 |
| D | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| E | 2.10 | - | 2.64 | 0.083 | - | 0.104 |
| E1 | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| e | - | 0.95 | - | - | 0.037 | - |
| e1 | - | 1.90 | - | - | 0.075 | - |
| L | 0.40 | 0.50 | 0.60 | 0.016 | 0.020 | 0.024 |
| L1 | - | 0.54 | - | - | 0.021 | - |
| k | 0d | - | 8d | - | - | - |

## 4.5 SOT23-5 package information

Figure 28. SOT23-5 package outline

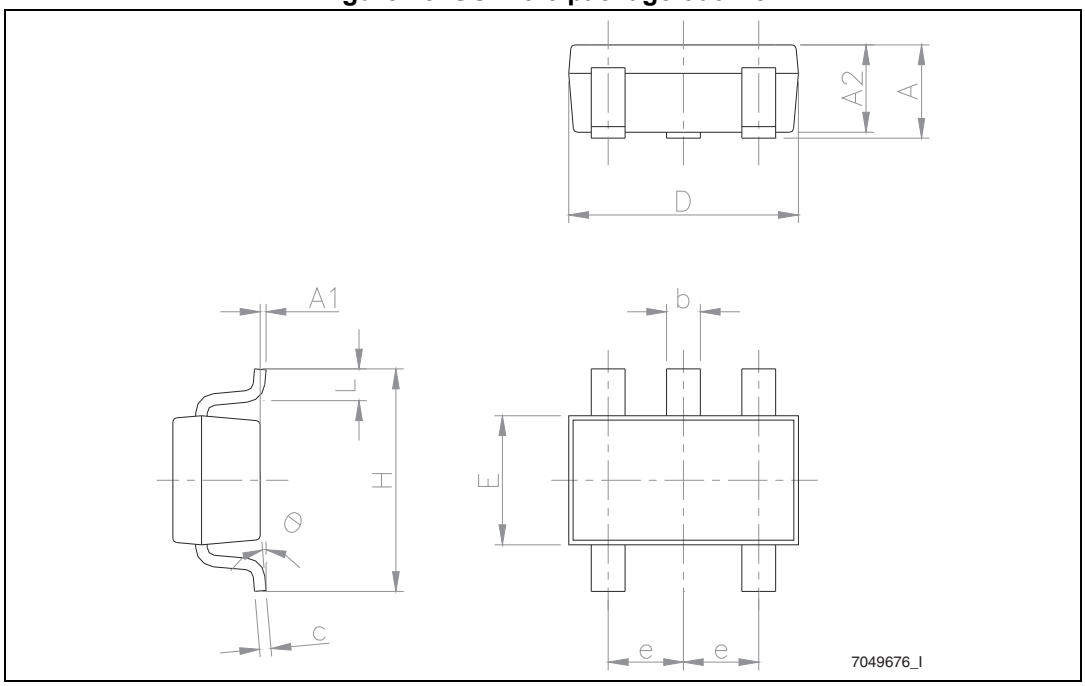



Table 10. SOT23-5 package mechanical data

| Symbol | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.90 | - | 1.45 | 0.035 | - | 0.057 |
| A1 | - | - | 0.15 | - | - | 0.006 |
| A2 | 0.90 | - | 1.30 | 0.035 | - | 0.051 |
| b | 0.35 | - | 0.50 | 0.014 | - | 0.020 |
| c | 0.09 | - | 0.20 | 0.004 | - | 0.008 |
| D | 2.80 | - | 3.05 | 0.110 | - | 0.120 |
| E | 1.50 | - | 1.75 | 0.059 | - | 0.069 |
| e | - | 0.95 | - | - | 0.037 | - |
| H | 2.60 | - | 3.00 | 0.102 | - | 0.118 |
| L | 0.10 | - | 0.60 | 0.004 | - | 0.024 |
| θ | 0 degrees | - | 10 degrees | - | - | - |

## 4.6 SOT323-6 package information

Figure 29. SOT323-6 package outline

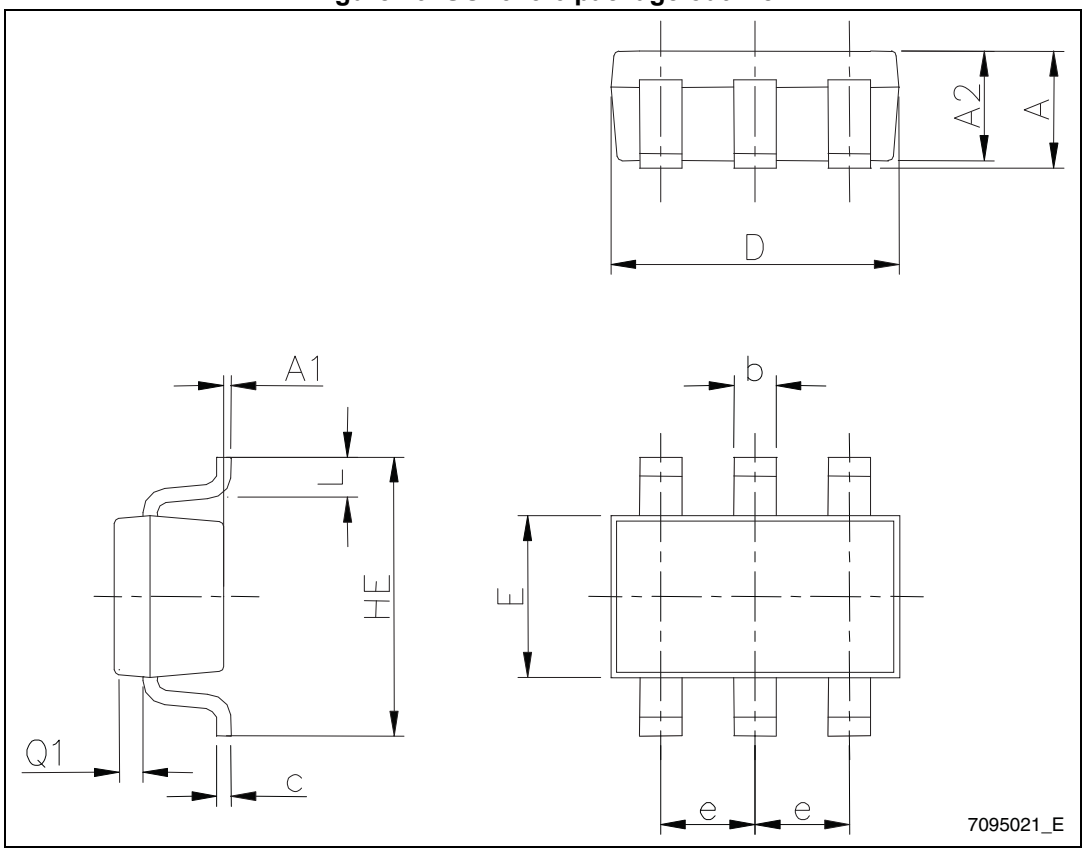



Table 11. SOT323-6 package mechanical data

| Symbol | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.80 | - | 1.10 | 0.031 | - | 0.043 |
| A1 | 0 | - | 0.10 | - | - | 0.004 |
| A2 | 0.80 | - | 1.00 | 0.031 | - | 0.039 |
| b | 0.15 | - | 0.30 | 0.006 | - | 0.012 |
| c | 0.10 | - | 0.18 | 0.004 | - | 0.007 |
| D | 1.80 | - | 2.20 | 0.071 | - | 0.087 |
| E | 1.15 | - | 1.35 | 0.045 | - | 0.053 |
| e | - | 0.65 | - | - | 0.026 | - |
| HE | 1.80 | - | 2.40 | 0.071 | - | 0.094 |
| L | 0.10 | - | 0.40 | 0.004 | - | 0.016 |
| Q1 | 0.10 | - | 0.40 | 0.004 | - | 0.016 |

# 5 Ordering information

**Table 12. Order codes**

| Order code | Accuracy (%) | Temperature range | Package | Packing | Marking |
|---|---|---|---|---|---|
| TL431CD<br>TL431CDT | 2 | 0 °C to +70 °C | SO-8 | Tube or<br>Tape and reel | 431C |
| TL431ACD<br>TL431ACDT | 1 | | | | 431AC |
| TL431CZ<br>TL431CZT<br>TL431CZ-AP | 2 | | TO-92 | Bulk or<br>Tape or<br>Ammopack | TL431C |
| TL431ACZ<br>TL431ACZT<br>TL431ACZ-AP | 1 | | | | TL431AC |
| TL431CL3T | 2 | | SOT23-3 | Tape | L19 |
| TL431ACL3T | 1 | | | | L18 |
| TL431CL5T | 2 | | SOT23-5 | | L19 |
| TL431ACL5T | 1 | | | | L18 |
| TL431CCT | 2 | | SOT323-6 | | 31C |
| TL431ACCT | 1 | | | | 31C |
| TL431ID<br>TL431IDT | 2 | -40 °C to + 105 °C | SO-8 | Tube or<br>tape and reel | 431I |
| TL431AID<br>TL431AIDT | 1 | | | | 431AI |
| TL431IZ<br>TL431IZT<br>TL431IZ-AP | 2 | | TO-92 | Bulk or<br>Tape or<br>Ammopack | TL431I |
| TL431AIZ<br>TL431AIZT<br>TL431AIZ-AP | 1 | | | | TL431AI |
| TL431IL3T | 2 | | SOT23-3 | Tape | L17 |
| TL431AIL3T | 1 | | | | L16 |
| TL432IL3T | 2 | | SOT23-3 | | 32I |
| TL432AIL3T | 1 | | | | 32AI |
| TL431IL5T | 2 | | SOT23-5 | | L17 |
| TL431AIL5T | 1 | | | | L16 |
| TL431ICT | 2 | | SOT323-6 | | 31I |
| TL431AICT | 1 | | | | 31I |

**Table 12. Order codes (continued)**

| Order code | Accuracy (%) | Temperature range | Package | Packing | Marking |
|---|---|---|---|---|---|
| TL431IYD(1)<br>TL431IYDT(1) | 2 | -40 °C to + 125 °C | SO-8 (Automotive grade level) | Tube or tape and reel | 431IY |
| TL431AIYD(1)<br>TL431AIYDT(1) | 1 | | | | 431AIY |

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q 002 or equivalent.

# 6 Revision history

**Table 13. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 01-Mar-2002 | 1 | Initial release. |
| 01-Nov-2005 | 2 | PPAP references inserted in order codes table on cover page. |
| 13-Dec-2006 | 3 | Corrected TO-92 package information. |
| 08-Jun-2007 | 4 | Specified that SO-8 package is batwing package.<br>In electrical characteristics tables, moved negative values from max column to min column.<br>Corrected captions of *Figure 7* and of *Figure 18*.<br>Added footnote to *Table 8: TO-92 bulk package mechanical data*. |
| 25-Feb-2008 | 5 | Corrected SO-8 package mechanical data.<br>Corrected footnote for automotive grade order codes in order code table.<br>Corrected packing information for TO-92 devices in order code table. |
| 04-Jun-2009 | 6 | Changed $I_{MIN}$ to 0.6 mA in *Table 3* and *Table 4*.<br>Increased temperature range to 125°C in temperature curves.<br>Added *Table 5*, dedicated to automotive version.<br>Increased high temperature for automotive range up to +125 °C in *Table 5* and in *Table 12: Order codes*.<br>Inserted accuracy column in *Table 12*. |
| 09-Jun-2009 | 7 | Corrected minor error in package column in *Table 12*. |
| 14-Mar-2011 | 8 | Added *Figure 3 on page 3*, *Section 4.4 on page 15* and *Section 4.5 on page 16*. |
| 07-Oct-2011 | 9 | Added new package mechanical data *Table 11 on page 17* and *Figure 29 on page 17*.<br>Updated *Table 12 on page 18*. |
| 17-Nov-2011 | 10 | Added new part number TL432, new order code *Table 12 on page 18* and pin connection for TL432 *Figure 3 on page 3*. |
| 03-Dec-2012 | 11 | Removed temperature range in title *Table 3 on page 5*, *Table 4 on page 6* and *Table 5 on page 7*. |
| 07-Dec-2017 | 12 | Updated main title *on page 1* and *Section : Features on page 1*, (added “automotive” - AEC-Q100 qualified).<br>Updated *Table 1 on page 4* (updated $R_{thja}$ and $R_{thjc}$).<br>Minor modifications throughout document. |