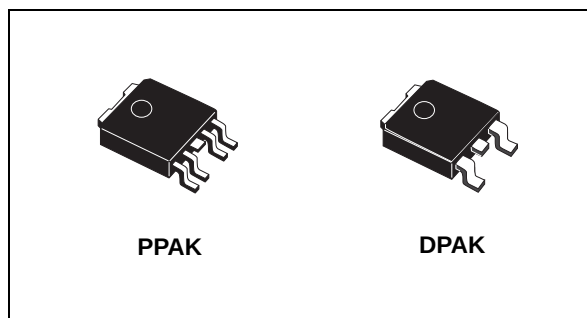


## Ultra low drop BICMOS voltage regulator

Datasheet - production data



### Features

- 3 A guaranteed output current
- Ultra low dropout voltage (200 mV typ. @ 3 A load, 40 mV typ. @ 600 mA load)
- Very low quiescent current (1.2 mA typ. @ 3 A load, 1  $\mu$ A max @ 25 °C in off mode)
- Logic-controlled electronic shutdown
- Current and thermal internal limit
- $\pm 1.5\%$  output voltage tolerance @ 25 °C
- Fixed and ADJ output voltages: 1.22 V, 1.8 V, 2.5 V, 3.3 V, ADJ
- Temperature range: -40 to 125 °C
- Fast dynamic response to line and load changes
- Stable with ceramic capacitor
- Available in PPAK and DPAK

### Application

- Microprocessor power supply
- DSPs power supply
- Post regulators for switching power supplies
- High efficiency linear regulator

### Description

The LD39300 is a fast ultra low drop linear regulator which operates from 2.5 V to 6 V input supply.

A wide range of output options are available. The low drop voltage, low noise, and ultra low quiescent current make it suitable for low voltage microprocessor and memory applications. The device is developed on a BiCMOS process which allows low quiescent current operation independently of output load current.

Table 1. Device summary

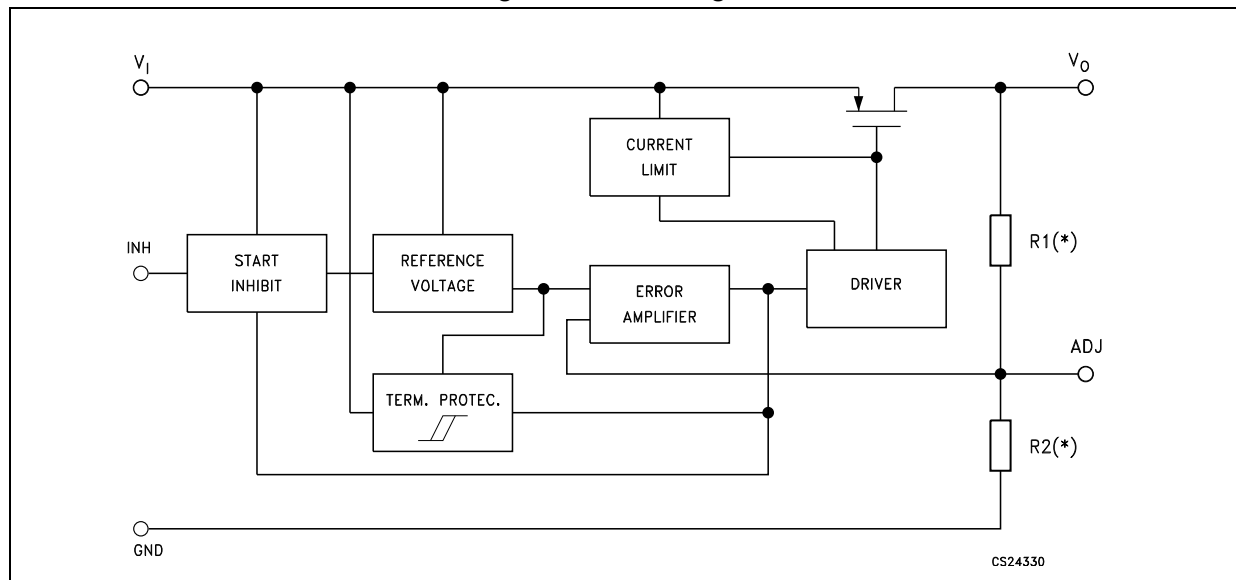
| Part numbers  |                              | Output voltage        |
|---------------|------------------------------|-----------------------|
| DPAK          | PPAK                         |                       |
| LD39300DT12-R |                              | 1.22V                 |
| LD39300DT18-R | LD39300PT18-R <sup>(1)</sup> | 1.8V                  |
| LD39300DT25-R | LD39300PT25-R <sup>(1)</sup> | 2.5V                  |
| LD39300DT33-R | LD39300PT33-R <sup>(1)</sup> | 3.3V                  |
|               | LD39300PT-R                  | ADJ from 1.22 to 5.0V |

1. Available on request

## Contents

|           |                                            |           |
|-----------|--------------------------------------------|-----------|
| <b>1</b>  | <b>Diagram</b>                             | <b>3</b>  |
| <b>2</b>  | <b>Pin configuration</b>                   | <b>4</b>  |
| <b>3</b>  | <b>Typical application circuits</b>        | <b>5</b>  |
| <b>4</b>  | <b>Maximum ratings</b>                     | <b>7</b>  |
| <b>5</b>  | <b>Electrical characteristics</b>          | <b>8</b>  |
| <b>6</b>  | <b>Typical performance characteristics</b> | <b>10</b> |
| <b>7</b>  | <b>Application notes</b>                   | <b>13</b> |
|           | 7.1 External capacitors                    | 13        |
|           | 7.2 Input capacitor                        | 13        |
|           | 7.3 Output capacitor                       | 13        |
|           | 7.4 Thermal note                           | 13        |
|           | 7.5 Inhibit input operation                | 13        |
| <b>8</b>  | <b>Package mechanical data</b>             | <b>14</b> |
| <b>9</b>  | <b>Packaging mechanical data</b>           | <b>20</b> |
| <b>10</b> | <b>Revision history</b>                    | <b>22</b> |

# 1 Diagram

**Figure 1. Block diagram**

(\*) Not present on ADJ versions

## 2 Pin configuration

Figure 2. Pin connections (top view for DPAK and PPAK)

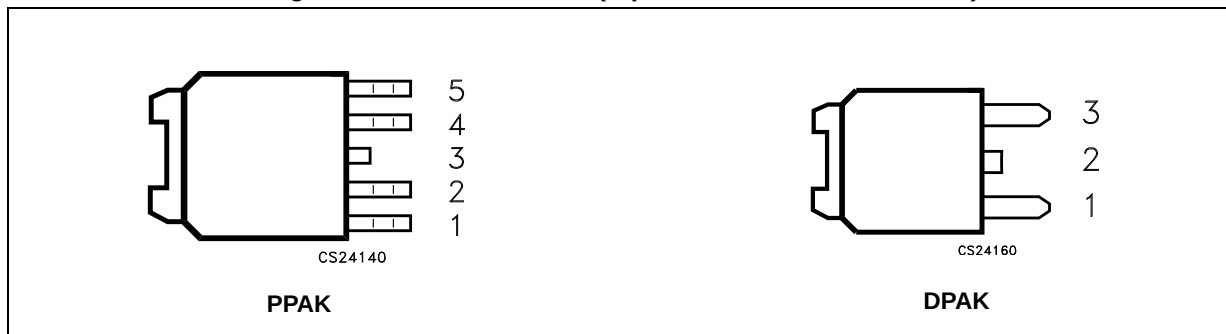


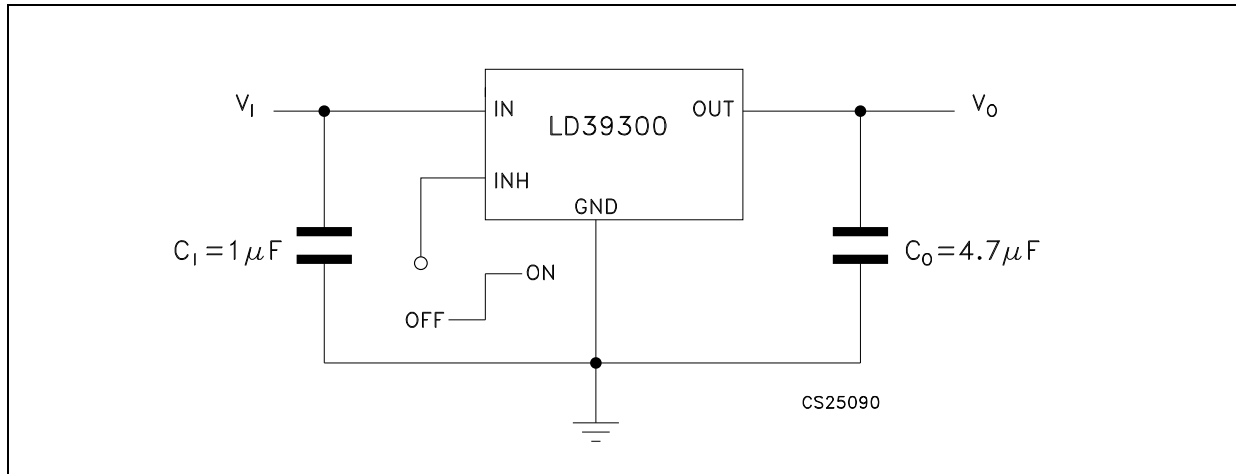
Table 2. Pin description

| Pin N° |      | Symbol           | Note                                                                                                                                             |
|--------|------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| PPAK   | DPAK |                  |                                                                                                                                                  |
| 5      |      | $V_{SENSE}/N.C.$ | For fixed versions: Not Connected on PPAK                                                                                                        |
|        |      | ADJ              | For adjustable version: Error Amplifier Input pin for $V_O$ from 1.22 to 5.0V                                                                    |
| 2      | 1    | $V_I$            | LDO Input Voltage; $V_I$ from 2.5V to 6V, $C_I=1\mu F$ must be located at a distance of not more than 0.5" from input pin.                       |
| 4      | 3    | $V_O$            | LDO Output Voltage pins, with minimum $C_O=4.7\mu F$ needed for stability (also refer to $C_O$ vs. ESR stability chart)                          |
| 1      |      | $V_{INH}$        | Inhibit Input Voltage: ON MODE when $V_{INH} \geq 2V$ , OFF MODE when $V_{INH} \leq 0.3V$ (Do not leave floating, not internally pulled down/up) |
| 3      | 2    | GND              | Common ground                                                                                                                                    |
| TAB    |      | GND              | Tab is connected to GND                                                                                                                          |

### 3 Typical application circuits

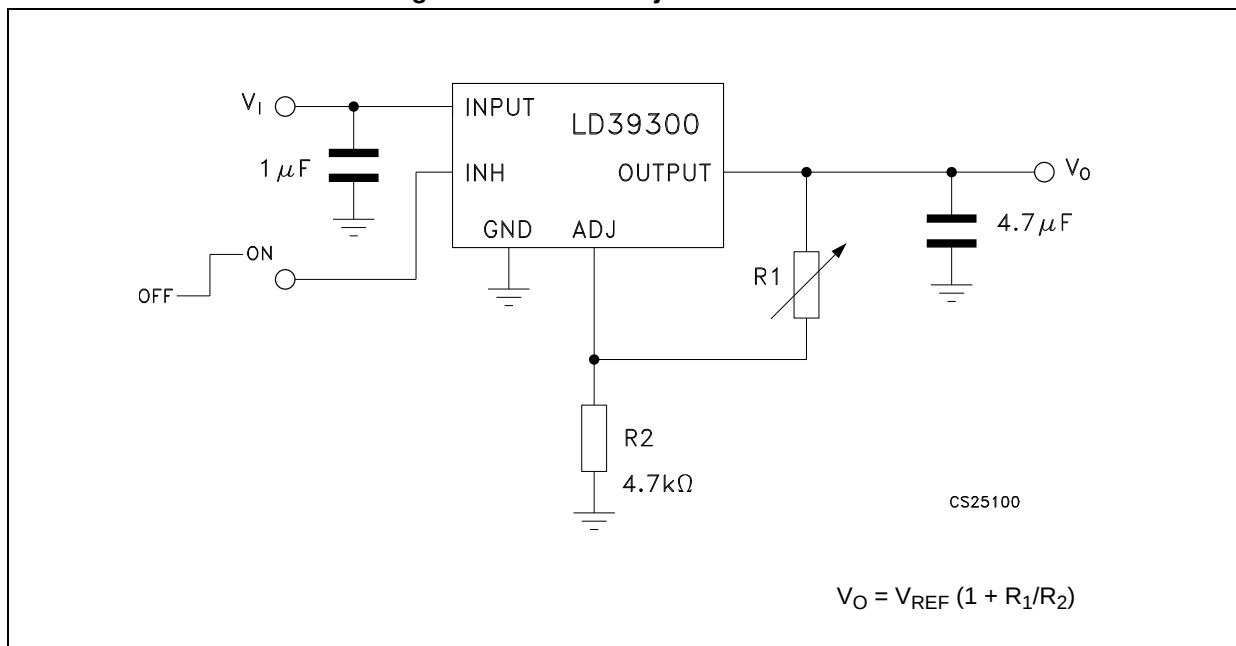
$C_I$  and  $C_O$  Capacitors must be placed as close as possible to the IC pins.

**Figure 3. LD39300 fixed version with inhibit**



- 1 Inhibit Pin is not internally pulled down/up then it must not be left floating. Disable the device when connected to GND or to a positive voltage less than 0.3 V

**Figure 4. LD39300 adjustable version**



- 2 Set  $R_2$  as close as possible to 4.7 K $\Omega$

Figure 5. LD39300 DPAK

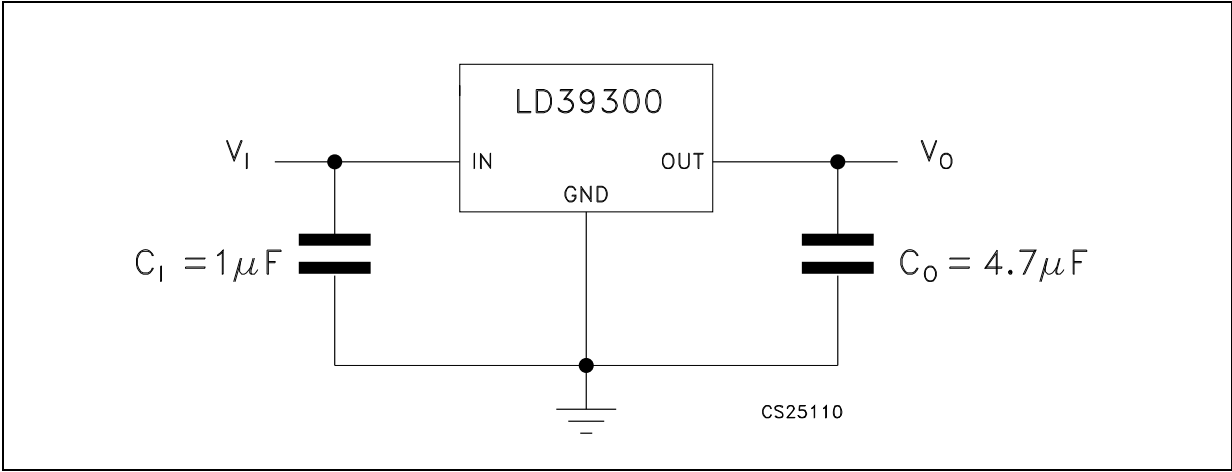
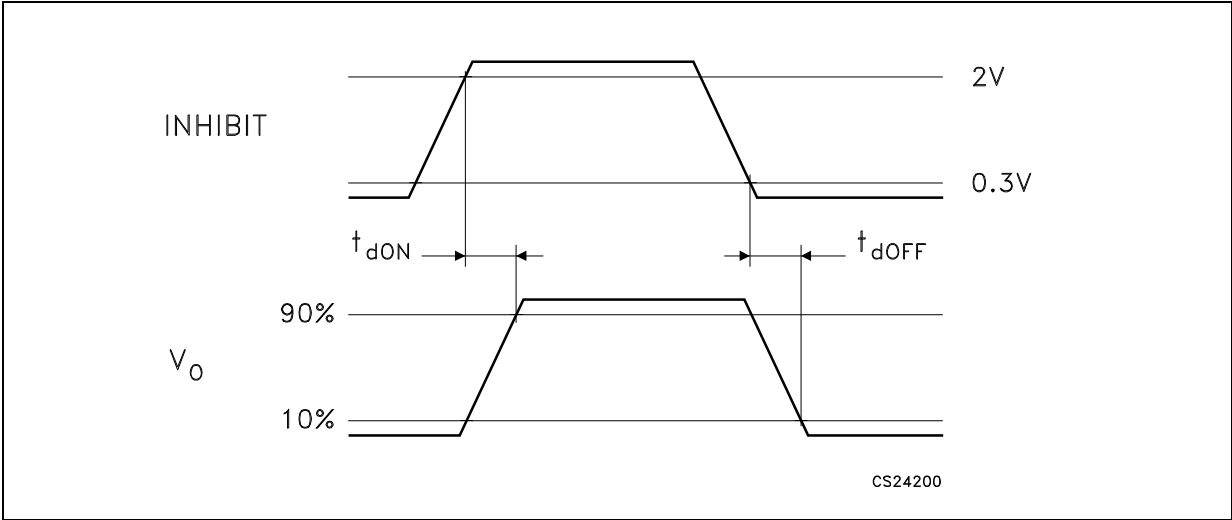


Figure 6. Timing diagram



## 4 Maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol    | Parameter                            | Value                          | Unit |
|-----------|--------------------------------------|--------------------------------|------|
| $V_I$     | DC input voltage                     | -0.3 to 6.5                    | V    |
| $V_{INH}$ | INHIBIT input voltage                | -0.3 to $V_I + 0.3$ (6.5V max) | V    |
| $V_O$     | DC output voltage                    | -0.3 to $V_I + 0.3$ (6.5V max) | V    |
| $V_{ADJ}$ | ADJ pin voltage                      | -0.3 to $V_I + 0.3$ (6.5V max) | V    |
| $I_O$     | Output current                       | Internally limited             | mA   |
| $P_D$     | Power dissipation                    | Internally limited             | mW   |
| $T_{STG}$ | Storage temperature range            | -50 to 150                     | °C   |
| $T_{OP}$  | Operating junction temperature range | -40 to 125                     | °C   |

*Note:* Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All values are referred to GND.

**Table 4. Thermal data**

| Symbol     | Parameter                           | PPAK | DPAK | Unit |
|------------|-------------------------------------|------|------|------|
| $R_{thJA}$ | Thermal resistance junction-ambient | 100  | 100  | °C/W |
| $R_{thJC}$ | Thermal resistance junction-case    | 8    | 8    | °C/W |

## 5 Electrical characteristics

$T_J = 25^\circ\text{C}$ ,  $V_I = V_O + 1\text{ V}$ ,  $C_I = 1\text{ }\mu\text{F}$ ,  $C_O = 4.7\text{ }\mu\text{F}$ ,  $I_{\text{LOAD}} = 10\text{ mA}$ ,  $V_{\text{INH}} = 2\text{ V}$ , unless otherwise specified.

**Table 5. Electrical characteristics**

| Symbol                              | Parameter                                          | Parameter                                                                                                  | Min. | Typ. | Max. | Unit                     |
|-------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------|------|------|------|--------------------------|
| V <sub>I</sub>                      | Operating input voltage                            |                                                                                                            | 2.5  |      | 6    | V                        |
| V <sub>O</sub>                      | Output voltage tolerance                           | V <sub>I</sub> = V <sub>O</sub> +1V, I <sub>LOAD</sub> = 10mA to 3A                                        | -1.5 |      | 1.5  | % of V <sub>O(NOM)</sub> |
|                                     |                                                    | V <sub>I</sub> = V <sub>O</sub> +1V to 6V, I <sub>LOAD</sub> = 10mA to 3A<br>T <sub>J</sub> = -40 to 125°C | -3   |      | 3    |                          |
| V <sub>REF</sub>                    | Reference voltage                                  |                                                                                                            |      | 1.22 |      | V                        |
| ΔV <sub>O</sub>                     | Output voltage LINE regulation                     | V <sub>I</sub> = V <sub>O</sub> +1V to 6V                                                                  |      | 0.04 |      | %                        |
|                                     |                                                    | V <sub>I</sub> = V <sub>O</sub> +1V to 6V, T <sub>J</sub> = -40 to 125°C                                   |      | 0.1  | 0.2  | %                        |
| ΔV <sub>O</sub> /ΔI <sub>LOAD</sub> | Output voltage LOAD regulation                     | I <sub>LOAD</sub> = 10mA to 3A                                                                             |      | 0.06 |      | % / A                    |
|                                     |                                                    | I <sub>LOAD</sub> = 10mA to 3A, T <sub>J</sub> = -40 to 125°C                                              |      | 0.2  | 0.4  |                          |
| V <sub>DROP</sub>                   | Dropout voltage (V <sub>I</sub> - V <sub>O</sub> ) | I <sub>LOAD</sub> = 600mA, T <sub>J</sub> =-40 to 125°C                                                    |      | 40   | 80   | mV                       |
|                                     |                                                    | I <sub>LOAD</sub> = 3A, T <sub>J</sub> = -40 to 125°C                                                      |      | 200  | 400  |                          |
| I <sub>Q</sub>                      | Quiescent current: ON MODE                         | I <sub>LOAD</sub> = 10mA to 3A, V <sub>INH</sub> = 2V<br>T <sub>J</sub> = -40 to 125°C                     |      | 1.2  | 2.5  | mA                       |
|                                     | Quiescent current: OFF MODE                        | V <sub>INH</sub> = 0.3V                                                                                    |      |      | 1    | μA                       |
|                                     |                                                    | V <sub>INH</sub> = 0.3V, T <sub>J</sub> = -40 to 125°C                                                     |      |      | 5    |                          |
| Short Circuit Protection            |                                                    |                                                                                                            |      |      |      |                          |
| I <sub>SC</sub>                     | Short circuit protection                           | R <sub>L</sub> = 0                                                                                         |      | 6    |      | A                        |
| Inhibit Input                       |                                                    |                                                                                                            |      |      |      |                          |
| V <sub>INH</sub>                    | Inhibit threshold LOW                              | V <sub>I</sub> = 2.5 to 6V OFF<br>T <sub>J</sub> = -40 to 125°C                                            |      |      | 0.3  | V                        |
|                                     | Inhibit threshold HIGH                             |                                                                                                            | 2    |      |      |                          |
| T <sub>D-OFF</sub>                  | Current limit                                      | I <sub>LOAD</sub> = 3A, V <sub>O</sub> = 3.3V                                                              |      | 20   |      | μs                       |
| T <sub>D-ON</sub>                   | Current limit                                      | I <sub>LOAD</sub> = 3A, V <sub>O</sub> = 3.3V                                                              |      | 20   |      |                          |
| I <sub>INH</sub>                    | Inhibit input current <sup>(1)</sup>               | V <sub>I</sub> = 6V, V <sub>INH</sub> = 0 to 6V                                                            |      | ±0.1 | ±1   | μA                       |

Table 5. Electrical characteristics (continued)

| Symbol        | Parameter                | Parameter                                                     | Min.        | Typ. | Max. | Unit          |
|---------------|--------------------------|---------------------------------------------------------------|-------------|------|------|---------------|
| AC Parameters |                          |                                                               |             |      |      |               |
| SVR           | Supply voltage rejection | $V_I = 4.5 \pm 1V$ ,<br>$V_O = 3.3V$ ,<br>$I_{LOAD} = 10mA$ , | $f = 120Hz$ |      | 65   | dB            |
|               |                          |                                                               | $f = 1kHz$  |      | 55   |               |
| $e_N$         | Output noise voltage     | $B_W = 10Hz$ to $100kHz$ ,<br>$C_O = 4.7\mu F$ , $V_O = 2.5V$ |             | 100  |      | $\mu V_{RMS}$ |
| $T_{SHDN}$    | Thermal shutdown OFF     |                                                               |             | 170  |      | $^{\circ}C$   |
|               | Hysteresis               |                                                               |             | 10   |      |               |

1. Guaranteed by design

# 6 Typical performance characteristics

( $T_J = 25^{\circ}\text{C}$ ,  $V_I = V_O + 1\text{V}$ ,  $C_I = 1\mu\text{F}$ ,  $C_O = 4.7\mu\text{F}$ ,  $I_{\text{LOAD}} = 10\text{mA}$ ,  $V_{\text{INH}} = V_I$ , unless otherwise specified)

Figure 7. Output voltage vs temperature

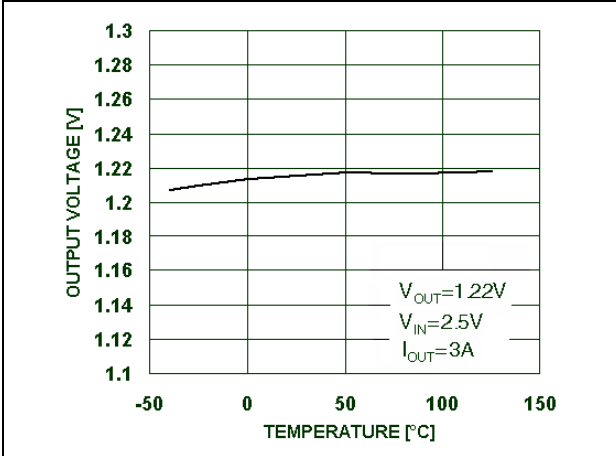


Figure 8. Dropout voltage vs temperature

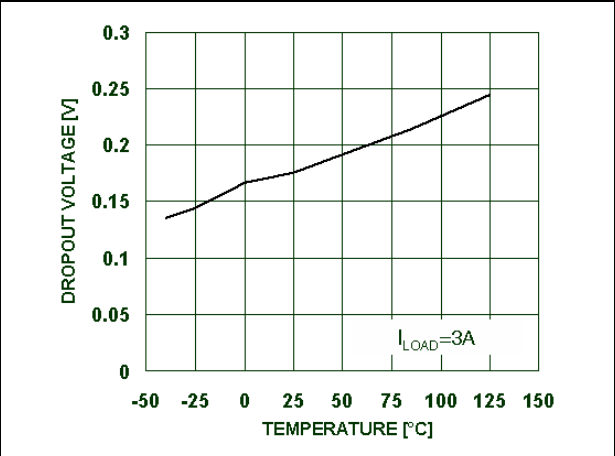


Figure 9. Dropout voltage vs output current

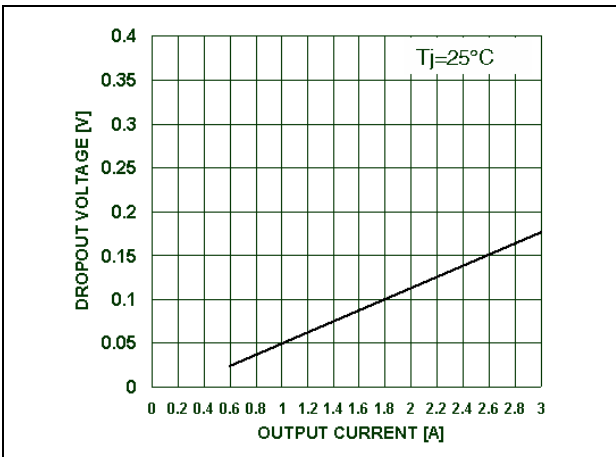


Figure 10. Quiescent current vs temperature ( $I_{\text{out}} = 10\text{ mA}$ )

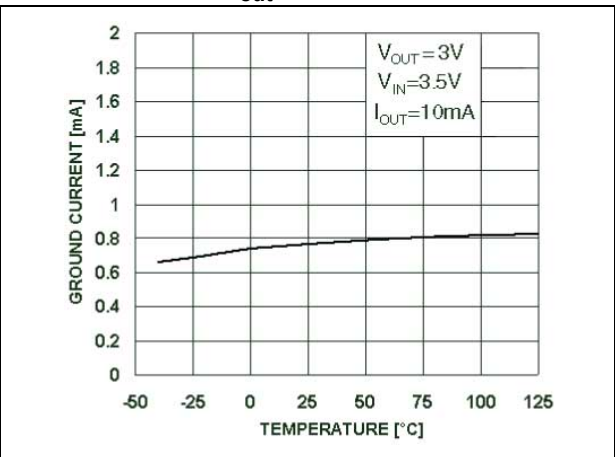


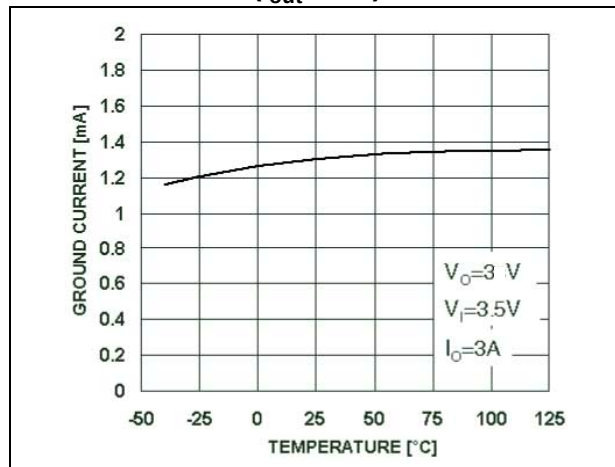
Figure 11. Quiescent current vs temperature  
( $I_{out} = 3\text{ A}$ )

Figure 12. Short circuit current vs temperature

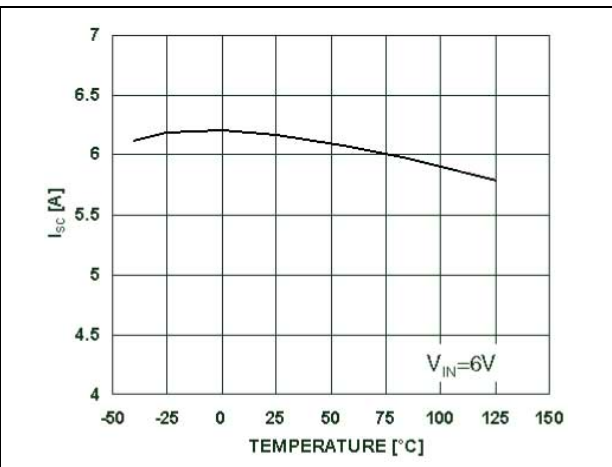


Figure 13. Output voltage vs input voltage

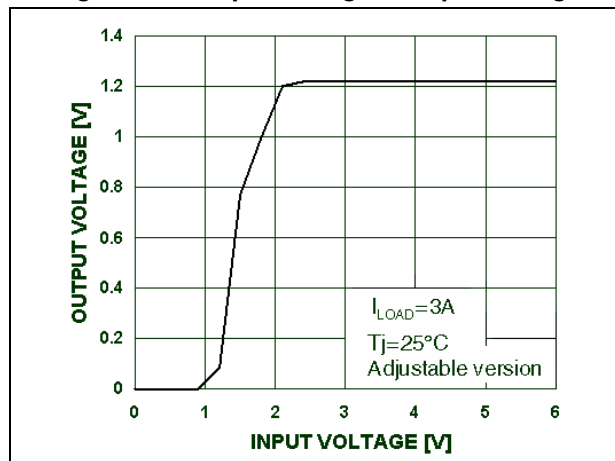
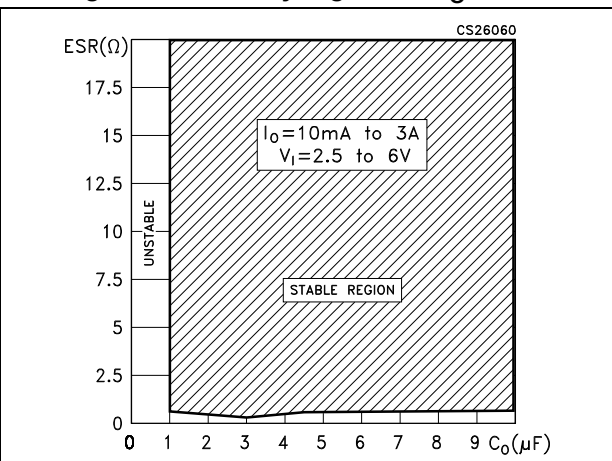
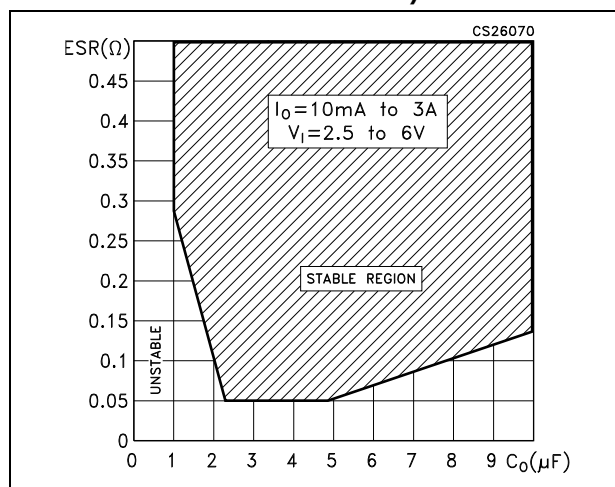
Figure 14. Stability region vs  $C_O$  & ESRFigure 15. Stability region vs  $C_O$  & ESR (low ESR zoom area)

Figure 16. Load transient (fall time)

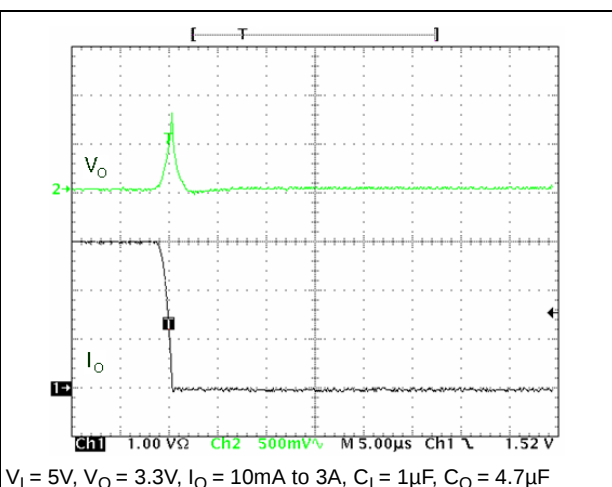


Figure 17. Load transient (rise time)

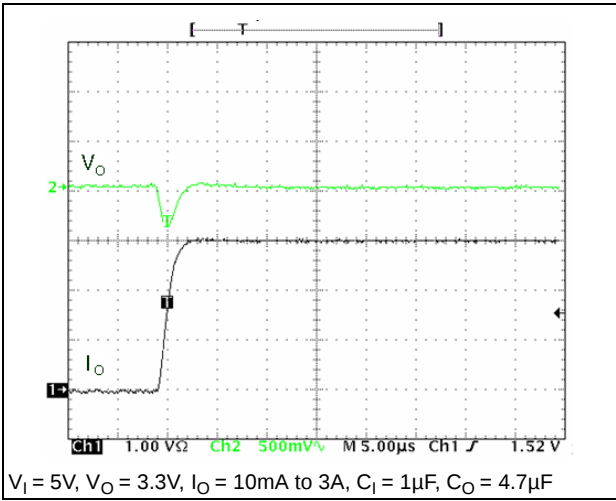
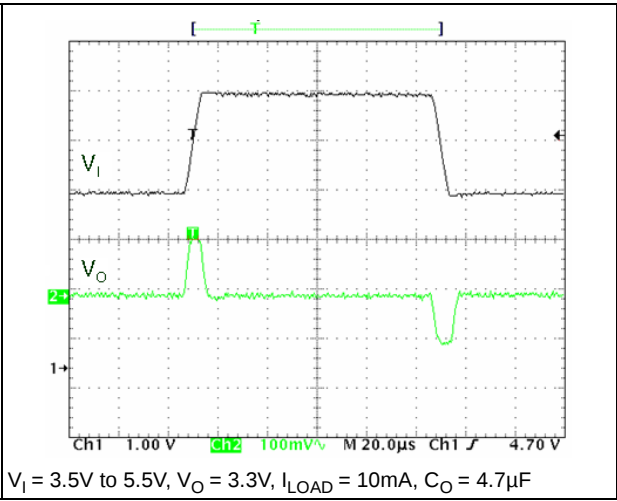


Figure 18. Line transient



## 7 Application notes

### 7.1 External capacitors

The LD39300 requires external capacitors for regulator stability. These capacitors must be selected to meet the requirements of minimum capacitance and equivalent series resistance (see [Figure 14.](#) and [Figure 15.](#)). The input/output capacitors must be located less than 1cm from the relative pins and connected directly to the input/output ground pins using traces which have no other currents flowing through them. Any good quality of Ceramic or Electrolytic capacitors can be used.

### 7.2 Input capacitor

An input capacitor whose minimum value is 1  $\mu\text{F}$  is required with the LD39300 (amount of capacitance can be increased without limit). This capacitor must be located a distance of not more than 1 cm from the input pin of the device and returned to a clean analog ground. Any good quality ceramic, tantalum or film capacitors can be used for this capacitor.

### 7.3 Output capacitor

It is possible to use Ceramic or Tantalum capacitors but the output capacitor must meet the requirement for minimum amount of capacitance and E.S.R. (equivalent series resistance) value. A minimum capacitance of 4.7  $\mu\text{F}$  is a good choice to guarantee the stability of the regulator. Anyway, other  $C_O$  values can be used according to the ([Figure 14.](#) and [Figure 15.](#)) showing the allowable ESR range as a function of the output capacitance. This curve represents the stability region over the full temperature and  $I_O$  range.

### 7.4 Thermal note

The output capacitor must maintain its ESR in the stable region over the full operating temperature range to assure stability. Also, capacitors tolerance and variation with temperature must be kept in consideration in order to assure the minimum amount of capacitance at all times.

### 7.5 Inhibit input operation

The inhibit pin can be used to turn OFF the regulator when pulled down, so drastically reducing the current consumption down to less than 1  $\mu\text{A}$ . When the inhibit feature is not used, this pin must be tied to  $V_I$  to keep the regulator output ON at all times. To assure proper operation, the signal source used to drive the inhibit pin must be able to swing above and below the specified thresholds listed in the electrical characteristics section ( $V_{IH}$   $V_{IL}$ ). The inhibit pin must not be left floating because it is not internally pulled down/up.

## 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](http://www.st.com). ECOPACK® is an ST trademark.

Figure 19. DPAK drawing

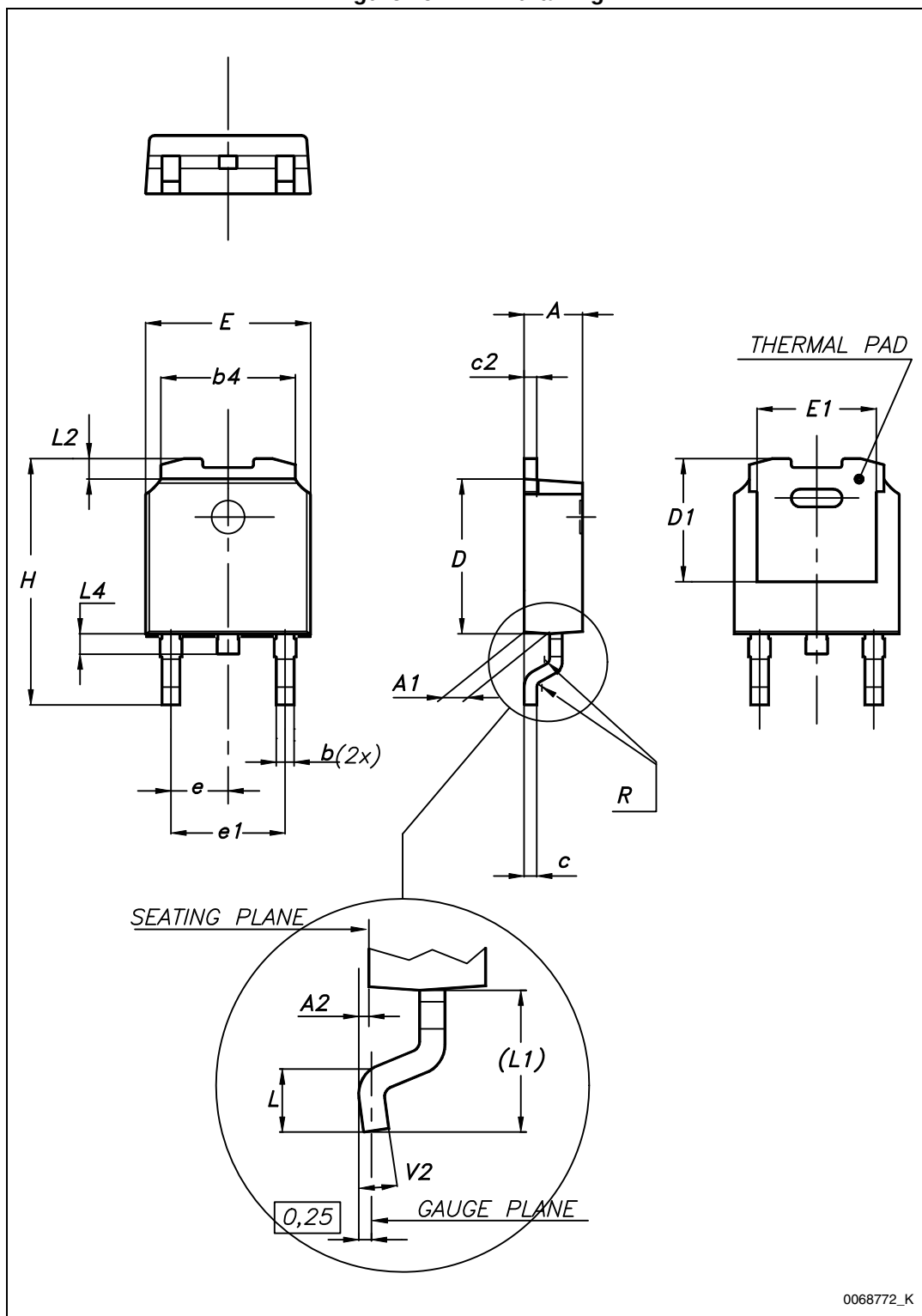
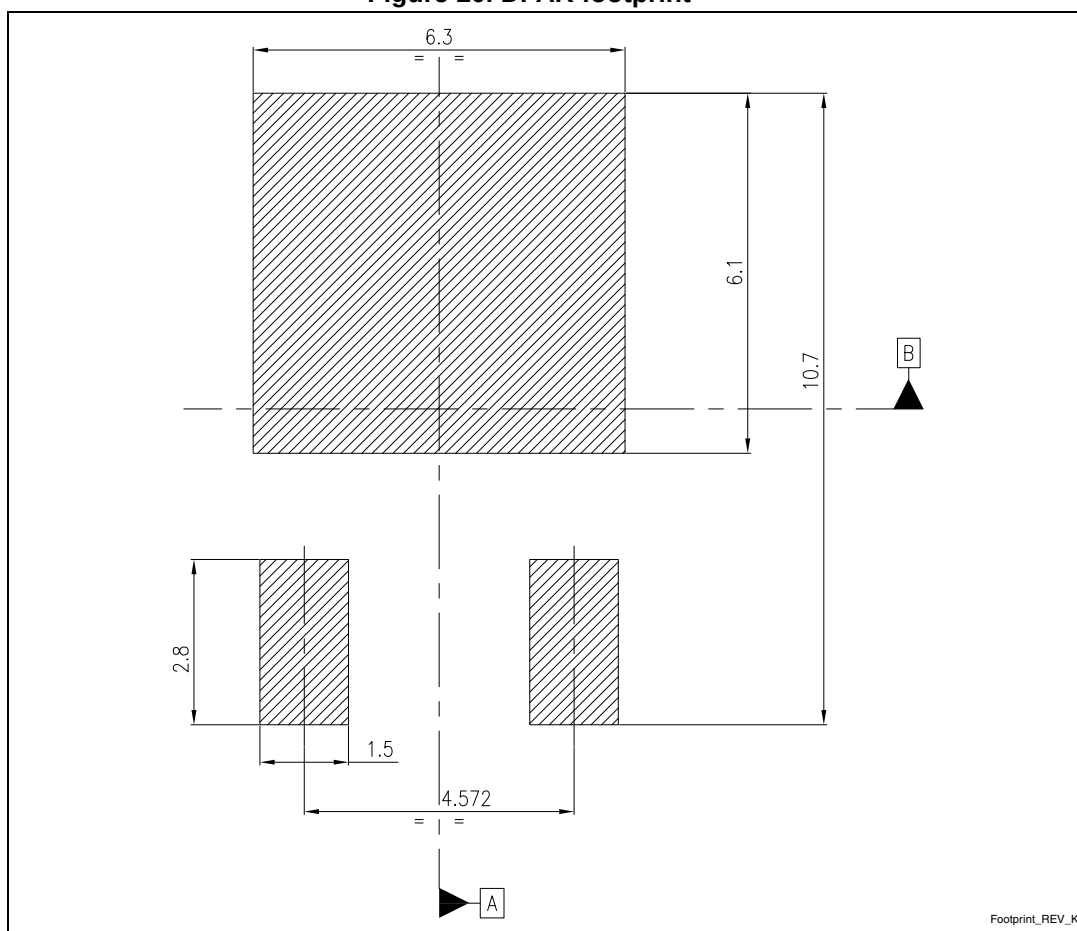


Table 6. DPAK mechanical data

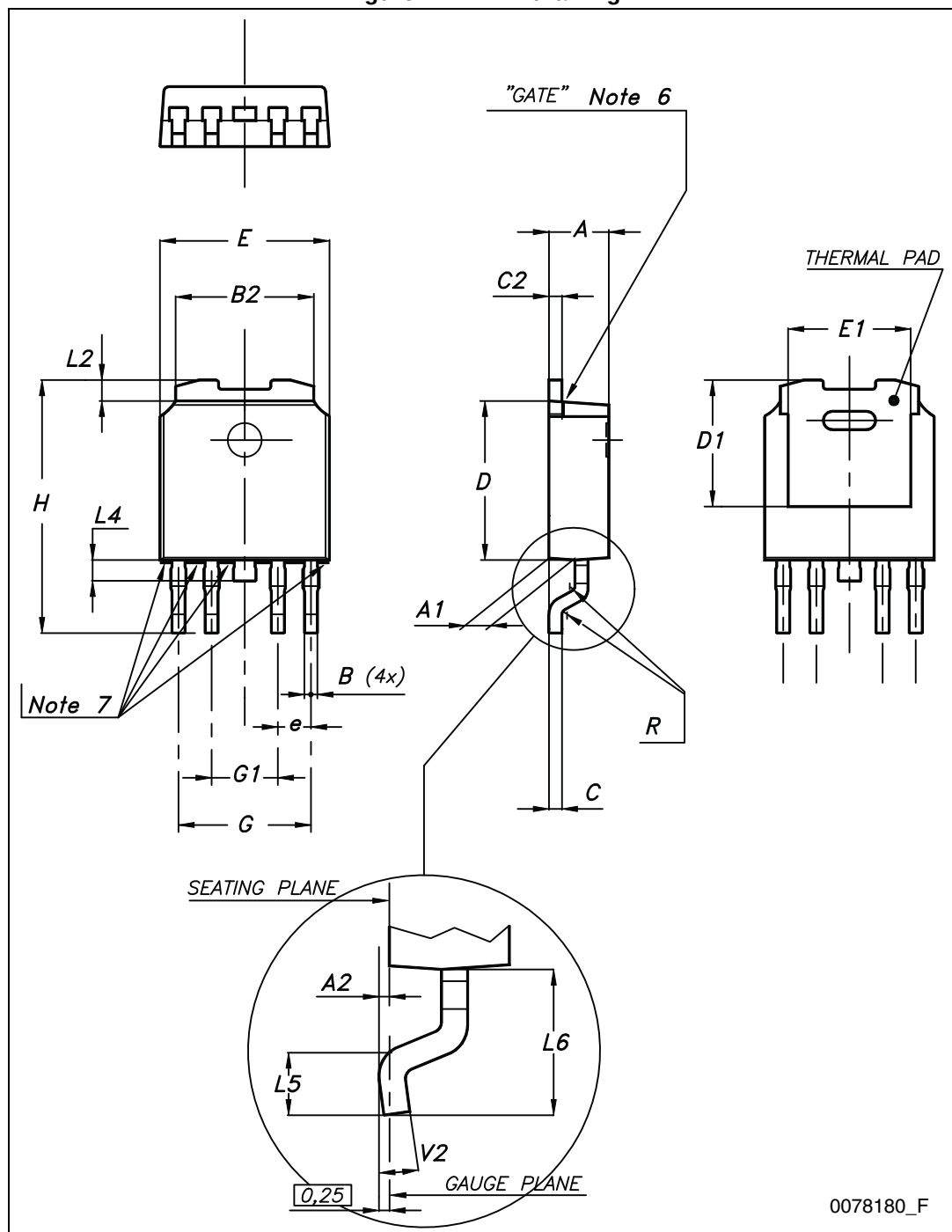
| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 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 20. DPAK footprint (a)



a. All dimensions are in millimeters.

Figure 21. PPAK drawing



0078180\_F

Table 7. PPAK mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 2.2  |      | 2.4  |
| A1   | 0.9  |      | 1.1  |
| A2   | 0.03 |      | 0.23 |
| B    | 0.4  |      | 0.6  |
| B2   | 5.2  |      | 5.4  |
| C    | 0.45 |      | 0.6  |
| C2   | 0.48 |      | 0.6  |
| D    | 6    |      | 6.2  |
| D1   |      | 5.1  |      |
| E    | 6.4  |      | 6.6  |
| E1   |      | 4.7  |      |
| e    |      | 1.27 |      |
| G    | 4.9  |      | 5.25 |
| G1   | 2.38 |      | 2.7  |
| H    | 9.35 |      | 10.1 |
| L2   |      | 0.8  | 1    |
| L4   | 0.6  |      | 1    |
| L5   | 1    |      |      |
| L6   |      | 2.8  |      |
| R    |      | 0.20 |      |
| V2   | 0°   |      | 8°   |

9 Packaging mechanical data

Figure 22. PPAK and DPAK tape

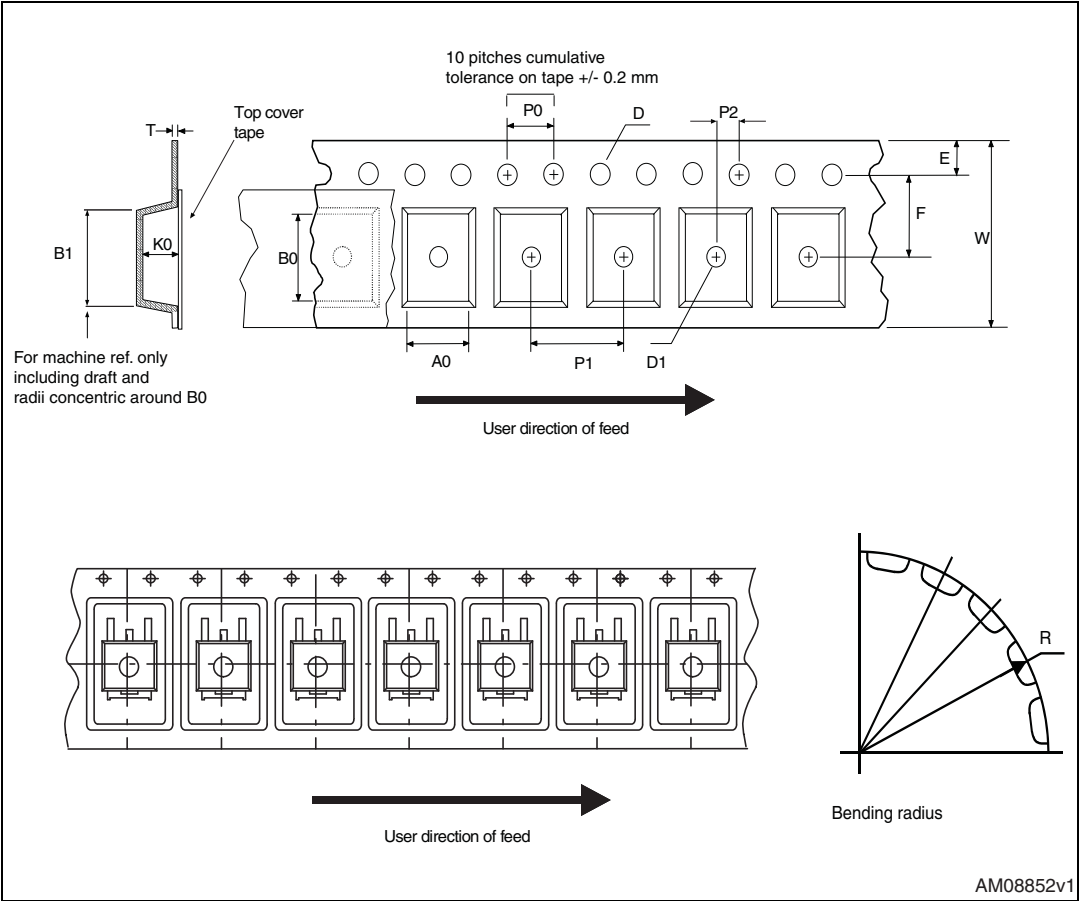


Figure 23. PPAK and DPAK reel

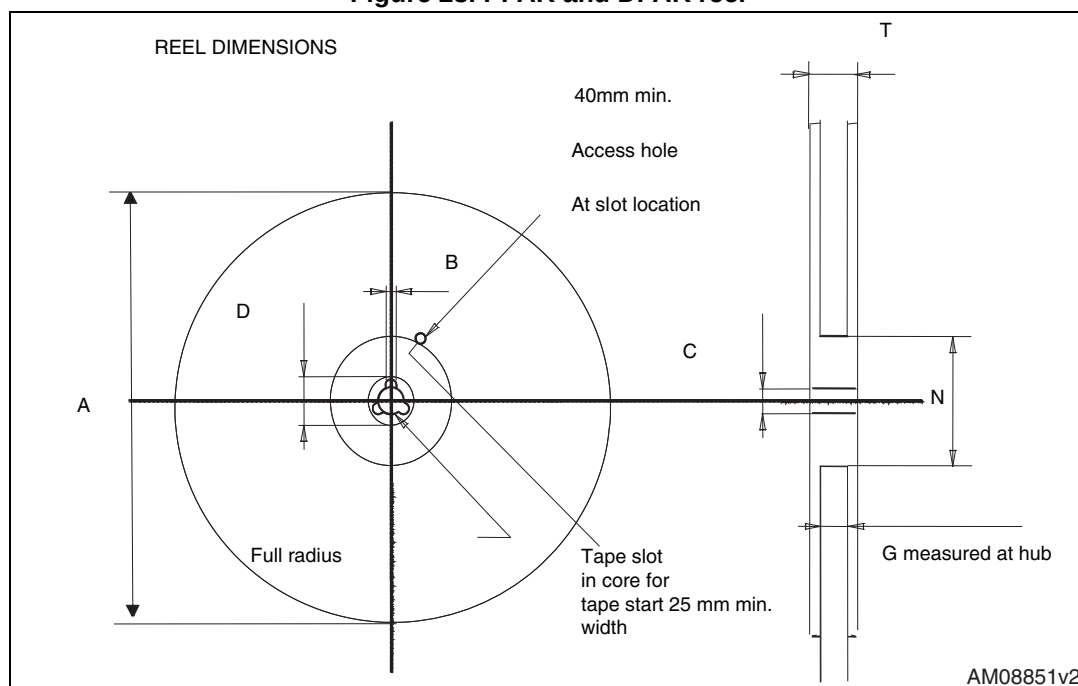


Table 8. PPAK and DPAK tape and reel mechanical data

| 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 |           |      |      |

## 10 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                    |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26-Jan-2007 | 1        | Initial release.                                                                                                                                                                                                                           |
| 04-Jun-2014 | 2        | Updated <a href="#">Table 1: Device summary</a> , <a href="#">Table 2: Pin description</a> and <a href="#">Section 8: Package mechanical data</a> .<br>Added <a href="#">Section 9: Packaging mechanical data</a> .<br>Minor text changes. |

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