# 2.5V micropower shunt voltage reference

## Features

- 2.50V typical output voltage
- Ultra low current consumption: 40µA typ.
- High precision @ 25°C
  - ±2% (standard version)
  - ±1% (A grade)
- High stability when used with capacitive loads
- Industrial temperature range: -40°C to +85°C
- 100ppm/°C maximum temperature coefficient

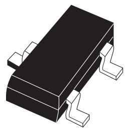
## Applications

- Computers
- Instrumentation
- Battery chargers
- Switch mode power supply
- Battery operated equipment

## Description

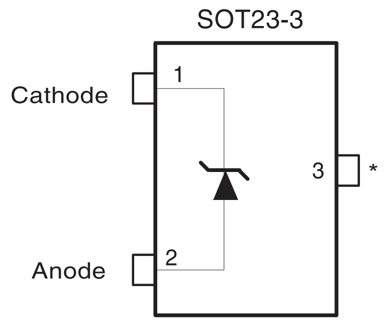
The TS822 is a low power shunt voltage reference providing a stable 2.5V output voltage over the industrial temperature range (-40°C to +85°C). Availabe in SOT23-3 surface mount package, it can be designed in applications where space saving is critical.

The low operating current is a key advantage for power restricted designs. In addition, the TS822 is very stable and can be used in a broad range of application conditions.



**L**
**SOT23-3L**
(Plastic micropackage)

**Pin connections**
(Top view)




* This pin must be left floating or connected to pin 2

# 1 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_k$ | Reverse breakdown current | 20 | mA |
| $I_f$ | Forward current | 10 | mA |
| $P_d$ | Power dissipation (1)SOT23-3 | 360 | mW |
| $T_{stg}$ | Storage temperature | -65 to +150 | °C |
| ESD | Human body model (HBM)(2) | 2 | kV |
| | Machine model (MM)(3) | 200 | V |
| $T_{lead}$ | Lead temperature (soldering, 10 seconds) | 260 | °C |

1. $P_d$ is calculated with $T_{amb}$ = 25°C and $R_{thja}$ = 340°C/W for the SOT23-3L package
2. Human body model: 100pF discharged through a 1.5kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
3. Machine model: a 200pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5Ω), done for all couples of pin combinations with other pins floating.

**Table 2. Operating conditions**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $I_{k\text{-}min}$ | Minimum operating current | 50 | µA |
| $I_{k\text{-}max}$ | Maximum operating current | 15 | mA |
| $T_{oper}$ | Operating free air temperature range | -40 to +85 | °C |

# 2 Electrical characteristics

**Table 3. TS822 (2% precision) $T_{amb}$ = 25°C(1) (unless otherwise specified)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_k$ | Reverse breakdown voltage | $I_k$ = 100µA | 2.45 | 2.5 | 2.55 | V |
| | Reverse breakdown voltage tolerance | $I_k$ = 100µA<br>-40°C < $T_{amb}$ < +85°C | -50<br>-66 | | 50<br>66 | mV |
| $I_{k\text{-}min}$ | Minimum operating current | T = 25°C | | 40 | 50 | µA |
| | | -40°C < $T_{amb}$ < +85°C | | | 60 | |
| $\Delta V_{ref}/\Delta T$ | Average temperature coefficient | $I_k$ = 100µA | | 30 | 100 | ppm/°C |
| $\Delta V_k/\Delta I_k$ | Reverse breakdown voltage change with operating current range | $I_{k\text{-}min}$ < $I_k$ < 1mA<br>-40°C < $T_{amb}$ < +85°C | | 0.4 | 1<br>1.2 | mV |
| | | 1mA < $I_k$ < 15mA<br>-40°C < $T_{amb}$ < +85°C | | 2.5 | 8<br>10 | |
| $R_{ka}$ | Reverse static impedance | $I_k$ = $I_{k\text{-}min}$ to 1mA<br>-40°C < $T_{amb}$ < +85°C | | 0.4 | 1<br>1.2 | Ω |
| | | $I_k$ = 1 to 15mA<br>-40°C < $T_{amb}$ < +85°C | | 0.2 | 0.6<br>0.7 | |
| $K_{vh}$ | Long term stability | $I_k$ = 100µA, t = 1000hrs | | 120 | | ppm |
| En | Wide band noise | $I_k$ = 100µA, 10Hz < f < 10kHz | | 35 | | nV/√Hz |

1. Limits are 100% production tested at 25°C. Behavior at temperature range limits is guaranteed by correlation and design.

**Table 4. TS822A (1% precision) $T_{amb}$ = 25°C(1) (unless otherwise specified)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_k$ | Reverse breakdown voltage | $I_k$ = 100µA | 2.475 | 2.5 | 2.525 | V |
| | Reverse breakdown voltage tolerance | $I_k$ = 100µA<br>-40°C < $T_{amb}$ < +85°C | -25<br>-41 | | 25<br>41 | mV |
| $I_{k\text{-}min}$ | Minimum operating current | T = 25°C | | 40 | 50 | µA |
| | | -40°C < $T_{amb}$ < +85°C | | | 60 | |
| $\Delta V_{ref}/\Delta T$ | Average temperature coefficient | $I_k$ = 100µA | | 30 | 100 | ppm/°C |
| $\Delta V_k/\Delta_{Ik}$ | Reverse breakdown voltage change with operating current range | $I_{k\text{-}min}$ < $I_k$ < 1mA<br>-40°C < $T_{amb}$ < +85°C | | 0.4 | 1<br>1.2 | mV |
| | | 1mA < $I_k$ < 15mA<br>-40°C < $T_{amb}$ < +85°C | | 2.5 | 8<br>10 | |
| $R_{ka}$ | Reverse static impedance | $I_k$ = $I_{k\text{-}min}$ to 1mA<br>-40°C < $T_{amb}$ < +85°C | | 0.4 | 1<br>1.2 | Ω |
| | | $I_k$ = 1mA to 15mA<br>-40°C < $T_{amb}$ < +85°C | | 0.2 | 0.6<br>0.7 | |
| $K_{vh}$ | Long term stability | $I_k$ = 100µA, t = 1000hrs | | 120 | | ppm |
| En | Wide band noise | $I_k$ = 100µA, 10Hz < f < 10kHz | | 35 | | nV/√Hz |

1. Limits are 100% production tested at 25°C. Behavior at temperature range limits is guaranteed by correlation and design.

**Figure 1. Reference voltage versus cathode current**

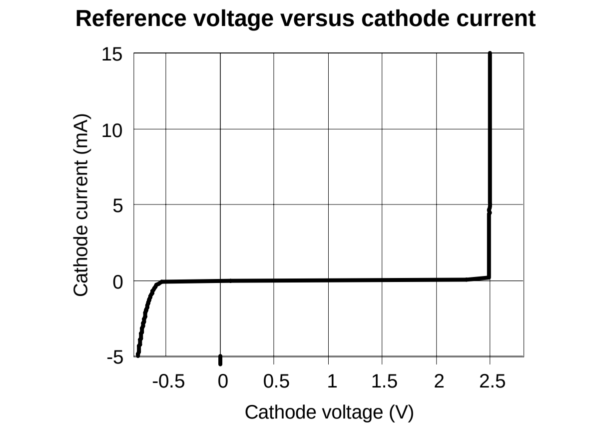



**Figure 2. Minimum operating current**

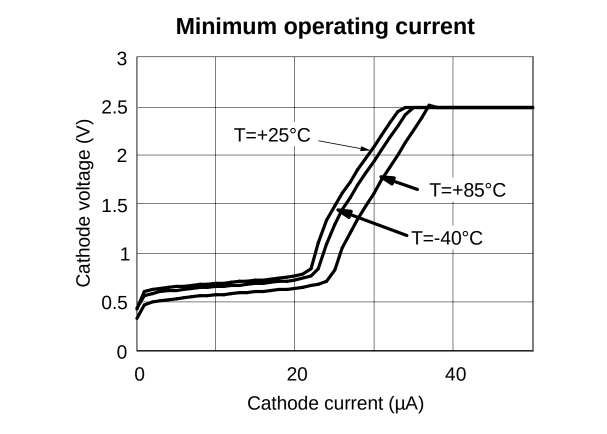



**Figure 3. Test circuit**

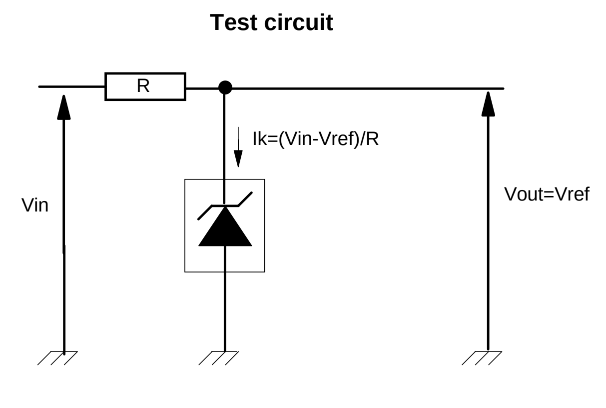



**Figure 4. Reference voltage versus temperature**

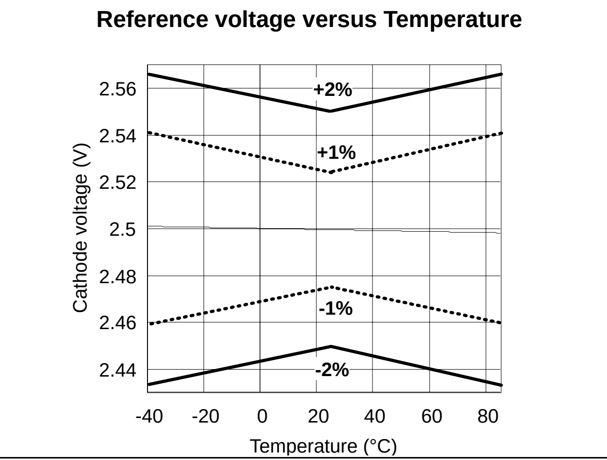



**Figure 5. Static impedance ($R_{ka}$) versus temperature**

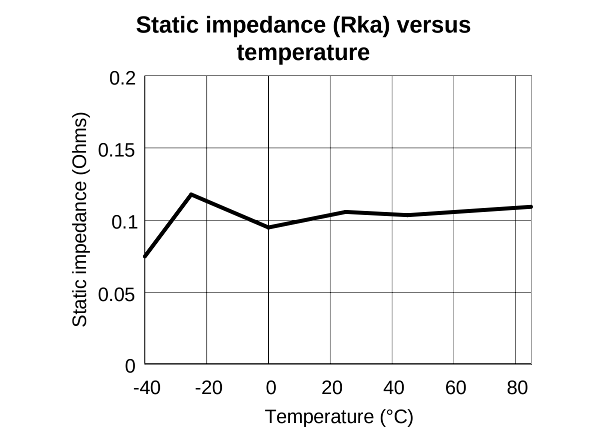



**Figure 6. Noise voltage versus frequency**

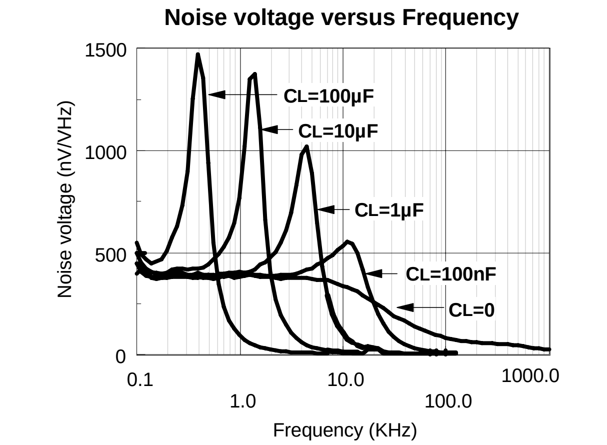


**Figure 7. Test circuit for pulse response at $I_k$=100µA**

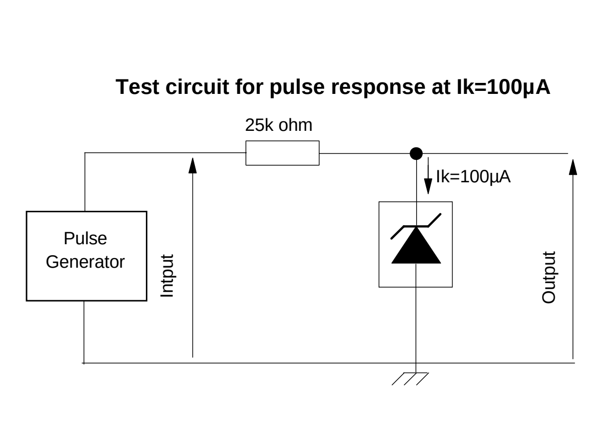



**Figure 8. Pulse response for $I_k$=100µA**

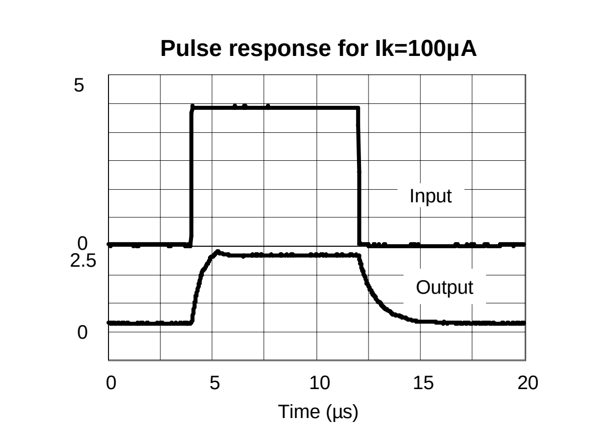



**Figure 9. Pulse response for $I_k$=100µA (detailed part)**

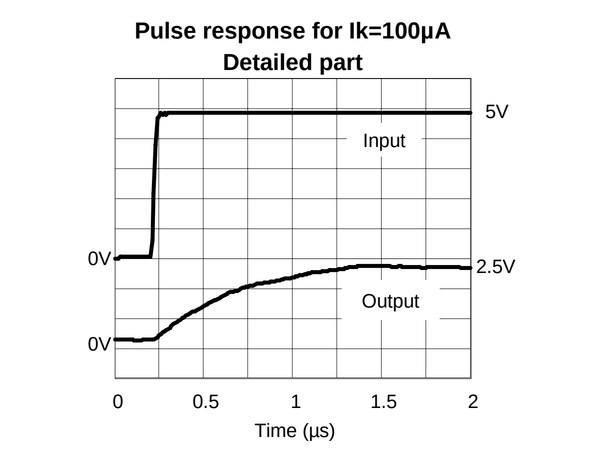



**Figure 10. Pulse response for $I_k$=100µA (detailed part)**

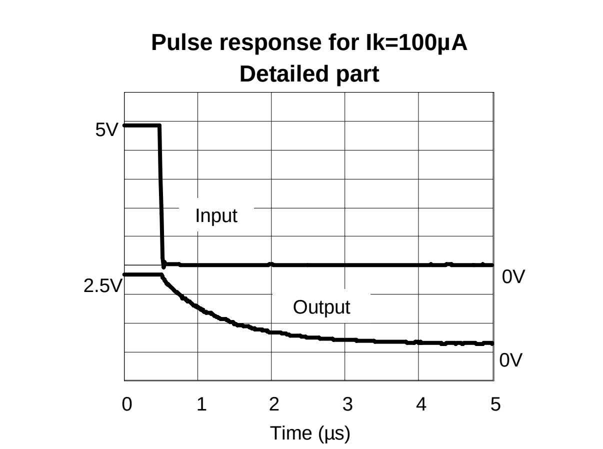



**Figure 11. Test circuit for pulse response at $I_k$=100mA**

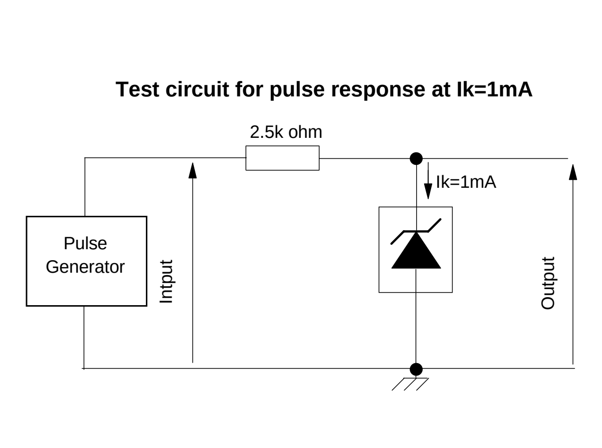



**Figure 12. Pulse response for $I_k$=100mA**

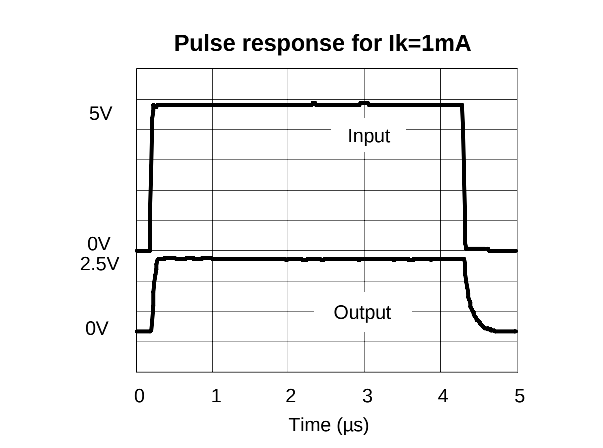


Figure 13. Pulse response for $I_k$=100mA (detailed part)

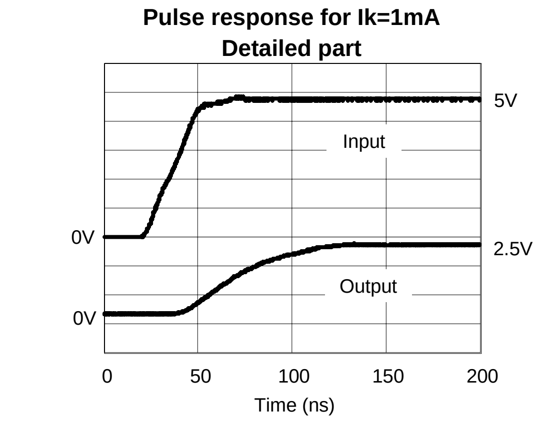
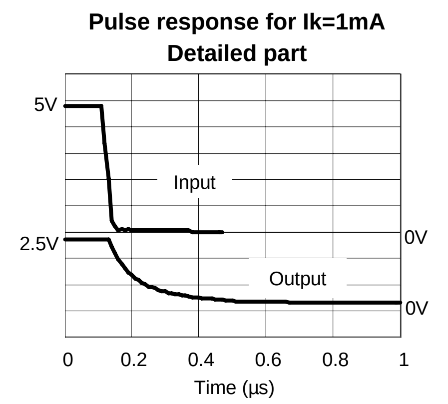



Figure 14. Pulse response for $I_k$=100mA (detailed part)

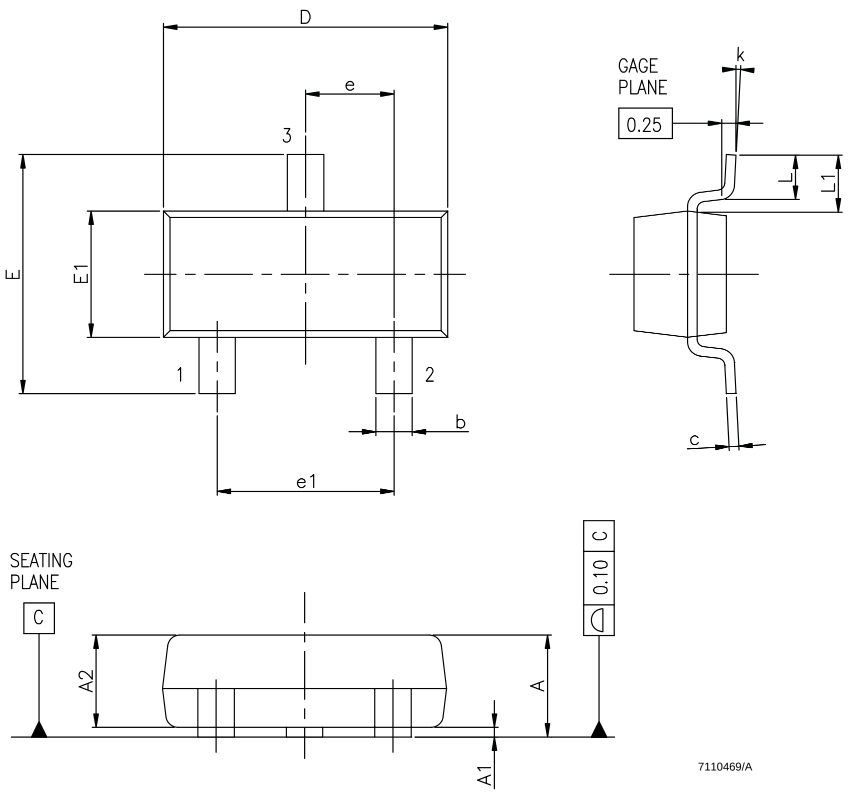



# 3 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

**Figure 15. SOT23-3 package mechanical data**

| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Mils | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.890 | | 1.120 | 35.05 | | 44.12 |
| A1 | 0.010 | | 0.100 | 0.39 | | 3.94 |
| A2 | 0.880 | 0.950 | 1.020 | 34.65 | 37.41 | 40.17 |
| b | 0.300 | | 0.500 | 11.81 | | 19.69 |
| C | 0.080 | | 0.200 | 3.15 | | 7.88 |
| D | 2.800 | 2.900 | 3.040 | 110.26 | 114.17 | 119.72 |
| E | 2.100 | | 2.64 | 82.70 | | 103.96 |
| E1 | 1.200 | 1.300 | 1.400 | 47.26 | 51.19 | 55.13 |
| e | | 0.950 | | | 37.41 | |
| e1 | | 1.900 | | | 74.82 | |
| L | 0.400 | | 0.600 | 15.75 | | 23.63 |
| L1 | | 0.540 | | | 21.27 | |
| k | 0° | | 8° | 0° | | 8° |



# 4 Ordering information

Table 5. Order codes

| Part number | Precision | Temperature range | Package | Packing | Marking |
|---|---|---|---|---|---|
| TS822ILT | 2% | -40°C to +85°C | SOT23-3 | Tape & reel | L223 |
| TS822AILT | 1% | | | | L222 |

# 5 Revision history

Table 6. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 21-Mar-2002 | 1 | Initial release. |
| 20-Aug-2007 | 2 | Removed information related to TO-92 package.<br>Format update. |