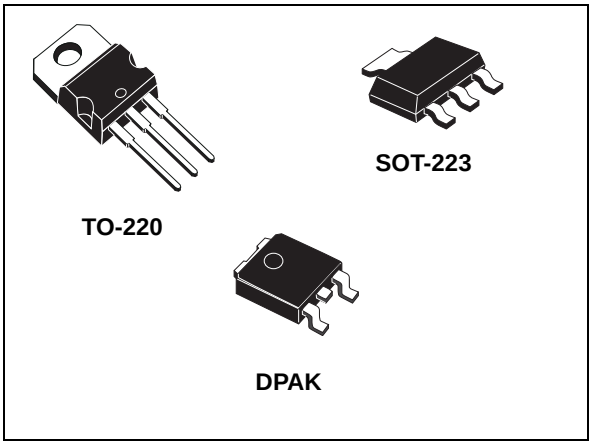
LD1117A

Low drop fixed and adjustable positive voltage regulators

Datasheet - production data



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 µF for stability
- Available in ± 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 µF minimum capacitor is needed for stability. Chip trimming allows the regulator to reach a very tight output voltage tolerance, within ± 2% at 25 °C.

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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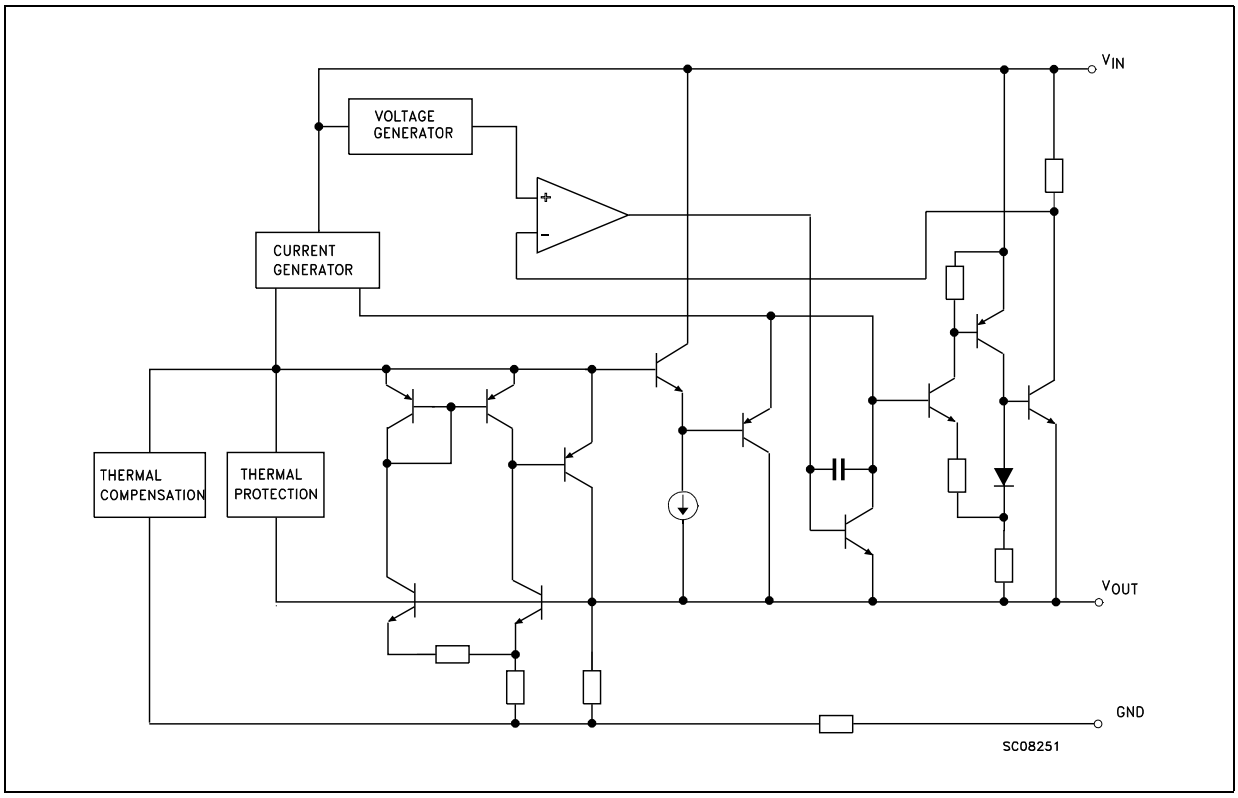
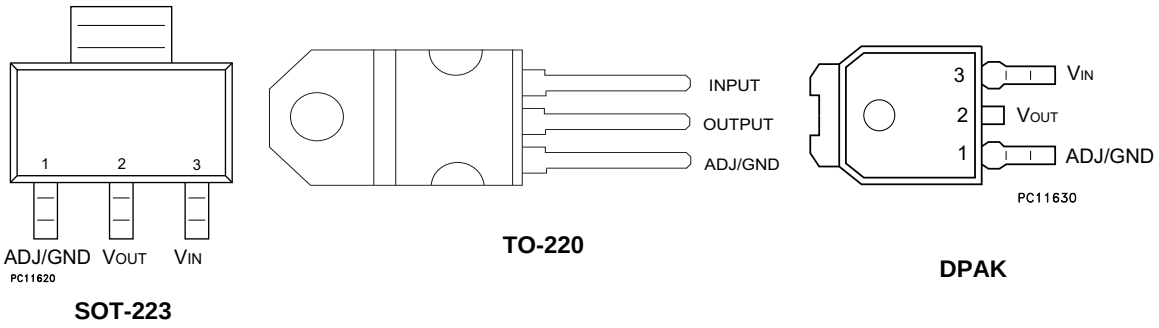
1 Diagram

Figure 1. Block diagram



2 Pin configuration

Figure 2. Pin connections (top view)



Note: The TAB is connected to the V_{OUT}.

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

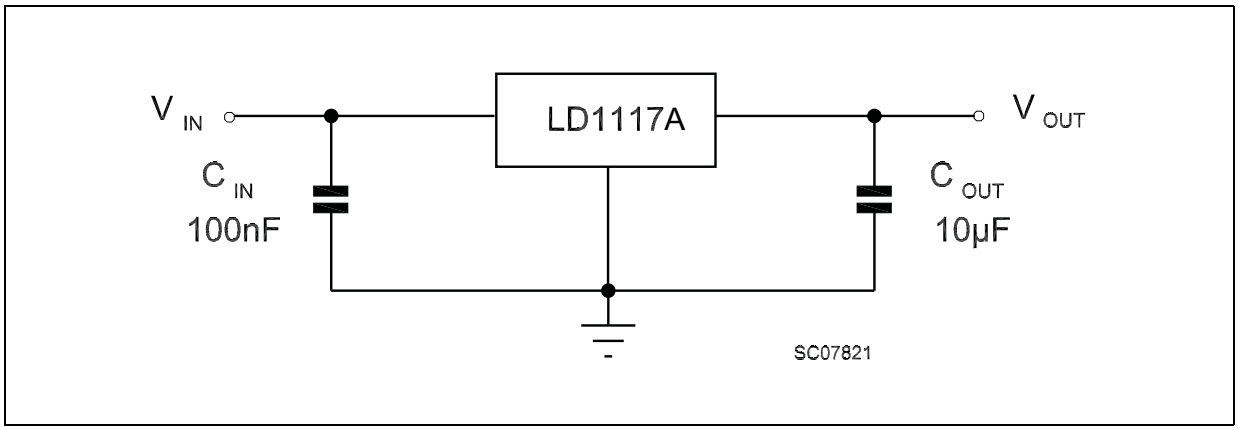
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. Beyond the above suggested max. power dissipation, a short-circuit may permanently damage the device.

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 µF, C_I = 10 µF, R = 120 Ω 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
ΔV_O	Line regulation	V_I = 2.75 to 8 V, I_O = 0 mA		1	6	mV
ΔV_O	Load regulation	V_I = 2.75 V, I_O = 0 to 1 A		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_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		µV
SVR	Supply voltage rejection	I_O = 40 mA, f = 120 Hz $V_I - V_O$ = 3 V, V_{ripple} = 1 V_{PP}	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 µF, C_I = 10 µF, 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
ΔV_O	Line regulation	V_I = 3.3 to 8 V, I_O = 0 mA		1	6	mV
ΔV_O	Load regulation	V_I = 3.3 V, I_O = 0 to 1 A		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_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_J = 25 °C		100		µV
SVR	Supply voltage rejection	I_O = 40 mA, f = 120 Hz V_I - V_O = 3 V, V_{ripple} = 1 V_{PP}	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 µF, C_I = 10 µF, unless otherwise specified.

Table 6. Electrical characteristics of LD1117A#33

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	3.234	3.3	3.366	V
V_O	Output voltage	I_O = 0 to 1 A, V_I = 4.75 to 10 V	3.168		3.432	V
ΔV_O	Line regulation	V_I = 4.75 to 8 V, I_O = 0 mA		1	6	mV
ΔV_O	Load regulation	V_I = 4.75 V, I_O = 0 to 1 A		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_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	$V_I \leq$ 10 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		µV
SVR	Supply voltage rejection	I_O = 40 mA, f = 120 Hz V_I - V_O = 3 V, V_{ripple} = 1 V_{PP}	60	75		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 µF, C_I = 10 µF, unless otherwise specified.

Table 7. Electrical characteristics of LD1117A (adjustable)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{REF}	Reference voltage	V_I = 5.3 V, I_O = 10 mA, T_J = 25 °C	1.225	1.25	1.275	V
V_{REF}	Reference voltage	I_O = 10 mA to 1 A, V_I = 2.75 to 10 V	1.2		1.3	V
ΔV_O	Line regulation	V_I = 2.75 to 8 V, I_O = 0 mA		1	6	mV

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
ΔV_O	Load regulation	V_I = 2.75 V, I_O = 0 to 1 A		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, T_J = 125 °C		0.3		%
V_I	Operating input voltage	I_O = 100 mA			10	V
I_{adj}	Adjustment pin current	$V_{in} \leq$ 10 V		60	120	µA
ΔI_{adj}	Adjustment pin current change	V_{in} - V_O = 1.4 to 10 V, I_O = 10 mA to 1 A		1	5	µA
$I_{O(min)}$	Minimum load current	V_{in} = 10 V		2	5	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		µV
SVR	Supply voltage rejection	I_O = 40 mA, f = 120 Hz V_I - V_O = 3 V, V_{ripple} = 1 V_{PP}	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

6 Typical application

Figure 4. Negative supply

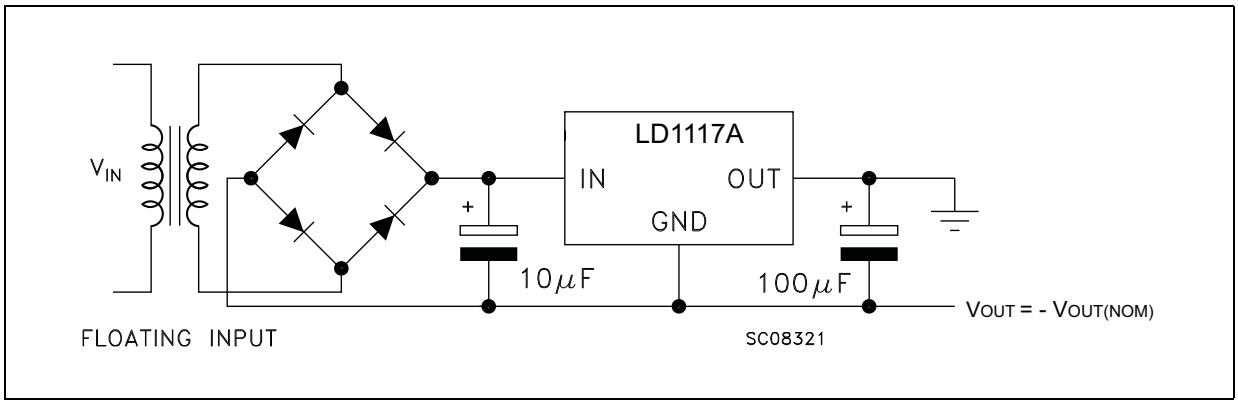


Figure 5. Circuit for increasing output voltage

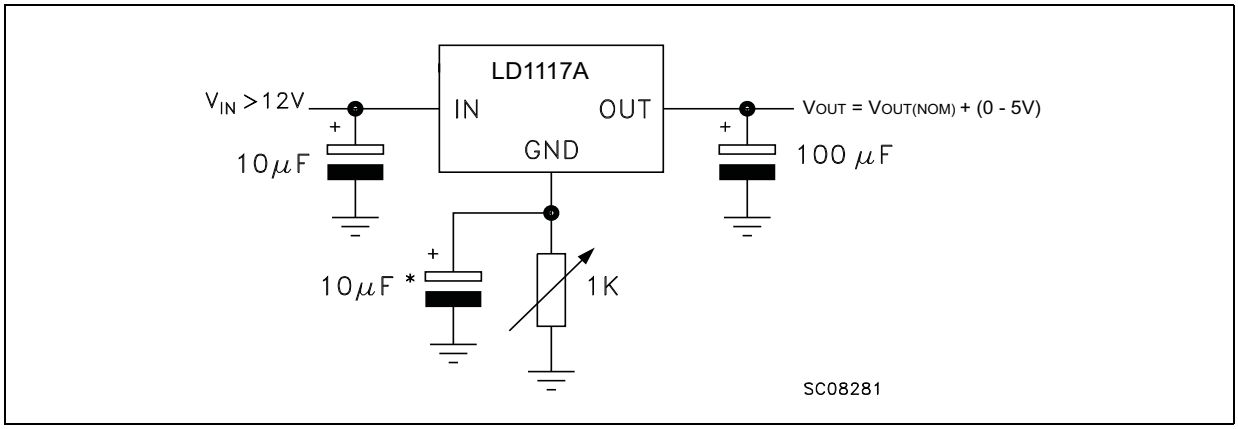


Figure 6. Voltage regulator with reference

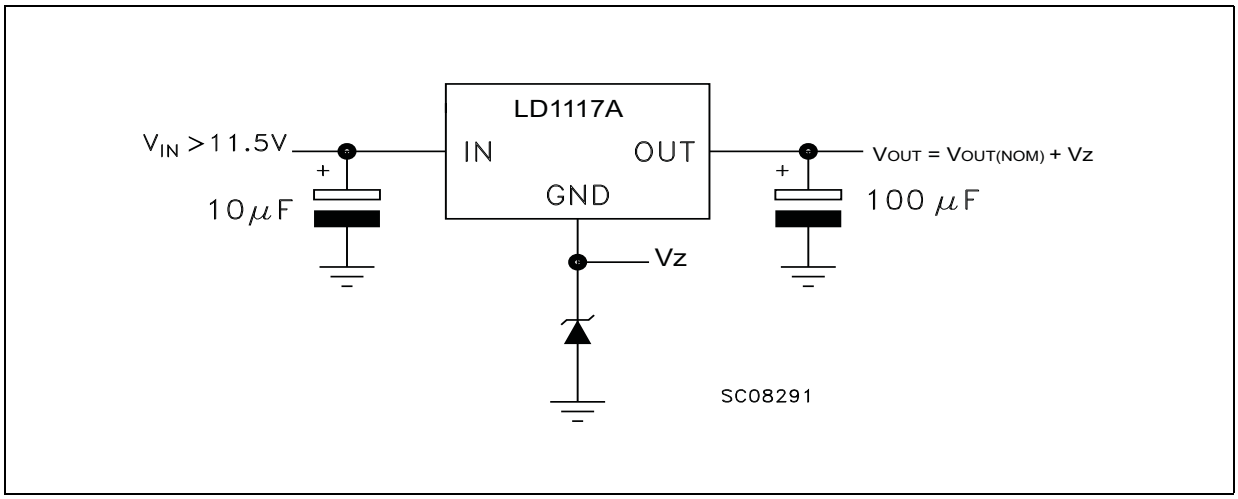
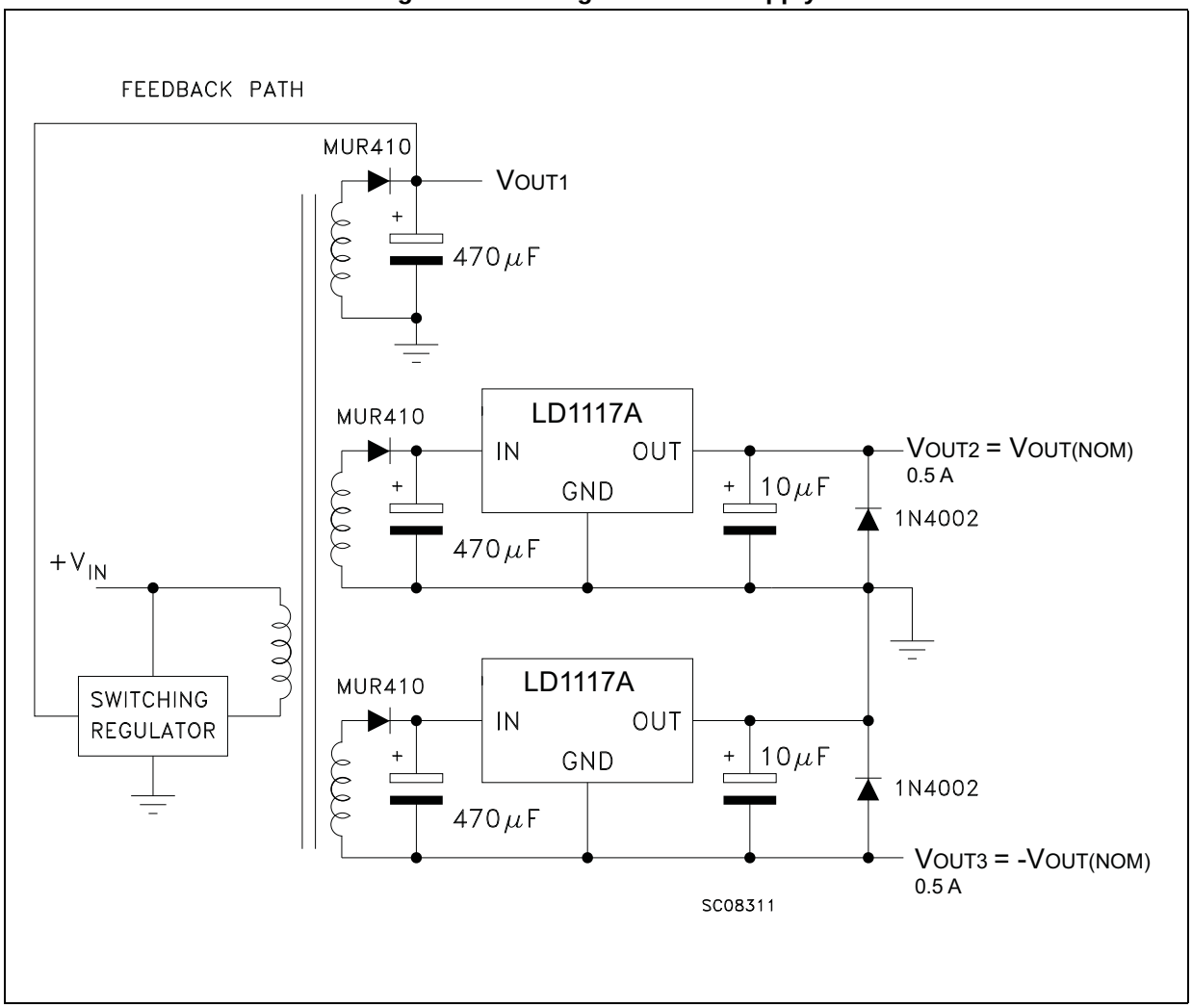


Figure 7. Post-regulated dual supply



7 LD1117A adjustable: application note

The LD1117A adjustable has a thermal stabilized 1.25 ± 0.012 V reference voltage between the OUT and ADJ pins. I_{ADJ} is 60 µA typ. (120 µA max.) and ΔI_{ADJ} is 1 µA typ. (5 µA max.).

R_1 is normally fixed to 120 Ω. 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 kΩ, 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 µF electrolytic capacitor placed in parallel to the R_2 resistor (see *Figure 8*).

Figure 8. Adjustable output voltage application

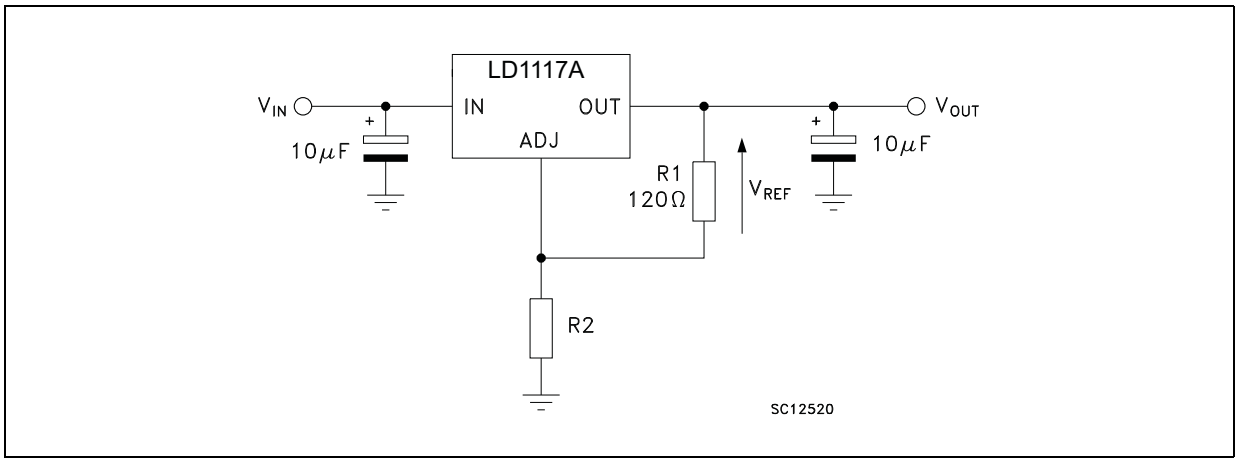
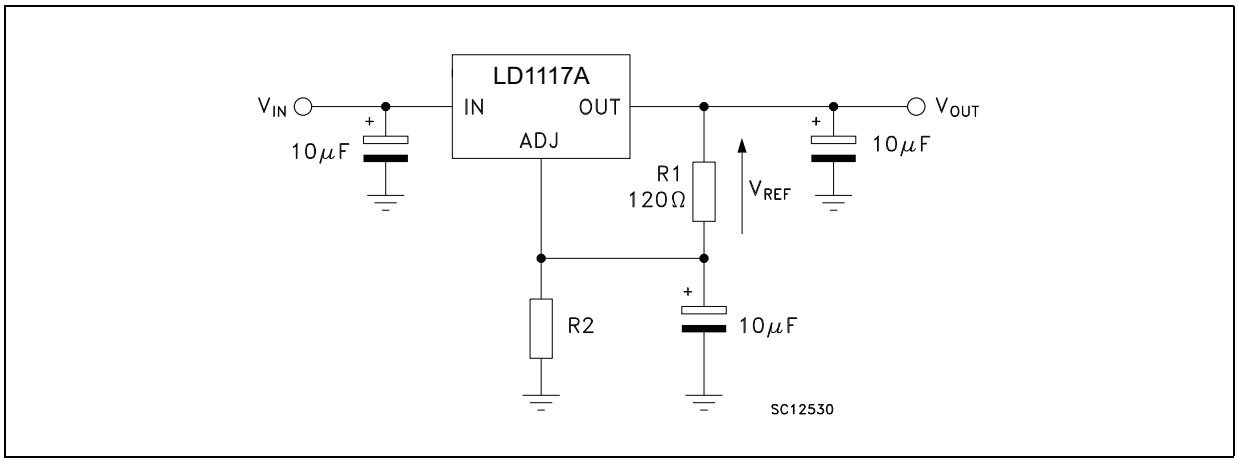


Figure 9. Adjustable output voltage application with improved ripple rejection



8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® 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 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	
∅P	3.75		3.85
Q	2.65		2.95

Figure 10. TO-220 SG (single gauge) drawing

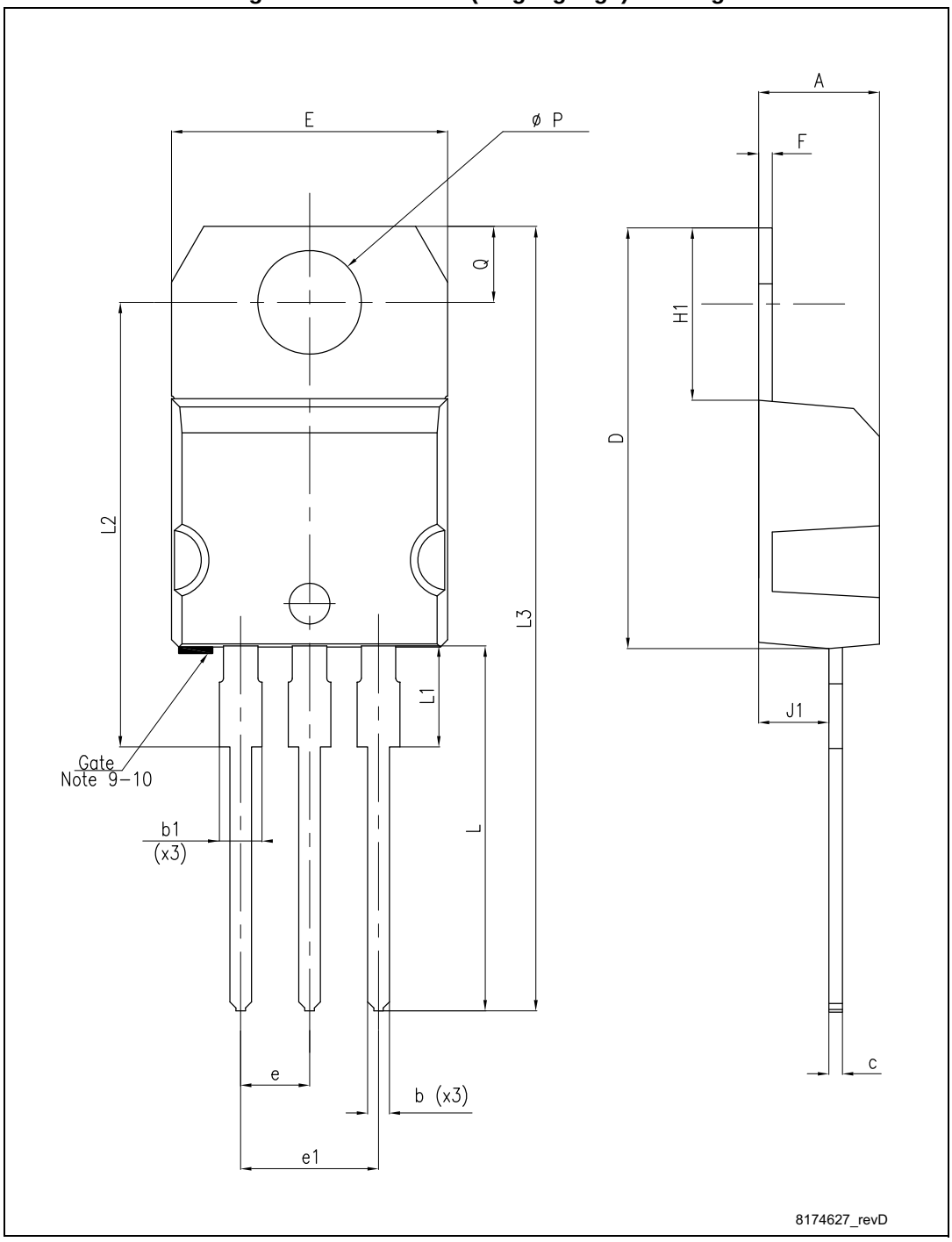


Table 9. SOT-223 mechanical data

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

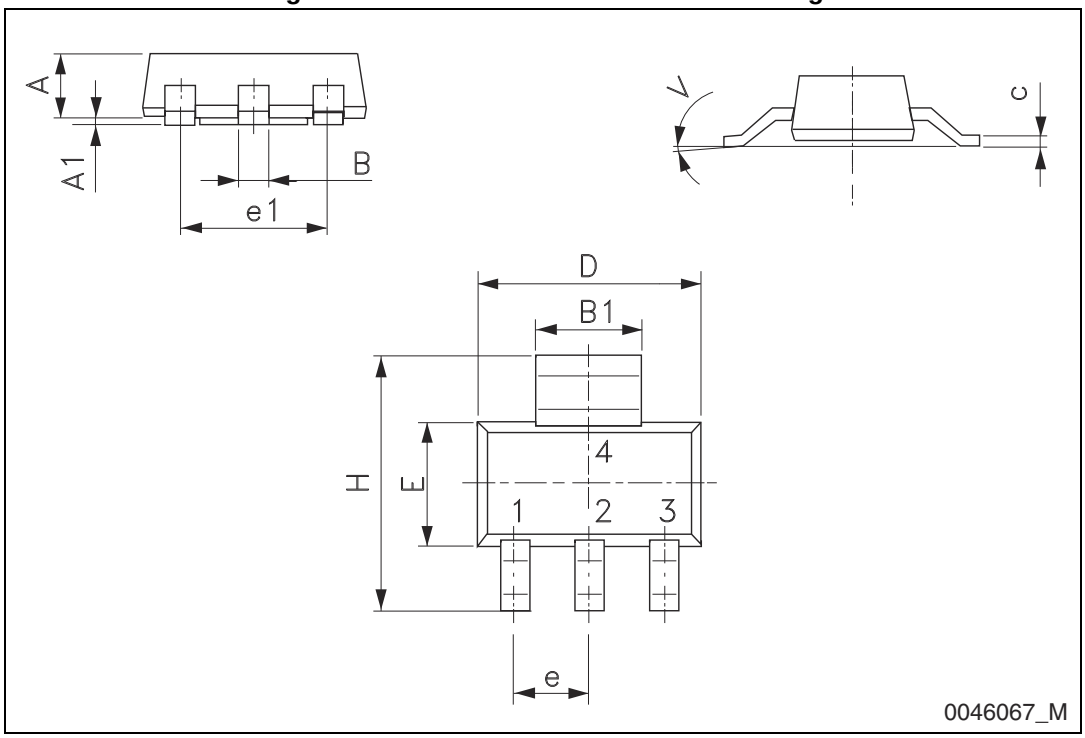


Table 10. DPAK (TO-252) mechanical data

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

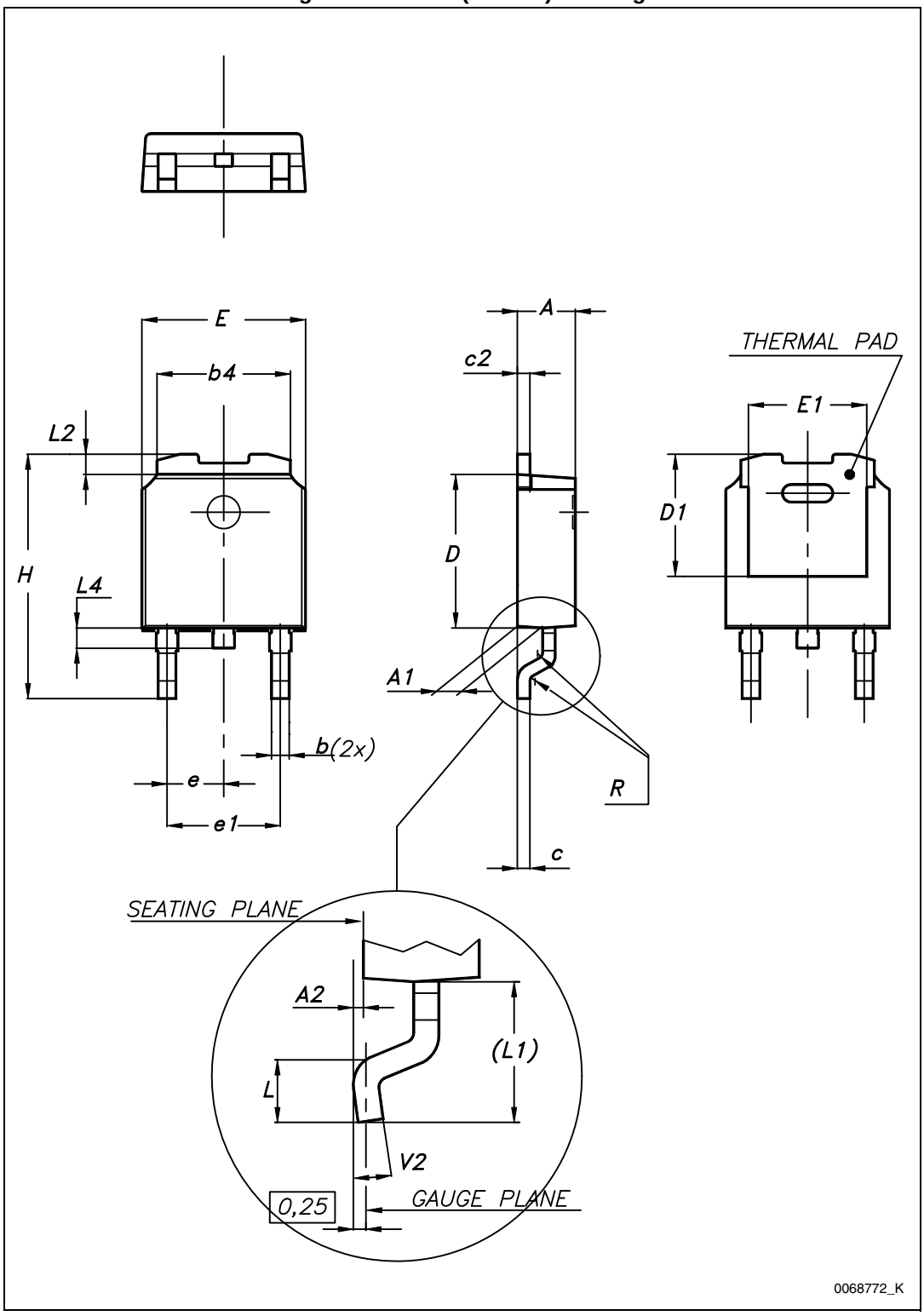
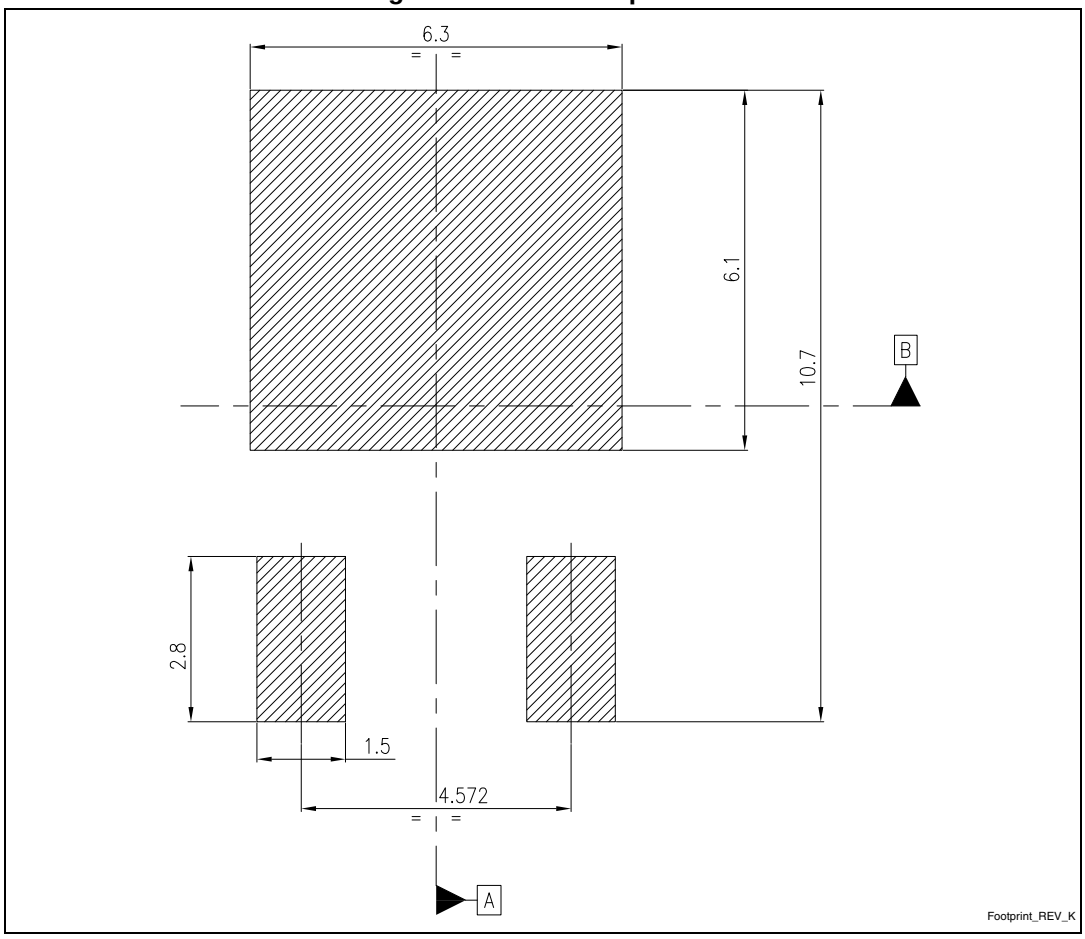


Figure 13. DPAK footprint [(a)]



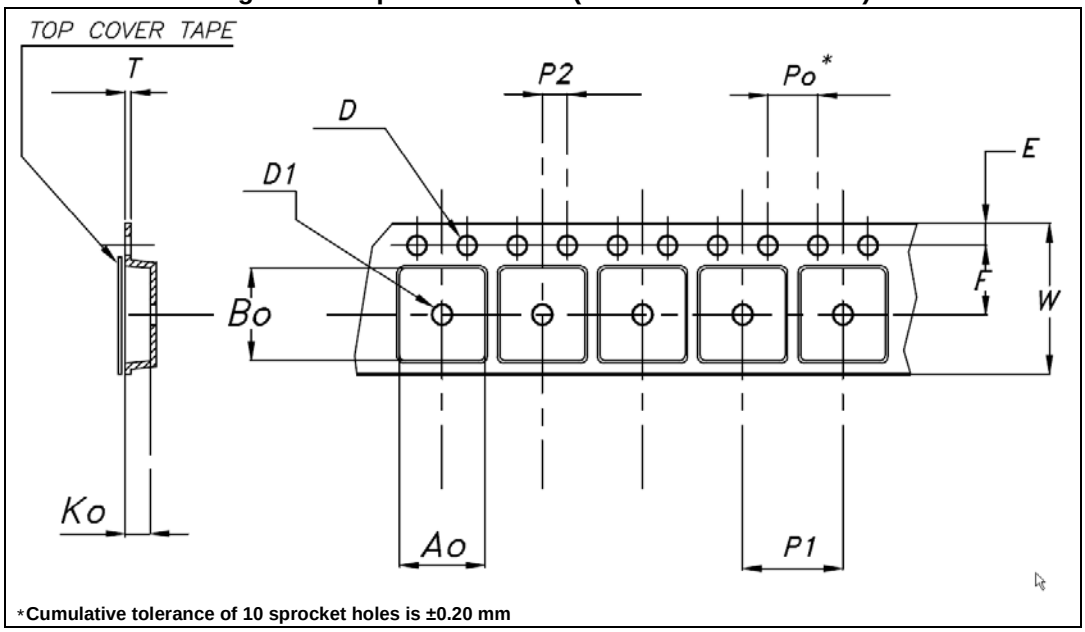
a. All dimensions are in millimeters

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)



*Cumulative tolerance of 10 sprocket holes is ±0.20 mm

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

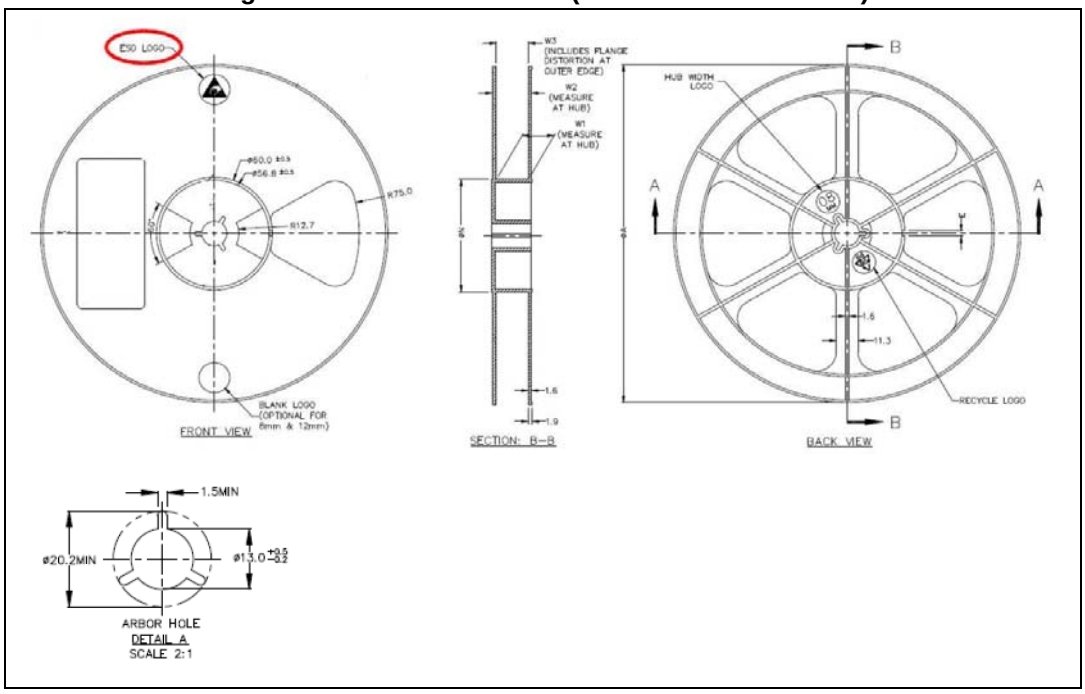


Table 12. DPAK tape and reel mechanical data

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

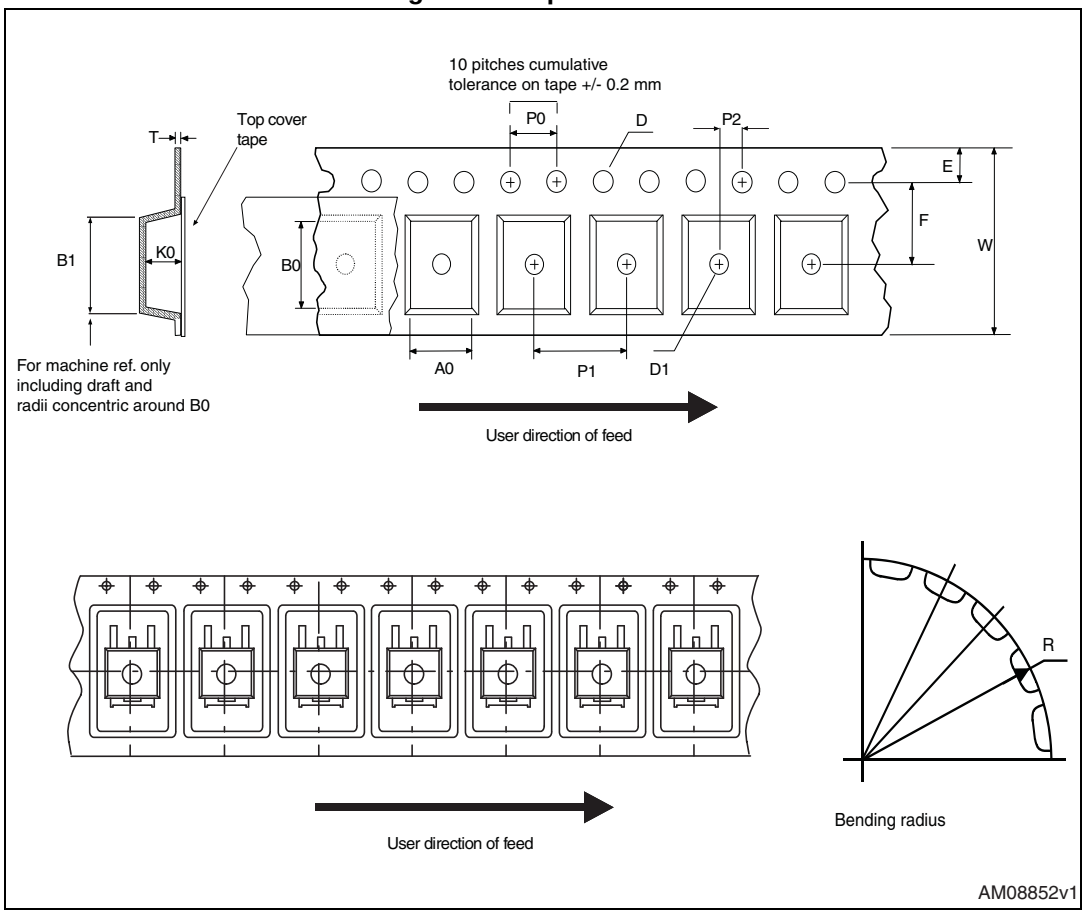
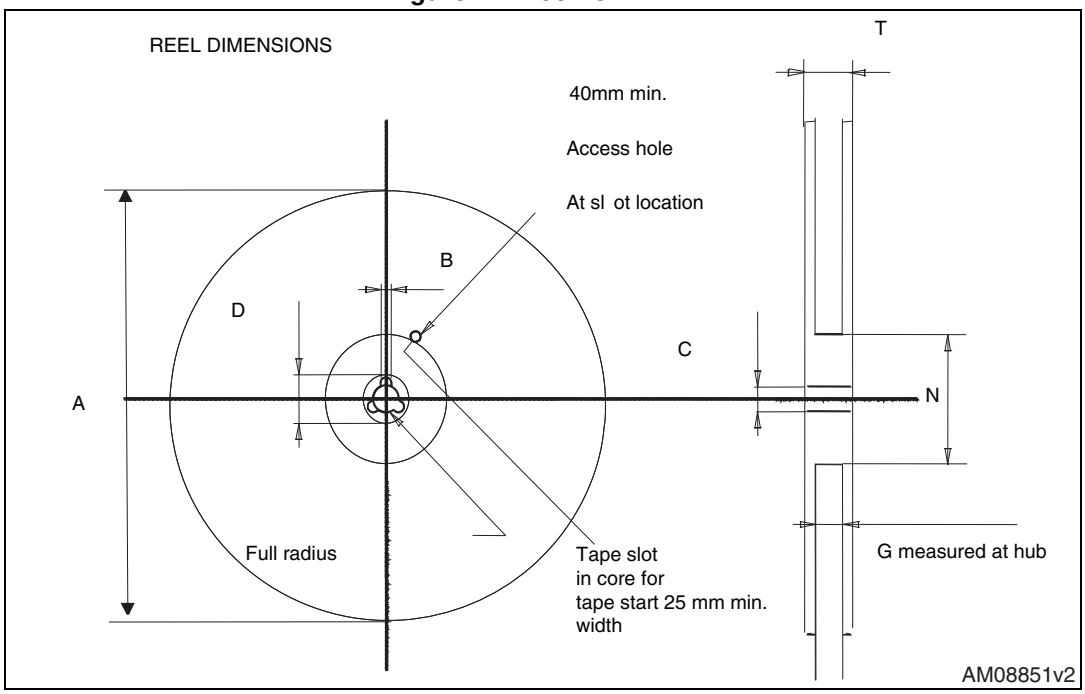


Figure 17. Reel for DPAK



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 - D²PAK/A.
05-Jul-2005	14	The DPAK mechanical data updated.
10-Feb-2006	15	Add new package - D²PAK/A (B type).
20-Dec-2006	16	Change value V_{IN} on *Table 2*.
19-Jan-2007	17	D²PAK/A mechanical data updated and add footprint data.
28-May-2007	18	Add I_{ADJ} and ΔI_{ADJ} values on *Table 7*.
07-Jun-2007	19	Add $I_{O(min)}$ value on *Table 7*.
15-Apr-2008	20	Modified: Table 10.
28-Jul-2009	21	Modified: Table 10.
05-Jul-2010	22	Added: *Table 8 on page 15*, *Figure 14 on page 18*, *Figure 15 on page 20*, *Figure 16* and *Figure 17 on page 21*.
16-Nov-2010	23	Modified: *Table 1 on page 1*, R_{thJC} value for TO-220 *Table 3 on page 5*.
16-Dec-2011	24	Modified: V_O parameter output voltage ==> Reference voltage *Table 7 on page 8*.
19-Oct-2012	25	Added: R_{thJA} value for DPAK and SOT-223 *Table 3 on page 5*.
24-Jul-2013	26	Part numbers LD1117AXX12, LD1117AXX18, LD1117AXX33, LD1117AXX changed to LD1117A. Modified *Chapter 6: Typical application*. Changed Vo symbol in to V_{REF} in *Table 7: Electrical characteristics of LD1117A (adjustable)*. Updated *Chapter 8: Package mechanical data*. Added *Chapter 9: Packaging mechanical data*. Minor text changes.

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