

LM4040

Precision micropower shunt voltage references

Description

The LM4040 is a family of bandgap circuits designed to achieve precision micro-power voltage references of 2.5V and 5.0V. The devices are available in 0.5% C-grade and 1% D-grade initial tolerances.

They are available in small outline SOT23 surface mount package which is ideal for applications where space saving is important.

Features

- Small packages: SOT23
- No output capacitor required
- Output voltage tolerance
 - LM4040C $\pm 0.5\%$ at 25°C
 - LM4040D $\pm 1\%$ at 25°C
- Low output noise
(10Hz to 10kHz) $45\mu\text{V}_{\text{RMS}}$
- Wide operating current range $60\mu\text{A}$ to 15mA
- Extended temperature range -40°C to $+125^{\circ}\text{C}$
- Low temperature coefficient $100\text{ ppm}/^{\circ}\text{C}$ (max)

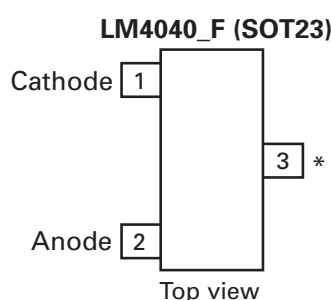
Excellent performance is maintained over the $60\mu\text{A}$ to 15mA operating current range with a typical temperature coefficient of only $20\text{ppm}/^{\circ}\text{C}$. The device has been designed to be highly tolerant of capacitive loads so maintaining excellent stability.

This device offers a pin for pin compatible alternative to the LM4040 voltage reference.

Applications

- Battery powered equipment
- Precision power supplies
- Portable instrumentation
- Portable communications devices
- Notebook and palmtop computers
- Data acquisition systems

Pinout information



* Pin 3 must be left floating or connected to pin 2

Ordering information

| 25°C Tol. | Voltage (V) | Order code | Pack | Part mark | Status | Reel size | Tape width | Quantity per reel |
|-----------|-------------|--------------|-------|-----------|---------|-----------|------------|-------------------|
| 0.5% | 2.5 | LM4040C25FTA | SOT23 | R2C | Preview | 7", 180mm | 8mm | 3000 |
| | 5.0 | LM4040C50FTA | SOT23 | R5C | Preview | 7", 180mm | 8mm | 3000 |
| 1% | 2.5 | LM4040D25FTA | SOT23 | R2D | Preview | 7", 180mm | 8mm | 3000 |
| | 5.0 | LM4040D50FTA | SOT23 | R5D | Preview | 7", 180mm | 8mm | 3000 |

Absolute maximum ratings

Continuous reverse current (I_R) 20mA

Continuous forward current (I_{REF}) 10mA

Operating junction temperature -40°C to 150°C

Storage temperature -55°C to 150°C

Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Unless otherwise stated voltages specified are relative to the ANODE pin.

Package thermal data

| Package | Θ_{JA} | P_{DIS} $T_{amb} = 25^\circ\text{C}, T_J = 150^\circ\text{C}$ |
|---------|---------------|--------------------------------------------------------------------|
| SOT23 | 380°C/W | 330mW |

Recommended operating conditions

| | Min. | Max. | Units |
|-------------------------------------|------|------|-------|
| Reverse current | 0.06 | 15 | mA |
| Operating ambient temperature range | -40 | 125 | °C |

LM4040 - 2.5

Electrical characteristics

Over recommended operating conditions, $T_{amb} = 25^{\circ}\text{C}$, unless otherwise stated.

| Symbol | Parameter | Conditions | | Typ. | LM4040C limits | LM4040D limits | Units |
|-------------------------|-----------------------------------------------------------|--------------------------------------------------------------|--------------------------------|----------|----------------|----------------|-------------------------|
| | | | T_{amb} | | | | |
| V_{REF} | Reverse breakdown voltage | $I_R = 100\mu\text{A}$ | 25°C | 2.5 | | | V |
| | Reverse breakdown voltage tolerance | $I_R = 100\mu\text{A}$ | 25°C | | ± 12 | ± 25 | mV |
| | | | -40 to 85°C | | ± 29 | ± 49 | |
| | | | -40 to 125°C | | ± 38 | ± 63 | |
| I_{RMIN} | Minimum operating current | | 25°C | 45 | 60 | 65 | μA |
| | | | -40 to 85°C | | 65 | 70 | |
| | | | -40 to 125°C | | 68 | 73 | |
| $\Delta V_R/\Delta T$ | Average reverse breakdown voltage temperature coefficient | $I_R = 10\text{mA}$ | -40 to 125°C | ± 20 | | | ppm/ $^{\circ}\text{C}$ |
| | | $I_R = 1\text{mA}$, | | ± 15 | ± 100 | ± 150 | |
| | | $I_R = 100\mu\text{A}$ | | ± 15 | | | |
| $\Delta V_R/\Delta I_R$ | Reverse breakdown change with current | $I_{RMIN} < I_R < 1\text{mA}$ | 25°C | 0.3 | 0.8 | 1.0 | mV |
| | | | -40 to 85°C | | 1.0 | 1.2 | |
| | | | -40 to 125°C | | 1.0 | 1.2 | |
| | | $1\text{mA} < I_R < 15\text{mA}$ | 25°C | 2.5 | 6.0 | 8.0 | |
| | | | -40 to 85°C | | 8.0 | 10.0 | |
| | | | -40 to 125°C | | 8.0 | 10.0 | |
| Z_R | Dynamic output impedance | $I_R = 1\text{mA}$, $f = 120\text{Hz}$ $I_{AC} = 0.1I_R$ | | 0.3 | 0.9 | 1.1 | Ω |
| e_n | Noise voltage | $I_R = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$ | | 45 | | | μV_{RMS} |
| ΔV_R | Long term stability (non cumulative) | $t = 1000\text{Hrs}$ $I_R = 100\mu\text{A}$ | 25°C | 120 | | | ppm |
| V_{HYST} | Thermal hysteresis | $\Delta T = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | | 0.08 | | | % |

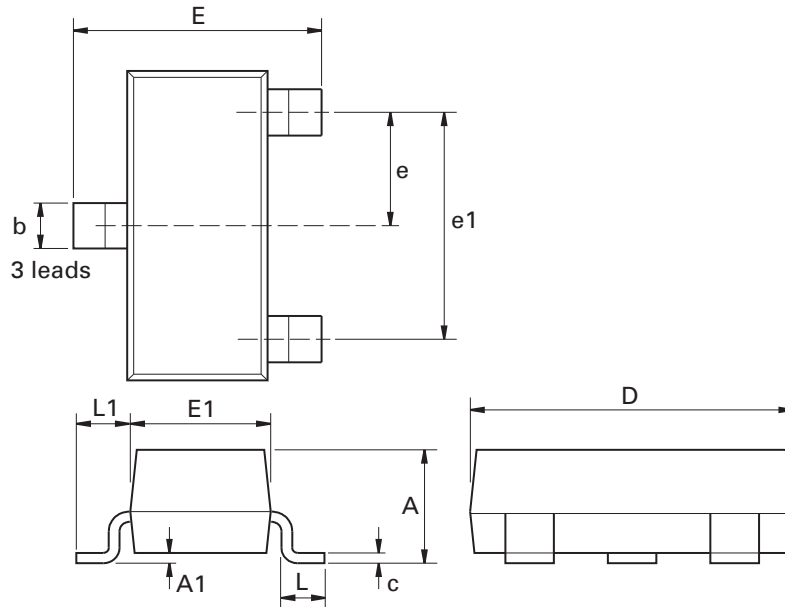
LM4040 - 5.0

Electrical characteristics

Over recommended operating conditions, $T_{amb} = 25^{\circ}\text{C}$, unless otherwise stated.

| Symbol | Parameter | Conditions | | Typ | LM4040C limits | LM4040D limits | Units |
|-------------------------|-----------------------------------------------------------|--------------------------------------------------------------|--------------------------------|----------|----------------|----------------|-------------------------|
| | | | T_{amb} | | | | |
| V_{REF} | Reverse breakdown voltage | $I_R = 100\mu\text{A}$ | 25°C | 5.00 | | | V |
| | Reverse breakdown voltage tolerance | $I_R = 100\mu\text{A}$ | 25°C | | ± 25 | ± 50 | mV |
| | | | -40 to 85°C | | ± 58 | ± 99 | |
| | | | -40 to 125°C | | ± 75 | ± 125 | |
| I_{RMIN} | Minimum operating current | | 25°C | 54 | 74 | 79 | μA |
| | | | -40 to 85°C | | 80 | 85 | |
| | | | -40 to 125°C | | 83 | 88 | |
| $\Delta V_R/\Delta T$ | Average reverse breakdown voltage temperature coefficient | $I_R = 10\text{mA}$ | -40 to 125°C | ± 30 | | | ppm/ $^{\circ}\text{C}$ |
| | | $I_R = 1\text{mA}$, | | ± 20 | ± 100 | ± 150 | |
| | | $I_R = 100\mu\text{A}$ | | ± 20 | | | |
| $\Delta V_R/\Delta I_R$ | Reverse breakdown change with current | $I_{RMIN} < I_R < 1\text{mA}$ | 25°C | 0.5 | 1.0 | 1.3 | mV |
| | | | -40 to 85°C | | 1.4 | 1.8 | |
| | | | -40 to 125°C | | 1.4 | 1.8 | |
| | | $1\text{mA} < I_R < 15\text{mA}$ | 25°C | 3.5 | 8.0 | 10.0 | |
| | | | -40 to 85°C | | 12.0 | 15.0 | |
| | | | -40 to 125°C | | 12.0 | 15.0 | |
| Z_R | Dynamic output impedance | $I_R = 1\text{mA}$, $f = 120\text{Hz}$ $I_{AC} = 0.1I_R$ | | 0.5 | 1.1 | 1.5 | Ω |
| e_n | Noise voltage | $I_R = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$ | | 105 | | | μV_{RMS} |
| ΔV_R | Long term stability (non cumulative) | $t = 1000\text{Hrs}$ $I_R = 100\mu\text{A}$ | 25°C | 120 | | | ppm |
| V_{HYST} | Thermal hysteresis | $\Delta T = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | | 0.08 | | | % |

Package outline - SOT23



| Dim. | Millimeters | | Inches | | Dim. | Millimeters | | Inches | |
|------|-------------|-------|------------|-------|------|-------------|------|-----------|-------|
| | Min. | Max. | Min. | Max. | | Min. | Max. | Max. | Max. |
| A | - | 1.12 | - | 0.044 | e1 | 1.90 NOM | | 0.075 NOM | |
| A1 | 0.01 | 0.10 | 0.0004 | 0.004 | E | 2.10 | 2.64 | 0.083 | 0.104 |
| b | 0.30 | 0.50 | 0.012 | 0.020 | E1 | 1.20 | 1.40 | 0.047 | 0.055 |
| C | 0.085 | 0.120 | 0.003 | 0.008 | L | 0.25 | 0.62 | 0.018 | 0.024 |
| D | 2.80 | 3.04 | 0.110 | 0.120 | L1 | 0.45 | 0.62 | 0.018 | 0.024 |
| e | 0.95 NOM | | 0.0375 NOM | | - | - | - | - | - |

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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Product status key:

| | |
|-----------------------------------|--------------------------------------------------------------------------------|
| "Preview" | Future device intended for production at some point. Samples may be available |
| "Active" | Product status recommended for new designs |
| "Last time buy (LTB)" | Device will be discontinued and last time buy period and delivery is in effect |
| "Not recommended for new designs" | Device is still in production to support existing designs and production |
| "Obsolete" | Production has been discontinued |

Datasheet status key:

| | |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zetex GmbH Kustermann-park Balanstraße 59 D-81541 München Germany Telefon: (49) 89 45 49 49 0 Fax: (49) 89 45 49 49 49 europe.sales@zetex.com | Zetex Inc 700 Veterans Memorial Highway Hauppauge, NY 11788 USA Telephone: (1) 631 360 2222 Fax: (1) 631 360 8222 usa.sales@zetex.com | Zetex (Asia Ltd) 3701-04 Metroplaza Tower 1 Hing Fong Road, Kwai Fong Hong Kong Telephone: (852) 26100 611 Fax: (852) 24250 494 asia.sales@zetex.com | Zetex Semiconductors plc Zetex Technology Park, Chadderton Oldham, OL9 9LL United Kingdom Telephone: (44) 161 622 4444 Fax: (44) 161 622 4446 hq@zetex.com |

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