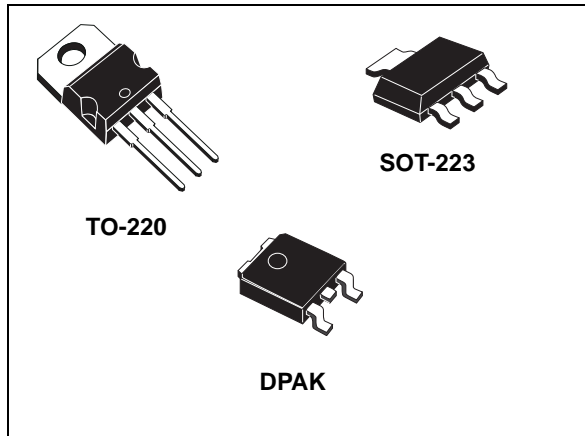


## Low drop fixed and adjustable positive voltage regulators

Datasheet - production data



- Available in  $\pm 2\%$  (at 25 °C) and 4% in full temperature range
- High supply voltage rejection:
  - 80 dB typ. (at 25 °C)
- Temperature range: 0 °C to 125 °C

### Description

The LD1117A is a low drop voltage regulator able to provide up to 1 A of output current, available also in adjustable versions ( $V_{REF} = 1.25$  V). In fixed versions, the following output voltages are offered: 1.2 V, 1.8 V, and 3.3 V. The device is supplied in: SOT-223, DPAK and TO-220. Surface mounted packages optimize the thermal characteristics while offering a relevant space saving advantage. High efficiency is assured by an NPN pass transistor. Only a very common 10  $\mu$ F minimum capacitor is needed for stability. Chip trimming allows the regulator to reach a very tight output voltage tolerance, within  $\pm 2\%$  at 25 °C.

### Features

- Low dropout voltage:
  - 1.15 V typ. @  $I_{OUT} = 1$  A, 25 °C
- Very low quiescent current:
  - 5 mA typ. @ 25 °C
- Output current up to 1 A
- Fixed output voltage of:
  - 1.2 V, 1.8 V, 3.3 V
- Adjustable version availability ( $V_{REF} = 1.25$  V)
- Internal current and thermal limit
- Only 10  $\mu$ F for stability

Table 1. Device summary

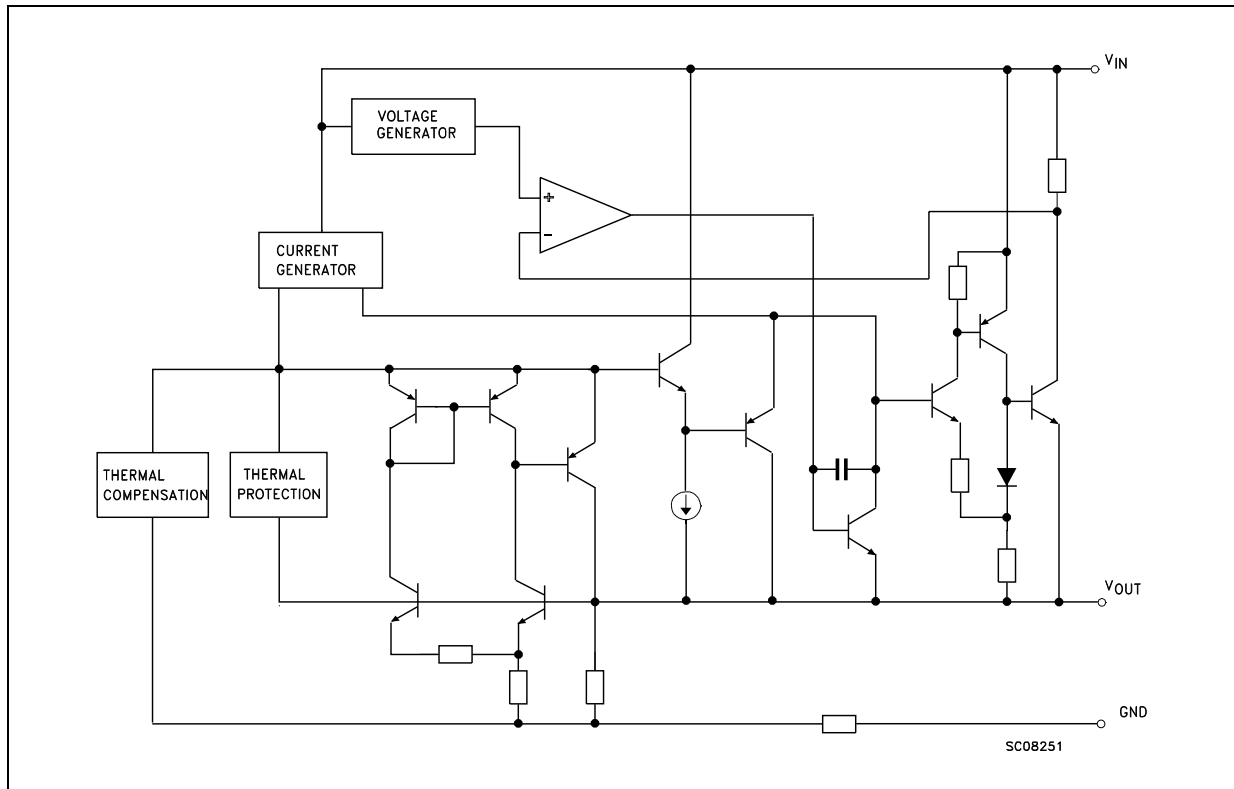
Order codes			Output voltage
SOT-223	DPAK	TO-220	
LD1117AS12TR	LD1117ADT12TR		1.2 V
LD1117AS18TR	LD1117ADT18TR		1.8 V
LD1117AS33TR	LD1117ADT33TR	LD1117AV33	3.3 V
LD1117ASTR	LD1117ADT-TR		Adjustable from 1.25 V

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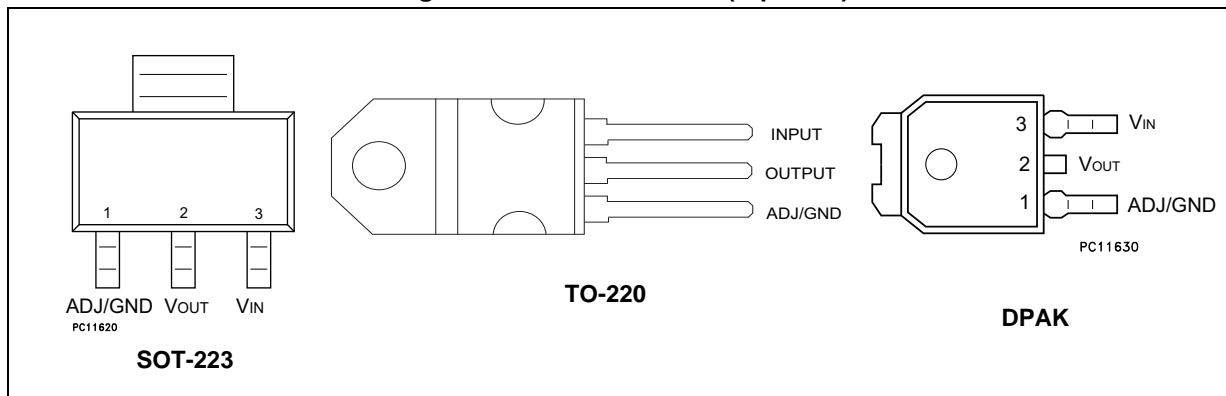


# 1 Diagram

**Figure 1. Block diagram**

## 2 Pin configuration

Figure 2. Pin connections (top view)



Note: The TAB is connected to the V<sub>OUT</sub>.

### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{IN}$	DC input voltage	15	V
$P_D$	Power dissipation	12	W
$T_{STG}$	Storage temperature range	-40 to +150	°C
$T_{OP}$	Operating junction temperature range	0 to +125	°C

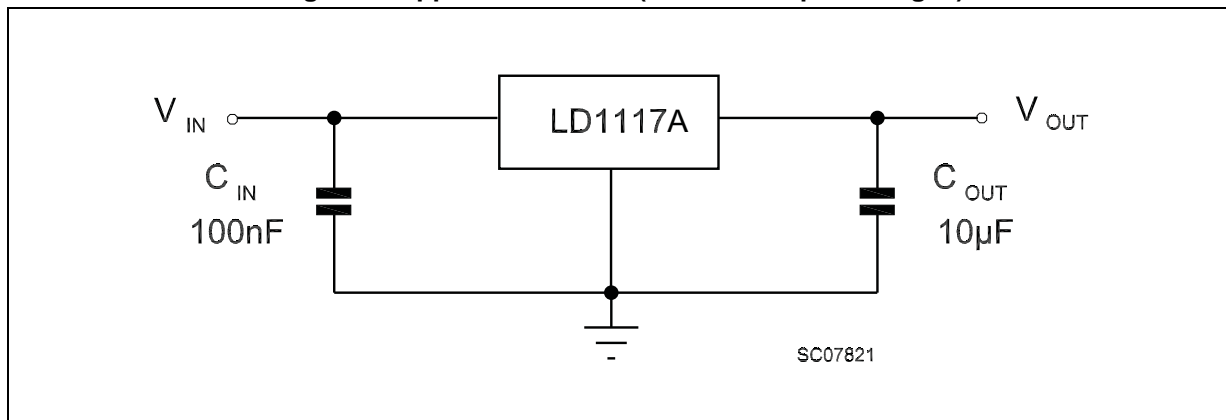
*Note:* Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. Beyond the above suggested max. power dissipation, a short-circuit may permanently damage the device.

**Table 3. Thermal data**

Symbol	Parameter	SOT-223	DPAK	TO-220	Unit
$R_{thJC}$	Thermal resistance junction-case	15	8	5	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	110	100	50	°C/W

## 4 Schematic application

Figure 3. Application circuit (for fixed output voltages)



## 5 Electrical characteristics

Refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $C_O = 10$   $\mu$ F,  $C_I = 10$   $\mu$ F,  $R = 120$   $\Omega$  between OUT-GND, unless otherwise specified.

**Table 4. Electrical characteristics of LD1117A#12**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$V_I = 5.3$ V, $I_O = 10$ mA, $T_J = 25$ °C	1.176	1.2	1.224	V
$V_O$	Output voltage	$I_O = 0$ to $1$ A, $V_I = 2.75$ to $10$ V	1.152	1.2	1.248	V
$\Delta V_O$	Line regulation	$V_I = 2.75$ to $8$ V, $I_O = 0$ mA		1	6	mV
$\Delta V_O$	Load regulation	$V_I = 2.75$ V, $I_O = 0$ to $1$ A		1	10	mV
$\Delta V_O$	Temperature stability			0.5		%
$\Delta V_O$	Long term stability	1000 hrs, $T_J = 125$ °C		0.3		%
$V_I$	Operating input voltage	$I_O = 100$ mA			10	V
$I_d$	Quiescent current	$V_I \leq 8$ V, $I_O = 0$ mA		5	10	mA
$I_O$	Output current	$V_I - V_O = 5$ V, $T_J = 25$ °C	1000	1200		mA
eN	Output noise voltage	$B = 10$ Hz to $10$ kHz, $T_J = 25$ °C		100		$\mu$ V
SVR	Supply voltage rejection	$I_O = 40$ mA, $f = 120$ Hz $V_I - V_O = 3$ V, $V_{ripple} = 1$ V <sub>PP</sub>	60	80		dB
$V_D$	Dropout voltage	$I_O = 100$ mA		1	1.10	V
		$I_O = 500$ mA		1.05	1.15	
		$I_O = 1$ A		1.15	1.30	
$\Delta V_{O(pwr)}$	Thermal regulation	$T_a = 25$ °C, 30 ms pulse		0.08	0.2	%/W

Refer to the test circuits,  $T_J = 0$  to  $125$  °C,  $C_O = 10$   $\mu$ F,  $C_I = 10$   $\mu$ F, unless otherwise specified.

**Table 5. Electrical characteristics of LD1117A#18**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$V_I = 3.8$ V, $I_O = 10$ mA, $T_J = 25$ °C	1.764	1.8	1.836	V
$V_O$	Output voltage	$I_O = 0$ to $1$ A, $V_I = 3.3$ to $8$ V	1.728		1.872	V
$\Delta V_O$	Line regulation	$V_I = 3.3$ to $8$ V, $I_O = 0$ mA		1	6	mV
$\Delta V_O$	Load regulation	$V_I = 3.3$ V, $I_O = 0$ to $1$ A		1	10	mV
$\Delta V_O$	Temperature stability			0.5		%
$\Delta V_O$	Long term stability	1000 hrs, $T_J = 125$ °C		0.3		%
$V_I$	Operating input voltage	$I_O = 100$ mA			10	V
$I_d$	Quiescent current	$V_I \leq 8$ V, $I_O = 0$ mA		5	10	mA
$I_O$	Output current	$V_I - V_O = 5$ V, $T_J = 25$ °C	1000			mA

**Table 5. Electrical characteristics of LD1117A#18 (continued)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
eN	Output noise voltage	B = 10 Hz to 10 kHz, T <sub>J</sub> = 25 °C		100		μV
SVR	Supply voltage rejection	I <sub>O</sub> = 40 mA, f = 120 Hz V <sub>I</sub> - V <sub>O</sub> = 3 V, V <sub>ripple</sub> = 1 V <sub>PP</sub>	60	80		dB
V <sub>D</sub>	Dropout voltage	I <sub>O</sub> = 100 mA		1	1.10	V
		I <sub>O</sub> = 500 mA		1.05	1.15	
		I <sub>O</sub> = 1 A		1.15	1.30	
ΔV <sub>O(pwr)</sub>	Thermal regulation	T <sub>a</sub> = 25 °C, 30 ms pulse		0.08	0.2	%/W

Refer to the test circuits, T<sub>J</sub> = 0 to 125 °C, C<sub>O</sub> = 10 μF, C<sub>I</sub> = 10 μF, unless otherwise specified.

**Table 6. Electrical characteristics of LD1117A#33**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>O</sub>	Output voltage	V <sub>I</sub> = 5.3 V, I <sub>O</sub> = 10 mA, T <sub>J</sub> = 25 °C	3.234	3.3	3.366	V
V <sub>O</sub>	Output voltage	I <sub>O</sub> = 0 to 1 A, V <sub>I</sub> = 4.75 to 10 V	3.168		3.432	V
ΔV <sub>O</sub>	Line regulation	V <sub>I</sub> = 4.75 to 8 V, I <sub>O</sub> = 0 mA		1	6	mV
ΔV <sub>O</sub>	Load regulation	V <sub>I</sub> = 4.75 V, I <sub>O</sub> = 0 to 1 A		1	10	mV
ΔV <sub>O</sub>	Temperature stability			0.5		%
ΔV <sub>O</sub>	Long term stability	1000 hrs, T <sub>J</sub> = 125 °C		0.3		%
V <sub>I</sub>	Operating input voltage	I <sub>O</sub> = 100 mA			10	V
I <sub>d</sub>	Quiescent current	V <sub>I</sub> ≤ 10 V, I <sub>O</sub> = 0 mA		5	10	mA
I <sub>O</sub>	Output current	V <sub>I</sub> - V <sub>O</sub> = 5 V, T <sub>J</sub> = 25 °C	1000	1200		mA
eN	Output noise voltage	B = 10 Hz to 10 kHz, T <sub>J</sub> = 25 °C		100		μV
SVR	Supply voltage rejection	I <sub>O</sub> = 40 mA, f = 120 Hz V <sub>I</sub> - V <sub>O</sub> = 3 V, V <sub>ripple</sub> = 1 V <sub>PP</sub>	60	75		dB
V <sub>D</sub>	Dropout voltage	I <sub>O</sub> = 100 mA		1	1.10	V
		I <sub>O</sub> = 500 mA		1.05	1.15	
		I <sub>O</sub> = 1 A		1.15	1.30	
ΔV <sub>O(pwr)</sub>	Thermal regulation	T <sub>a</sub> = 25 °C, 30 ms pulse		0.08	0.2	%/W

Refer to the test circuits, T<sub>J</sub> = 0 to 125 °C, C<sub>O</sub> = 10 μF, C<sub>I</sub> = 10 μF, unless otherwise specified.

**Table 7. Electrical characteristics of LD1117A (adjustable)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>REF</sub>	Reference voltage	V <sub>I</sub> = 5.3 V, I <sub>O</sub> = 10 mA, T <sub>J</sub> = 25 °C	1.225	1.25	1.275	V
V <sub>REF</sub>	Reference voltage	I <sub>O</sub> = 10 mA to 1 A, V <sub>I</sub> = 2.75 to 10 V	1.2		1.3	V
ΔV <sub>O</sub>	Line regulation	V <sub>I</sub> = 2.75 to 8 V, I <sub>O</sub> = 0 mA		1	6	mV





Table 7. Electrical characteristics of LD1117A (adjustable) (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$\Delta V_O$	Load regulation	$V_I = 2.75 \text{ V}$ , $I_O = 0 \text{ to } 1 \text{ A}$		1	10	mV
$\Delta V_O$	Temperature stability			0.5		%
$\Delta V_O$	Long term stability	1000 hrs, $T_J = 125 \text{ }^\circ\text{C}$		0.3		%
$V_I$	Operating input voltage	$I_O = 100 \text{ mA}$			10	V
$I_{\text{adj}}$	Adjustment pin current	$V_{\text{in}} \leq 10 \text{ V}$		60	120	$\mu\text{A}$
$\Delta I_{\text{adj}}$	Adjustment pin current change	$V_{\text{in}} - V_O = 1.4 \text{ to } 10 \text{ V}$ , $I_O = 10 \text{ mA to } 1 \text{ A}$		1	5	$\mu\text{A}$
$I_{O(\text{min})}$	Minimum load current	$V_{\text{in}} = 10 \text{ V}$		2	5	mA
$I_O$	Output current	$V_I - V_O = 5 \text{ V}$ , $T_J = 25 \text{ }^\circ\text{C}$	1000	1200		mA
eN	Output noise voltage	$B = 10 \text{ Hz to } 10 \text{ kHz}$ , $T_J = 25 \text{ }^\circ\text{C}$		100		$\mu\text{V}$
SVR	Supply voltage rejection	$I_O = 40 \text{ mA}$ , $f = 120 \text{ Hz}$ $V_I - V_O = 3 \text{ V}$ , $V_{\text{ripple}} = 1 \text{ V}_{\text{PP}}$	60	80		dB
$V_D$	Dropout voltage	$I_O = 100 \text{ mA}$		1	1.10	V
		$I_O = 500 \text{ mA}$		1.05	1.15	
		$I_O = 1 \text{ A}$		1.15	1.30	
$\Delta V_{O(\text{pwr})}$	Thermal regulation	$T_a = 25 \text{ }^\circ\text{C}$ , 30 ms pulse		0.08	0.2	%/W

# 6 Typical application

Figure 4. Negative supply

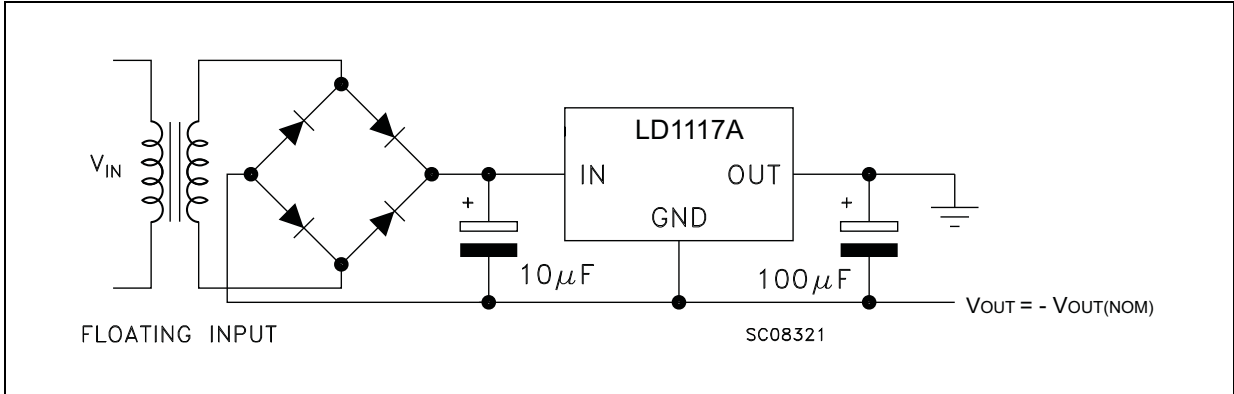


Figure 5. Circuit for increasing output voltage

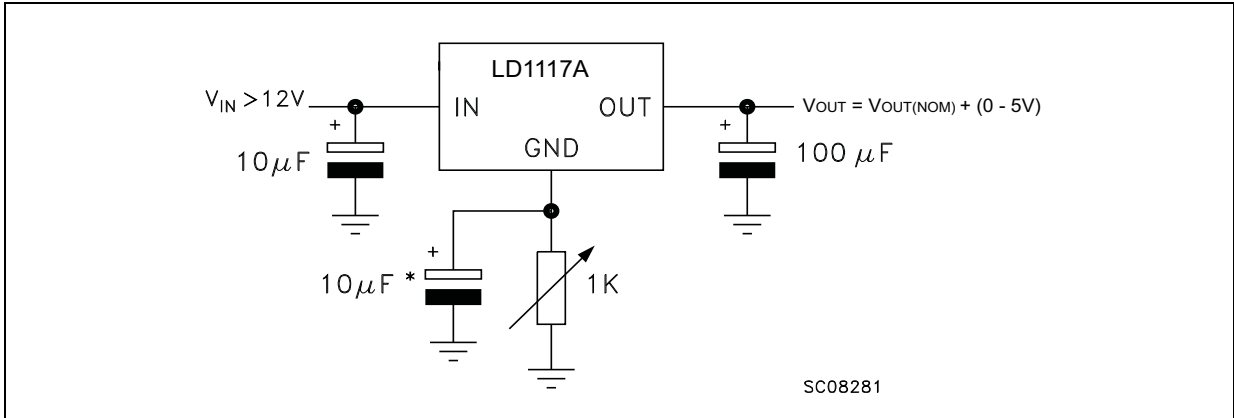


Figure 6. Voltage regulator with reference

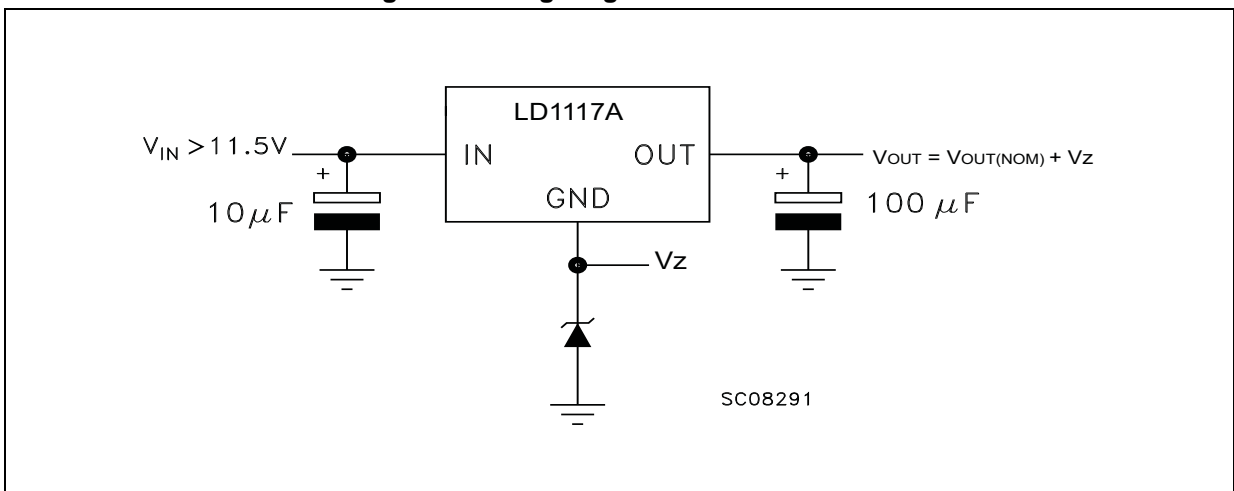
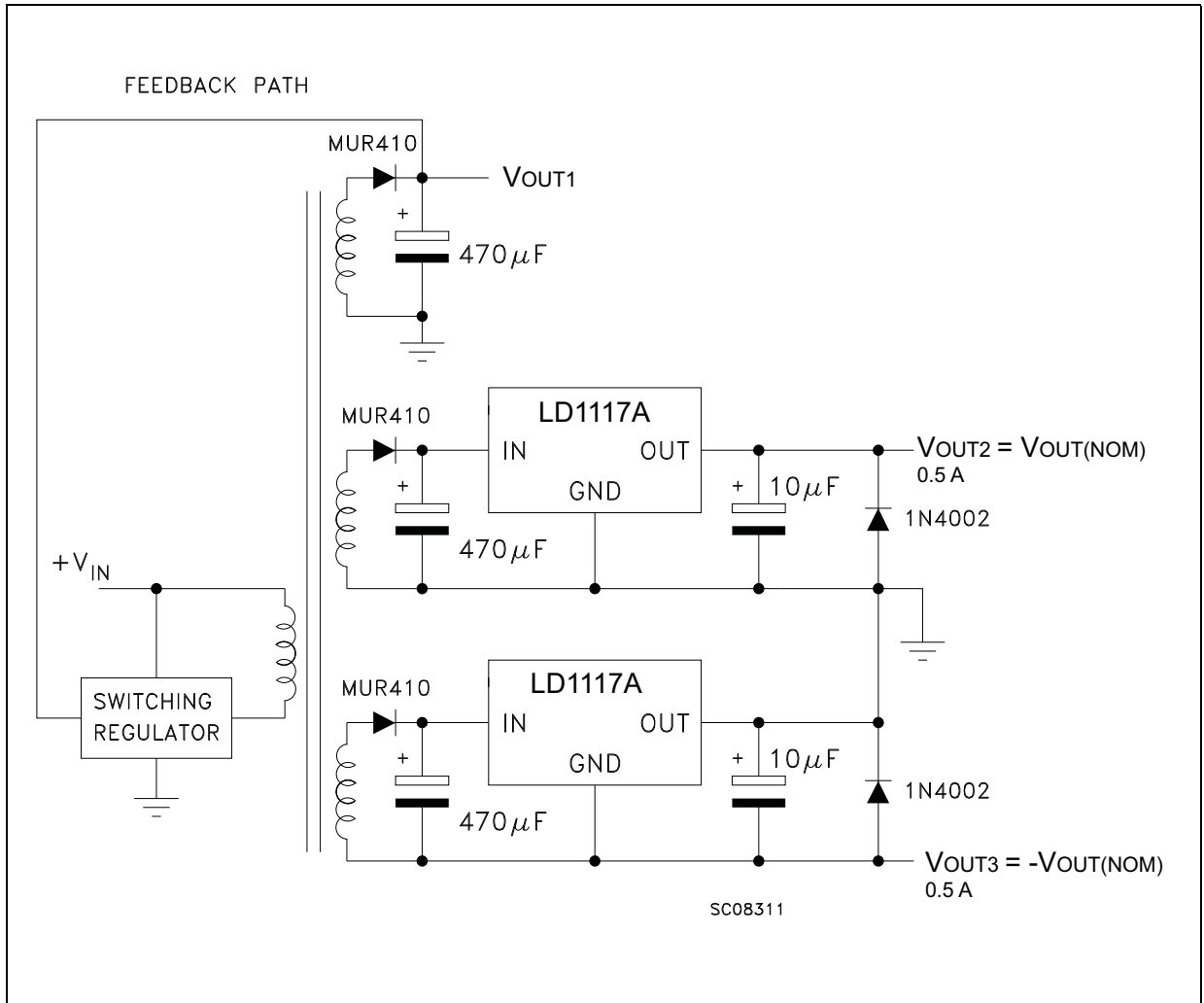


Figure 7. Post-regulated dual supply



## 7 LD1117A adjustable: application note

The LD1117A adjustable has a thermal stabilized  $1.25 \pm 0.012$  V reference voltage between the OUT and ADJ pins.  $I_{ADJ}$  is 60  $\mu$ A typ. (120  $\mu$ A max.) and  $\Delta I_{ADJ}$  is 1  $\mu$ A typ. (5  $\mu$ A max.).

$R_1$  is normally fixed to 120  $\Omega$ . From *Figure 6* the following is obtained:

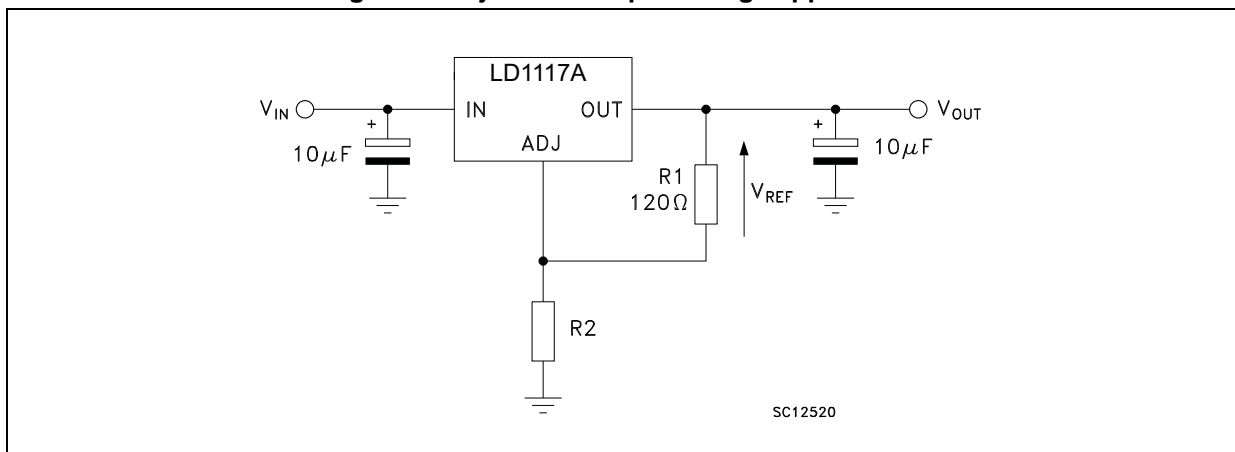
$$V_{OUT} = V_{REF} + R_2 (I_{ADJ} + I_{R1}) = V_{REF} + R_2 (I_{ADJ} + V_{REF} / R_1) = V_{REF} (1 + R_2 / R_1) + R_2 \times I_{ADJ}$$

In normal applications the  $R_2$  value is in the range of a few k $\Omega$ , so the  $R_2 \times I_{ADJ}$  product can not be considered in the  $V_{OUT}$  calculation; the above expression then becomes:

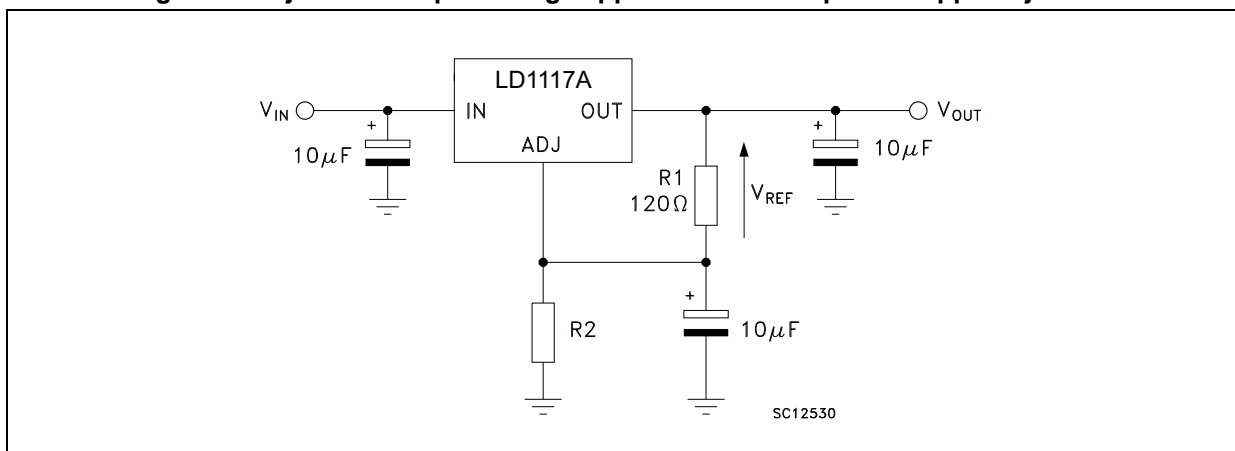
$$V_{OUT} = V_{REF} (1 + R_2 / R_1)$$

In order to have a better load regulation it is important to realize a good Kelvin connection of  $R_1$  and  $R_2$  resistors. In particular, the  $R_1$  connection must be realized very close to the OUT and ADJ pins, while the  $R_2$  ground connection must be placed as near as possible to the negative load pin. Ripple rejection can be improved by introducing a 10  $\mu$ F electrolytic capacitor placed in parallel to the  $R_2$  resistor (see *Figure 8*).

**Figure 8. Adjustable output voltage application**



**Figure 9. Adjustable output voltage application with improved ripple rejection**



## 8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Table 8. TO-220 SG (single gauge) mechanical data**

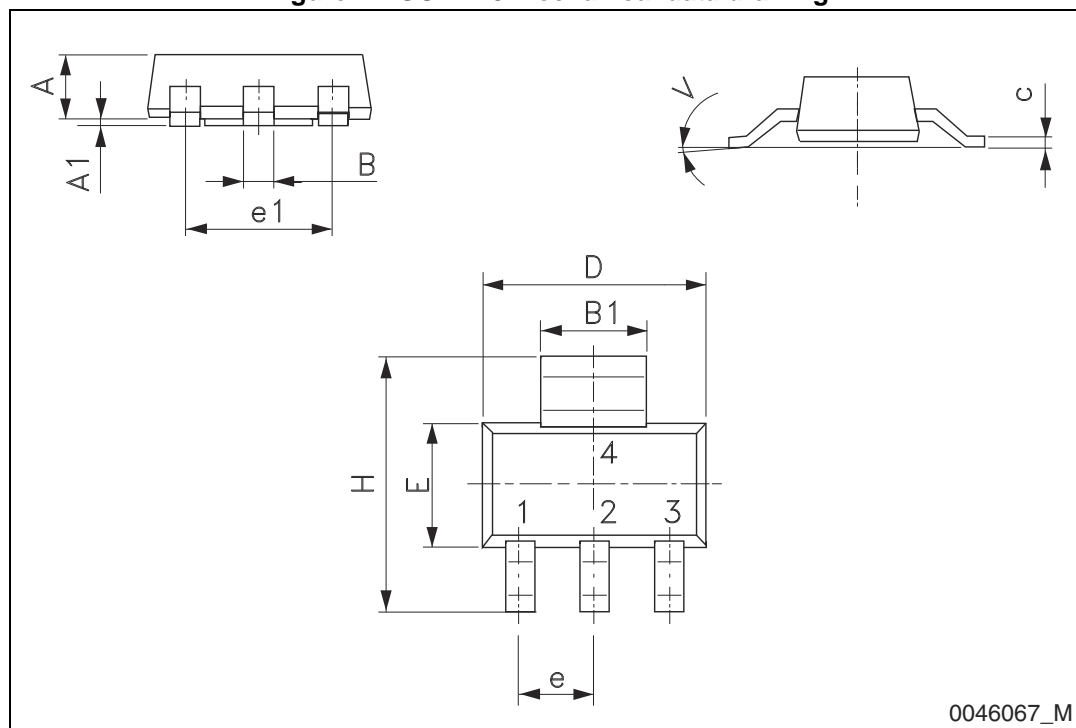
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	0.51		0.60
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95



Table 9. SOT-223 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.80
A1	0.02		0.1
B	0.60	0.70	0.85
B1	2.90	3.00	3.15
c	0.24	0.26	0.35
D	6.30	6.50	6.70
e		2.30	
e1		4.60	
E	3.30	3.50	3.70
H	6.70	7.00	7.30
V			10°

Figure 11. SOT-223 mechanical data drawing



0046067\_M

Table 10. DPAK (TO-252) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°



Figure 12. DPAK (TO-252) drawing

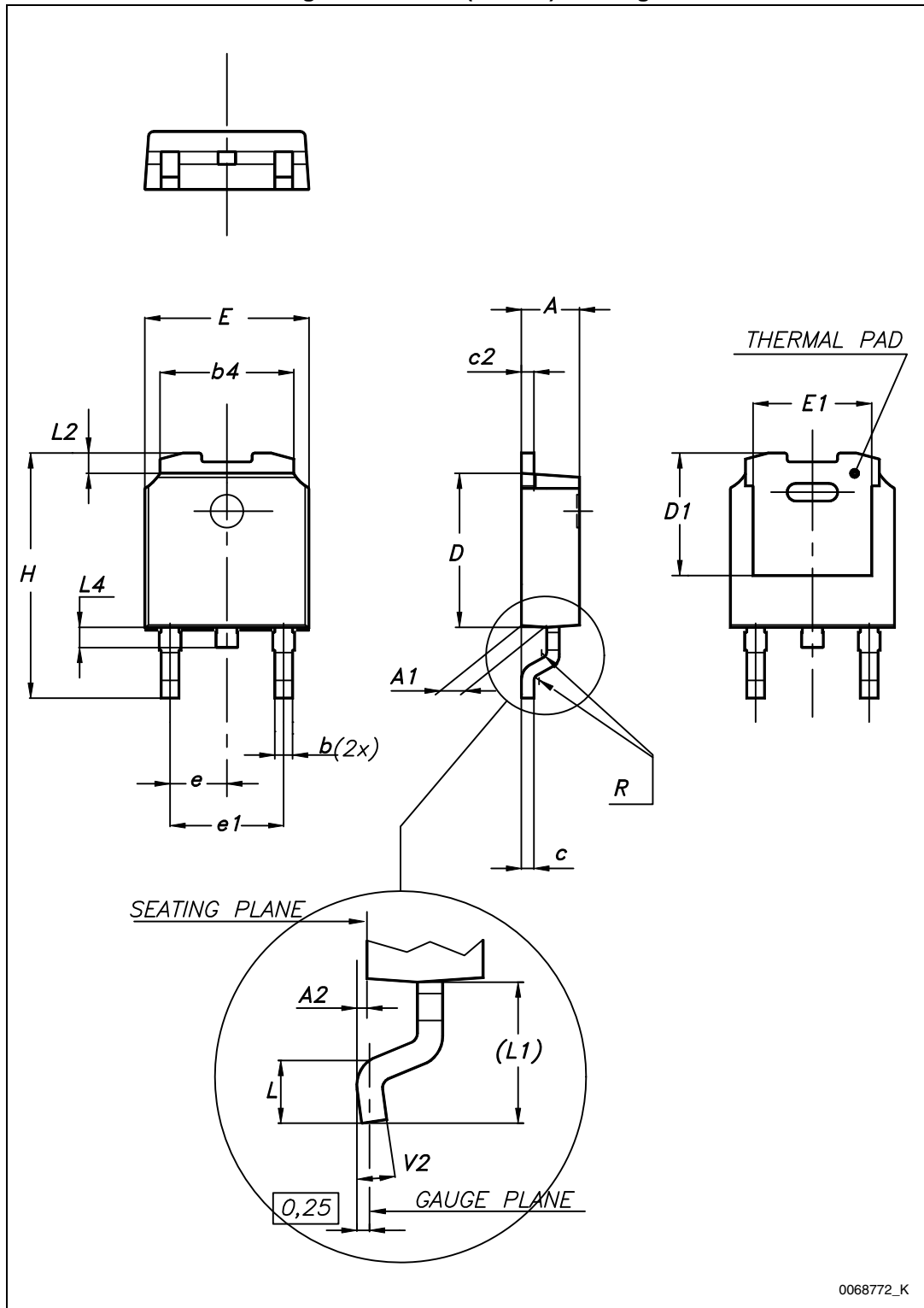
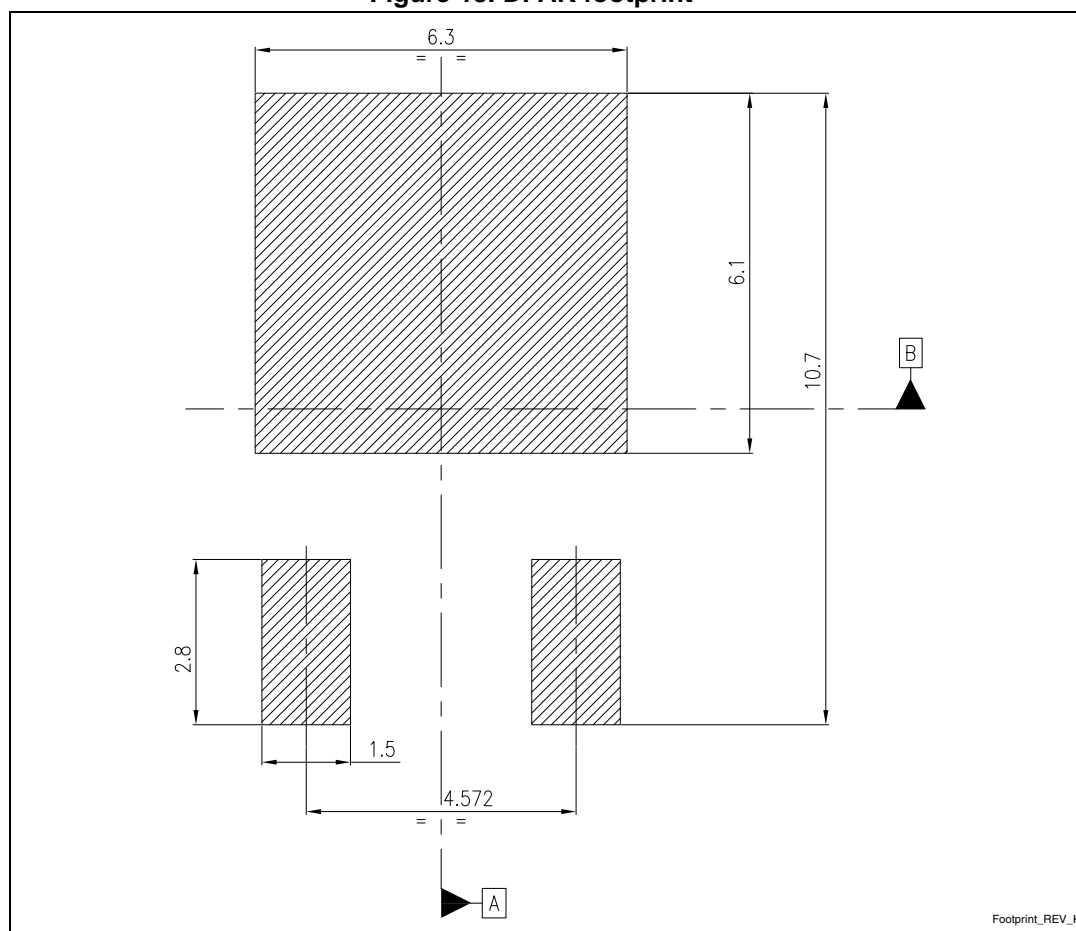


Figure 13. DPAK footprint (a)



a. All dimensions are in millimeters

## 9 Packaging mechanical data

Table 11. SOT-223 tape and reel mechanical data

Tape				Reel		
Dim.	mm			Dim.	mm	
	Min.	Typ.	Max.		Min.	Max.
A0	6.75	6.85	6.95	A		180
B0	7.30	7.40	7.50	N	60	
K0	1.80	1.90	2.00	W1		12.4
F	5.40	5.50	5.60	W2		18.4
E	1.65	1.75	1.85	W3	11.9	15.4
W	11.7	12	12.3			
P2	1.90	2	2.10	Base quantity pcs		1000
P0	3.90	4	4.10	Bulk quantity pcs		1000
P1	7.90	8	8.10			
T	0.25	0.30	0.35			
Df	1.50	1.55	1.60			
D1f	1.50	1.60	1.70			

Figure 14. Tape for SOT-223 (dimensions are in mm)

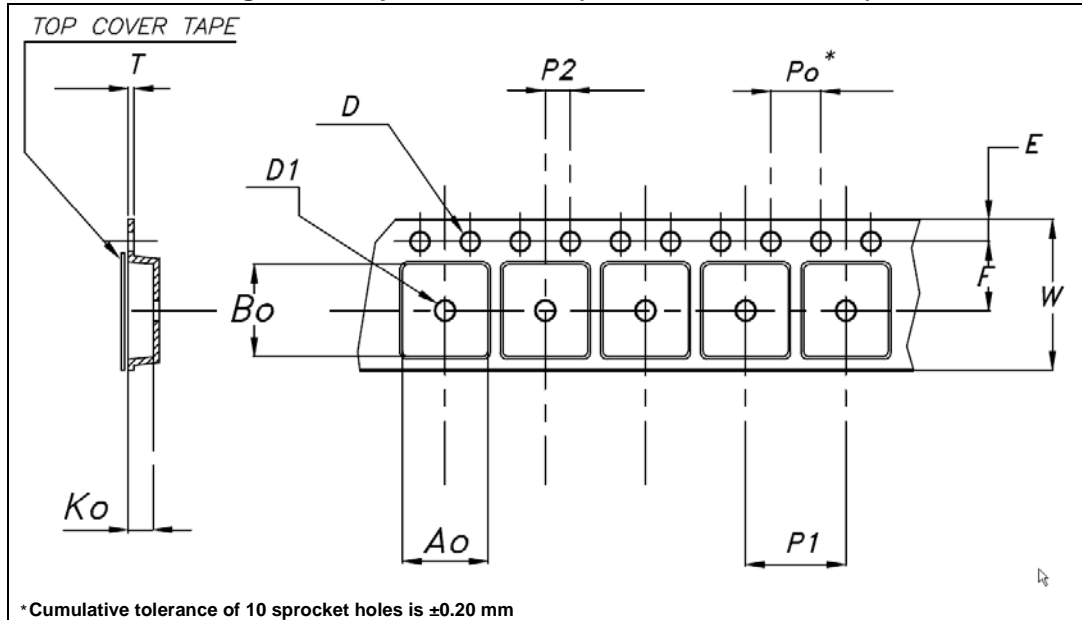


Figure 15. Reel for SOT-223 (dimensions are in mm)

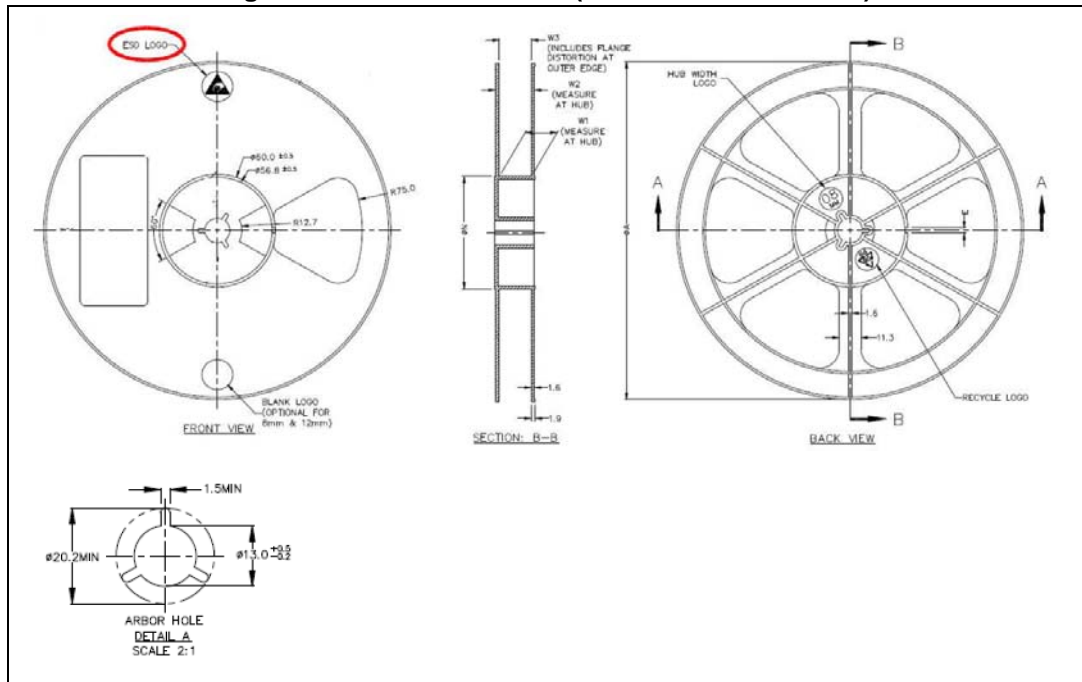


Table 12. DPAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Figure 16. Tape for DPAK

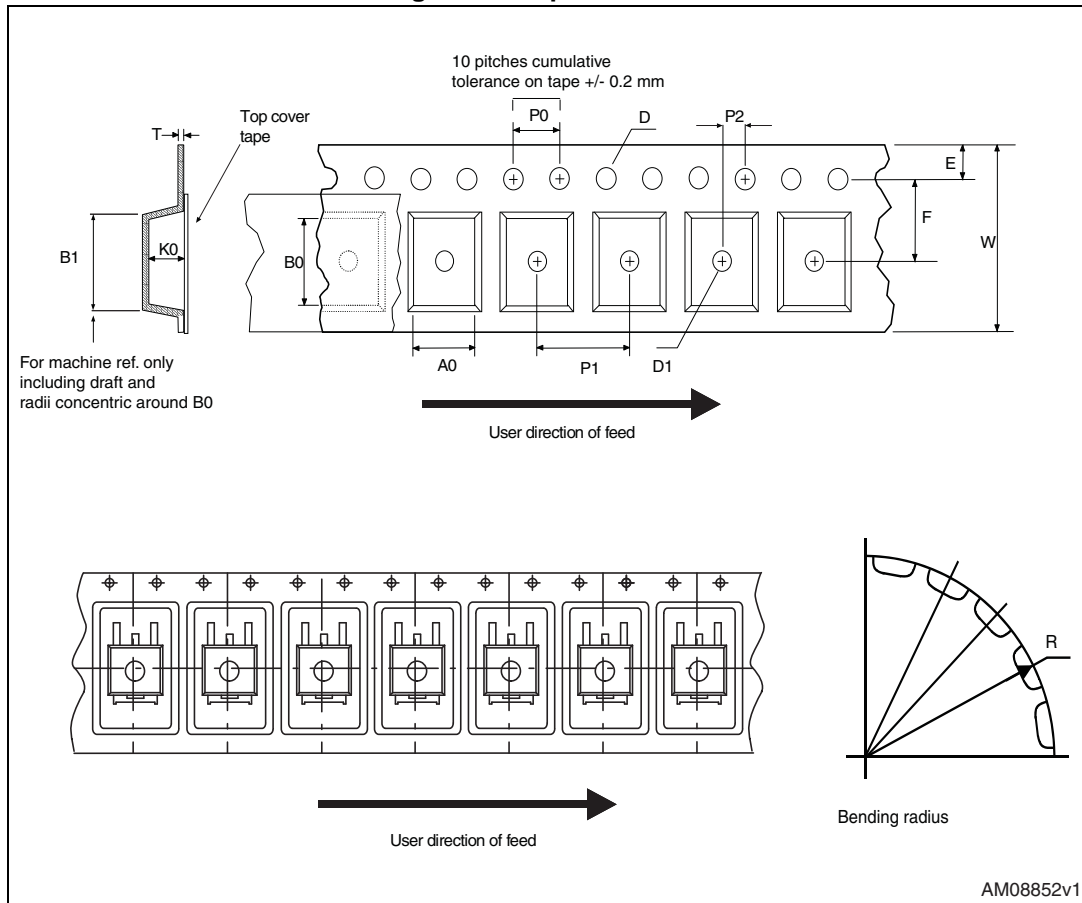
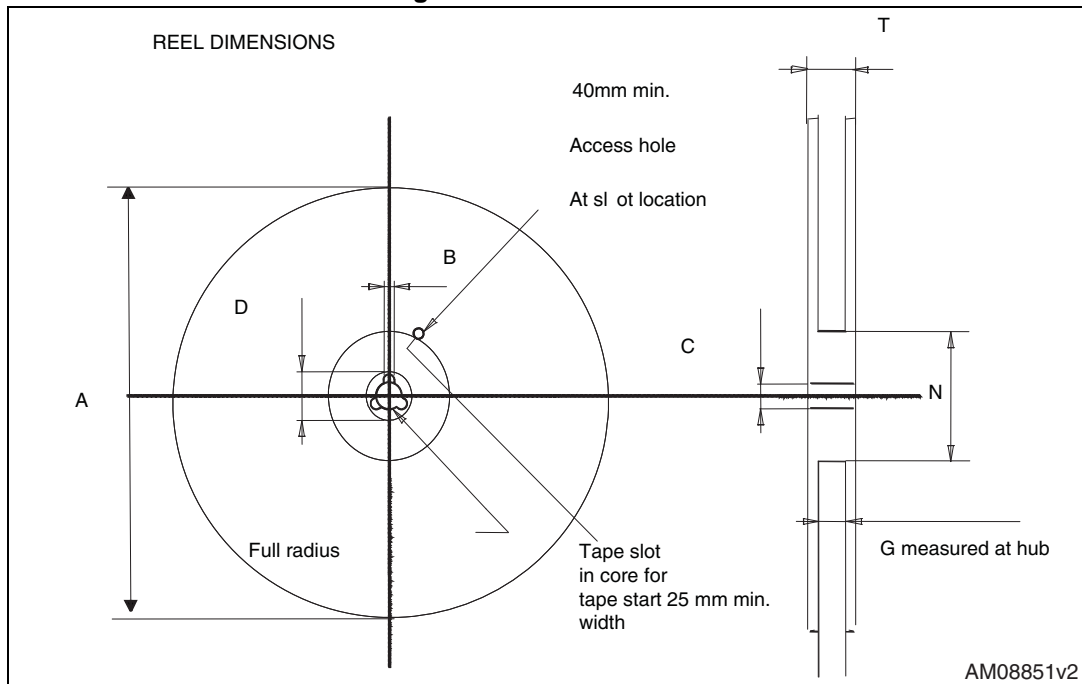


Figure 17. Reel for DPAK



## 10 Revision history

**Table 13. Document revision history**

Date	Revision	Changes
29-Sep-2004	11	Add new part number.
12-Oct-2004	12	Mistake $V_O$ max. - Table 4.
21-Apr-2005	13	Add new package - D <sup>2</sup> PAK/A.
05-Jul-2005	14	The DPAK mechanical data updated.
10-Feb-2006	15	Add new package - D <sup>2</sup> PAK/A (B type).
20-Dec-2006	16	Change value $V_{IN}$ on <a href="#">Table 2</a> .
19-Jan-2007	17	D <sup>2</sup> PAK/A mechanical data updated and add footprint data.
28-May-2007	18	Add $I_{ADJ}$ and $\Delta I_{ADJ}$ values on <a href="#">Table 7</a> .
07-Jun-2007	19	Add $I_{O(min)}$ value on <a href="#">Table 7</a> .
15-Apr-2008	20	Modified: Table 10.
28-Jul-2009	21	Modified: Table 10.
05-Jul-2010	22	Added: <a href="#">Table 8 on page 15</a> , <a href="#">Figure 14 on page 18</a> , <a href="#">Figure 15 on page 20</a> , <a href="#">Figure 16</a> and <a href="#">Figure 17 on page 21</a> .
16-Nov-2010	23	Modified: <a href="#">Table 1 on page 1</a> , $R_{thJC}$ value for TO-220 <a href="#">Table 3 on page 5</a> .
16-Dec-2011	24	Modified: $V_O$ parameter output voltage ==> Reference voltage <a href="#">Table 7 on page 8</a> .
19-Oct-2012	25	Added: $R_{thJA}$ value for DPAK and SOT-223 <a href="#">Table 3 on page 5</a> .
24-Jul-2013	26	Part numbers LD1117AXX12, LD1117AXX18, LD1117AXX33, LD1117AXX changed to LD1117A. Modified <a href="#">Chapter 6: Typical application</a> . Changed $V_O$ symbol in to $V_{REF}$ in <a href="#">Table 7: Electrical characteristics of LD1117A (adjustable)</a> . Updated <a href="#">Chapter 8: Package mechanical data</a> . Added <a href="#">Chapter 9: Packaging mechanical data</a> . Minor text changes.

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