

TS4040

2.5V micropower shunt voltage reference

Features

- 2.5V output voltage
- Ultra low current consumption: 40µA typ.
- High precision @ 25°C: ±2% and ±1%
- High stability when used with capacitive loads
- Industrial temperature range:-40°C to +85°C
- 150ppm/°C maximum temperature coefficient

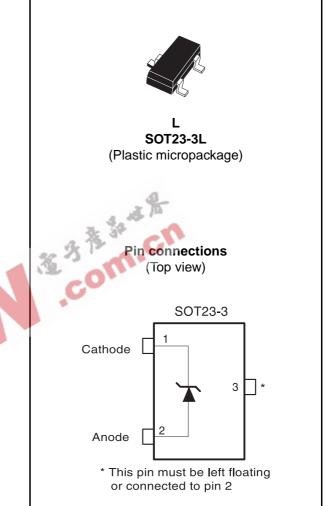
Applications

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

Description

The TS4040 is a low power shunt voltage reference providing a stable 2.5V output voltage over the industrial temperature range (-40°C to +85°C). Available 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 TS4040 is very stable and can be used in a broad range of application conditions.



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Absolute maximum ratings and operating conditions

| Symbol | Parameter | Value | Unit |
|-------------------|--|-------------|------|
| ۱ _k | Reverse breakdown current | 20 | mA |
| ۱ _f | Forward current | 10 | mA |
| Pd | 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 |

| Table 1. | Absolute maximum | ratings | (AMR) |
|----------|------------------|---------|-------|
| | | radings | |

1. Pd is calculated with T_{amb} = 25°C, $T_{junction}$ =150°C and R_{thja} = 340°C/W for the SOT23-3 package.

2. Human body model: 100pF discharged through a $1.5k\Omega$ 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 2 30 × % combinations with other pins floating.

| Table 2. | Operating | conditions |
|----------|-----------|------------|
|----------|-----------|------------|

| Symbol | Parameter 👷 🧏 隆 | Value | Unit |
|--------------------|--------------------------------------|------------|------|
| l _{k-min} | Minimum operating current | 65 | μA |
| I _{k-max} | Maximum operating current | 15 | mA |
| T _{oper} | Operating free air temperature range | -40 to +85 | °C |
| | | | |

-

Ω

ppm

nV/√Hz

0.2

120

35

0.6 0.7

R_{ka}

 K_{vh}

En

2 Electrical characteristics

Reverse static impedance

Long term stability

Wide band noise

| | | • | - | - | | |
|----------------------------------|-------------------------------------|--|------------|------|----------|--------|
| Symbol | Parameter | Test conditions | Min. | Тур. | Max. | Unit |
| | Reverse breakdown voltage | I _k = 100μA | 2.45 | 2.5 | 2.55 | V |
| V _k | Reverse breakdown voltage tolerance | $I_{k} = 100\mu A$ -40°C < T _{amb} < +85°C | -50 -74 | | 50 74 | mV |
| I _{k-min} | Minimum operating current | T = 25°C -40°C < T _{amb} < +85°C | | 40 | 65 70 | μA |
| $\Delta V_{ref} / \Delta T$ | Average temperature coefficient | I _k = 100μA | | 30 | 150 | ppm/°C |
| ΔV _k /ΔI _k | Reverse breakdown voltage change | I _{k-min} < I _k < 1mA -40°C < T _{amb} < +85°C | | 0.4 | 1 1.2 | mV |
| Δv _k /Δi _k | with operating current range | 1mA < I _k < 15mA -40°C < T _{amb} < +85°C | | 2.5 | 8 10 | |
| | | I _k = I _{k-min} to 1mA -40°C < T _{amb} < +85°C | | 0.4 | 1 1.2 | |

Table 3. TS4040E (2% precision) $T_{amb} = 25^{\circ}C^{(1)}$ (unless otherwise specified)

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

 $I_k = 1$ to 15mA -40°C < T_{amb} < +85°C

 $I_{k} = 100 \mu A, t = 1000 hrs$

 $I_k = 100 \mu A \ 10 Hz < f < 10 kHz$

Table 4. TS4040D (1% precision) $T_{amb} = 25^{\circ}C^{(1)}$ (unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Тур. | Max. | Unit |
|----------------------------------|-------------------------------------|--|------------|--------------|------------|--------|
| | Reverse breakdown voltage | I _k = 100μA | 2.475 | 2.5 | 2.525 | V |
| V _k | Reverse breakdown voltage tolerance | $I_{k} = 100 \mu A$ -40°C < T _{amb} < +85°C | -25 -49 | | 25 49 | mV |
| I _{k-min} | Minimum operating current | T = 25°C -40°C < T _{amb} < +85°C | | 40 | 65 70 | μΑ |
| $\Delta V_{ref} / \Delta T$ | Average temperature coefficient | I _k = 100μA | | 30 | 150 | ppm/°C |
| $\Delta V_k / \Delta I_k$ | Reverse breakdown voltage change | I _{k-min} < I _k < 1mA -40°C < T _{amb} < +85°C | | 0.4 1 1.2 | mV | |
| Δv _k /Δi _k | with operating current range | 1mA < I _k < 15mA -40°C < T _{amb} < +85°C | | 2.5 | 8 10 | ΠV |
| D | Reverse static impedance | I _k = I _{k-min} to 1mA -40°C < T _{amb} < +85°C | | 0.4 | 1 1.2 | Ω |
| R _{ka} | | I _k = 1mA to 15mA -40°C < T _{amb} < +85°C | | 0.2 | 0.6 0.7 | 52 |
| K _{vh} | Long term stability | $I_{k} = 100 \mu A, t = 1000 hrs$ | | 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 the temperature range limits is guaranteed through correlation and by design.



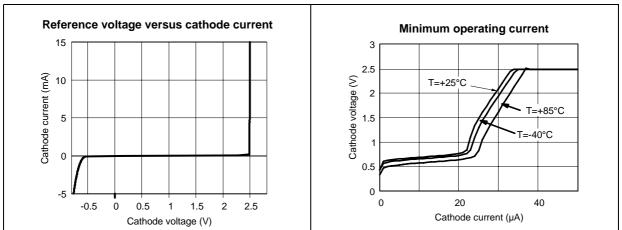




Figure 4. Reference voltage versus temperature

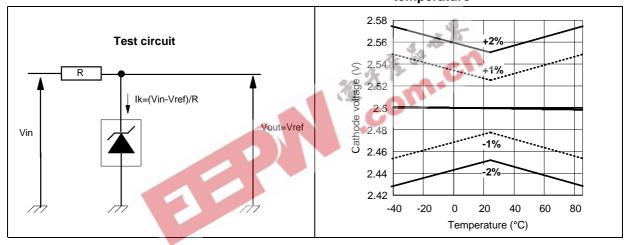
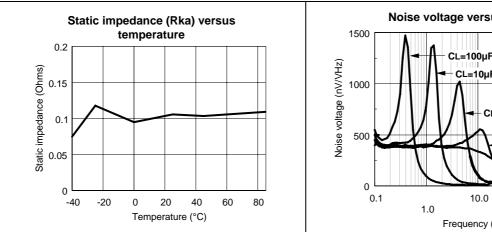
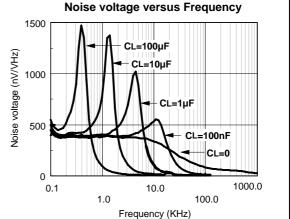


Figure 5. Static impedance Rka versus temperature







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

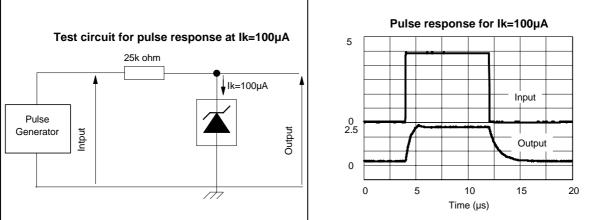
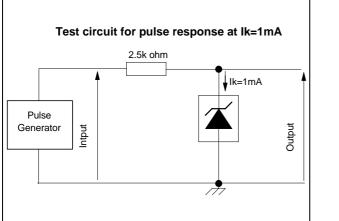


Figure 9. Test circuit for pulse response at I_k=100µA (detailed part)

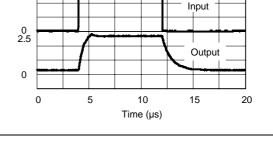
Pulse response for Ik=100µA **Detailed part** 5V Input 36 0V 2.5V 2.5\ Output 0V 0 0.5 1.5 1 0 1 Time (µs)

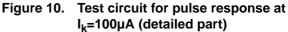
Figure 11. Test circuit for pulse response at I_k=1mA



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Figure 8. Pulse response for Ik=100µA





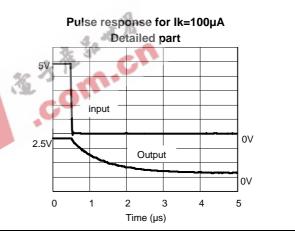
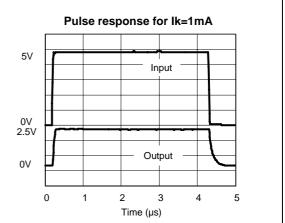
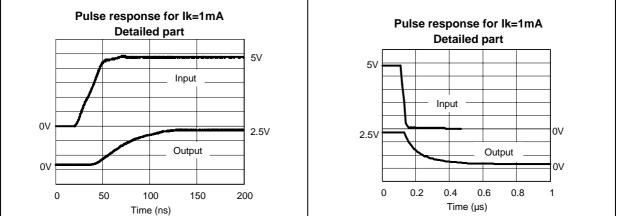


Figure 12. Pulse response at Ik=1mA







3 Package information

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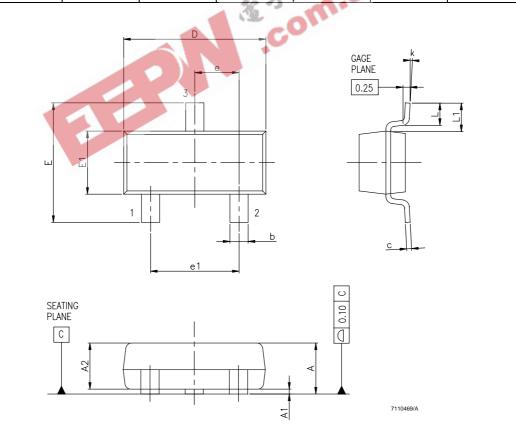
In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK[®] packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. 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: <u>www.st.com</u>.

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Figure 14. Test circuit for pulse response at I_k=1mA (detailed part)

| | | | Dime | nsions | | | |
|------|-------------|-------|-------|---------|--------|--------|--|
| Ref. | Millimeters | | | | Mils | | |
| | Min. | Тур. | Max. | Min. | Тур. | Max. | |
| А | 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 | |
| С | 0.080 | | 0.200 | 3.15 | | 7.88 | |
| D | 2.800 | 2.900 | 3.040 | 110.26 | 114.17 | 119.72 | |
| Е | 2.100 | | 2.64 | 82.70 | | 103.96 | |
| E1 | 1.200 | 1.300 | 1.400 | 47.26 | 51.19 | 55.13 | |
| е | | 0.950 | | | 37.41 | | |
| e1 | | 1.900 | | | 74.82 | | |
| L | 0.400 | | 0.600 | 15.75 | | 23.63 | |
| L1 | | 0.540 | | 4. 15 1 | 21.27 | | |
| k | 0° | | 8° 🔔 | 0° 🕜 | | 8° | |

Figure 15. SOT23-3 package mechanical data





4 Ordering information

Table 5. Order codes

| Part number | Precision | Temperature range | Package | Packing | Marking | |
|----------------|-----------|----------------------|---------|-------------|---------|--|
| TS4040EILT-2.5 | 2% | -40°C to +85°C | SOT23-3 | Tape & reel | L243 | |
| TS4040DILT-2.5 | 1% | -40 C 10 +05 C | 50125-5 | Tape & Teel | L242 | |

5 Revision history

Table 6.Document revision history

| Date | Revision Changes | |
|-------------|------------------|--|
| 14-Mar-2002 | 1 | Initial release. |
| 20-Aug-2007 | 2 | Removed TO-92 package information. Format update. |
| | | .com.cu |

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