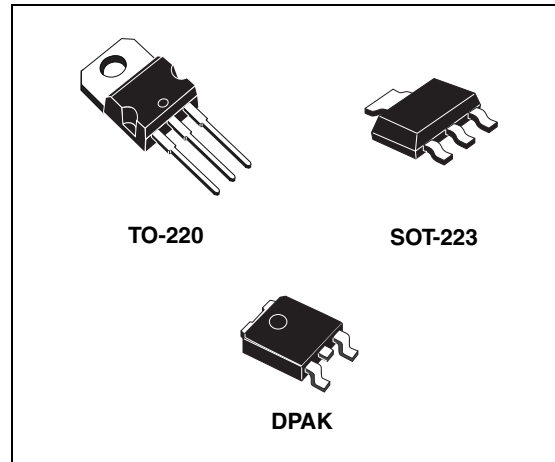


Low drop fixed and adjustable positive voltage regulators

Features

- Low dropout voltage:
 - (1.15 V typ. @ $I_{OUT} = 1\text{ A}$, 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, 2.5 V, 3.3 V
- Adjustable version availability ($V_{REL} = 1.25\text{ V}$)
- Internal current and thermal limit
- Only 10 μF for stability
- 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 LD1117Axx is a low drop voltage regulator able to provide up to 1 A of output current, available even in adjustable version ($V_{REF} = 1.25\text{ V}$). Concerning fixed versions, are offered the following output voltages: 1.2 V, 1.8 V, 2.5 V and 3.3 V. The device is supplied in: SOT-223, DPAK and TO-220. Surface mount packages optimize the thermal characteristics even offering a relevant space saving effect. High efficiency is assured by NPN pass transistor. Only a very common 10 μF minimum capacitor is needed for stability. Only chip trimming allows the regulator to reach a very tight output voltage tolerance, within $\pm 2\%$ at 25 °C.

Table 1. Device summary

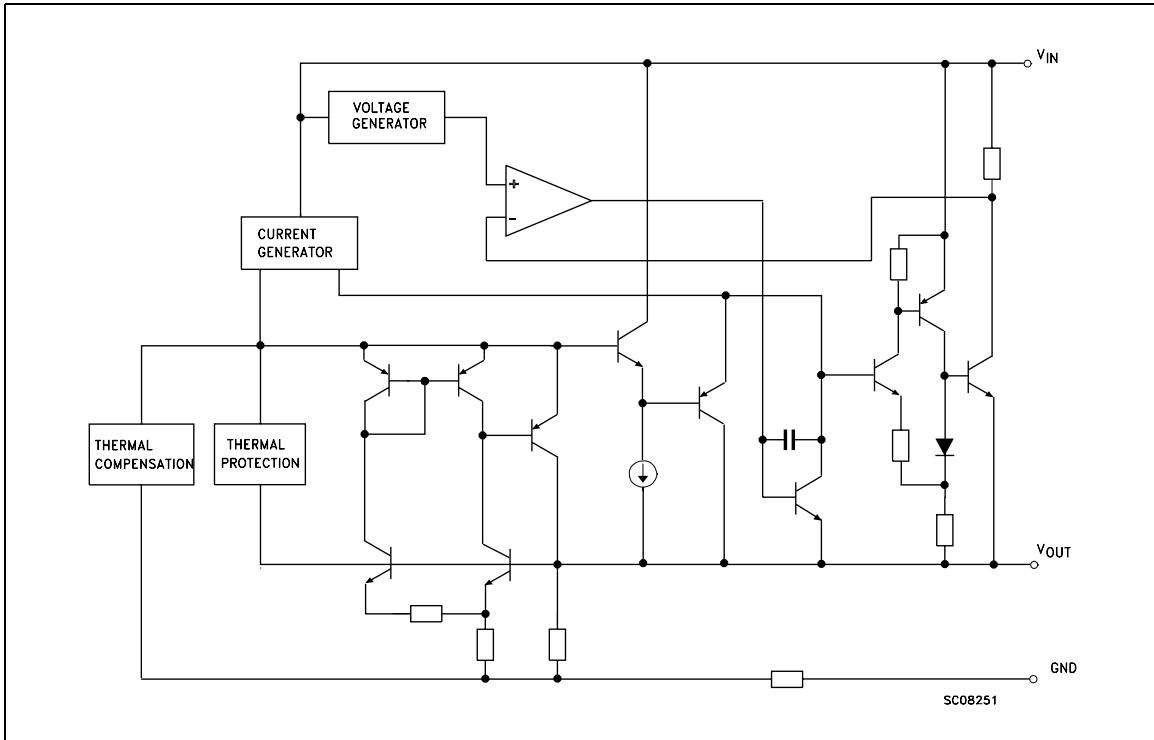
Part numbers	
LD1117AXX12	LD1117AXX33
LD1117AXX18	LD1117AXX
LD1117AXX25	

Contents

1	Diagram	3
2	Pin configuration	4
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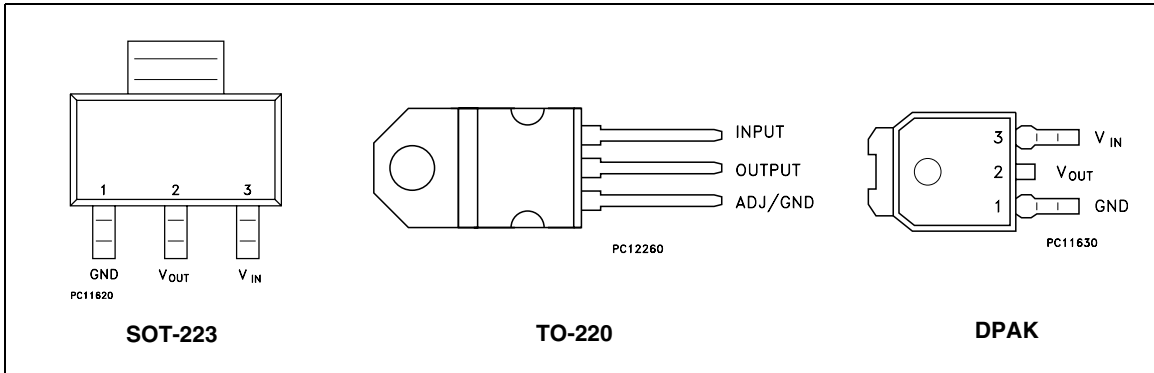
1 Diagram

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

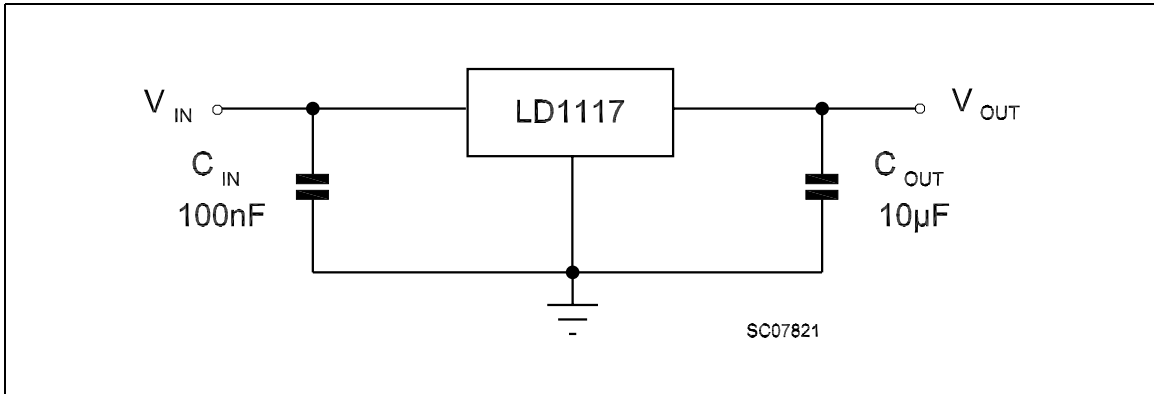
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. Over the above suggested max power dissipation a short circuit could definitively damage the device.

Table 3. Thermal data

Symbol	Parameter	SOT-223	DPAK	TO-220	Unit
R_{thJC}	Thermal resistance junction-case	15	8	3	°C/W
R_{thJA}	Thermal resistance junction-ambient			50	°C/W

4 Schematic application

Figure 3. Application circuit (for other fixed output voltages)



5 Electrical characteristics

Refer to the test circuits, $T_J = 0$ to 125 °C, $C_O = 10$ μ F, $C_I = 10$ μ F, $R = 120$ 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	$V_I = 5.3V$, $I_O = 10mA$, $T_J = 25^\circ C$	1.176	1.2	1.224	V
V_O	Output voltage	$I_O = 0$ to $1A$, $V_I = 2.75$ to $10V$	1.152	1.2	1.248	V
ΔV_O	Line regulation	$V_I = 2.75$ to $8V$, $I_O = 0mA$		1	6	mV
ΔV_O	Load regulation	$V_I = 2.75V$, $I_O = 0$ to $1A$		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, $T_J = 125^\circ C$		0.3		%
V_I	Operating input voltage	$I_O = 100mA$			10	V
I_d	Quiescent current	$V_I \leq 8V$, $I_O = 0mA$		5	10	mA
I_O	Output current	$V_I - V_O = 5V$, $T_J = 25^\circ C$	1000	1200		mA
eN	Output noise voltage	$B = 10Hz$ to $10kHz$, $T_J = 25^\circ C$		100		μ V
SVR	Supply voltage rejection	$I_O = 40mA$, $f = 120Hz$ $V_I - V_O = 3V$, $V_{ripple} = 1V_{PP}$	60	80		dB
V_D	Dropout voltage	$I_O = 100mA$		1	1.10	V
		$I_O = 500mA$		1.05	1.15	
		$I_O = 1A$		1.15	1.30	
$\Delta V_{O(pwr)}$	Thermal regulation	$T_a = 25^\circ C$, 30 ms Pulse		0.08	0.2	%/W

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

Table 5. Electrical characteristics of LD1117A#18

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$V_I = 3.8\text{V}$, $I_O = 10\text{mA}$, $T_J = 25^\circ\text{C}$	1.764	1.8	1.836	V
V_O	Output voltage	$I_O = 0$ to 1A , $V_I = 3.3$ to 8V	1.728		1.872	V
ΔV_O	Line regulation	$V_I = 3.3$ to 8V , $I_O = 0\text{mA}$		1	6	mV
ΔV_O	Load regulation	$V_I = 3.3\text{V}$, $I_O = 0$ to 1A		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, $T_J = 125^\circ\text{C}$		0.3		%
V_I	Operating input voltage	$I_O = 100\text{mA}$			10	V
I_d	Quiescent current	$V_I \leq 8\text{V}$, $I_O = 0\text{mA}$		5	10	mA
I_O	Output current	$V_I - V_O = 5\text{V}$, $T_J = 25^\circ\text{C}$	1000			mA
eN	Output noise voltage	$B = 10\text{Hz}$ to 10kHz , $T_J = 25^\circ\text{C}$		100		μV
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	$T_a = 25^\circ\text{C}$, 30 ms Pulse		0.08	0.2	%/W

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

Table 6. Electrical characteristics of LD1117A#25

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$V_I = 4.5V, I_O = 10mA, T_J = 25^\circ C$	2.45	2.5	2.55	V
V_O	Output voltage	$I_O = 0$ to $1A, V_I = 3.9$ to $8V$	2.4		2.6	V
ΔV_O	Line regulation	$V_I = 3.9$ to $8V, I_O = 0mA$		1	6	mV
ΔV_O	Load regulation	$V_I = 3.9V, I_O = 0$ to $1A$		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, $T_J = 125^\circ C$		0.3		%
V_I	Operating input voltage	$I_O = 100mA$			10	V
I_d	Quiescent current	$V_I \leq 10V, I_O = 0mA$		5	10	mA
I_O	Output current	$V_I - V_O = 5V, T_J = 25^\circ C$	1000	1200		mA
eN	Output noise voltage	$B = 10Hz$ to $10kHz, T_J = 25^\circ C$		100		μ V
SVR	Supply voltage rejection	$I_O = 40mA, f = 120Hz$ $V_I - V_O = 3V, V_{ripple} = 1V_{PP}$	60	80		dB
V_D	Dropout voltage	$I_O = 100mA$		1	1.10	V
		$I_O = 500mA$		1.05	1.15	
		$I_O = 1A$		1.15	1.30	
$\Delta V_{O(pwr)}$	Thermal regulation	$T_a = 25^\circ C, 30$ ms Pulse		0.08	0.2	%/W

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

Table 7. Electrical characteristics of LD1117A#33

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$V_I = 5.3V, I_O = 10mA, T_J = 25^\circ C$	3.234	3.3	3.366	V
V_O	Output voltage	$I_O = 0$ to $1A, V_I = 4.75$ to $10V$	3.168		3.432	V
ΔV_O	Line regulation	$V_I = 4.75$ to $8V, I_O = 0mA$		1	6	mV
ΔV_O	Load regulation	$V_I = 4.75V, I_O = 0$ to $1A$		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, $T_J = 125^\circ C$		0.3		%
V_I	Operating input voltage	$I_O = 100mA$			10	V
I_d	Quiescent current	$V_I \leq 10V, I_O = 0mA$		5	10	mA
I_O	Output current	$V_I - V_O = 5V, T_J = 25^\circ C$	1000	1200		mA
eN	Output noise voltage	$B = 10Hz$ to $10kHz, T_J = 25^\circ C$		100		μ V
SVR	Supply voltage rejection	$I_O = 40mA, f = 120Hz$ $V_I - V_O = 3V, V_{ripple} = 1V_{PP}$	60	75		dB
V_D	Dropout voltage	$I_O = 100mA$		1	1.10	V
		$I_O = 500mA$		1.05	1.15	
		$I_O = 1A$		1.15	1.30	
$\Delta V_{O(pwr)}$	Thermal regulation	$T_a = 25^\circ C, 30$ ms Pulse		0.08	0.2	%/W

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

Table 8. Electrical characteristics of LD1117A (Adjustable)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	$V_I = 5.3V$, $I_O = 10mA$, $T_J = 25^\circ C$	1.225	1.25	1.275	V
V_O	Output voltage	$I_O = 0$ to $1A$, $V_I = 2.75$ to $10V$	1.2		1.3	V
ΔV_O	Line regulation	$V_I = 2.75$ to $8V$, $I_O = 0mA$		1	6	mV
ΔV_O	Load regulation	$V_I = 2.75V$, $I_O = 0$ to $1A$		1	10	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, $T_J = 125^\circ C$		0.3		%
V_I	Operating input voltage	$I_O = 100mA$			10	V
I_{adj}	Adjustment pin current	$V_{in} \leq 10V$		60	120	μA
ΔI_{adj}	Adjustment pin current change	$V_{in} - V_O = 1.4$ to $10V$, $I_O = 10mA$ to $1A$		1	5	μA
$I_{O(min)}$	Minimum load current	$V_{in} = 10V$		2	5	mA
I_O	Output current	$V_I - V_O = 5V$, $T_J = 25^\circ C$	1000	1200		mA
eN	Output noise voltage	$B = 10Hz$ to $10kHz$, $T_J = 25^\circ C$		100		μV
SVR	Supply voltage rejection	$I_O = 40mA$, $f = 120Hz$ $V_I - V_O = 3V$, $V_{ripple} = 1V_{PP}$	60	80		dB
V_D	Dropout voltage	$I_O = 100mA$		1	1.10	V
		$I_O = 500mA$		1.05	1.15	
		$I_O = 1A$		1.15	1.30	
$\Delta V_{O(pwr)}$	Thermal regulation	$T_a = 25^\circ C$, 30 ms Pulse		0.08	0.2	%/W

6 Typical application

Figure 4. Negative supply

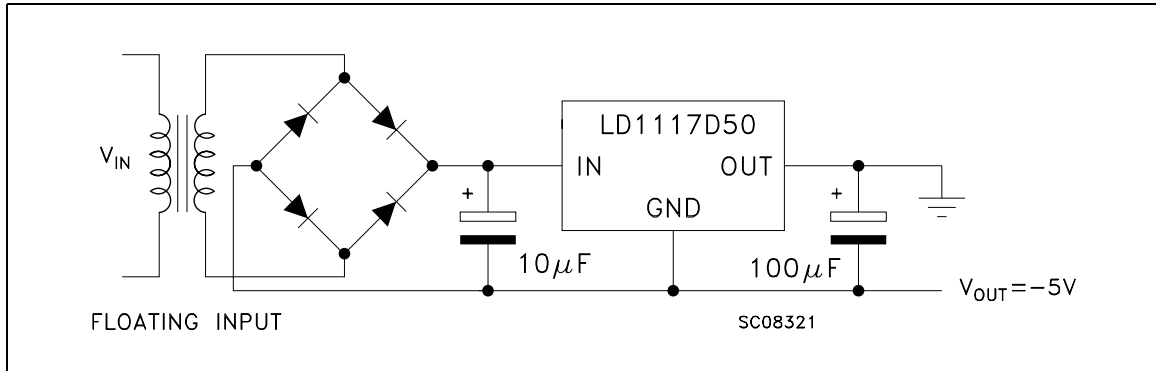


Figure 5. Active terminator for SCSI-2 bus

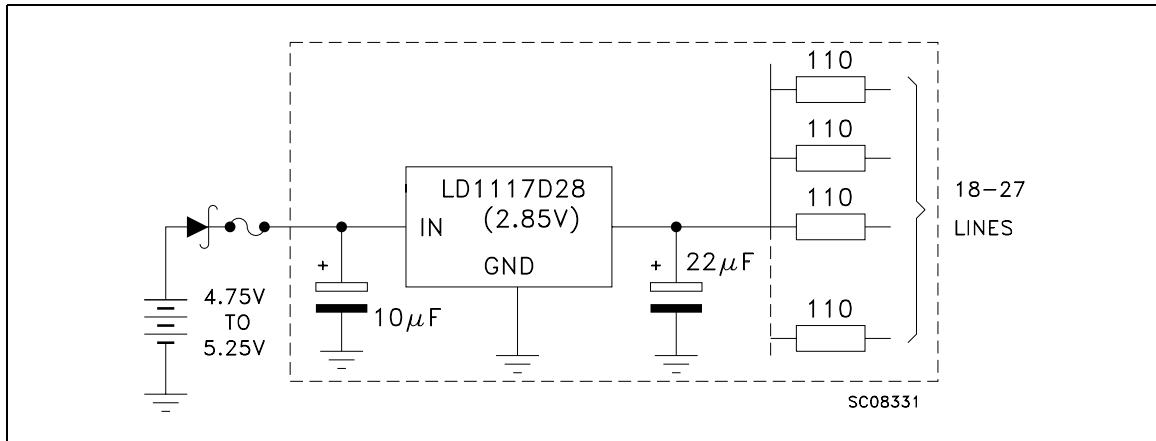


Figure 6. Circuit for increasing output voltage

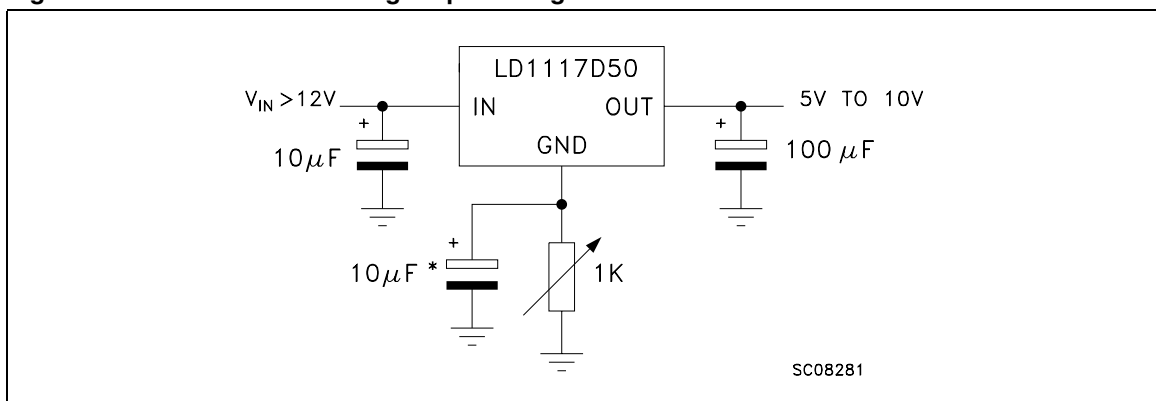


Figure 7. Voltage regulator with reference

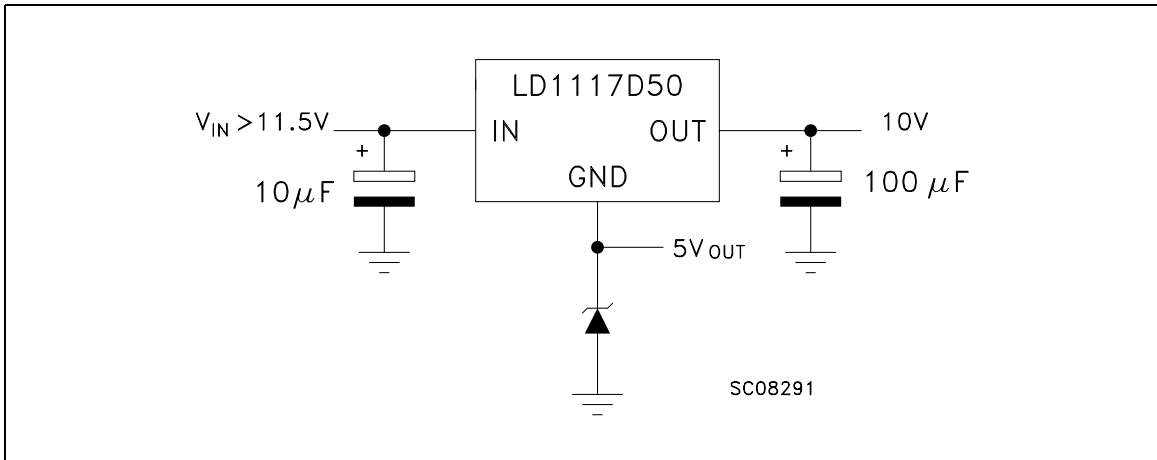


Figure 8. Battery backed-up regulated supply

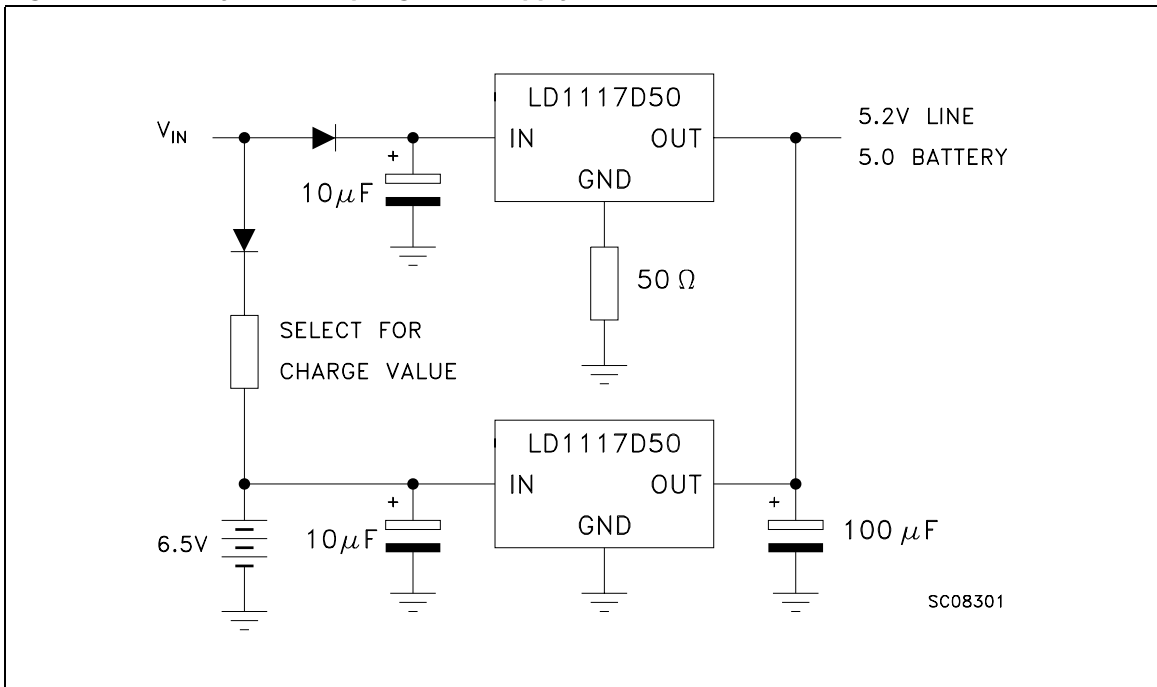
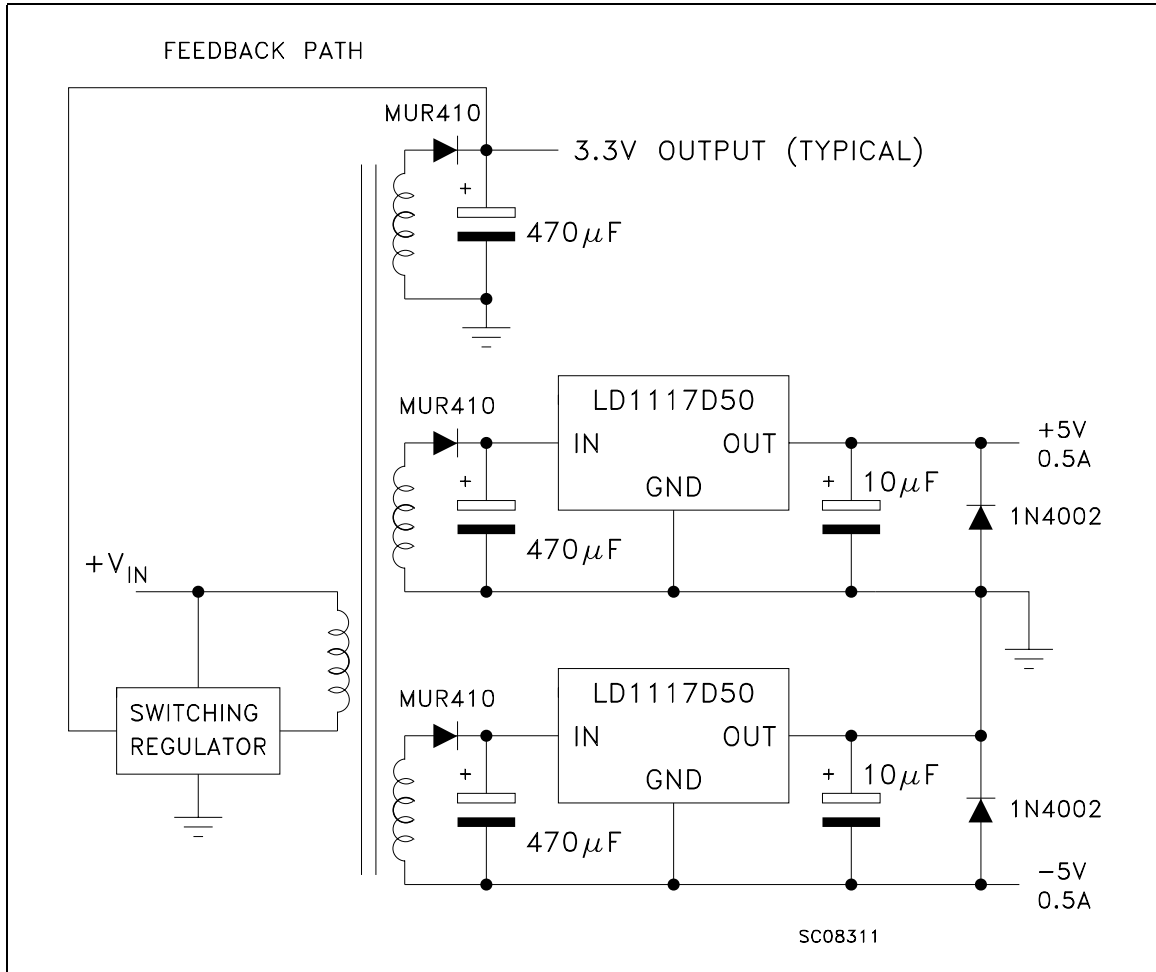


Figure 9. Post-regulated dual supply



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 $60 \mu\text{A}$ typ. ($120 \mu\text{A}$ max.) and ΔI_{ADJ} is $1 \mu\text{A}$ typ. ($5 \mu\text{A}$ max.).

R_1 is normally fixed to 120Ω . From [Figure 7](#) we obtain:

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

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

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

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

Figure 10. Adjustable output voltage application

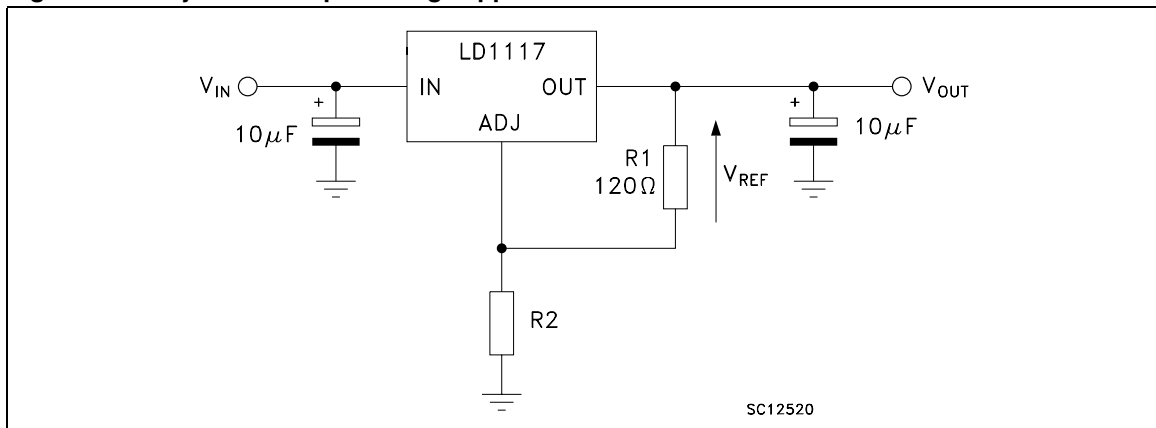
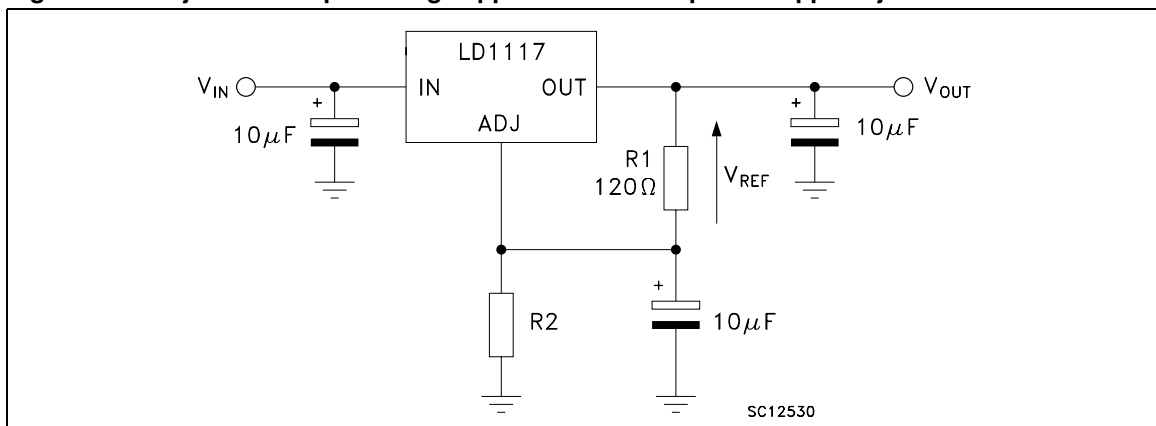


Figure 11. Adjustable output voltage application with improved ripple rejection



8 Package mechanical data

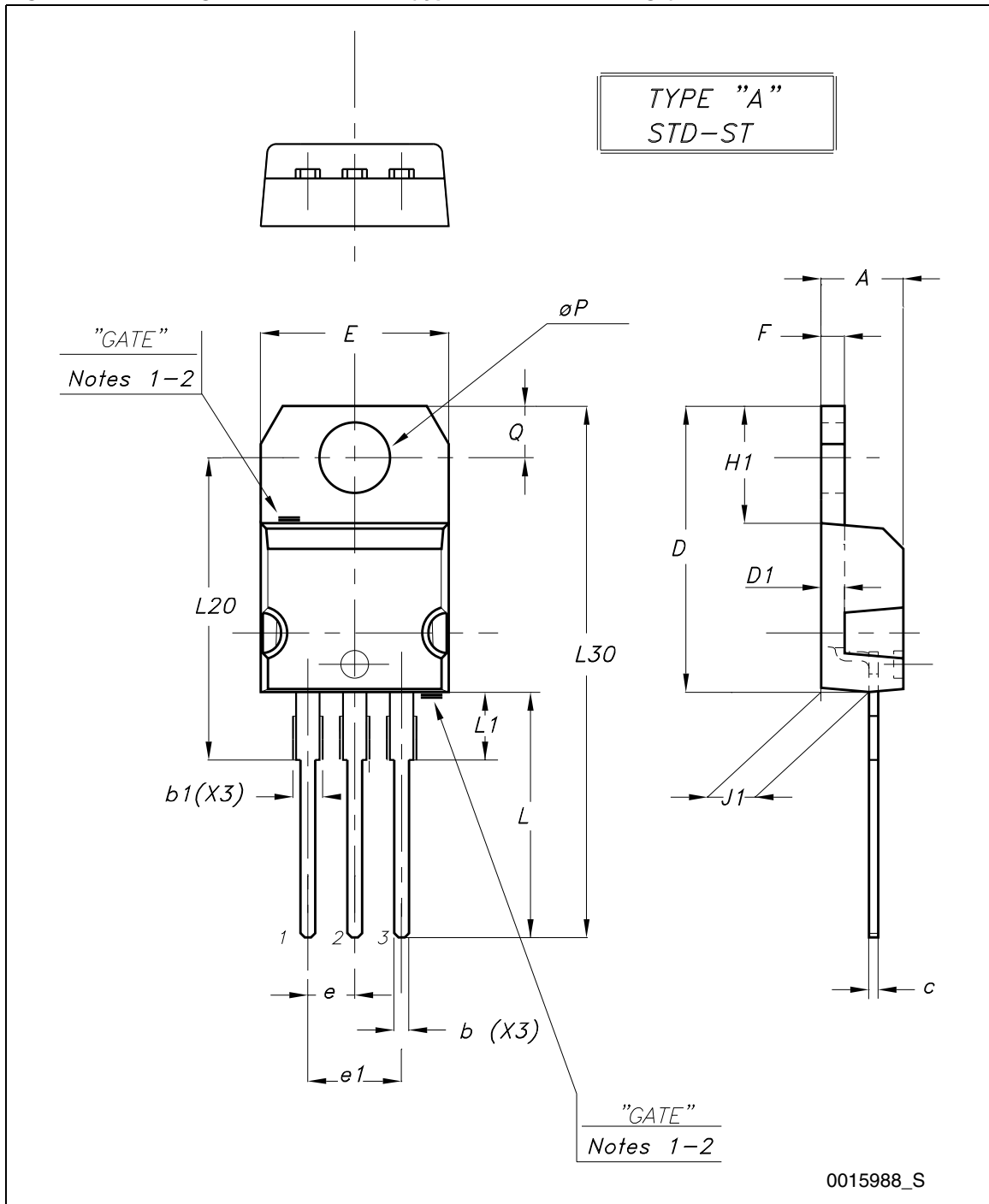
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.

Table 9. TO-220 mechanical data

Dim.	Type STD - ST Dual Gauge			Type STD - ST Single Gauge		
	mm.			mm.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	4.40		4.60
b	0.61		0.88	0.61		0.88
b1	1.14		1.70	1.14		1.70
c	0.48		0.70	0.48		0.70
D	15.25		15.75	15.25		15.75
D1		1.27				
E	10.00		10.40	10.00		10.40
e	2.40		2.70	2.40		2.70
e1	4.95		5.15	4.95		5.15
F	1.23		1.32	0.51		0.60
H1	6.20		6.60	6.20		6.60
J1	2.40		2.72	2.40		2.72
L	13.00		14.00	13.00		14.00
L1	3.50		3.93	3.50		3.93
L20		16.40			16.40	
L30		28.90			28.90	
∅P	3.75		3.85	3.75		3.85
Q	2.65		2.95	2.65		2.95

In spite of some difference in tolerances, the packages are compatible.

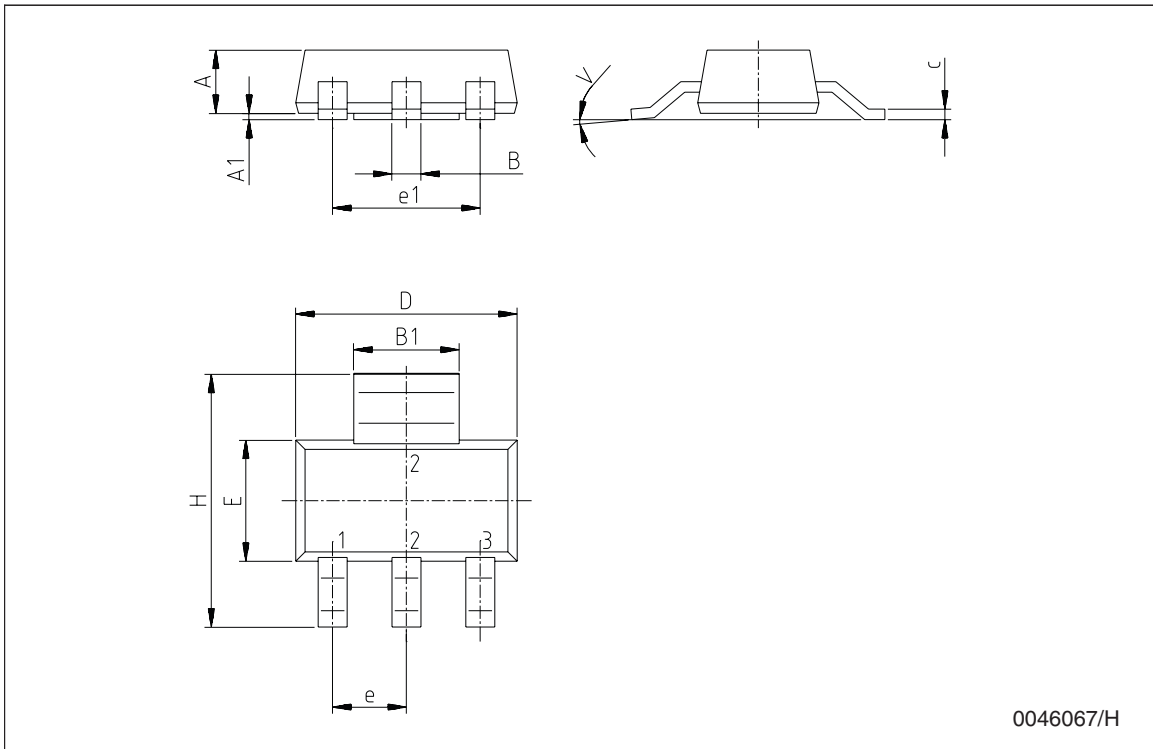
Figure 12. Drawing dimension TO-220 (type STD-ST Dual Gauge)



- Note: 1 Maximum resin gate protrusion: 0.5 mm.
2 Resin gate position is accepted in each of the two positions shown on the drawing, or their symmetrical.

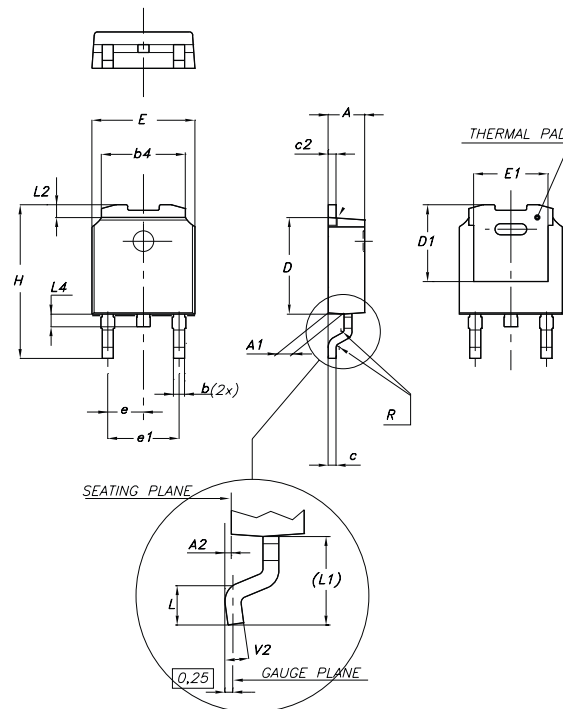
SOT-223 mechanical data

Dim.	mm.			mils.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.8			70.9
A1	0.02		0.1	0.8		3.9
B	0.6	0.7	0.85	23.6	27.6	33.5
B1	2.9	3	3.15	114.2	118.1	124.0
c	0.24	0.26	0.35	9.4	10.2	13.8
D	6.3	6.5	6.7	248.0	255.9	263.8
e		2.3			90.6	
e1		4.6			181.1	
E	3.3	3.5	3.7	129.9	137.8	145.7
H	6.7	7	7.3	263.8	275.7	287.5
V			10°			10°



DPAK mechanical data

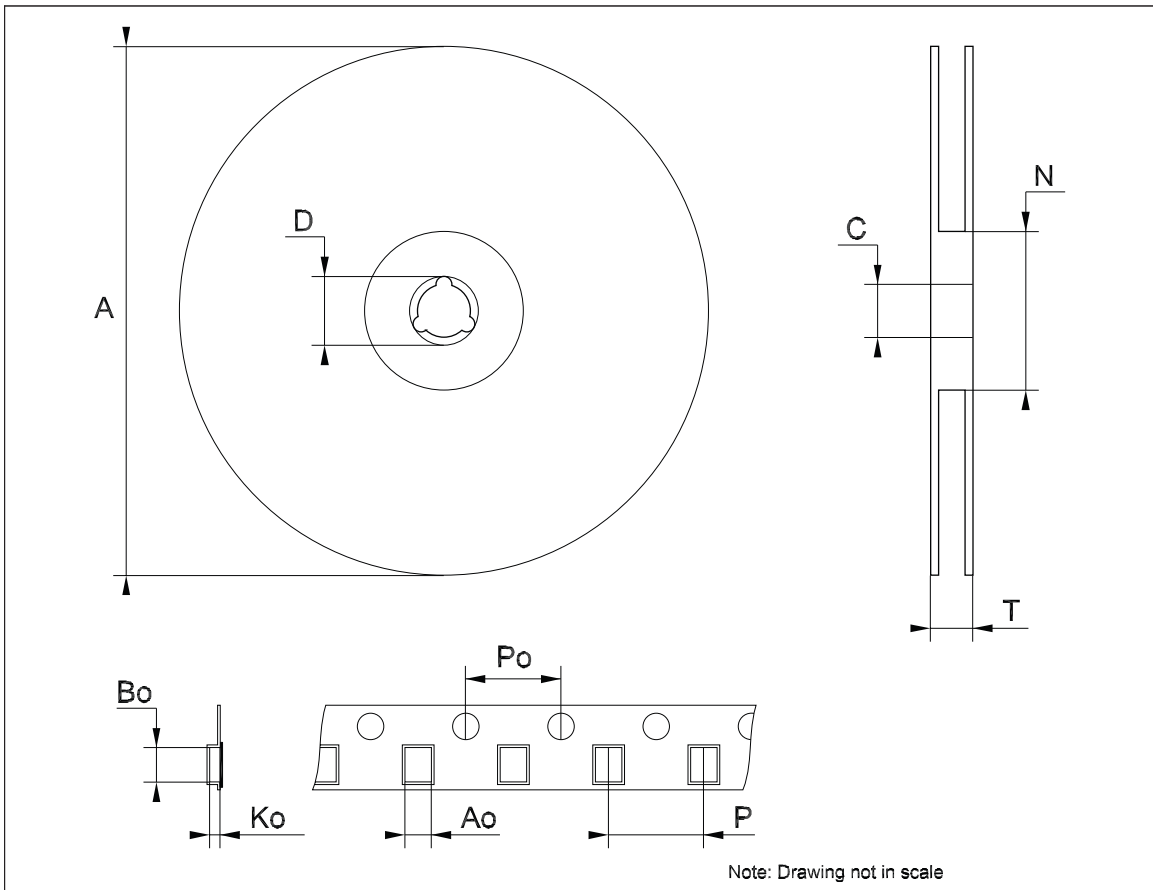
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°



0068772-F

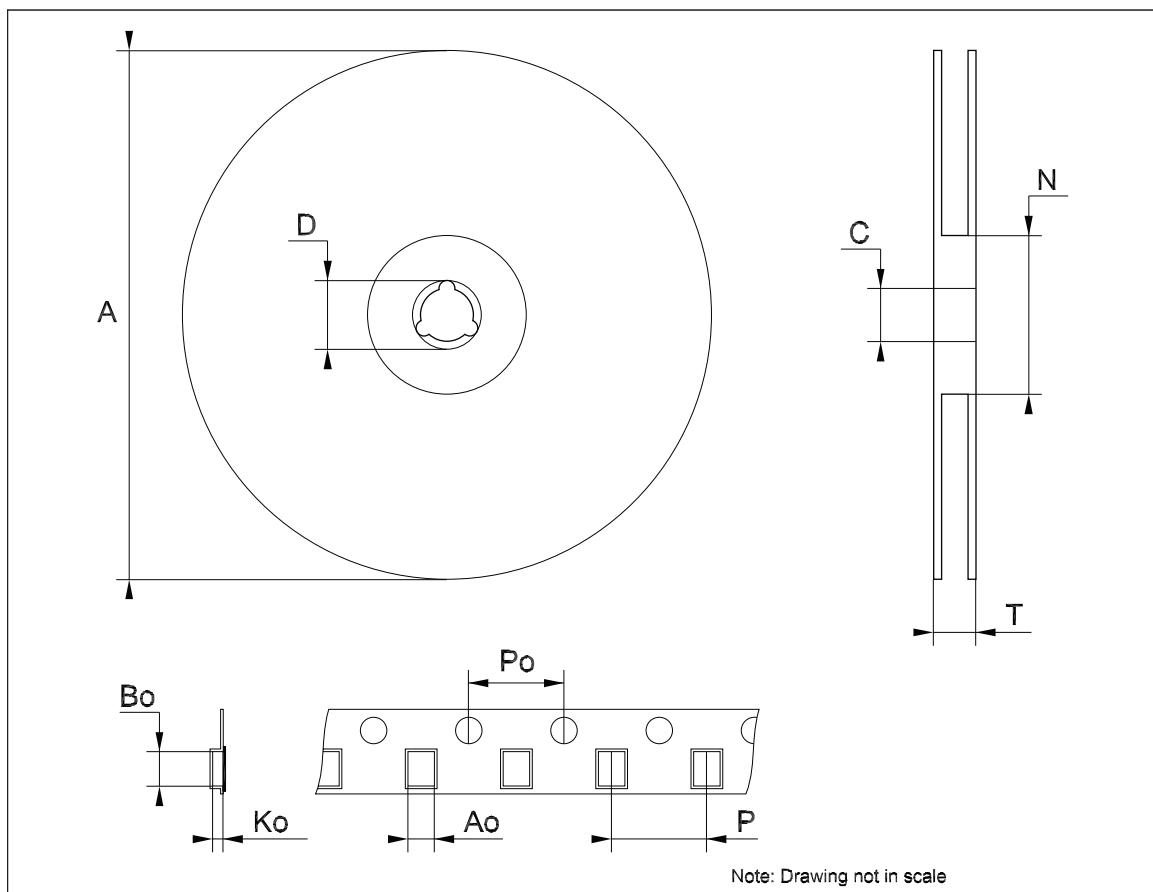
Tape & reel SOT223 mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
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	6.73	6.83	6.93	0.265	0.269	0.273
Bo	7.32	7.42	7.52	0.288	0.292	0.296
Ko	1.78		2	0.070		0.078
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	7.9	8.0	8.1	0.311	0.315	0.319



Tape & reel DPAK-PPAK mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.80	6.90	7.00	0.268	0.272	0.276
Bo	10.40	10.50	10.60	0.409	0.413	0.417
Ko	2.55	2.65	2.75	0.100	0.104	0.105
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	7.9	8.0	8.1	0.311	0.315	0.319



9 Order codes

Table 10. Order codes

Packages			Output voltage
SOT-223	DPAK	TO-220	
LD1117AS12TR	LD1117ADT12TR		1.2 V
LD1117AS18TR	LD1117ADT18TR		1.8 V
LD1117AS25TR	LD1117ADT25TR		2.5 V
LD1117AS33TR	LD1117ADT33TR	LD1117AV33	3.3 V
LD1117ASTR	LD1117ADT-TR		Adjustable from 1.25 to 15 V

10 Revision history

Table 11. 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 ² PAK/A.
05-Jul-2005	14	The DPAK mechanical data updated.
10-Feb-2006	15	Add new package - D ² PAK/A (B Type).
20-Dec-2006	16	Change value V_{IN} on Table 2 .
19-Jan-2007	17	D ² PAK/A mechanical data updated and add footprint data.
28-May-2007	18	Add I_{ADJ} and ΔI_{ADJ} values on Table 8 .
07-Jun-2007	19	Add $I_{O(min)}$ value on Table 8 .
15-Apr-2008	20	Modified: Table 10 on page 24 .
28-Jul-2009	21	Modified: Table 10 on page 24 .
05-Jul-2010	22	Added: Table 9 on page 16 , Figure 12 on page 17 , Figure 13 on page 18 , Figure 14 and Figure 15 on page 19 .

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