

Precision micropower shunt voltage reference

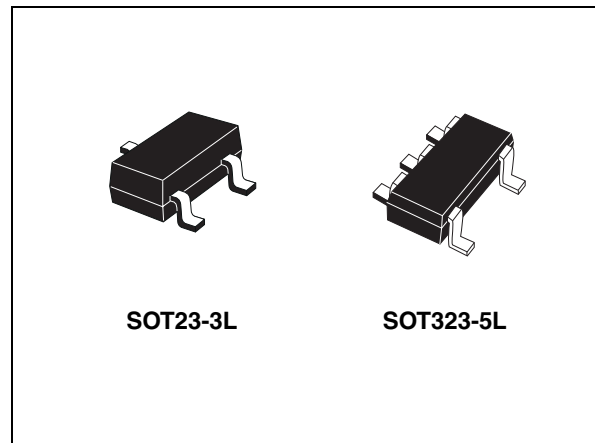
Datasheet – production data

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



Description

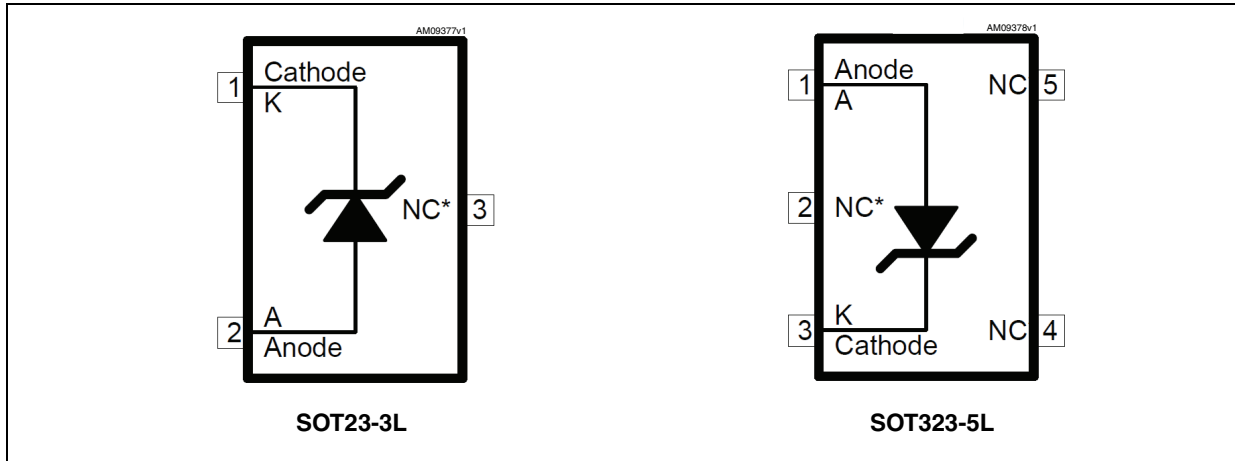
The LM4041 is a micropower shunt voltage reference, providing a stable 1.225 V output voltage, with an initial accuracy of 0.1% @ 25 °C and a low temperature coefficient. Available in SOT323-5L and SOT23-3L surface mount packages, it can be designed in applications where space saving is a critical issue. 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.

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1 Pin configuration

Figure 1. Pin connection (top view)



* This pin must be left floating or connected to Anode pin.

2 Maximum ratings

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⁾		
	SOT23-3L	500	mW
	SOT323-5L	536	
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

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

Table 4. Electrical characteristics

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

1. $T_{max} = 85\text{ }^{\circ}\text{C}$ for LM4041xI (industrial version) and $T_{max} = 125\text{ }^{\circ}\text{C}$ 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/ $^{\circ}\text{C}$].

Note: Limits are 100% production tested at $25\text{ }^{\circ}\text{C}$. 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

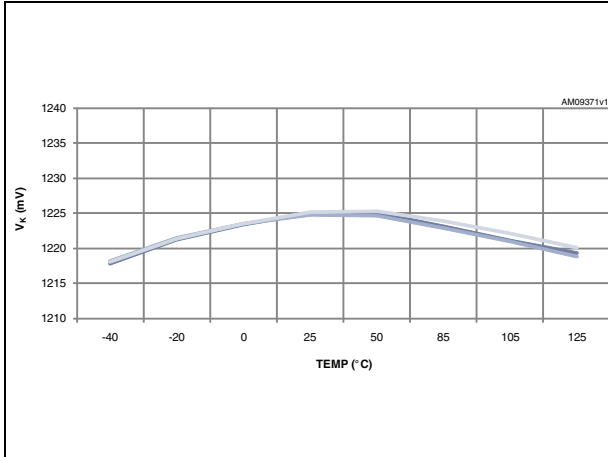


Figure 3. Minimum current for regulation

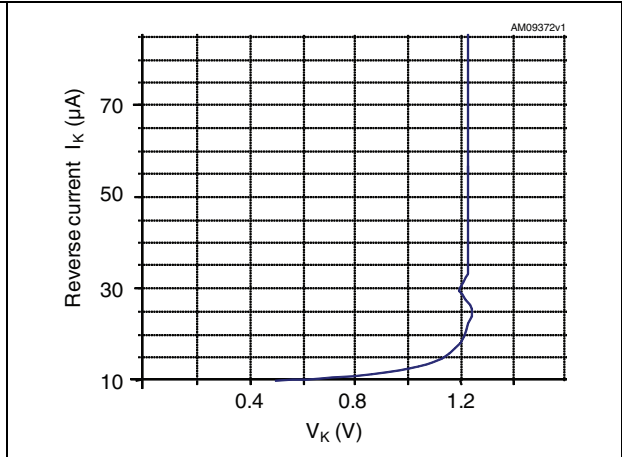


Figure 4. Output impedance vs. frequency

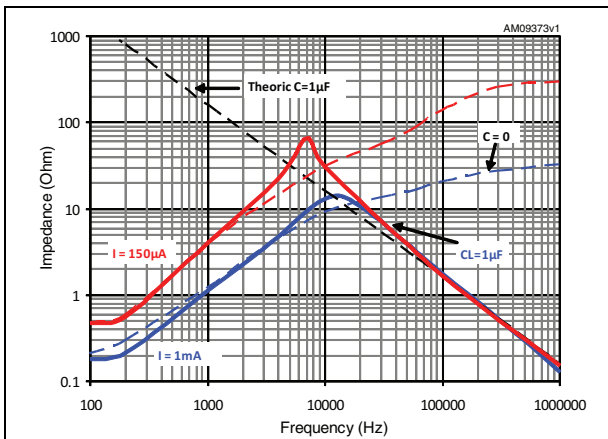


Figure 5. Minimum current for regulation vs. temperature

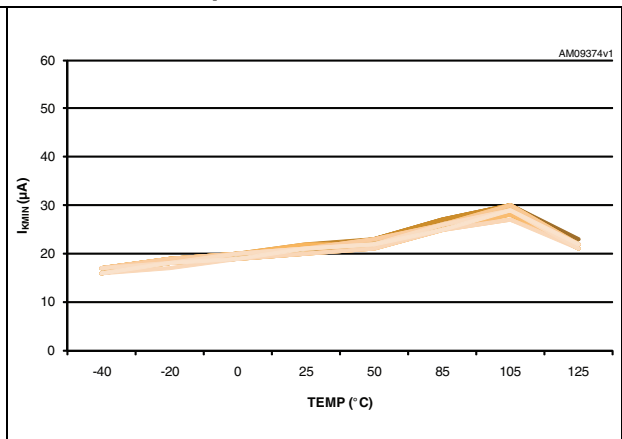


Figure 6. Startup characteristics

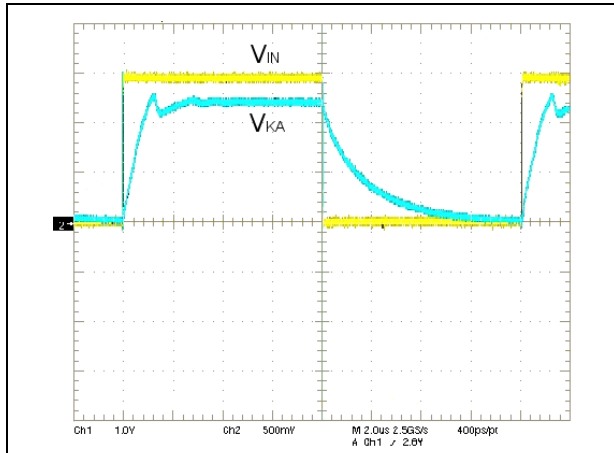


Figure 7. Startup measure circuit

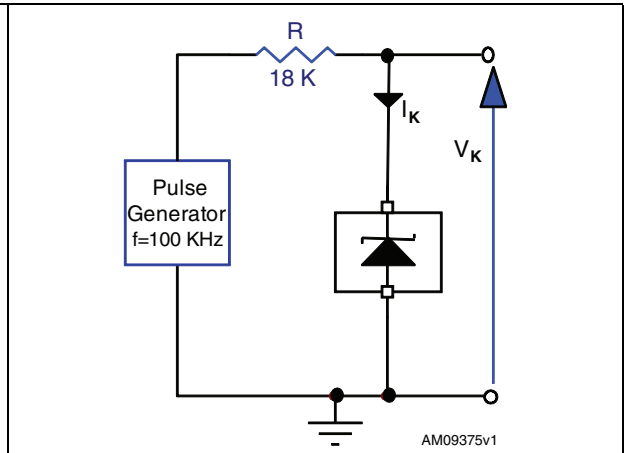
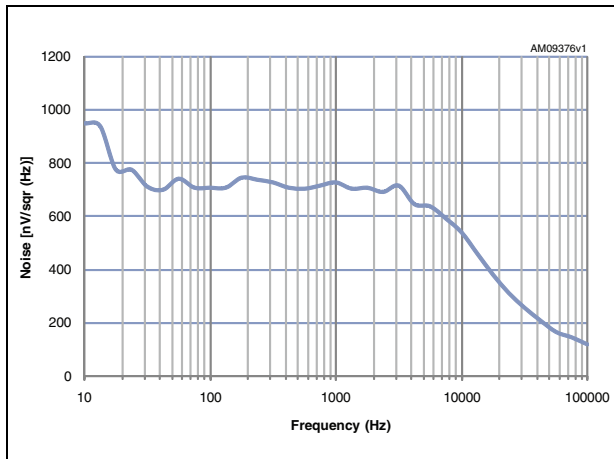


Figure 8. Wideband noise voltage



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.

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 9. SOT23-3L dimensions

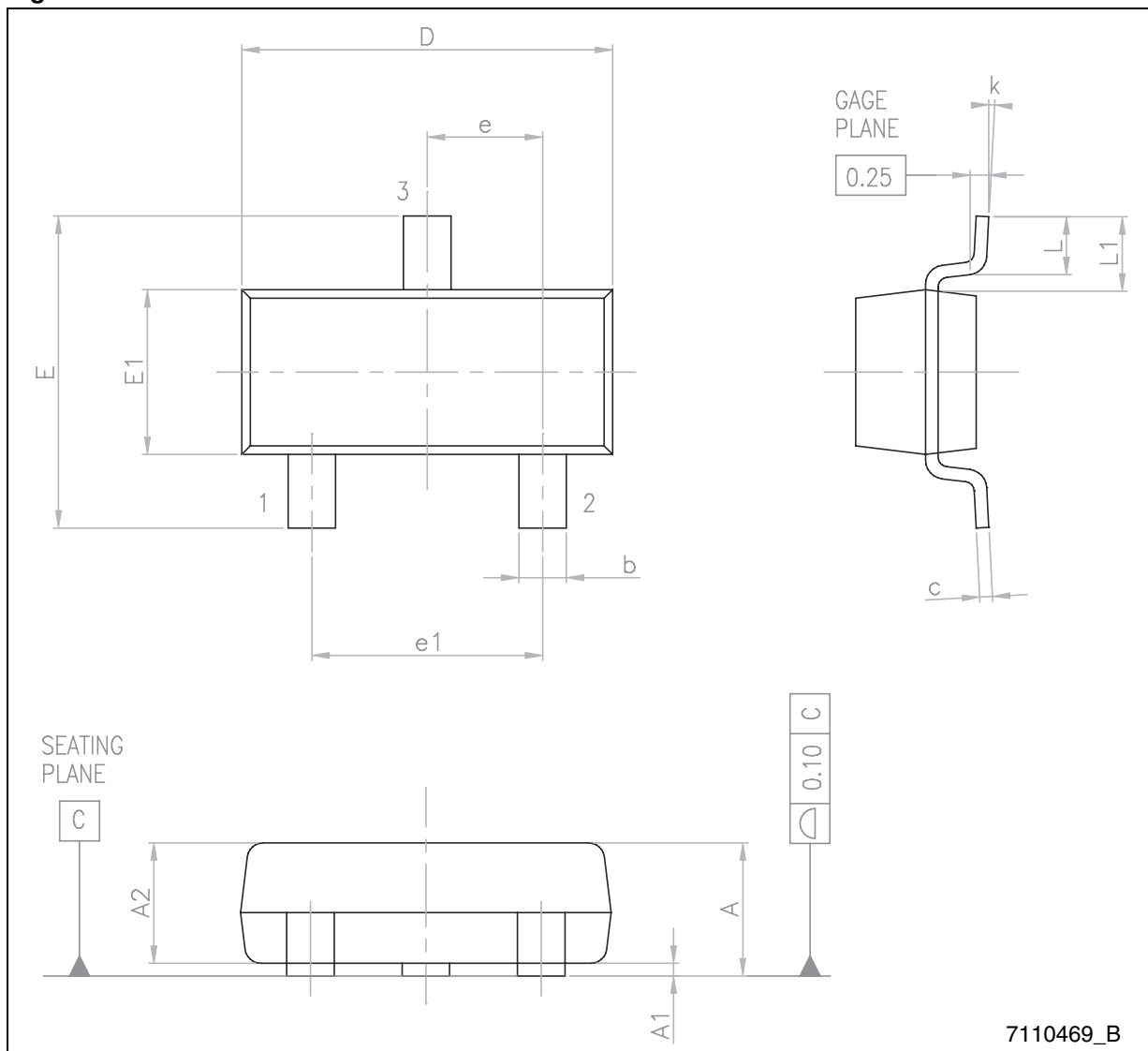
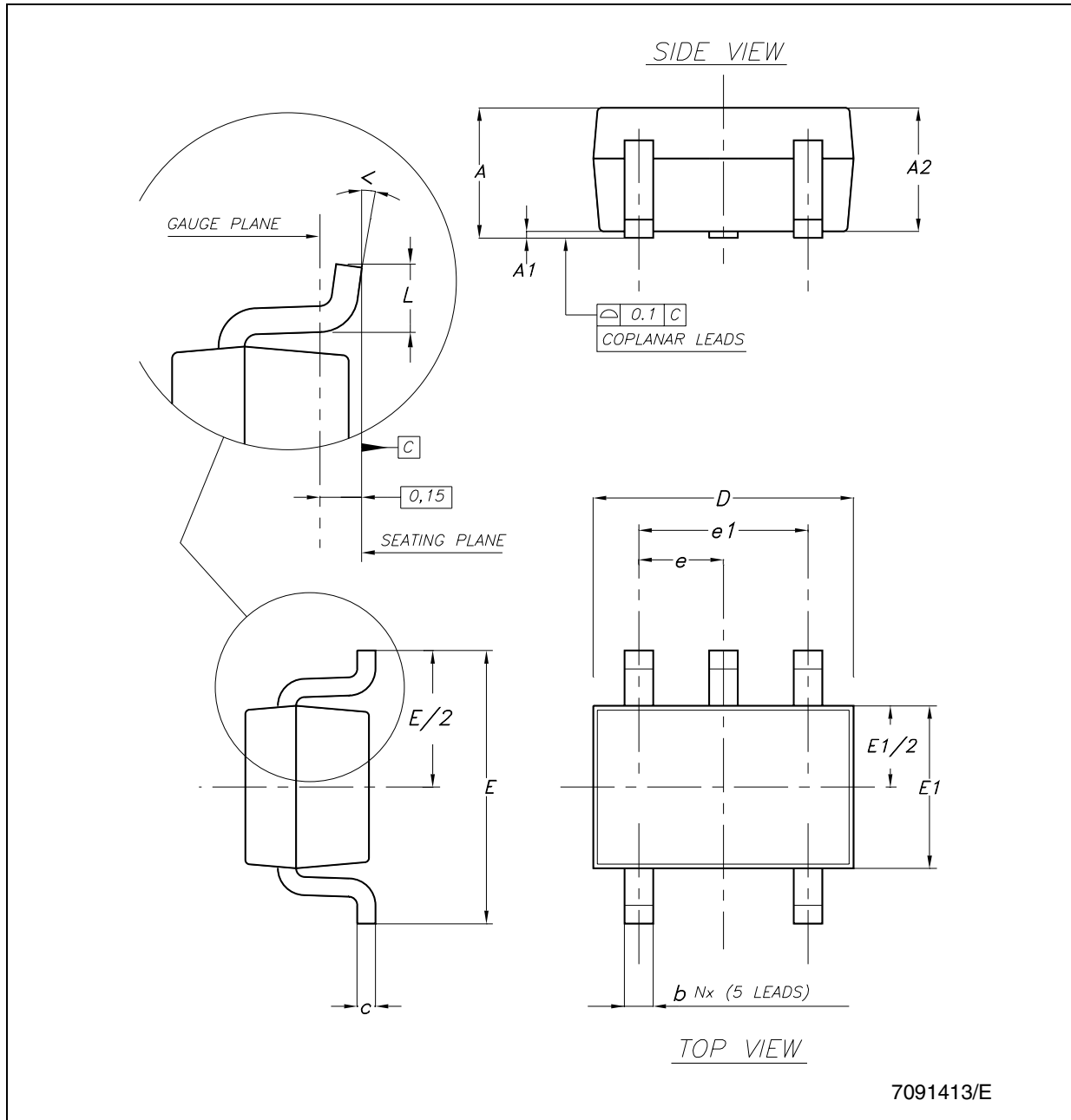


Table 6. SOT323-5L mechanical data

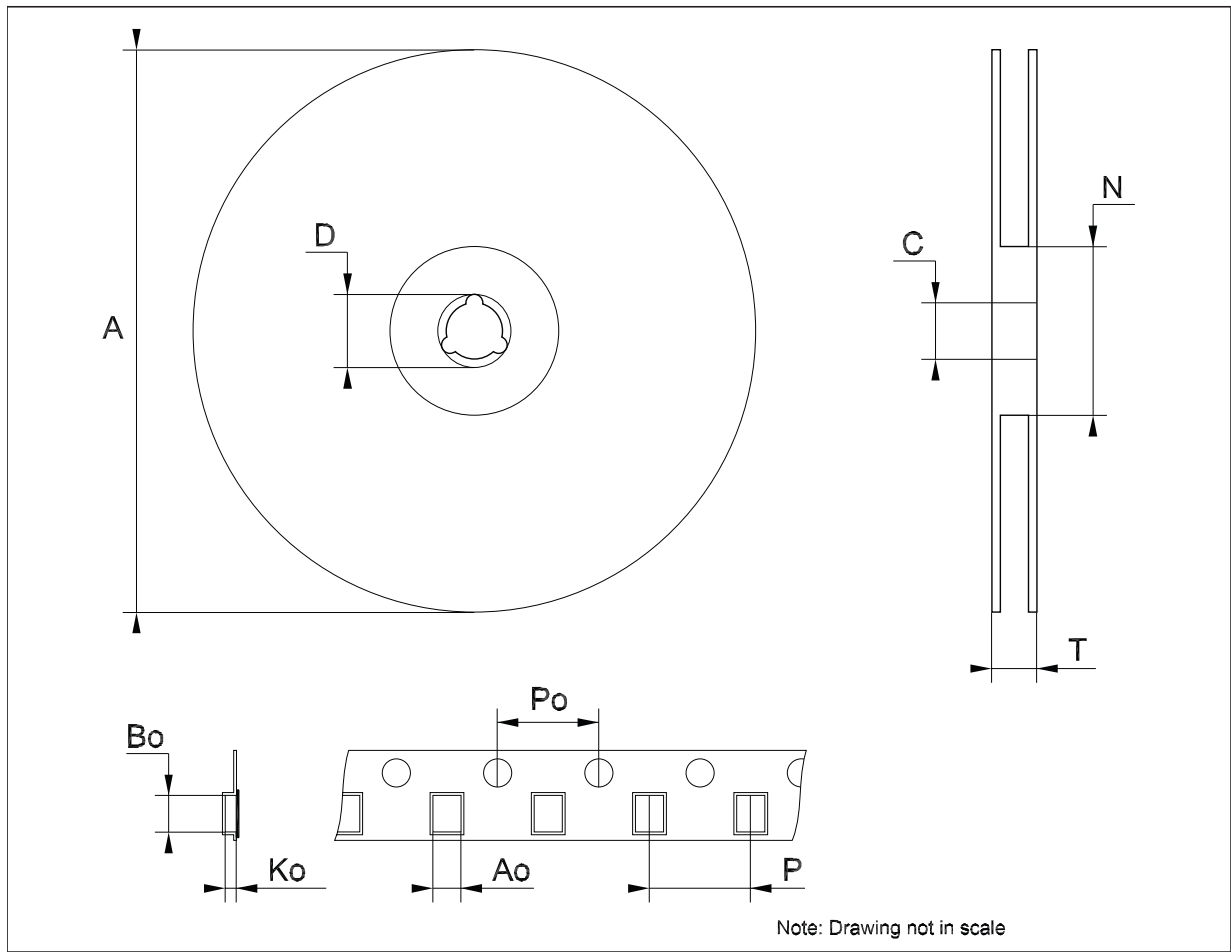
Dim.	mm.		
	Min.	Typ.	Max.
A	0.80		1.10
A1	0		0.10
A2	0.80	0.90	1
b	0.15		0.30
c	0.10		0.22
D	1.80	2	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e		0.65	
e1		1.30	
L	0.26	0.36	0.46
<	0°		8°

Figure 10. SOT323-5L dimensions



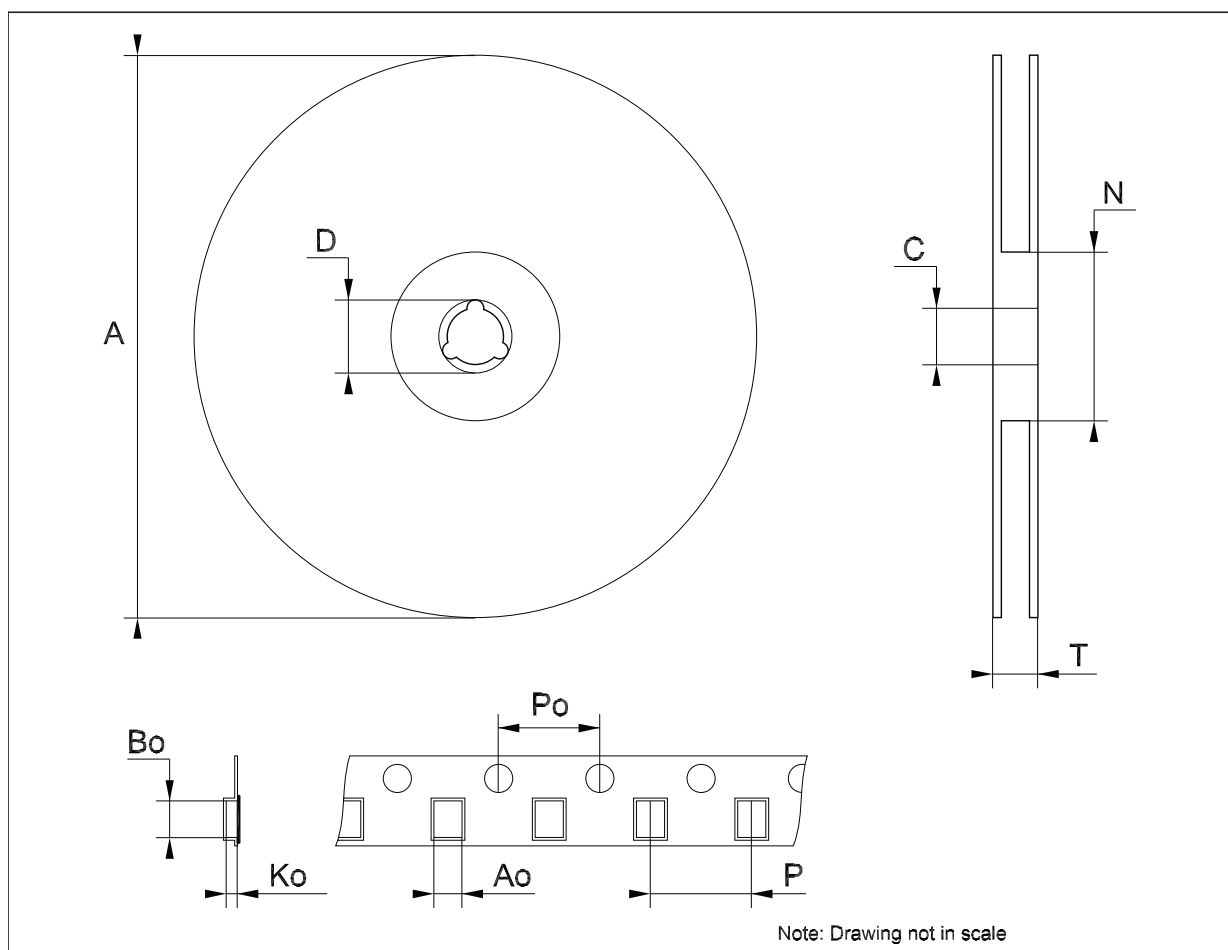
Tape & reel SOT23-xL mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			180			7.086
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			14.4			0.567
Ao	3.13	3.23	3.33	0.123	0.127	0.131
Bo	3.07	3.17	3.27	0.120	0.124	0.128
Ko	1.27	1.37	1.47	0.050	0.054	0.058
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	3.9	4.0	4.1	0.153	0.157	0.161



Tape & reel SOT323-xL mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	175	180	185	6.889	7.086	7.283
C	12.8	13	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	59.5	60	60.5		2.362	
T			14.4			0.567
Ao		2.25			0.088	
Bo		2.7			0.106	
Ko		1.2			0.047	
Po	3.9	4	4.1	0.153	0.157	0.161
P	3.8	4	4.2	0.149	0.157	0.165



6 Order codes

Table 7. 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

7 Revision history

Table 8. Document revision history

Date	Revision	Changes
09-May-2011	1	Initial release.
05-Dec-2011	2	Changed maturity code and updated Table 7 on page 14 .
25-Jul-2012	3	Added: marking order codes Table 7 on page 14 .

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