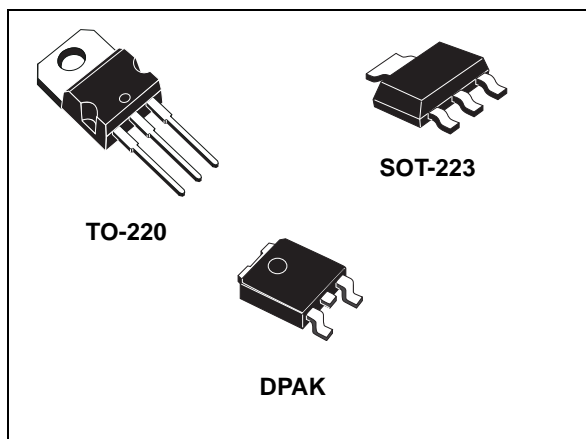


Low drop fixed and adjustable positive voltage regulators

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 ($V_{REF} = 1.25\text{ V}$). 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 $\pm 2\%$ at 25 °C.

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, 3.3 V
- Adjustable version availability ($V_{REF} = 1.25\text{ V}$)
- Internal current and thermal limit
- Only 10 μF for stability

Table 1. Device summary

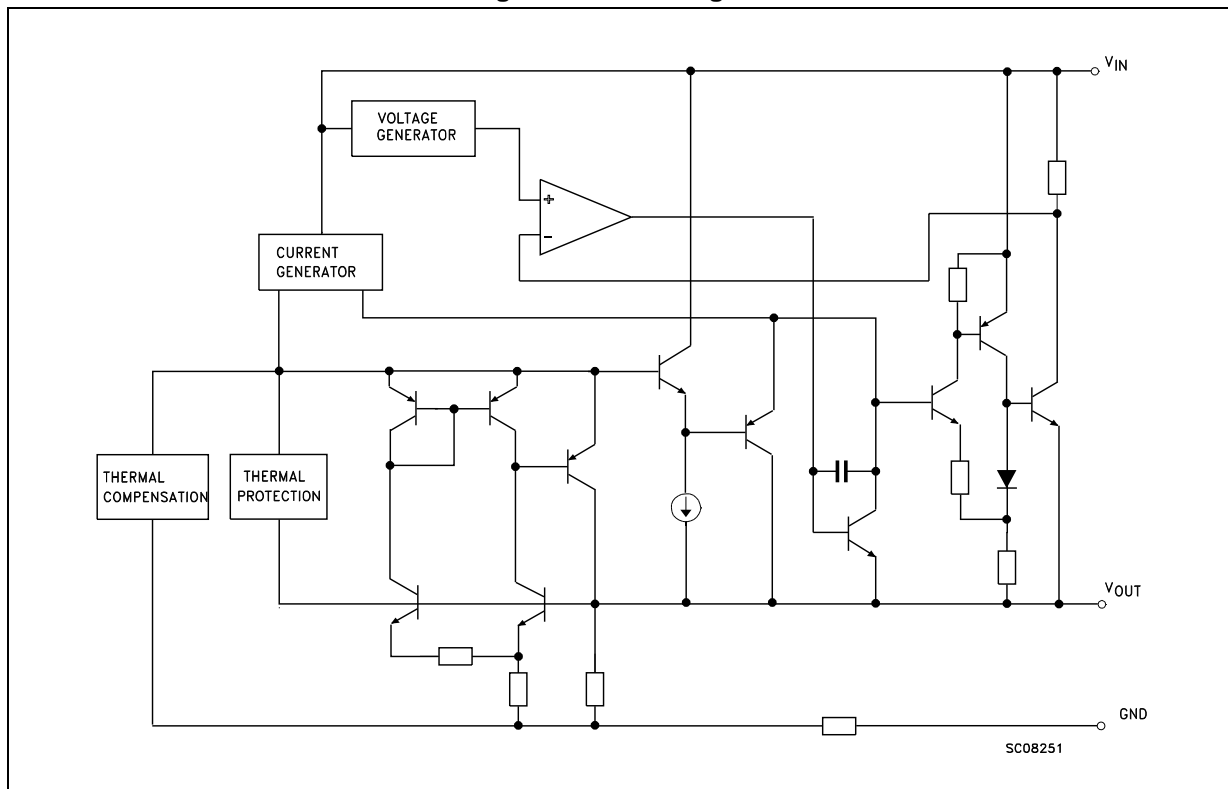
| Order codes | | | Output voltage |
|--------------|---------------|------------|------------------------|
| SOT-223 | DPAK | TO-220 | |
| LD1117AS12TR | LD1117ADT12TR | | 1.2 V |
| LD1117AS18TR | LD1117ADT18TR | | 1.8 V |
| LD1117AS33TR | LD1117ADT33TR | LD1117AV33 | 3.3 V |
| LD1117ASTR | LD1117ADT-TR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

Contents

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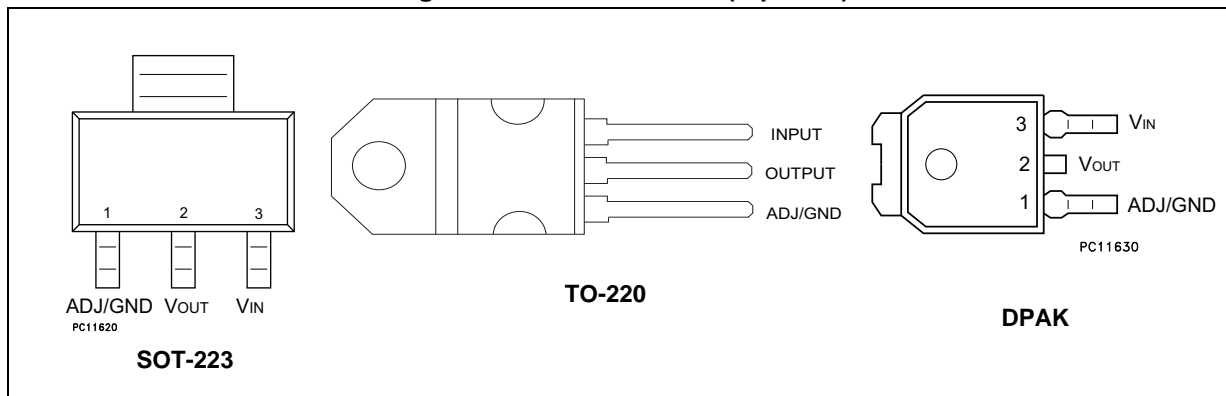
1 Diagram

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 |

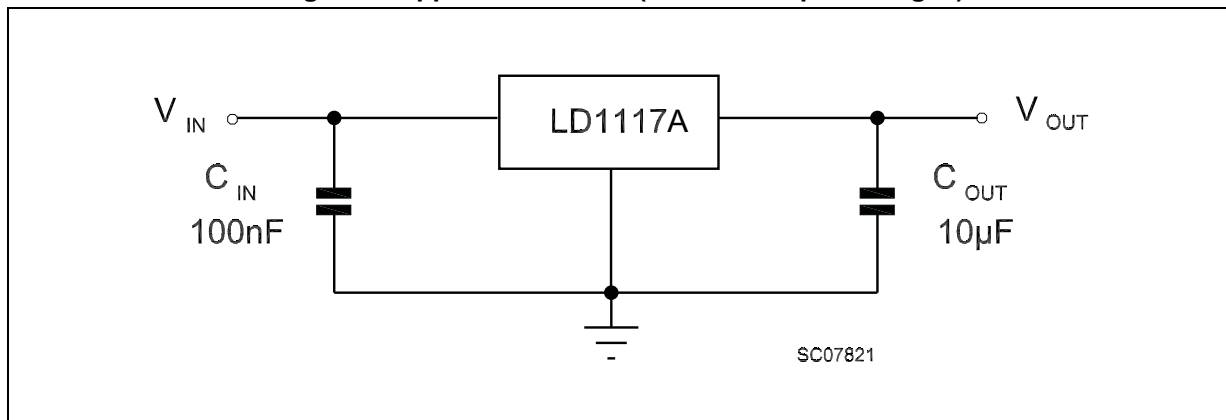
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. Beyond the above suggested max. power dissipation, a short-circuit may permanently damage the device.

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 $125\text{ }^\circ\text{C}$, $C_O = 10\text{ }\mu\text{F}$, $C_I = 10\text{ }\mu\text{F}$, $R = 120\text{ }\Omega$ 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 | $V_I = 5.3\text{ V}$, $I_O = 10\text{ mA}$, $T_J = 25\text{ }^\circ\text{C}$ | 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 , $I_O = 0\text{ mA}$ | | 1 | 6 | mV |
| ΔV_O | Load regulation | $V_I = 2.75\text{ V}$, $I_O = 0$ to 1 A | | 1 | 10 | mV |
| ΔV_O | Temperature stability | | | 0.5 | | % |
| ΔV_O | Long term stability | 1000 hrs, $T_J = 125\text{ }^\circ\text{C}$ | | 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 | $V_I - V_O = 5\text{ V}$, $T_J = 25\text{ }^\circ\text{C}$ | 1000 | 1200 | | mA |
| eN | Output noise voltage | $B = 10\text{ Hz}$ to 10 kHz , $T_J = 25\text{ }^\circ\text{C}$ | | 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 | $T_a = 25\text{ }^\circ\text{C}$, 30 ms pulse | | 0.08 | 0.2 | %/W |

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

Table 5. Electrical characteristics of LD1117A#18

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|-------------------------|--|-------|------|-------|------|
| V_O | Output voltage | $V_I = 3.8\text{ V}$, $I_O = 10\text{ mA}$, $T_J = 25\text{ }^\circ\text{C}$ | 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 , $I_O = 0\text{ mA}$ | | 1 | 6 | mV |
| ΔV_O | Load regulation | $V_I = 3.3\text{ V}$, $I_O = 0$ to 1 A | | 1 | 10 | mV |
| ΔV_O | Temperature stability | | | 0.5 | | % |
| ΔV_O | Long term stability | 1000 hrs, $T_J = 125\text{ }^\circ\text{C}$ | | 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 | $V_I - V_O = 5\text{ V}$, $T_J = 25\text{ }^\circ\text{C}$ | 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 | |
| ΔV _{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 ≤ 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 | |
| ΔV _{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 | $V_I = 2.75 \text{ V}$, $I_O = 0 \text{ to } 1 \text{ A}$ | | 1 | 10 | mV |
| ΔV_O | Temperature stability | | | 0.5 | | % |
| ΔV_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_{adj} | Adjustment pin current | $V_{\text{in}} \leq 10 \text{ V}$ | | 60 | 120 | μA |
| ΔI_{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 | μA |
| $I_{O(\text{min})}$ | 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 | | 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 | $T_a = 25 \text{ }^\circ\text{C}$, 30 ms pulse | | 0.08 | 0.2 | %/W |

6 Typical application

Figure 4. Negative supply

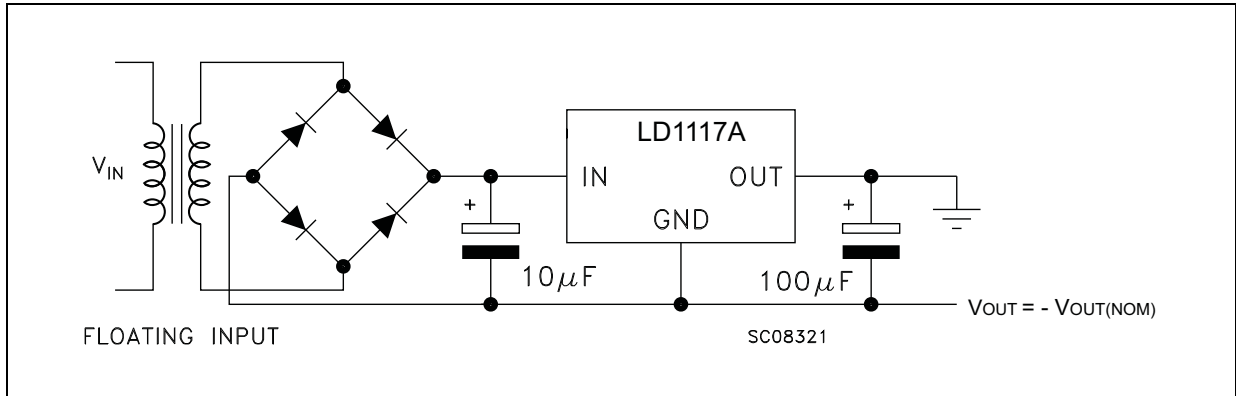


Figure 5. Circuit for increasing output voltage

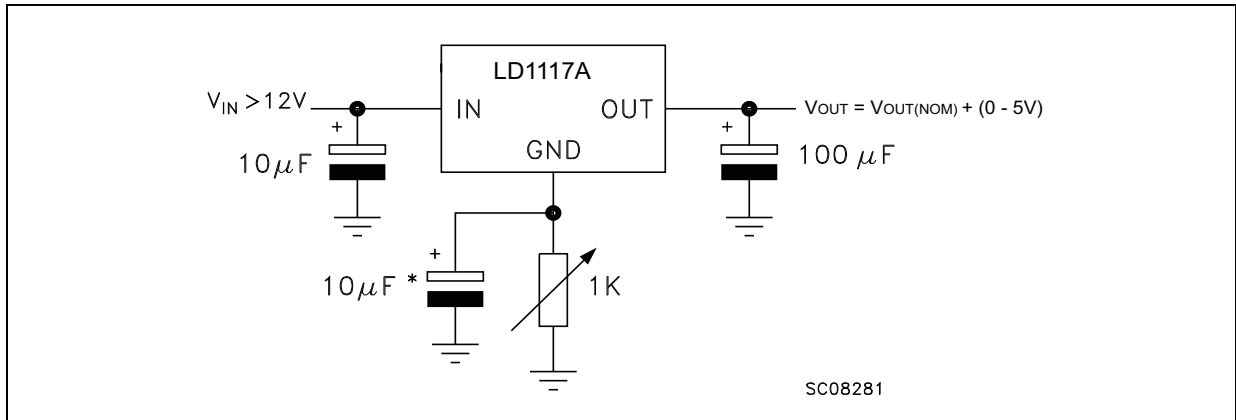


Figure 6. Voltage regulator with reference

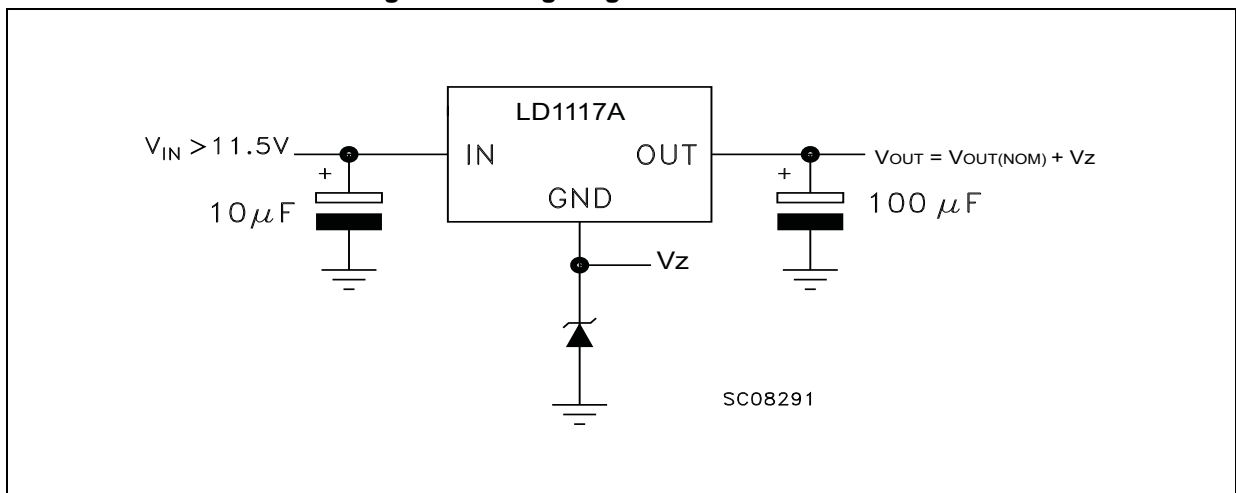
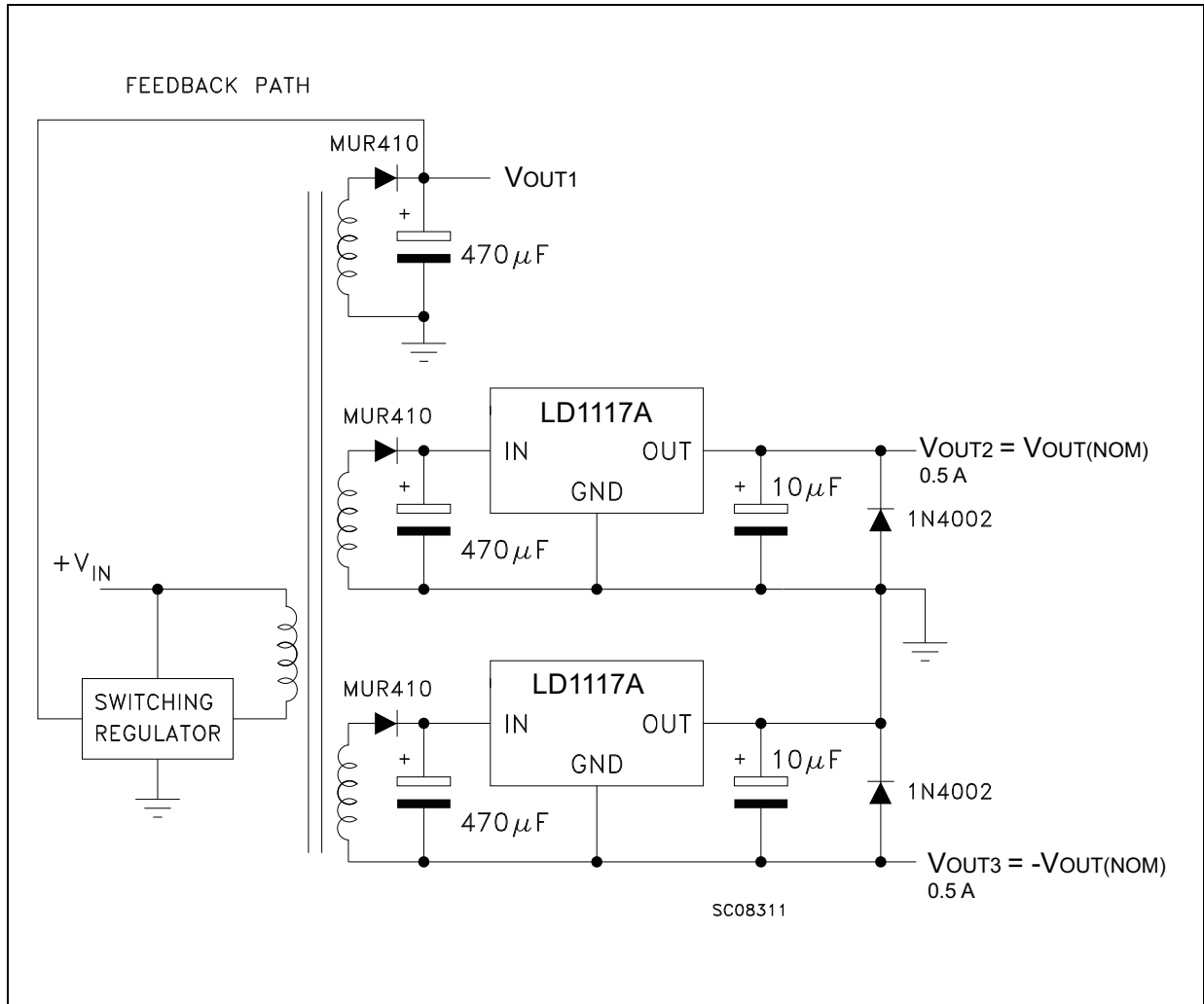


Figure 7. Post-regulated dual supply



7 LD1117A adjustable: application note

The LD1117A adjustable has a thermal stabilized 1.25 ± 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 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 $\text{k}\Omega$, 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 $10 \mu\text{F}$ electrolytic capacitor placed in parallel to the R_2 resistor (see [Figure 8](#)).

Figure 8. Adjustable output voltage application

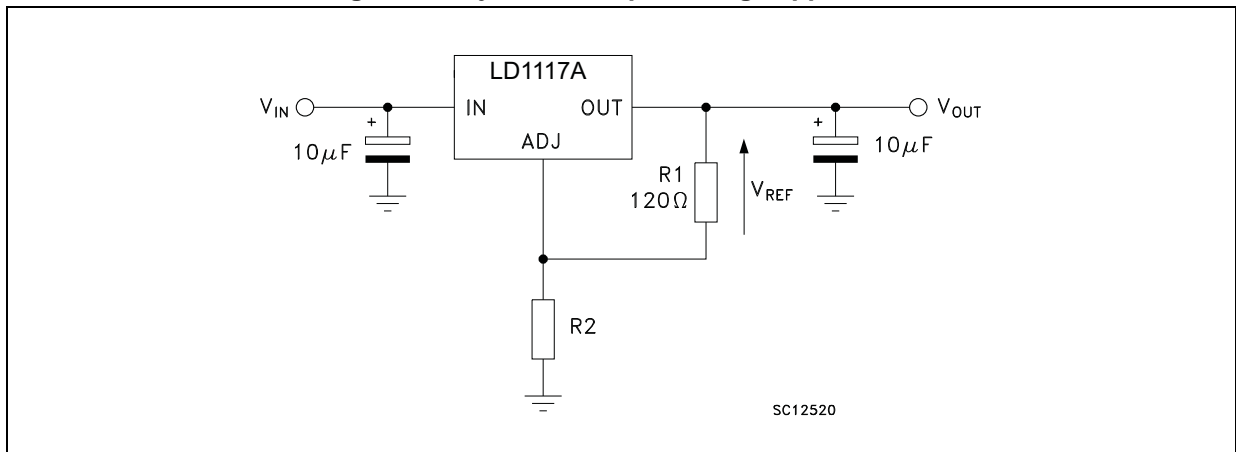
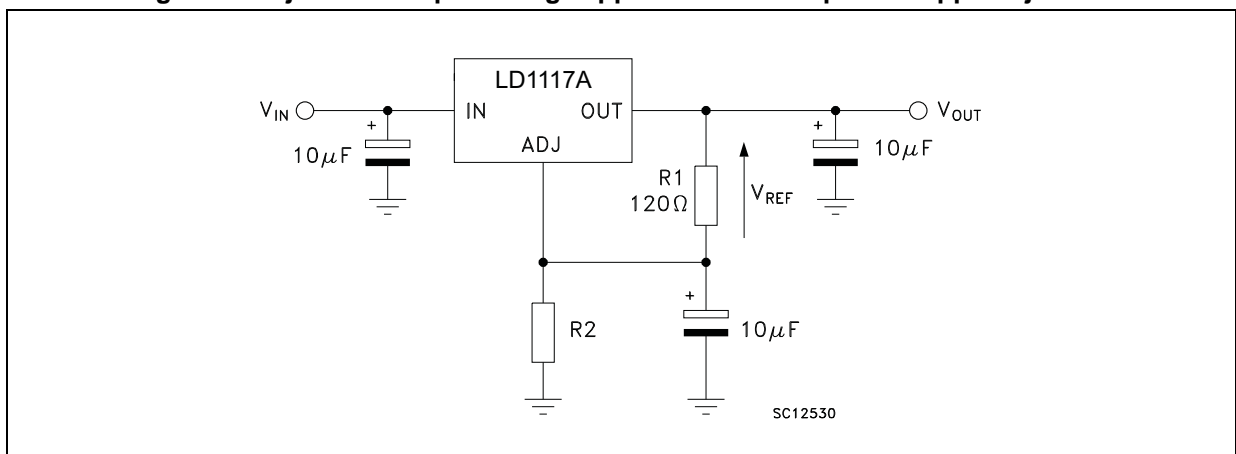


Figure 9. Adjustable output voltage application with improved ripple rejection



8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] 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 | |
| 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

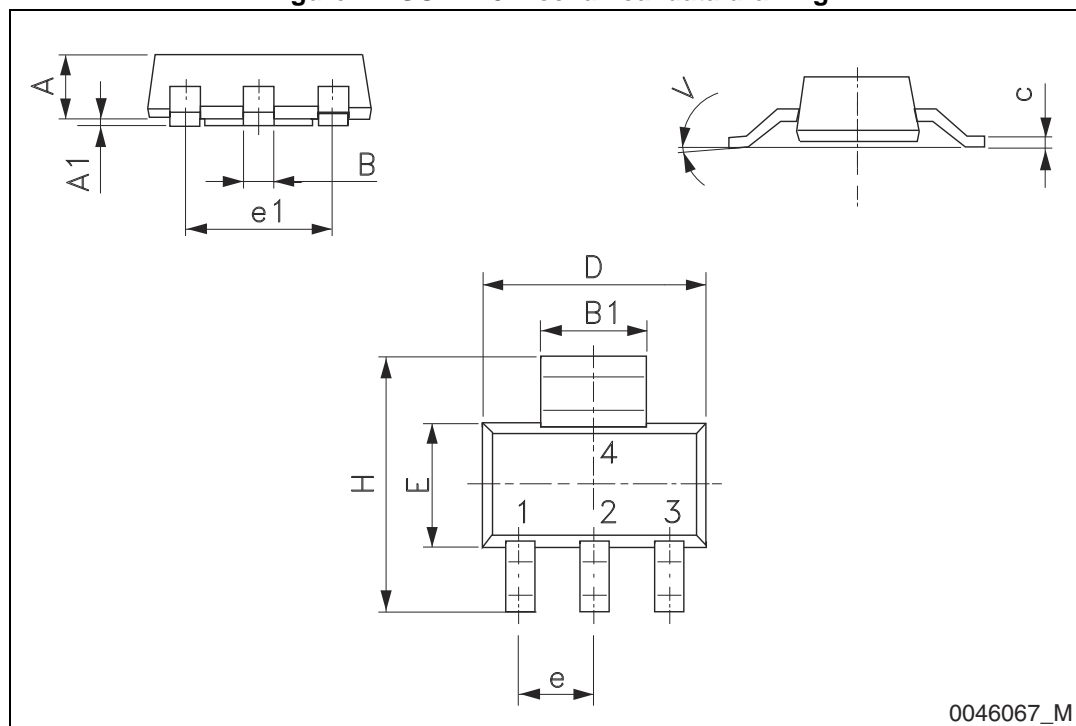
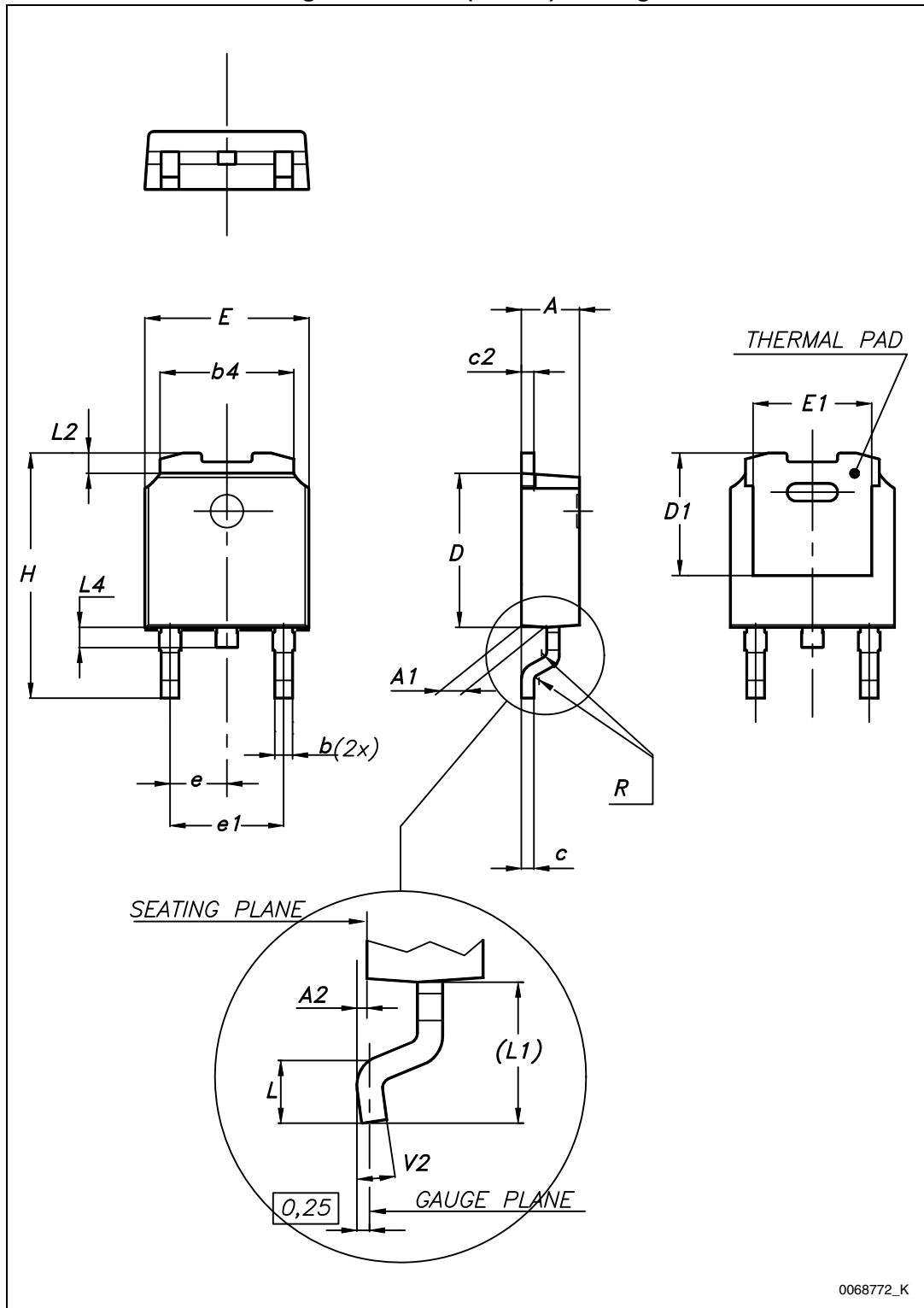


Table 10. DPAK (TO-252) mechanical data

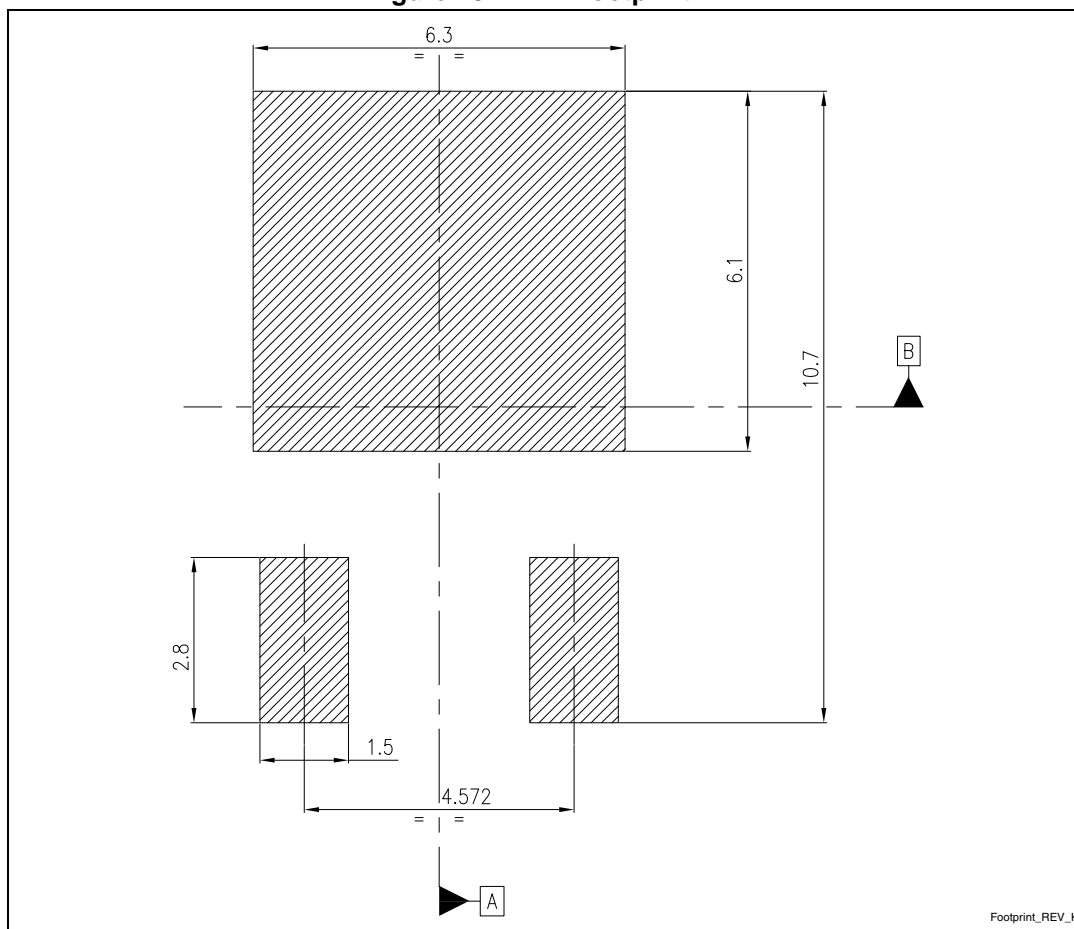
| Dim. | mm | | |
|------|------|------|-------|
| | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 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



0068772_K

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)

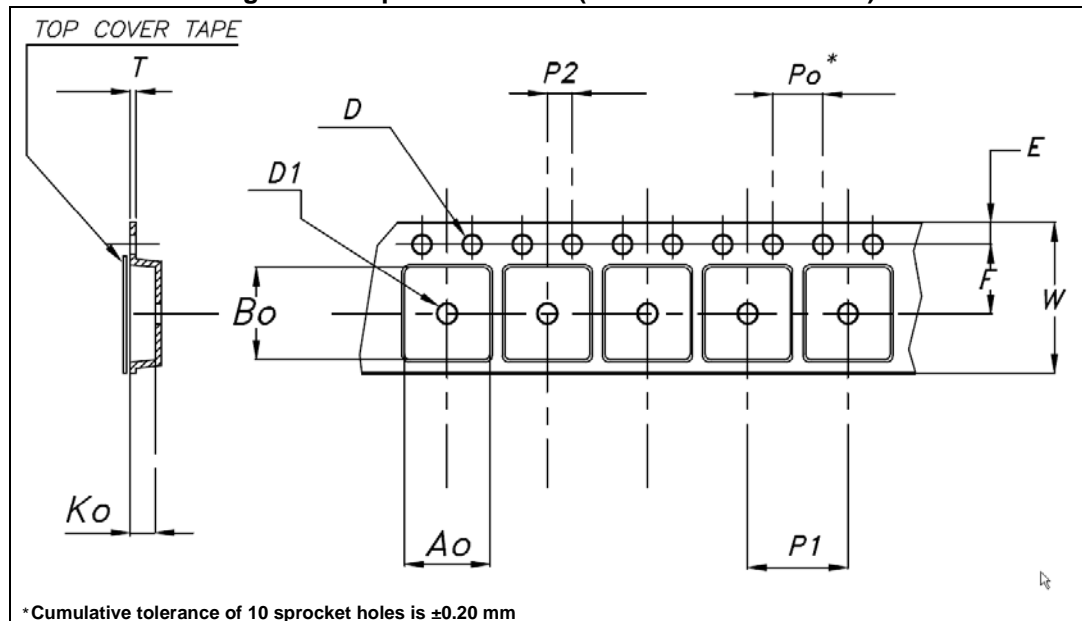


Figure 15. Reel for SOT-223 (dimensions are in mm)

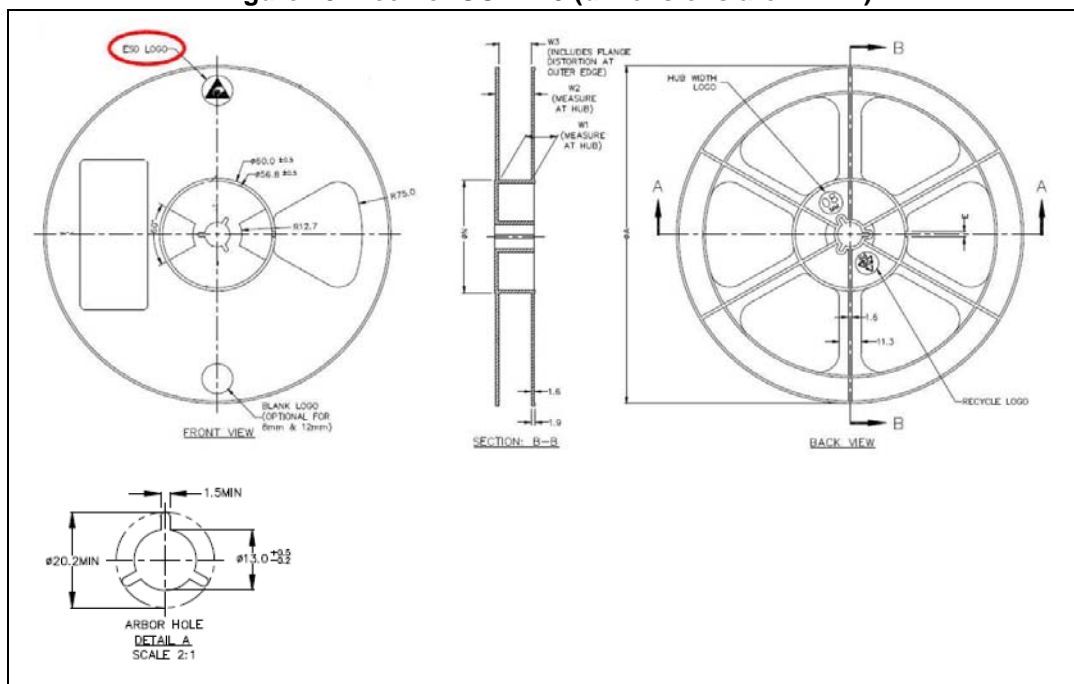


Table 12. DPAK tape and reel mechanical data

| 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

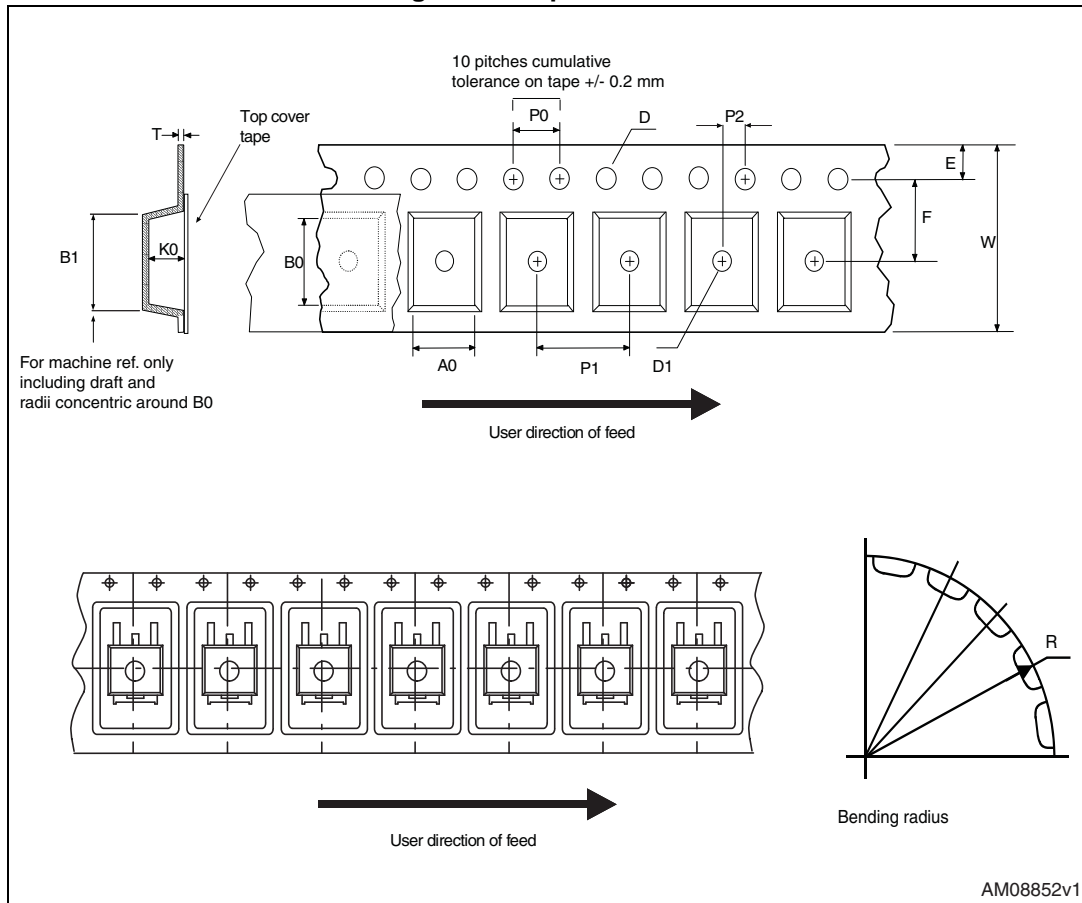
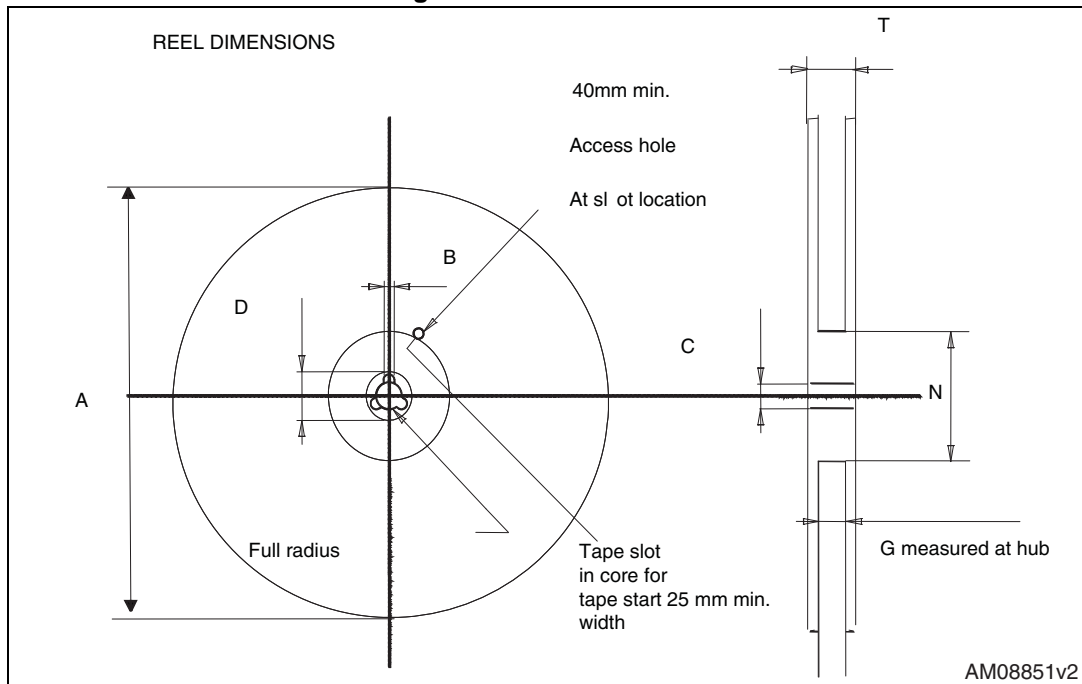


Figure 17. Reel for DPAK



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 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 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 V_O 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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