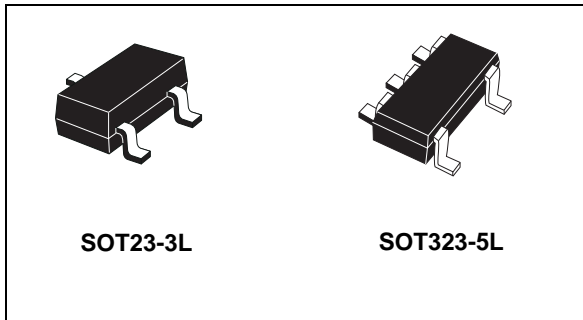


Precision micropower shunt voltage reference

Datasheet - production data



Description

The LM4041 is a micropower shunt voltage reference, providing a stable 1.225 V output voltage, with an initial accuracy of 0.1% @ 25 °C and a low temperature coefficient. Available in SOT323-5L and SOT23-3L surface mount packages, it can be designed in applications where space saving is a critical issue. The low operating current is a key advantage for power restricted designs. In addition, the LM4041 is very stable and can be used in a broad range of application conditions.

Features

- Fixed 1.225 V typical output voltage
- Ultra low operating current: 40 μ A at 25 °C
- High precision: +/- 0.1% @ 25 °C (0.2%, 0.5% and 1% versions are also available)
- Stable when used with capacitive loads
- Industrial (- 40 to+ 85 °C) and Extended (- 40 to +125 °C) temperature range versions available
- 100 ppm/°C maximum temperature coefficient
- Available in SOT23-3L and SOT323-5L packages

Applications

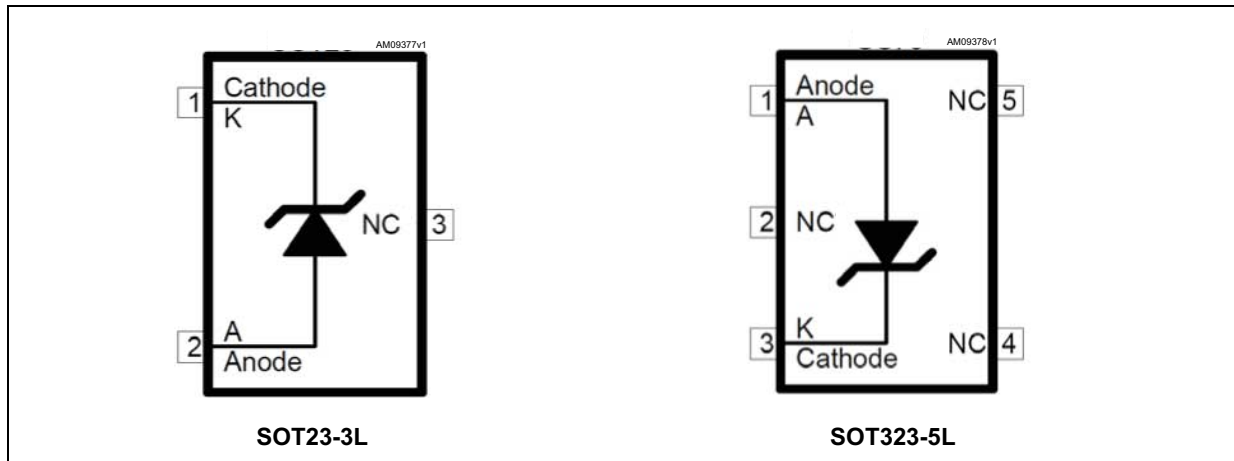
- Computers
- Battery chargers
- Switch mode power supply
- Battery operated equipment
- Data acquisition systems
- Energy management
- Instrumentation

Contents

| | | |
|---|---|----|
| 1 | Pin configuration | 3 |
| 2 | Maximum ratings | 4 |
| 3 | Electrical characteristics | 5 |
| 4 | Typical performance characteristics | 6 |
| 5 | Package mechanical data | 8 |
| 6 | Packaging mechanical data | 12 |
| 7 | Order codes | 14 |
| 8 | Revision history | 15 |

1 Pin configuration

Figure 1. Pin connection (top view)



Note: Below pins must be left floating or connected to Anode pin to improve noise immunity due to PCB layout.

SOT23-3L: pin 3.

SOT323-5L: pin 2, pin 4 and pin 5.

2 Maximum ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|------------|-------------------------------------|--------------|------|
| I_K | Reverse breakdown current | 20 | mA |
| V_K | Maximum cathode voltage | 8 | V |
| I_F | Forward current | 10 | mA |
| P_D | Power dissipation ⁽¹⁾ | | |
| | SOT23-3L SOT323-5L | 500 536 | mW |
| T_{STG} | Storage temperature | - 65 to +150 | °C |
| ESD | Human body model (HBM) | 2 | kV |
| | Machine model (MM) | 200 | V |
| | Charged device model | 1500 | V |
| T_{LEAD} | Lead temperature (soldering) 10 sec | 260 | °C |
| T_J | Max junction temperature | +150 | °C |

1. P_D has been calculated with $T_{AMB} = 25^\circ\text{C}$ and $T_{JMAX} = 150^\circ\text{C}$.

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 2. Thermal data

| Symbol | Parameter | SOT323-5L | SOT23-3L | Unit |
|------------|-------------------------------------|-----------|----------|------|
| R_{thJA} | Thermal resistance junction-ambient | 233 | 248 | °C/W |
| R_{thJC} | Thermal resistance junction-case | 90 | 136 | °C/W |

Table 3. Operating conditions

| Symbol | Parameter | Value | Unit |
|------------|--------------------------------------|------------|---------------|
| I_{KMIN} | Minimum operating current | 40 | μA |
| I_{KMAX} | Maximum operating current | 12 | mA |
| T_{OPER} | Operating free air temperature range | Industrial | - 40 to + 85 |
| | | Extended | - 40 to + 125 |

3 Electrical characteristics

$T_{AMB} = 25\text{ °C}$, unless otherwise specified.

Table 4. Electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------|---|---|------------------------------------|----------|------------------------------------|---------------------|
| V_k | Reverse breakdown voltage | $I_k = 100\ \mu\text{A}$ LM4041A, 0.1% LM4041B, 0.2% LM4041C, 0.5% LM4041D, 1% | 1.2238 1.2225 1.219 1.213 | 1.225 | 1.2262 1.2275 1.231 1.237 | V |
| I_{kmin} | Minimum operating current | $T_{amb} = 25\text{ °C}$ $-40\text{ °C} < T_{amb} < T_{max}^{(1)}$ | | 25 | 40 50 | μA |
| $\Delta V_k/\Delta T$ | Average temperature coefficient ⁽²⁾ | $I_k = 100\ \mu\text{A}$ | | ± 36 | ± 100 | ppm/°C |
| $\Delta V_k/\Delta I_k$ | Reverse breakdown voltage change with operating current range | $I_{kmin} < I_k < 1\ \text{mA}$ $-40\text{ °C} < T_{amb} < T_{max}^{(1)}$ $1\ \text{mA} < I_k < 12\ \text{mA}$ $-40\text{ °C} < T_{amb} < T_{max}^{(1)}$ | | 0.4 4 | 1 8 10 | mV |
| R_{ka} | Static impedance | $\Delta I_k = 100\ \mu\text{A}$ to 1 mA | | 0.4 | 1 | W |
| K_{vh} | Long term stability | $I_k = 100\ \mu\text{A}$, $t = 1000\ \text{hrs}$ | | 120 | | ppm |
| e_n | Wide band noise | $I_k = 100\ \mu\text{A}$, $10\ \text{Hz} < f < 10\ \text{kHz}$ | | 60 | | μV_{RMS} |

1. $T_{max} = 85\text{ °C}$ for LM4041xI (industrial version) and $T_{max} = 125\text{ °C}$ for LM4041xE (extended version).

2. The average temperature coefficient is defined as: $10^6 \times \{\max(\Delta V_k) / [V_{k@25^\circ\text{C}} \times (T_{max} - T_{min})]\}$ [ppm/°C].

Note: *Limits are 100% production tested at 25 °C. Limits over temperature are guaranteed through correlation and by design.*

4 Typical performance characteristics

The following plots are referred to the typical application circuit and, unless otherwise noted, at $T_A = 25\text{ }^\circ\text{C}$.

Figure 2. V_k change vs. temperature

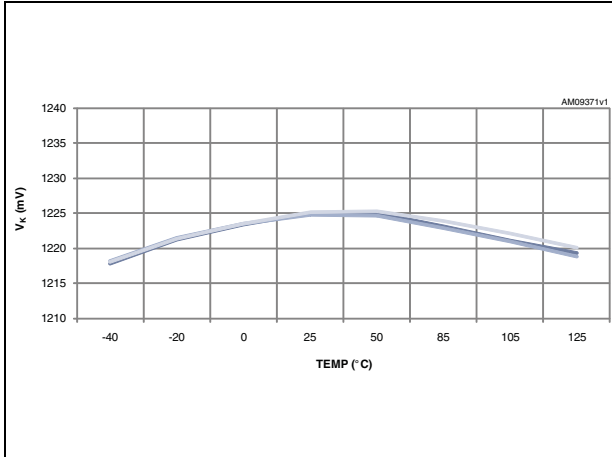


Figure 3. Minimum current for regulation

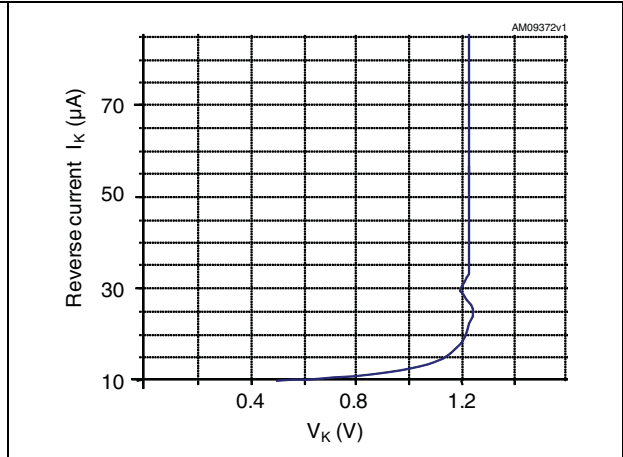


Figure 4. Output impedance vs. frequency

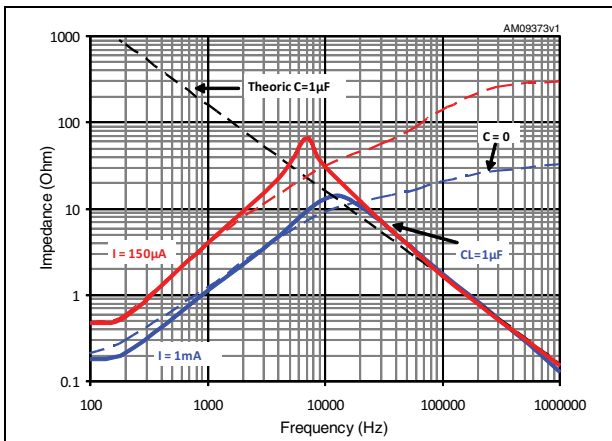


Figure 5. Minimum current for regulation vs. temperature

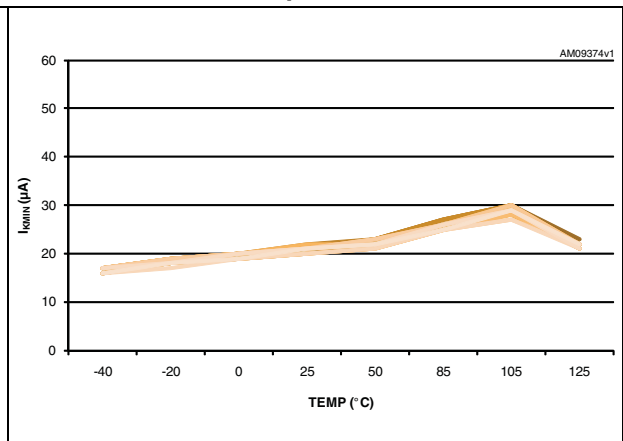


Figure 6. Startup characteristics

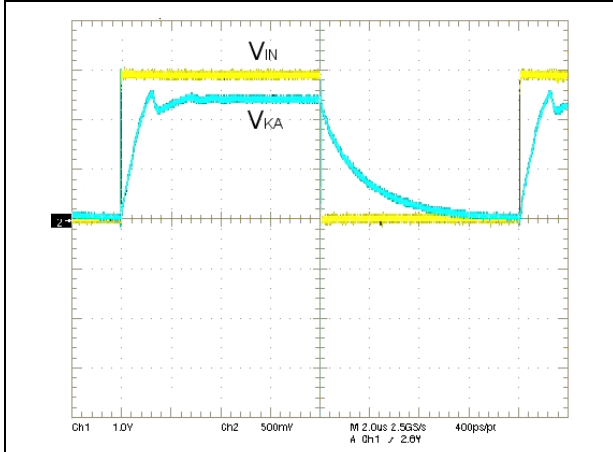


Figure 7. Startup measure circuit

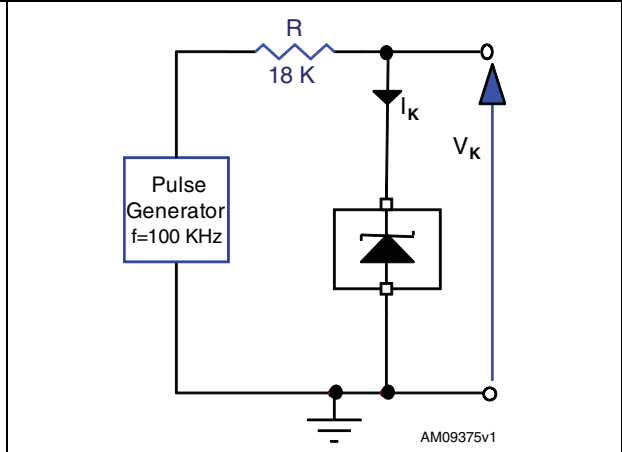
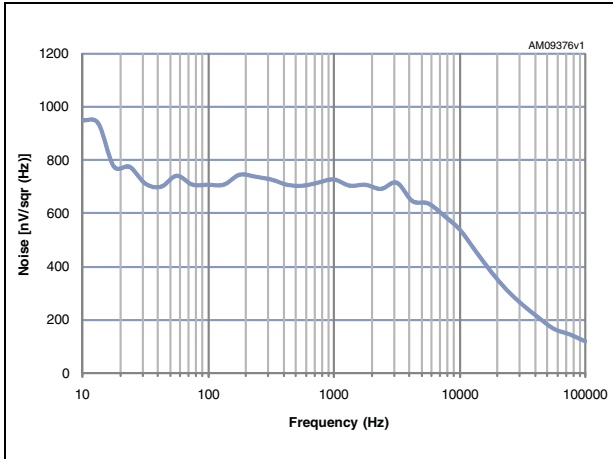


Figure 8. Wideband noise voltage



5 Package mechanical data

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.

Figure 9. SOT23-3L dimensions

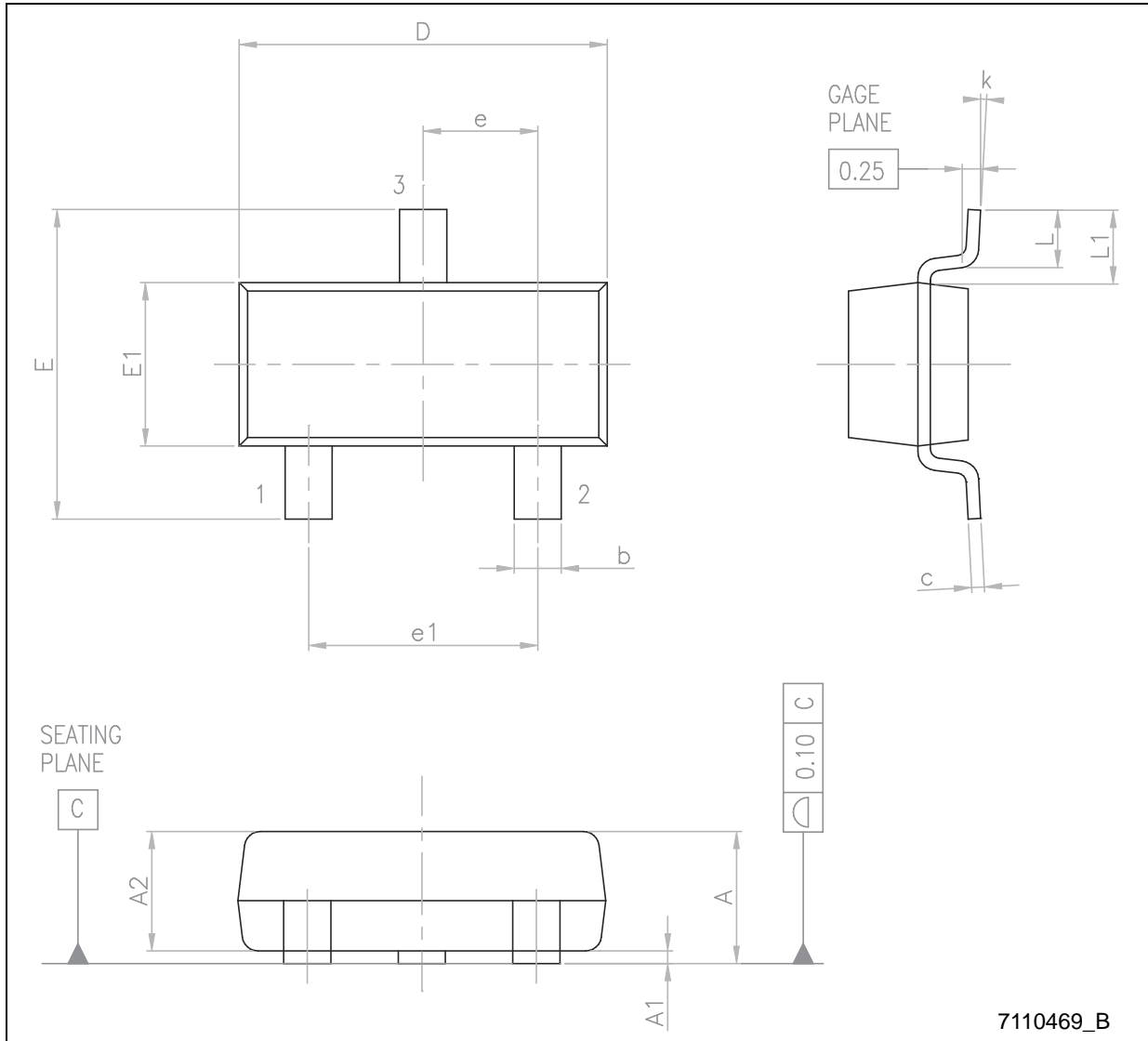


Table 5. SOT23-3L mechanical data

| Dim. | mm. | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 0.89 | | 1.12 |
| A1 | 0.01 | | 0.10 |
| A2 | 0.88 | 0.95 | 1.02 |
| b | 0.30 | | 0.50 |
| c | 0.08 | | 0.20 |
| D | 2.80 | 2.90 | 3.04 |
| E | 2.10 | | 2.64 |
| E1 | 1.20 | 1.30 | 1.40 |
| e | | 0.95 | |
| e1 | | 1.90 | |
| L | 0.40 | 0.50 | 0.60 |
| L1 | | 0.54 | |
| k | 0° | | 8° |

Figure 10. SOT323-5L dimensions

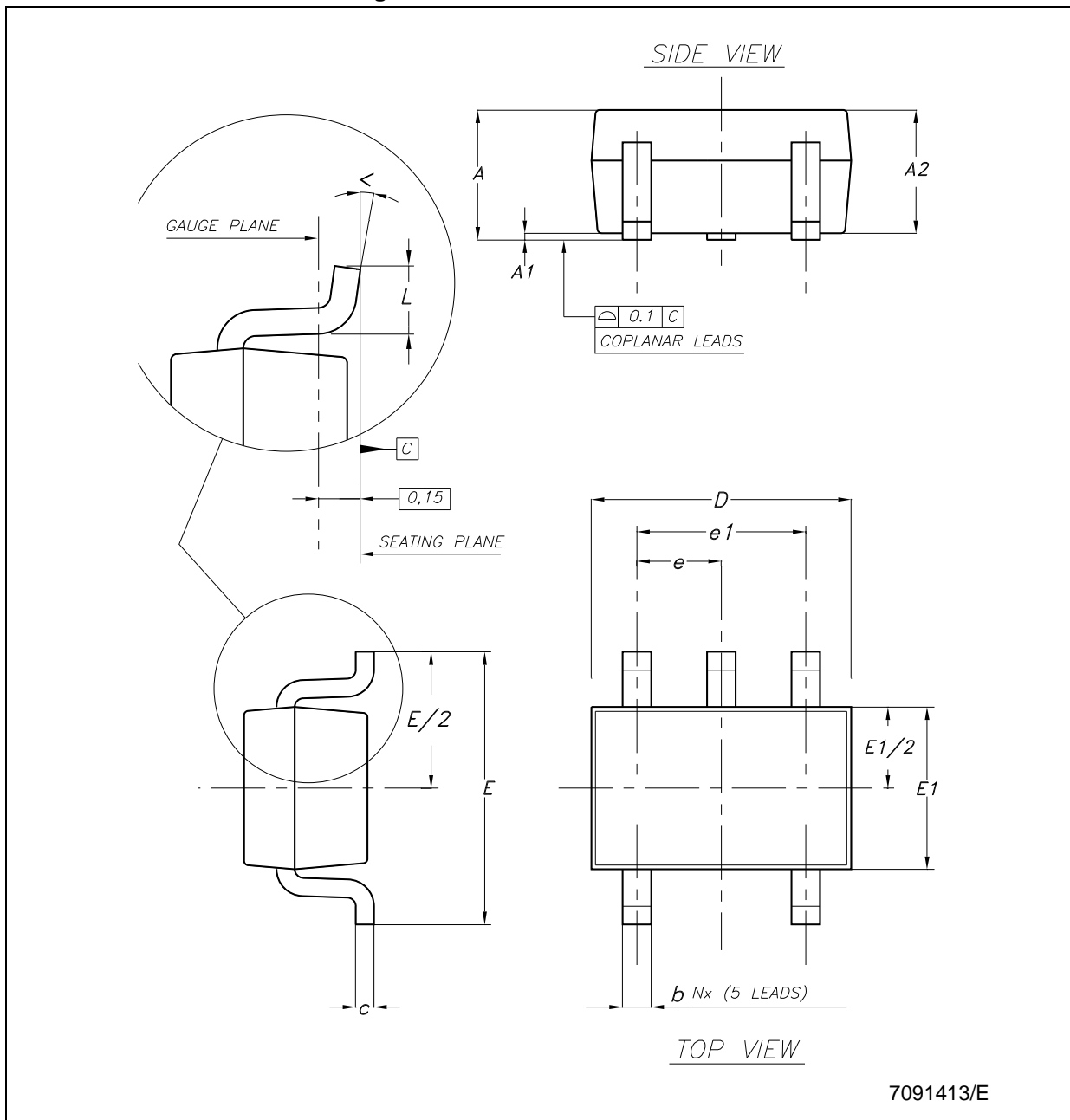


Table 6. SOT323-5L mechanical data

| Dim. | mm. | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 0.80 | | 1.10 |
| A1 | 0 | | 0.10 |
| A2 | 0.80 | 0.90 | 1 |
| b | 0.15 | | 0.30 |
| c | 0.10 | | 0.22 |
| D | 1.80 | 2 | 2.20 |
| E | 1.80 | 2.10 | 2.40 |
| E1 | 1.15 | 1.25 | 1.35 |
| e | | 0.65 | |
| e1 | | 1.30 | |
| L | 0.26 | 0.36 | 0.46 |
| < | 0° | | 8° |

6 Packaging mechanical data

Figure 11. Tape and reel SOT23-3L and SOT323-5L mechanical drawing

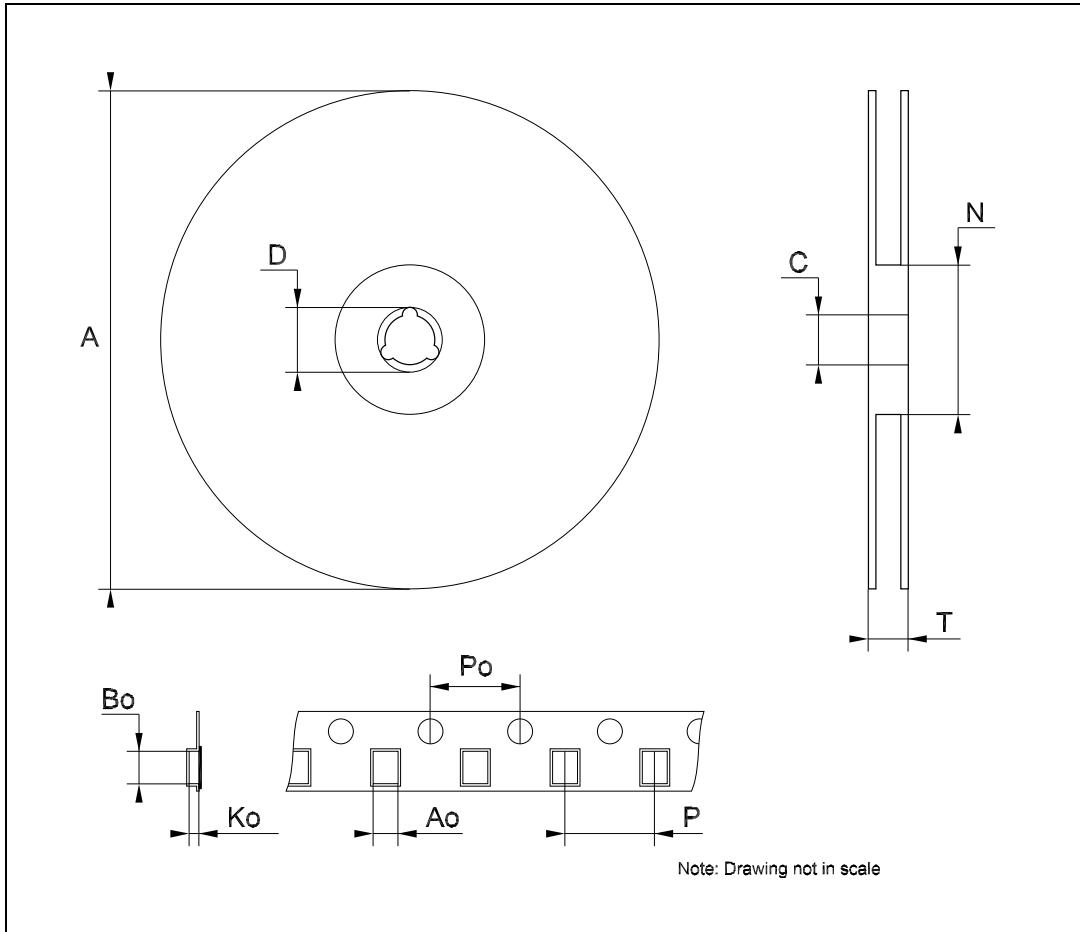


Table 7. Tape and reel SOT23-3L mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | | | 180 |
| C | 12.8 | 13.0 | 13.2 |
| D | 20.2 | | |
| N | 60 | | |
| T | | | 14.4 |
| Ao | 3.13 | 3.23 | 3.33 |
| Bo | 3.07 | 3.17 | 3.27 |
| Ko | 1.27 | 1.37 | 1.47 |
| Po | 3.9 | 4.0 | 4.1 |
| P | 3.9 | 4.0 | 4.1 |

Table 8. SOT323-5L mechanical data

| Dim. | mm. | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 175 | 180 | 185 |
| C | 12.8 | 13 | 13.2 |
| D | 20.2 | | |
| N | 59.5 | 60 | 60.5 |
| T | | | 14.4 |
| Ao | | 2.25 | |
| Bo | | 2.7 | |
| Ko | | 1.2 | |
| Po | 3.9 | 4 | 4.1 |
| P | 3.8 | 4 | 4.2 |

7 Order codes

Table 9. Order codes

| Order codes | Precision | Packages | Operating temperature range | Marking |
|----------------|-----------|-----------|-------------------------------|---------|
| LM4041AICT-1.2 | 0.1% | SOT323-5L | Industrial - 40 to + 85 °C | L2 |
| LM4041BICT-1.2 | 0.2% | | | L2 |
| LM4041CICT-1.2 | 0.5% | | | L25 |
| LM4041DICT-1.2 | 1% | | | L26 |
| LM4041AILT-1.2 | 0.1% | SOT23-3L | Industrial - 40 to + 85 °C | L23 |
| LM4041BILT-1.2 | 0.2% | | | L24 |
| LM4041CILT-1.2 | 0.5% | | | L25 |
| LM4041DILT-1.2 | 1% | | | L26 |
| LM4041AECT-1.2 | 0.1% | SOT323-5L | Extended - 40 to + 125 °C | E2 |
| LM4041BECT-1.2 | 0.2% | | | E2 |
| LM4041CECT-1.2 | 0.5% | | | E25 |
| LM4041DECT-1.2 | 1% | | | E26 |
| LM4041AELT-1.2 | 0.1% | SOT23-3L | Extended - 40 to + 125 °C | E23 |
| LM4041BELT-1.2 | 0.2% | | | E24 |
| LM4041CELT-1.2 | 0.5% | | | E25 |
| LM4041DELT-1.2 | 1% | | | E26 |

8 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 09-May-2011 | 1 | Initial release. |
| 05-Dec-2011 | 2 | Changed maturity code and updated Table 9 on page 14 . |
| 25-Jul-2012 | 3 | Added: marking order codes Table 9 on page 14 . |
| 18-Feb-2014 | 4 | Part number LM4041xx changed to LM4041. Updated Table 1: Absolute maximum ratings , Section 1: Pin configuration and Section 5: Package mechanical data . Added Section 6: Packaging mechanical data . Minor text changes. |

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com