

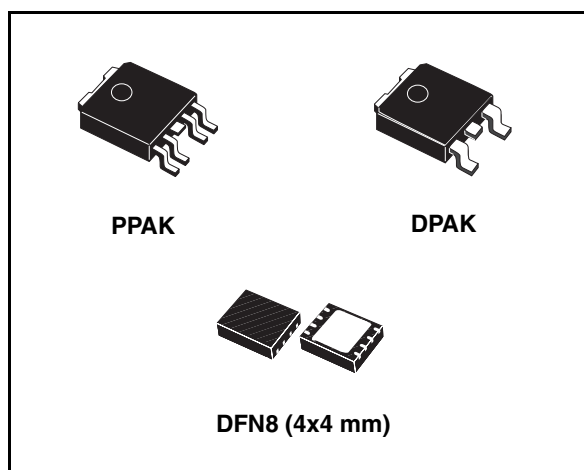
Ultra low drop BICMOS voltage regulator

Feature summary

- 1.5A Guaranteed output current
- Ultra low dropout voltage (200mV typ. @ 1.5A load, 40mV typ. @300mA load)
- Very low quiescent current (1mA typ. @ 1.5A load, 1µA max @ 25°C in off mode)
- Logic-controlled electronic shutdown
- Current and thermal internal limit
- ±1.5% Output voltage tolerance @ 25°C
- Fixed and ADJ output voltages: 1.22V, 1.8V, 2.5V, 3.3V, ADJ. (*see order code)
- Temperature range: -40 to 125°C
- Fast dynamic response to line and load changes
- Stable with ceramic capacitor (see paragraph 7.1, 7.2, 7.3)
- Available in PPAK, DPAK and DFN8 (4x4mm)

Typical application

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



Description

The LD39150 is a fast ultra low drop linear regulator which operates from 2.5V to 6V 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.

Order codes

| Part numbers | | | Output Voltage |
|---------------|---------------|--------------------|-----------------------|
| DPAK (T&R) | PPAK (T&R) | DFN ⁽¹⁾ | |
| LD39150DT12-R | | LD39150PU12R | 1.22V |
| LD39150DT18-R | LD39150PT18-R | LD39150PU18R | 1.8V |
| LD39150DT25-R | LD39150PT25-R | LD39150PU25R | 2.5V |
| LD39150DT33-R | LD39150PT33-R | LD39150PU33R | 3.3V |
| | LD39150PT-R | LD39150PU-R | ADJ From 1.22 to 5.0V |

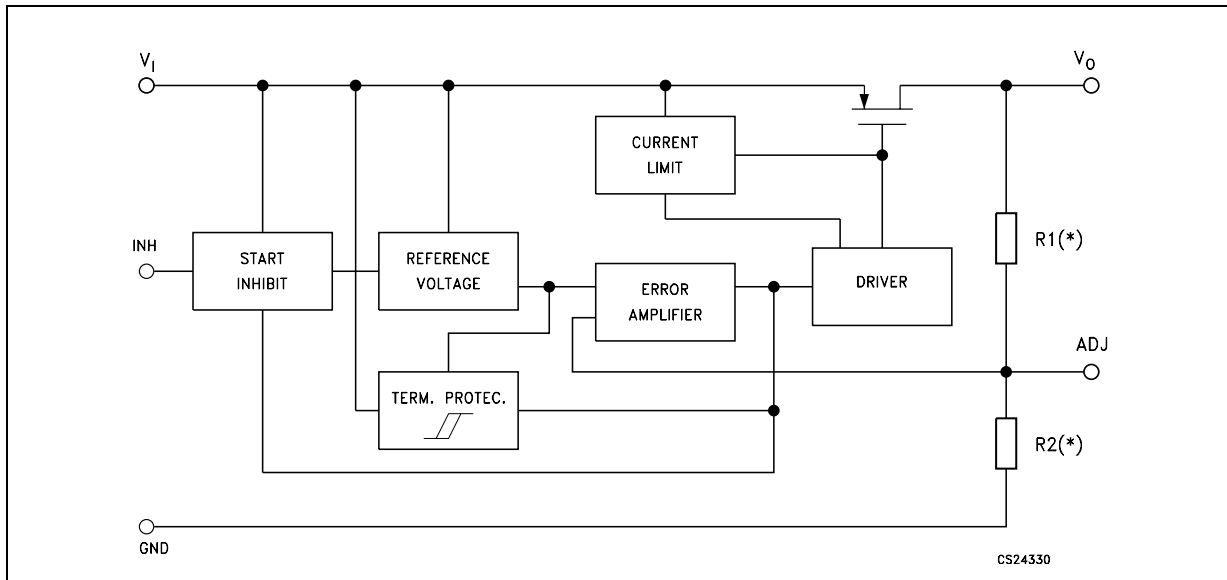
1. Available on request

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1 Diagram

Figure 1. Block diagram



(*) Not present on ADJ Versions

2 Pin configuration

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

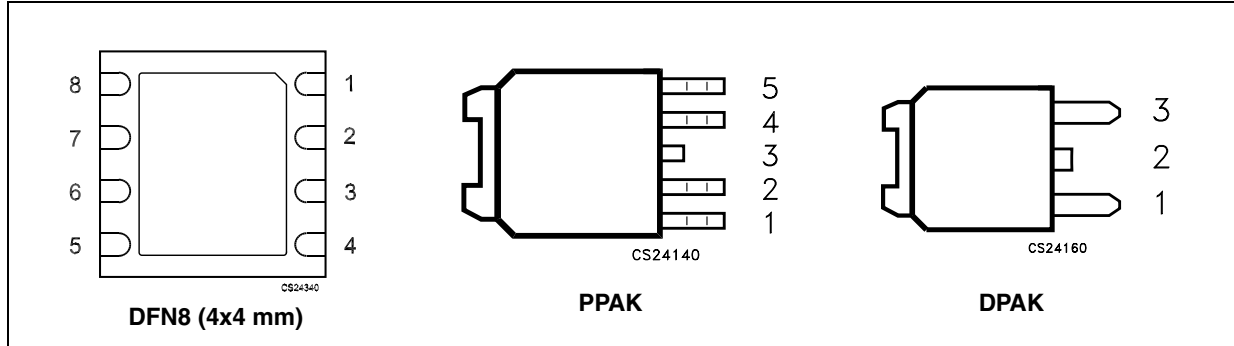


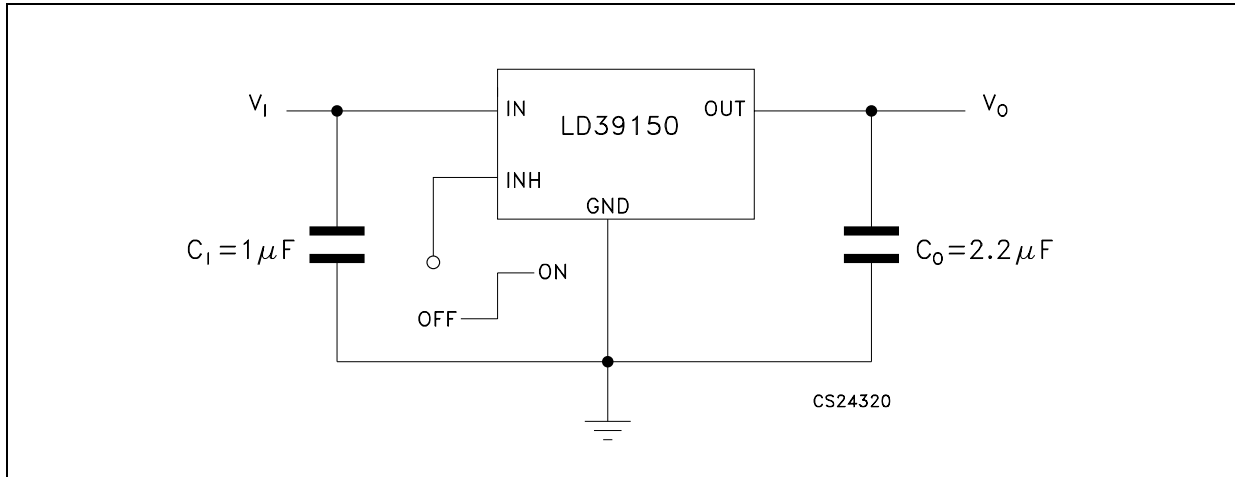
Table 1. Pin description

| PIN N° | | | SYMBOL | NOTE |
|--------|------|------|------------------|--|
| DFN | PPAK | DPAK | | |
| 8 | 5 | | $V_{SENSE}/N.C.$ | For fixed versions: to be connected with LDO Output Voltage pins for DFN package and Not Connected on PPAK |
| | | | ADJ | For adjustable version: Error Amplifier Input pin for V_O from 1.22 to 5.0V |
| 3, 4 | 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. |
| 6, 7 | 4 | 3 | V_O | LDO Output Voltage pins, with minimum $C_O=2.2\mu F$ needed for stability (also refer to C_O vs. ESR stability chart) |
| 2 | 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) |
| 1 | 3 | 2 | GND | Common ground |
| 5 | | | N.C. | Not Connected |

3 Typical application circuits

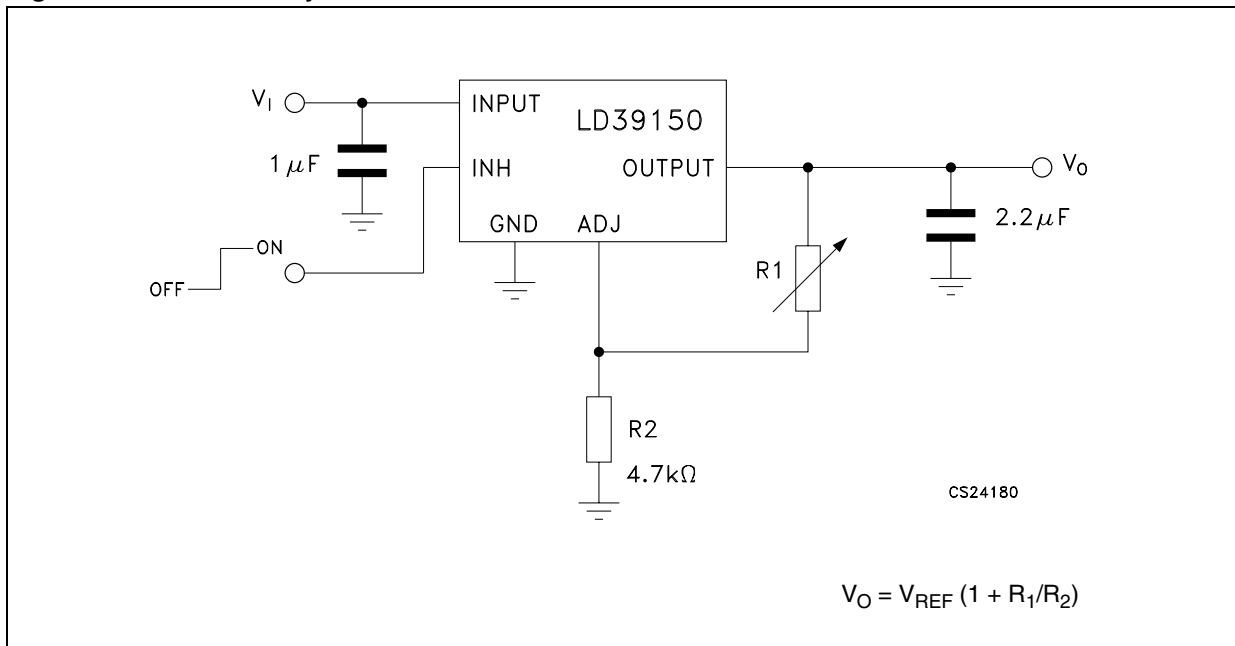
(C_1 and C_0 Capacitors must be placed as close as possible to the IC pins)

Figure 3. LD39150 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 0.3V

Figure 4. LD39150 adjustable version



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

Figure 5. LD39150 DPAK

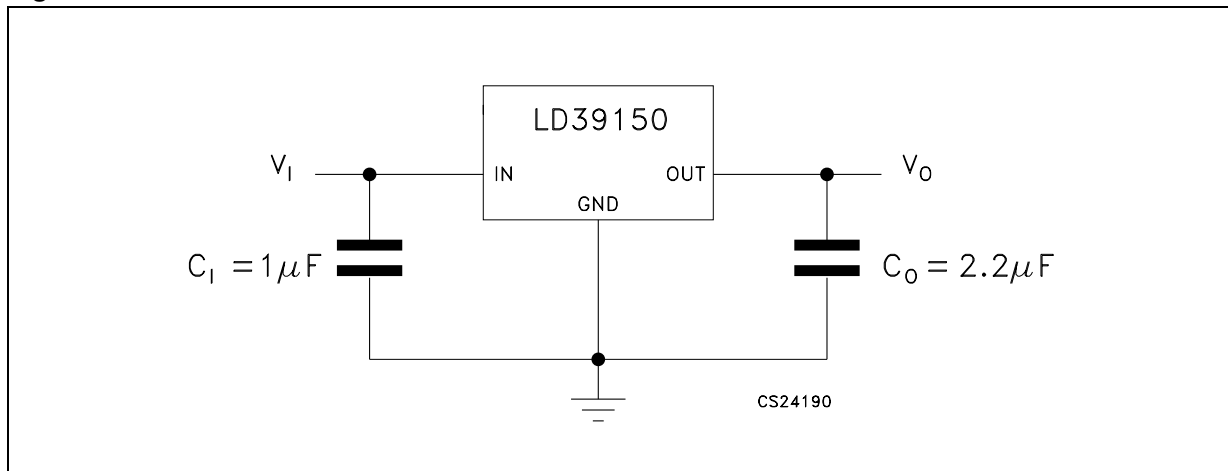
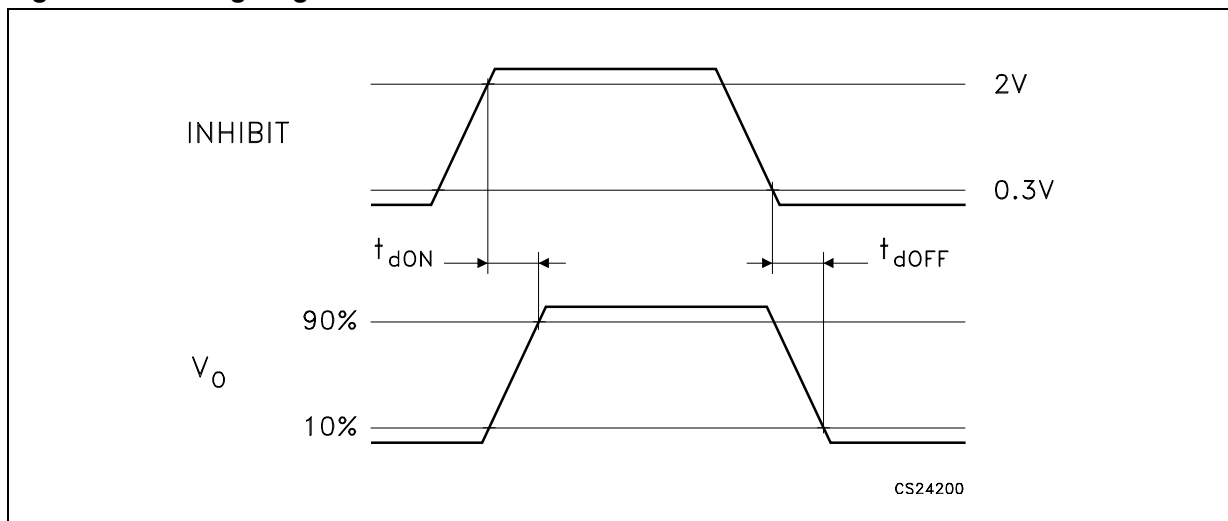


Figure 6. Timing diagram



4 Maximum ratings

Table 2. 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 3. Thermal Data

| Symbol | Parameter | PPAK | DPAK | DFN ⁽¹⁾ | Unit |
|------------|-------------------------------------|------|------|--------------------|------|
| R_{thJA} | Thermal resistance junction-ambient | 100 | 100 | 40 | °C/W |
| R_{thJC} | Thermal resistance junction-case | 8 | 8 | 10 | °C/W |

1. With PCB ground plane heatsink.

5 Electrical characteristics

Table 4. Electrical characteristics

($T_J = 25^\circ\text{C}$, $V_I = V_O + 1\text{V}$, $C_I = 1\mu\text{F}$, $C_O = 2.2\mu\text{F}$, $I_{\text{LOAD}} = 10\text{mA}$, $V_{\text{INH}} = 2\text{V}$, unless otherwise specified)

| Symbol | Parameter | Parameter | Min. | Typ. | Max. | Unit |
|---------------------------------------|--------------------------------------|--|--------------------|-----------|---------|----------------------------|
| V_I | Operating input voltage | | 2.5 | | 6 | V |
| V_O | Output voltage tolerance | $V_I = V_O + 1\text{V}$, $I_{\text{LOAD}} = 10\text{mA}$ to 1.5A | -1.5 | | 1.5 | % of $V_{\text{O(NOM)}}$ |
| | | $V_I = V_O + 1\text{V}$ to 6V , $I_{\text{LOAD}} = 10\text{mA}$ to 1.5A $T_J = -40$ to 125°C | -3 | | 3 | |
| V_{REF} | Reference voltage | | | 1.22 | | V |
| ΔV_O | Output voltage LINE regulation | $V_I = V_O + 1\text{V}$ to 6V | | 0.04 | | % |
| | | $V_I = V_O + 1\text{V}$ to 6V , $T_J = -40$ to 125°C | | 0.1 | 0.2 | % |
| $\Delta V_O / \Delta I_{\text{LOAD}}$ | Output voltage LOAD regulation | $I_{\text{LOAD}} = 10\text{mA}$ to 1.5A | | 0.06 | | % / A |
| | | $I_{\text{LOAD}} = 10\text{mA}$ to 1.5A , $T_J = -40$ to 125°C | | 0.2 | 0.4 | |
| V_{DROP} | Dropout voltage ($V_I - V_O$) | $I_{\text{LOAD}} = 300\text{mA}$, $T_J = -40$ to 125°C | | 40 | 80 | mV |
| | | $I_{\text{LOAD}} = 1.5\text{A}$, $T_J = -40$ to 125°C | | 200 | 400 | |
| I_Q | Quiescent current: ON MODE | $I_{\text{LOAD}} = 10\text{mA}$ to 1.5A , $V_{\text{INH}} = 2\text{V}$ $T_J = -40$ to 125°C | | 1 | 2.5 | mA |
| | Quiescent current: OFF MODE | $V_{\text{INH}} = 0.3\text{V}$ | | | 1 | μA |
| | | $V_{\text{INH}} = 0.3\text{V}$, $T_J = -40$ to 125°C | | | 5 | |
| Short Circuit Protection | | | | | | |
| I_{SC} | Short circuit protection | $R_L = 0$ | | 3 | | A |
| Inhibit Input | | | | | | |
| V_{INH} | Inhibit threshold LOW | $V_I = 2.5$ to 6V OFF $T_J = -40$ to 125°C | | | 0.3 | V |
| | Inhibit threshold HIGH | | 2 | | | |
| $T_{\text{D-OFF}}$ | Current limit | $I_{\text{LOAD}} = 1.5\text{A}$, $V_O = 3.3\text{V}$ | | 15 | | μs |
| $T_{\text{D-ON}}$ | Current limit | $I_{\text{LOAD}} = 1.5\text{A}$, $V_O = 3.3\text{V}$ | | 15 | | |
| I_{INH} | Inhibit input current ⁽¹⁾ | $V_I = 6\text{V}$, $V_{\text{INH}} = 0$ to 6V | | ± 0.1 | ± 1 | μA |
| AC Parameters | | | | | | |
| SVR | Supply voltage rejection | $V_I = 4.5 \pm 1\text{V}$, $V_O = 3.3\text{V}$, $I_{\text{LOAD}} = 10\text{mA}$, | $f = 120\text{Hz}$ | | 65 | dB |
| | | | $f = 1\text{kHz}$ | | 55 | |
| e_N | Output noise voltage | $B_W = 10\text{Hz}$ to 100kHz , $C_O = 2.2\mu\text{F}$, $V_O = 2.5\text{V}$ | | 100 | | μV_{RMS} |
| T_{SHDN} | Thermal shutdown OFF | | | 170 | | $^\circ\text{C}$ |
| | Hysteresis | | | 10 | | |

1. Guaranteed by design

6 Typical performance characteristics

($T_J = 25^\circ\text{C}$, $V_I = V_O + 1\text{V}$, $C_I = 1\mu\text{F}$, $C_O = 2.2\mu\text{F}$, $I_{\text{LOAD}} = 10\text{mA}$, $V_{\text{INH}} = V_I$, unless otherwise specified)

Figure 7. Output voltage vs temperature

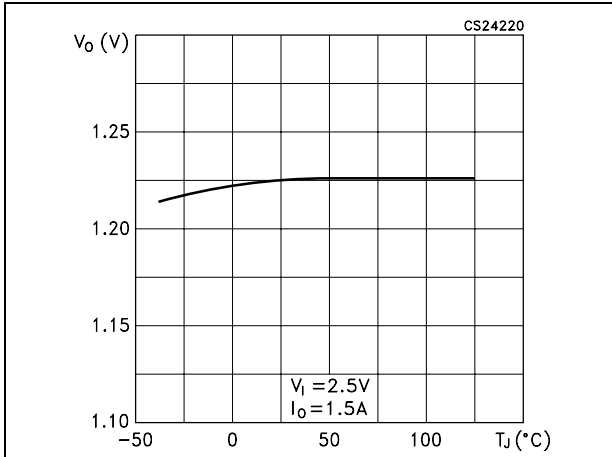


Figure 8. Dropout voltage vs temperature

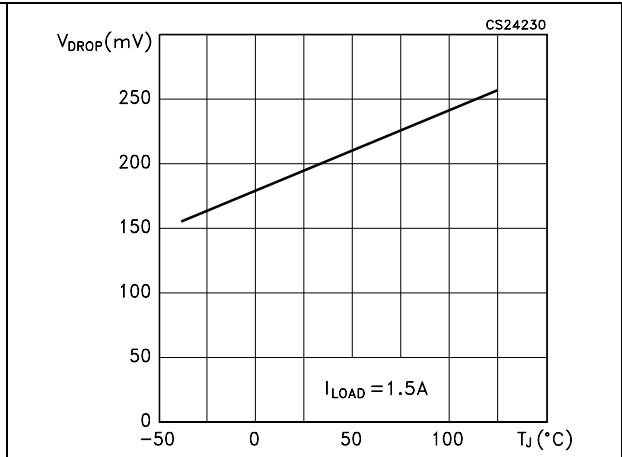


Figure 9. Dropout voltage vs output current

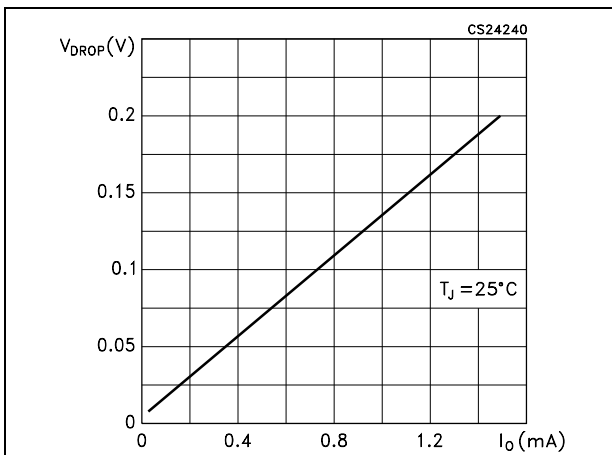


Figure 10. Quiescent current vs supply voltage

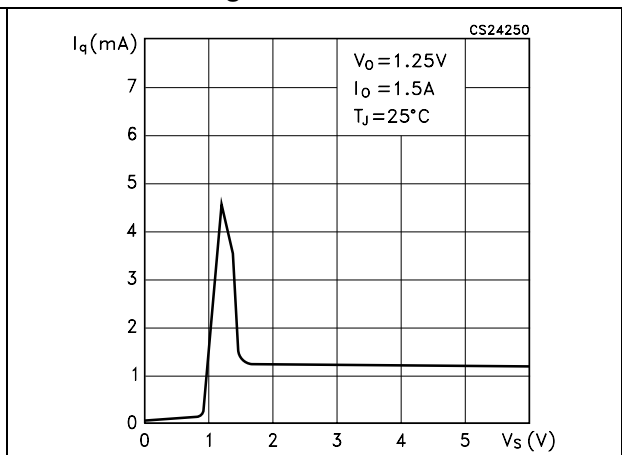


Figure 11. Quiescent current vs temperature

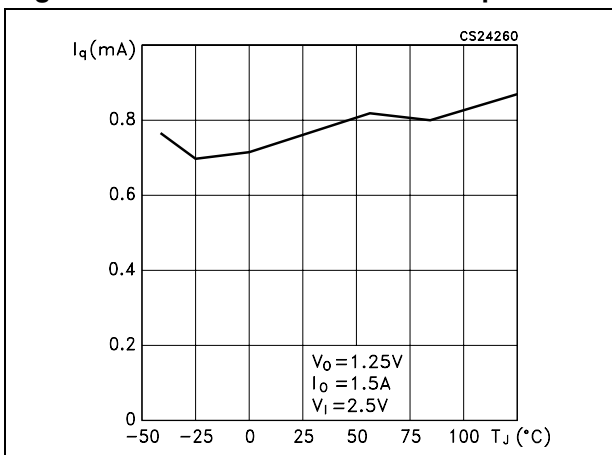


Figure 12. Quiescent current vs temperature

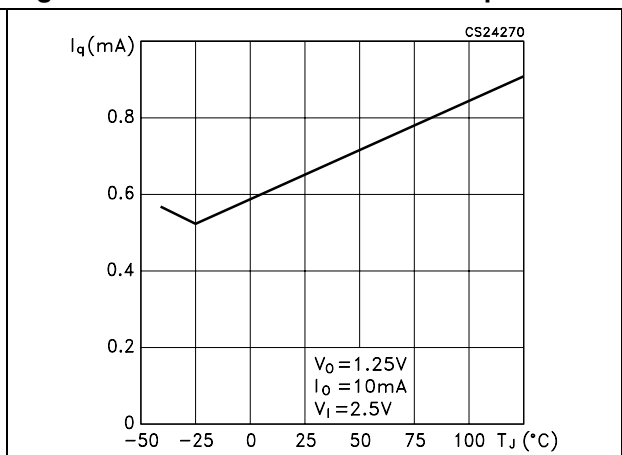


Figure 13. Short circuit current vs temperature Figure 14. Output voltage vs input voltage

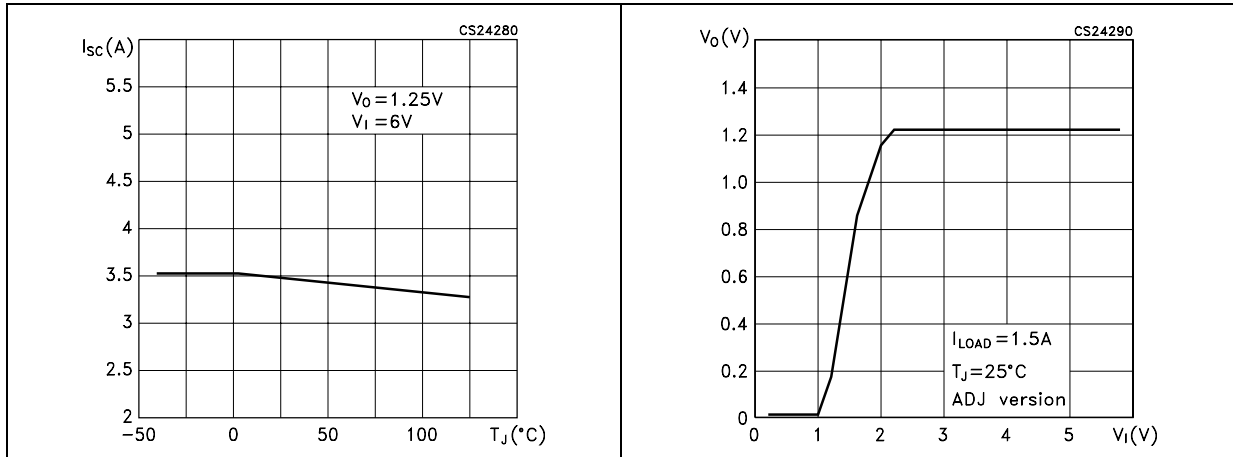


Figure 15. Stability region vs C_O & ESR (at 100kHz)

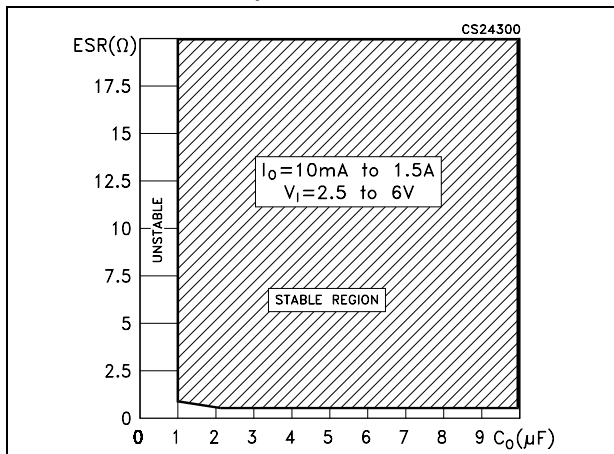


Figure 16. Stability region vs C_O & Low ESR (at 100kHz)

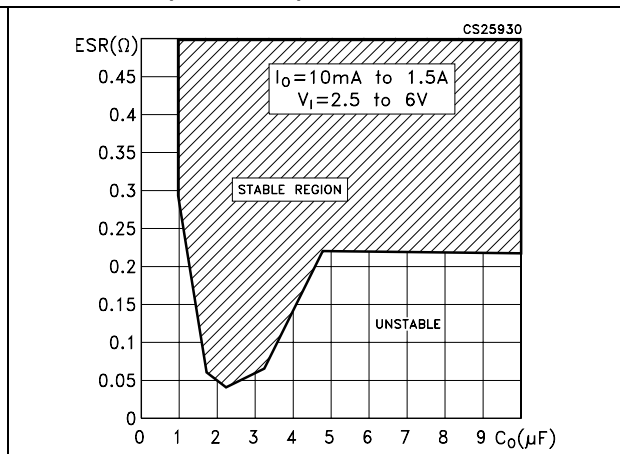


Figure 17. Load transient

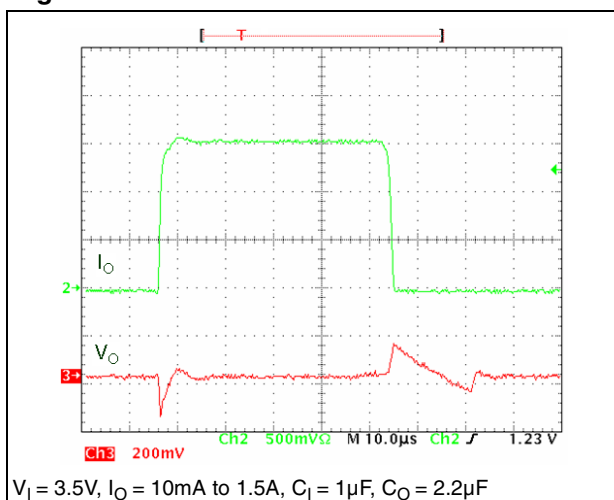
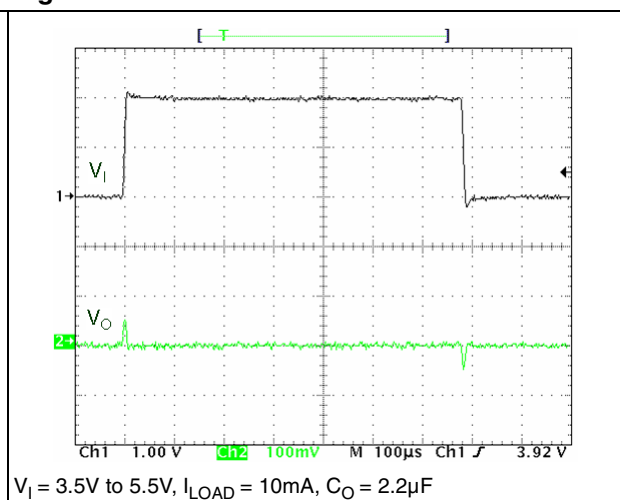


Figure 18. Line transient



7 Application notes

7.1 External capacitors

The LD39150 requires external capacitors for regulator stability. These capacitors must be selected to meet the requirements of minimum capacitance and equivalent series resistance (see [Figure 15](#), [Figure 16](#)). 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 μ F is required with the LD39150 (amount of capacitance can be increased without limit). This capacitor must be located a distance of not more than 1cm 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 2.2 μ F is a good choice to guarantee the stability of the regulator. Anyway, other C_O values can be used according to the ([Figure 15](#), [Figure 16](#)) 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

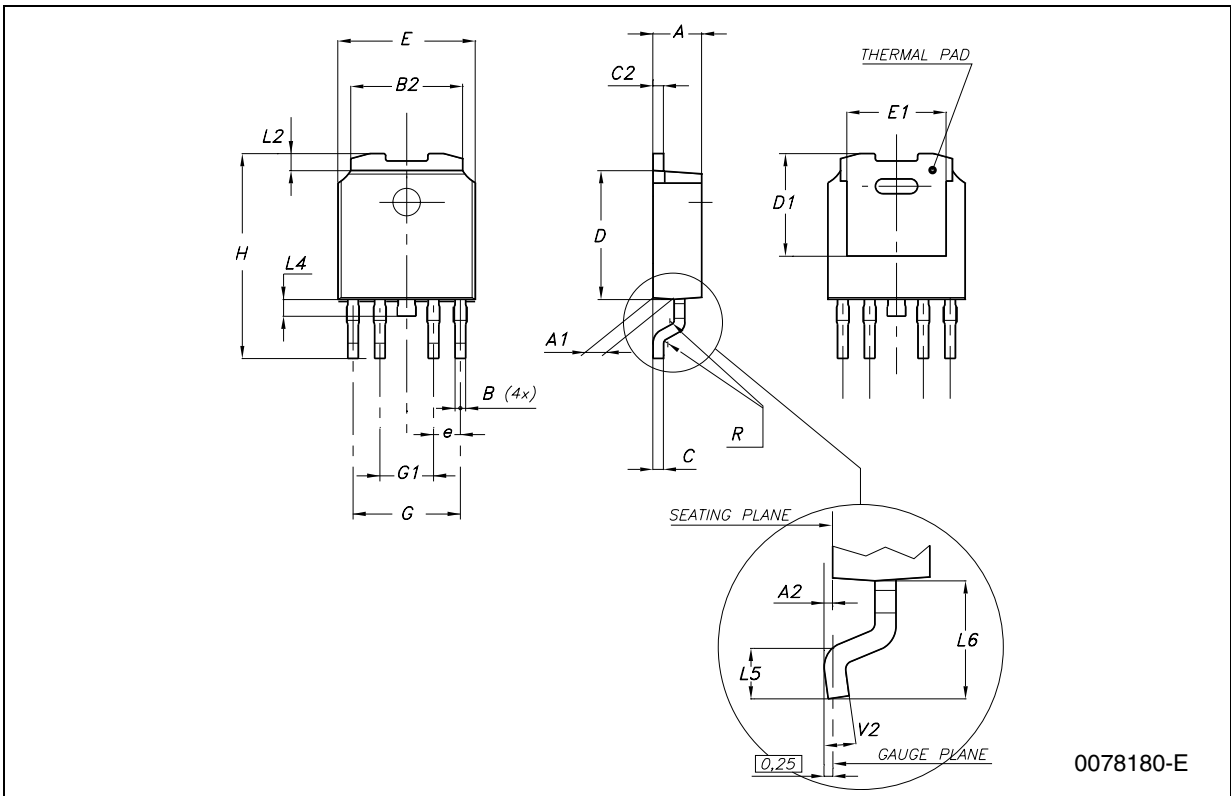
The inhibit pin can be used to turn OFF the regulator when pulled down, so drastically reducing the current consumption down to less than 1 μ A. When the inhibit feature is not used, this pin must be tied to V_I to keep the regulator output ON at all times. To assure proper operation, the signal source 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 ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

PPAK MECHANICAL DATA

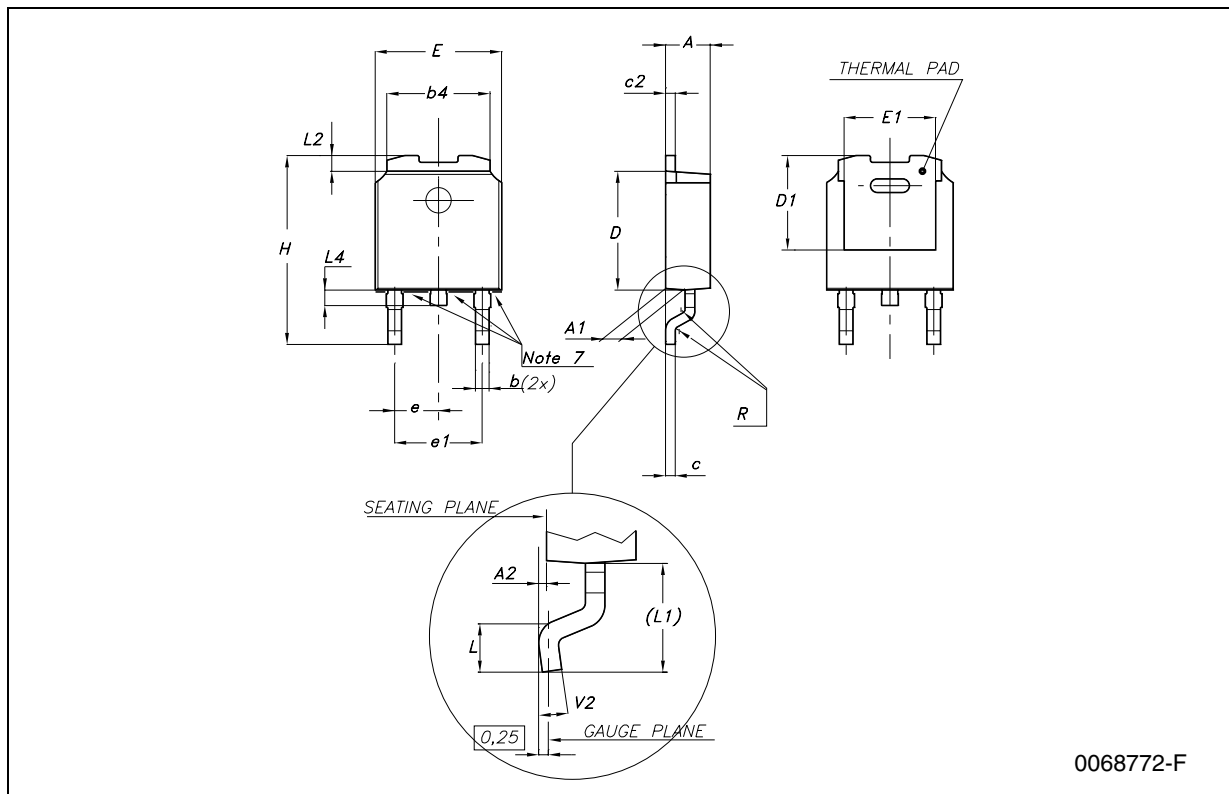
| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.4 | | 0.6 | 0.015 | | 0.023 |
| B2 | 5.2 | | 5.4 | 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 | | | 0.201 | |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| E1 | | 4.7 | | | 0.185 | |
| e | | 1.27 | | | 0.050 | |
| G | 4.9 | | 5.25 | 0.193 | | 0.206 |
| G1 | 2.38 | | 2.7 | 0.093 | | 0.106 |
| H | 9.35 | | 10.1 | 0.368 | | 0.397 |
| L2 | | 0.8 | 1 | | 0.031 | 0.039 |
| L4 | 0.6 | | 1 | 0.023 | | 0.039 |
| L5 | 1 | | | 0.039 | | |
| L6 | | 2.8 | | | 0.110 | |



0078180-E

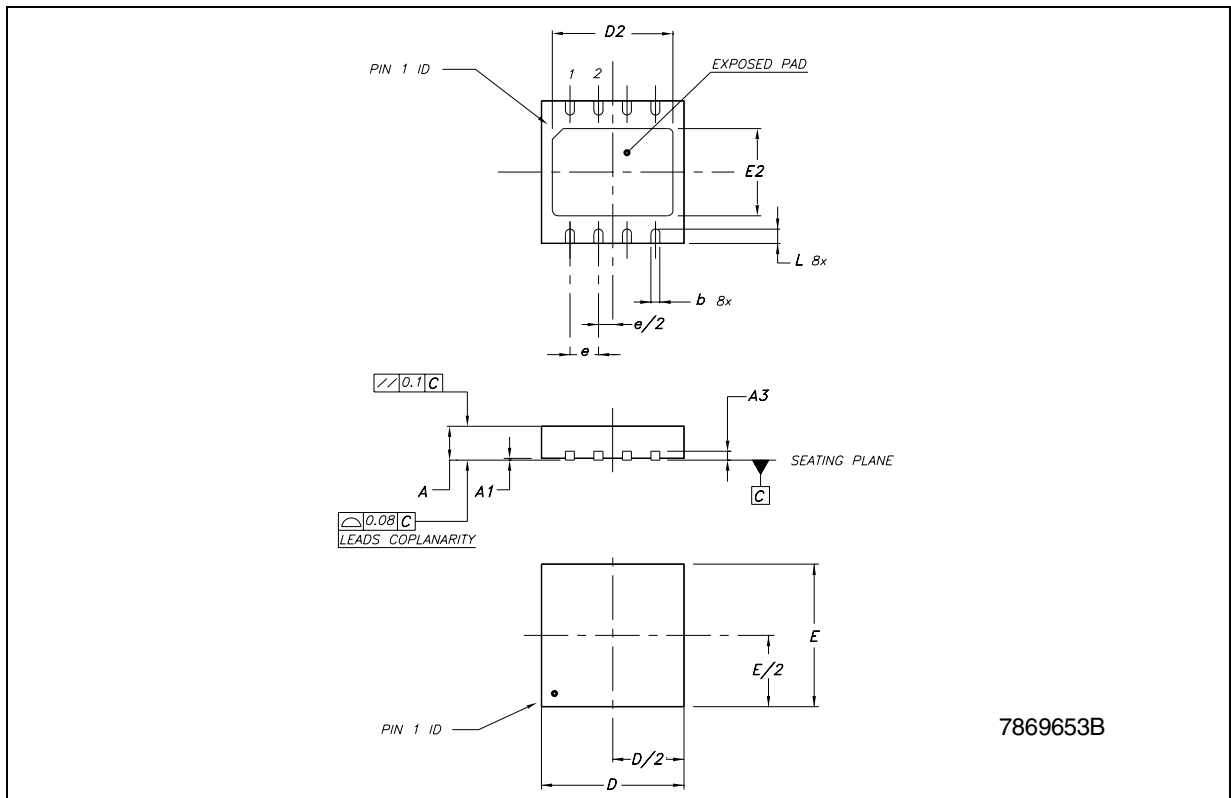
DPAK MECHANICAL DATA

| 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 |



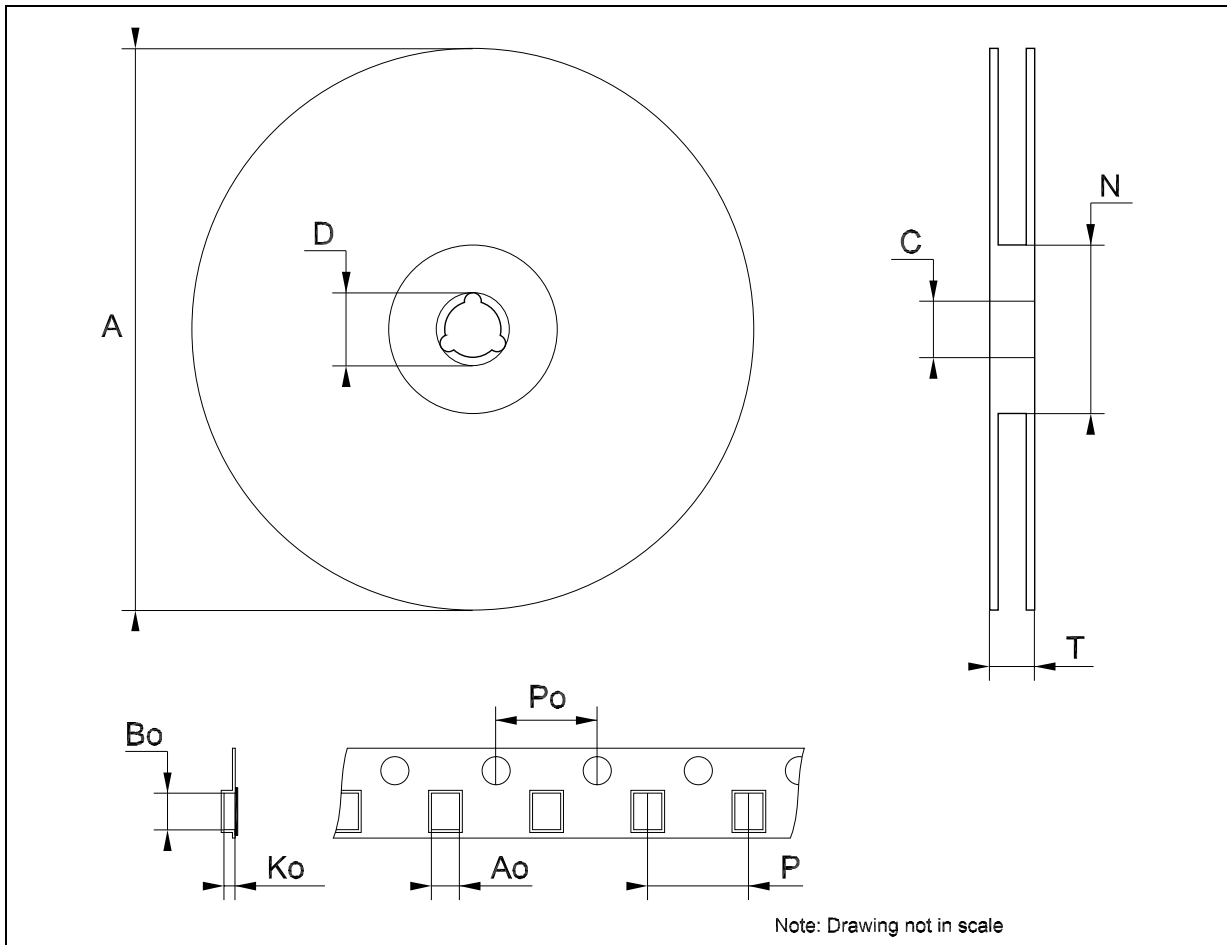
DFN8 (4x4) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 0.80 | 0.90 | 1.00 | 0.031 | 0.035 | 0.039 |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.001 | 0.002 |
| A3 | | 0.20 | | | 0.008 | |
| b | 0.23 | 0.30 | 0.38 | 0.009 | 0.012 | 0.015 |
| D | 3.90 | 4.00 | 4.10 | 0.154 | 0.157 | 0.161 |
| D2 | 2.82 | 3.00 | 3.23 | 0.111 | 0.118 | 0.127 |
| E | 3.90 | 4.00 | 4.10 | 0.154 | 0.157 | 0.161 |
| E2 | 2.05 | 2.20 | 2.30 | 0.081 | 0.087 | 0.091 |
| e | | 0.80 | | | 0.031 | |
| L | 0.40 | 0.50 | 0.60 | 0.016 | 0.020 | 0.024 |



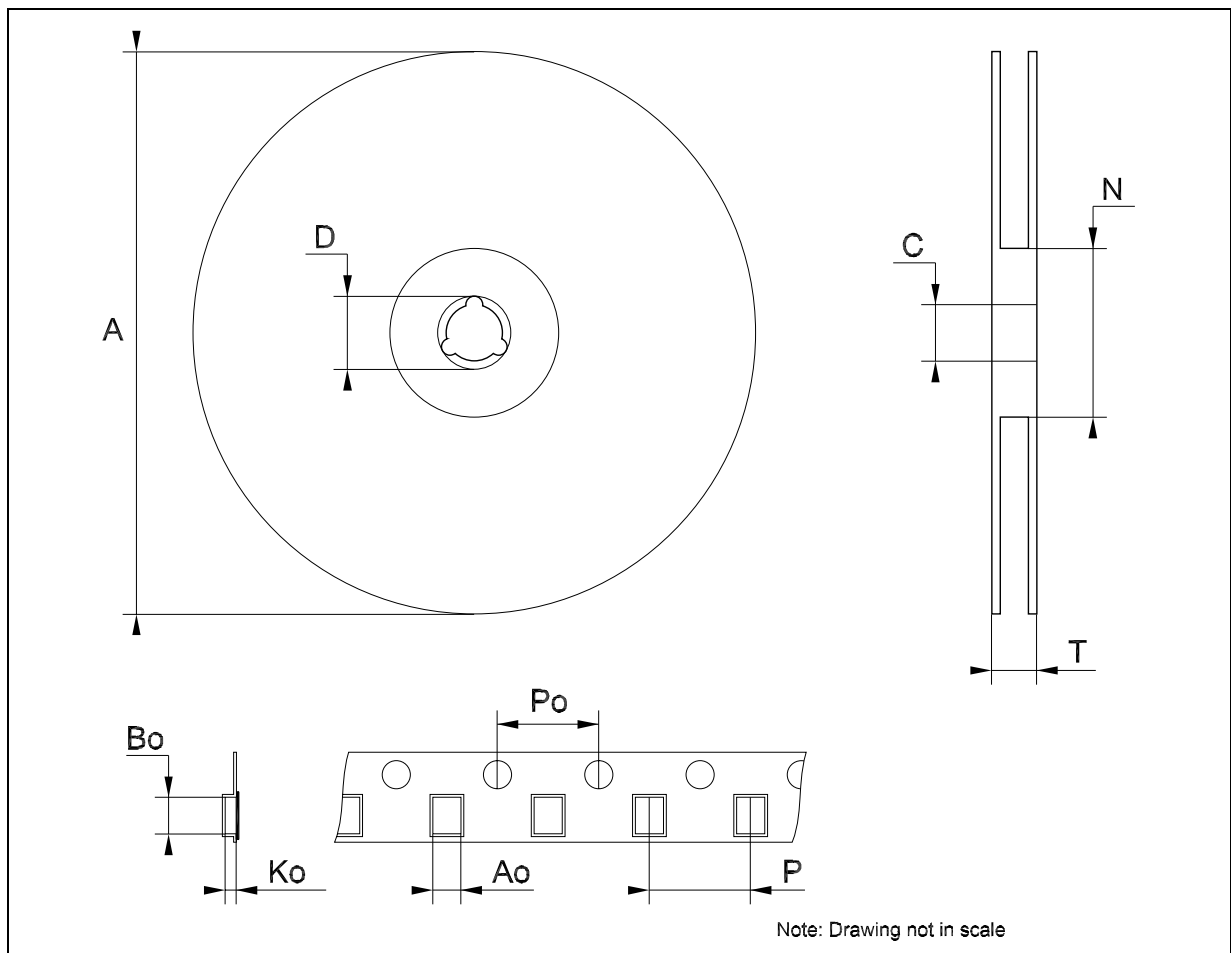
Tape & Reel DPAK-PPAK MECHANICAL DATA

| 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 |



Tape & Reel QFNxx/DFNxx (4x4) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|--------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 330 | | | 12.992 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 99 | | 101 | 3.898 | | 3.976 |
| T | | | 14.4 | | | 0.567 |
| Ao | | 4.35 | | | 0.171 | |
| Bo | | 4.35 | | | 0.171 | |
| Ko | | 1.1 | | | 0.043 | |
| Po | | 4 | | | 0.157 | |
| P | | 8 | | | 0.315 | |



9 Revision history

Table 5. Revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 26-Jan-2007 | 1 | Initial release. |

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