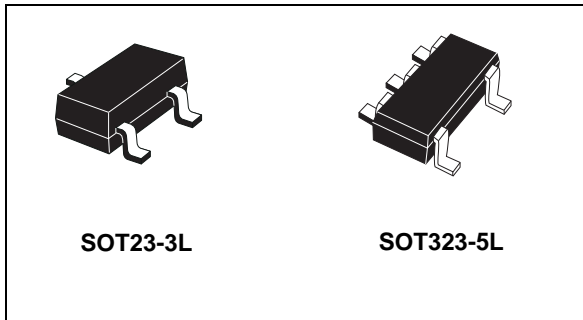# LM4041

Precision micropower shunt voltage reference

SOT23-3L   **SOT323-5L**

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 µA 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
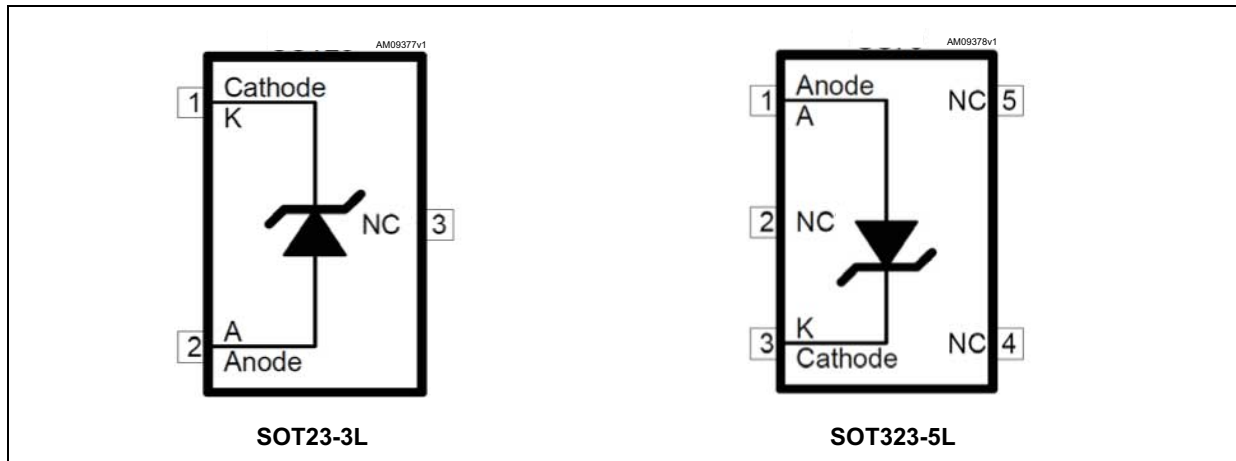
Applications

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

Contents

1 Pin configuration

Figure 1. Pin connection (top view)

SOT23-3L   SOT323-5L

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°C and T_{JMAX} = 150 °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	°C
		Extended	- 40 to + 125	

3 Electrical characteristics

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

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_k	Reverse breakdown voltage	I_k = 100 µA 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 °C		25	40	µA
		-40 °C < T_{amb} < T_{max} [1]			50	
$\Delta V_k/\Delta T$	Average temperature coefficient [2]	I_k = 100 µA		± 36	± 100	ppm/°C
$\Delta V_k/\Delta I_k$	Reverse breakdown voltage change with operating current range	I_{kmin} < I_k < 1 mA - 40 °C < T_{amb} < T_{max} [1]		0.4	1 1.5	mV
		1 mA < I_k < 12 mA - 40 °C < T_{amb} < T_{max} [1]		4	8 10	
R_{ka}	Static impedance	ΔI_k = 100 µA to 1 mA		0.4	1	W
K_{vh}	Long term stability	I_k = 100 µA, t = 1000 hrs		120		ppm
e_n	Wide band noise	I_k = 100 µA, 10 Hz < f < 10 kHz		60		µV$_{RMS}$

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

2. The average temperature coefficient is defined as: 10^6 x {max(ΔV_k) / [$V_{k@25°C}$ x (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 °C.

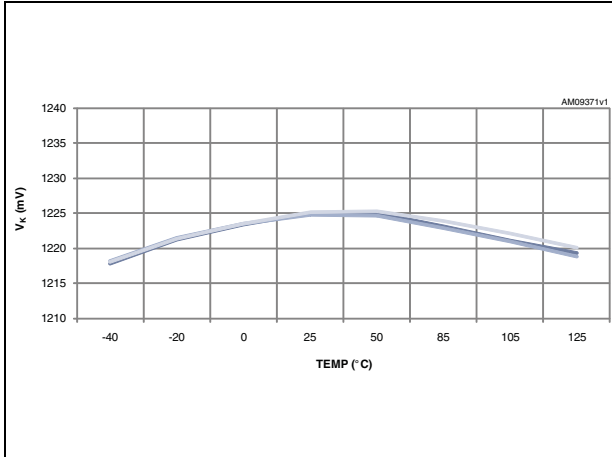**Figure 2. V_k change vs. temperature**
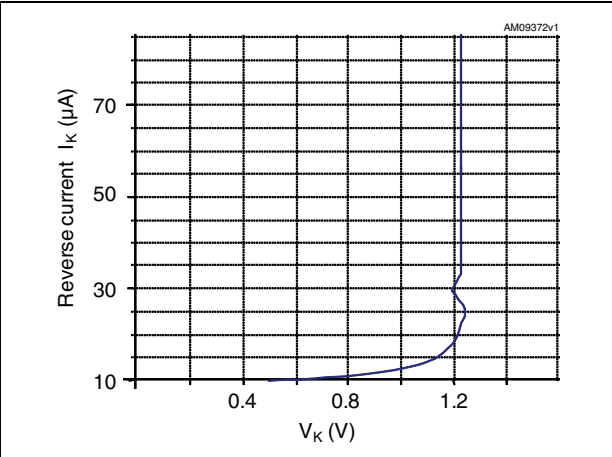

Figure 3. Minimum current for regulation

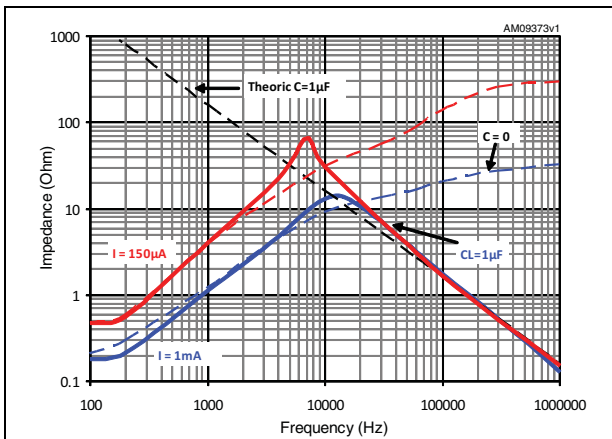**Figure 4. Output impedance vs. frequency**

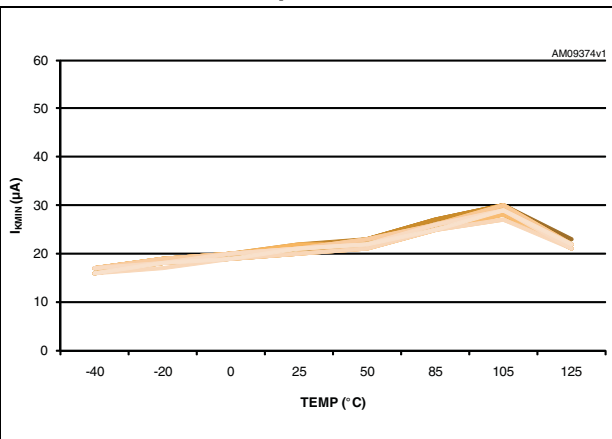
Figure 5. Minimum current for regulation vs. temperature
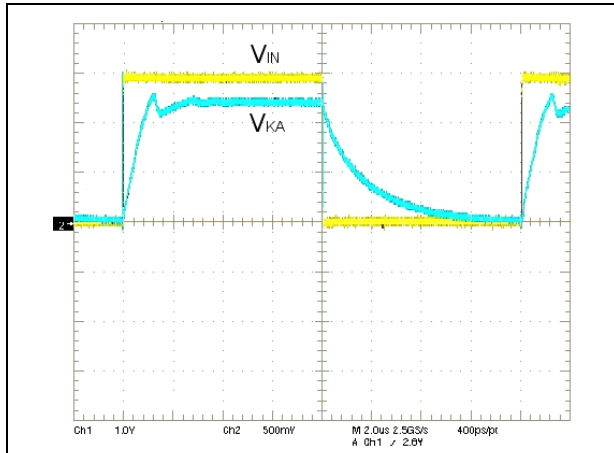
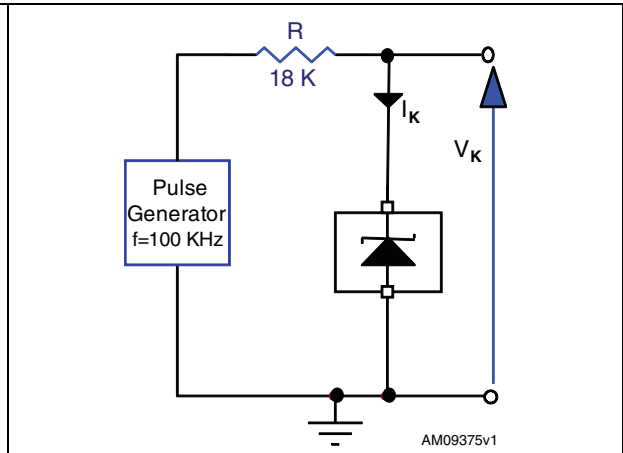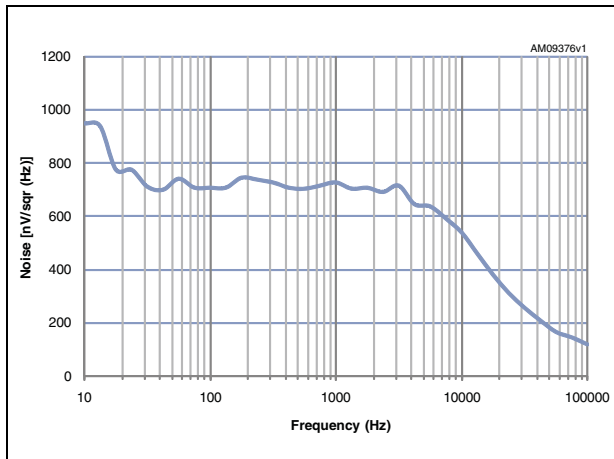**Figure 6. Startup characteristics**

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

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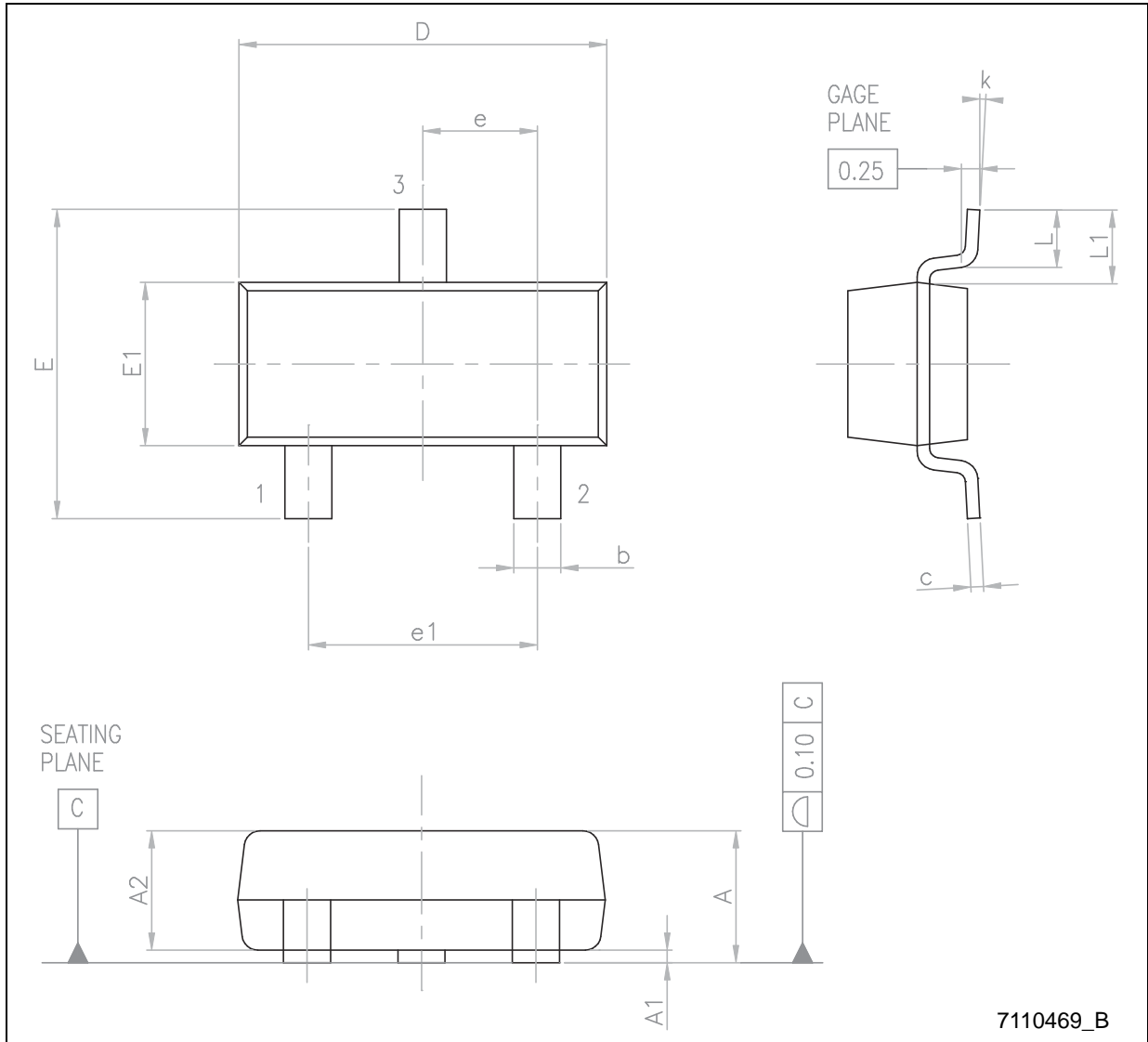
Table 5. SOT23-3L mechanical data

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

7091413/E
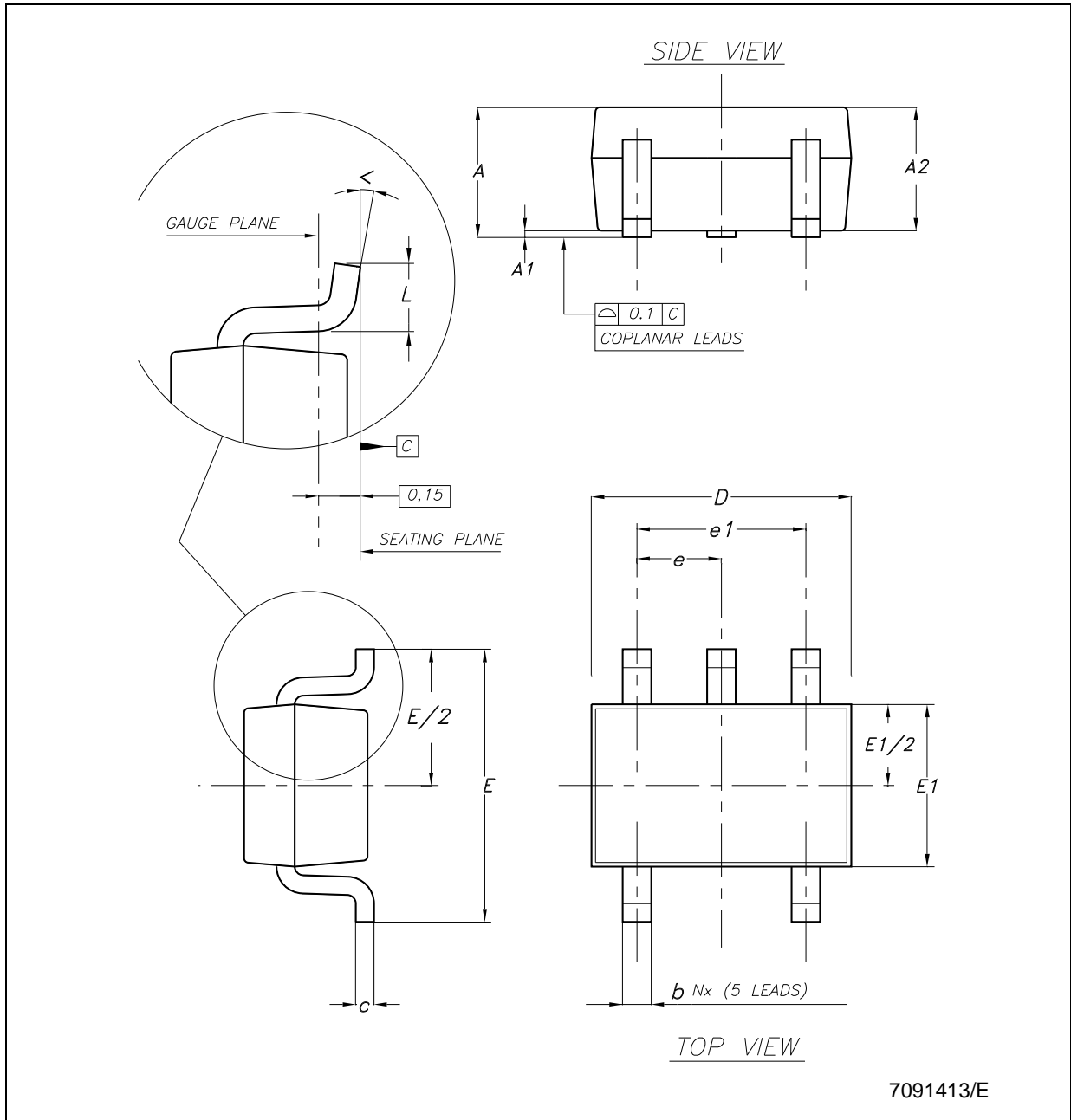
Table 6. SOT323-5L mechanical data

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

Note: Drawing not in scale
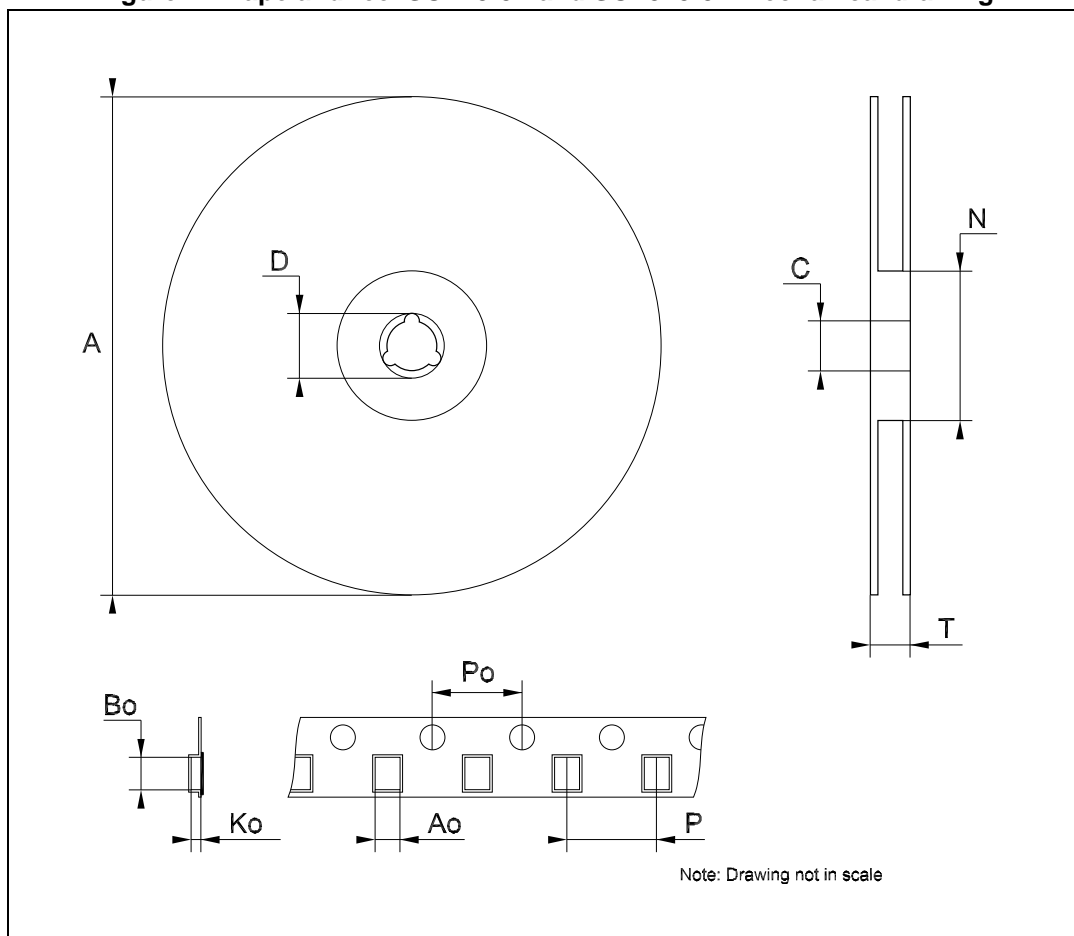
Table 7. Tape and reel SOT23-3L mechanical data

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: