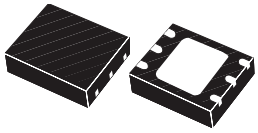
LD39150

Ultra low drop BiCMOS voltage regulator

Datasheet - production data

PPAK DPAK



DFN6 (3 x 3 mm)

Features

- 1.5 A guaranteed output current
- Ultra low dropout voltage (200 mV typ. @ 1.5 A load, 40 mV typ. @ 300 mA load)
- Very low quiescent current (1 mA typ. @ 1.5 A load, 1 µA 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: 1.8 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, DPAK and DFN6 (3x3 mm)

Applications

- 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 2.5 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.

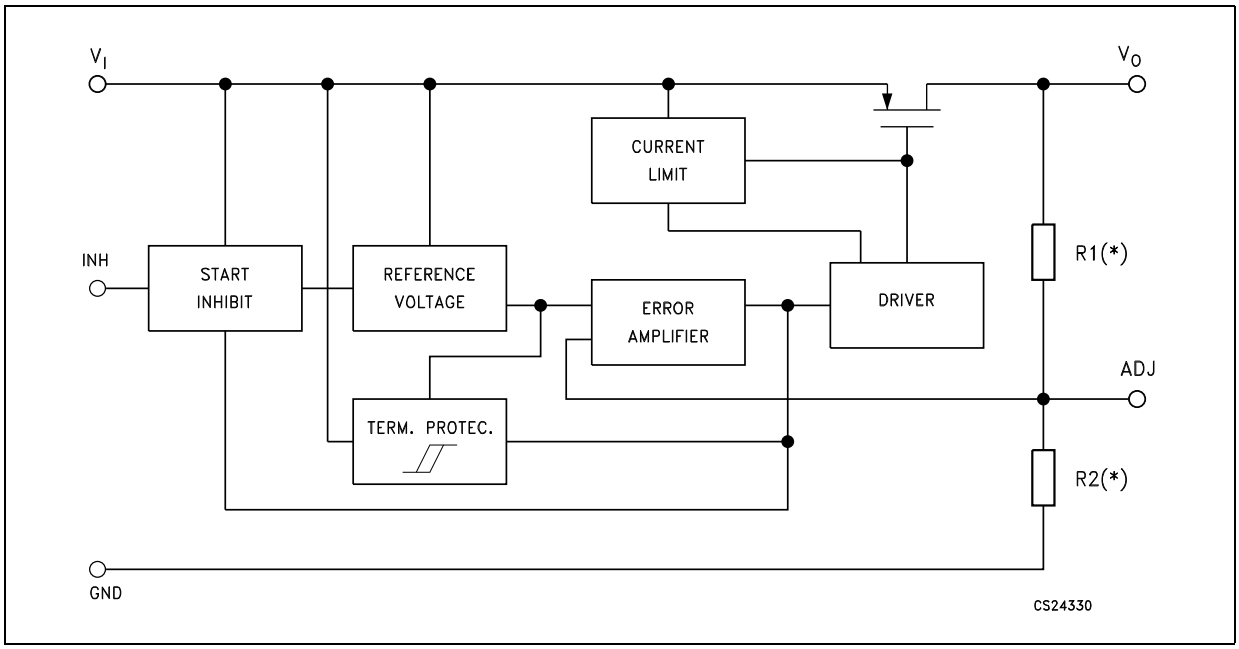
Table 1. Device summary

Order codes			Output voltages
DPAK (tape and reel)	PPAK (tape and reel)	DFN	
LD39150DT18-R			1.8 V
LD39150DT25-R			2.5 V
LD39150DT33-R			3.3 V
	LD39150PT-R	LD39150PU-R	ADJ from 1.22 to 5.0 V

Contents

1 Diagram

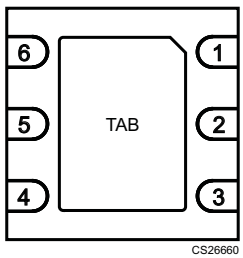
Figure 1. Block diagram



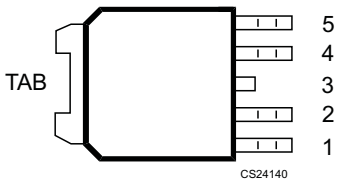
(*) Not present on ADJ versions.

2 Pin configuration

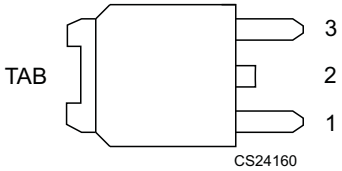
Figure 2. Pin connections (top view for DPAK and PPAK, bottom view for DFN)



DFN6 (3 x 3 mm)



PPAK



DPAK

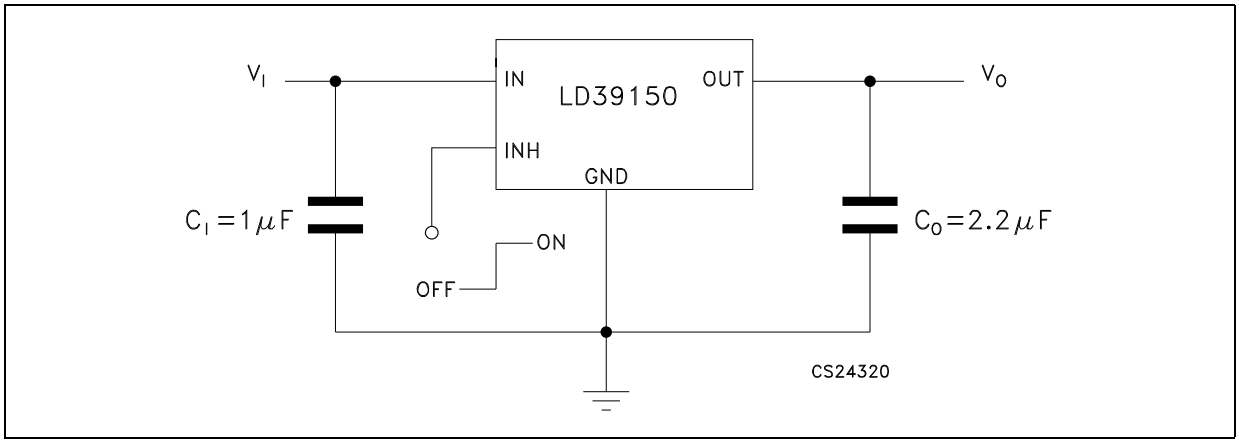
Table 2. Pin description

Pin n°			SYMBOL	NOTE
DFN	PPAK	DPAK		
5	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 5.0 V
3	2	1	V_I	LDO input voltage; V_I from 2.5 V to 6 V, C_I = 1 µF must be located at a distance of not more than 0.5” from input pin.
4	4	3	V_O	LDO output voltage pins, with minimum C_O = 2.2 µF needed for stability (also refer to C_O vs ESR stability chart)
2	1		V_{INH}	Inhibit input voltage: ON MODE when $V_{INH} \geq 2$ V, OFF MODE when $V_{INH} \leq$ 0.3 V (Do not leave floating, not internally pulled down/up)
1	3	2	GND	Common ground
6			N.C.	Not connected
	TAB	TAB	GND	Electrically connected to GND
Exp. Pad				Connect to GND (it is not a power GND)

3 Typical application circuits

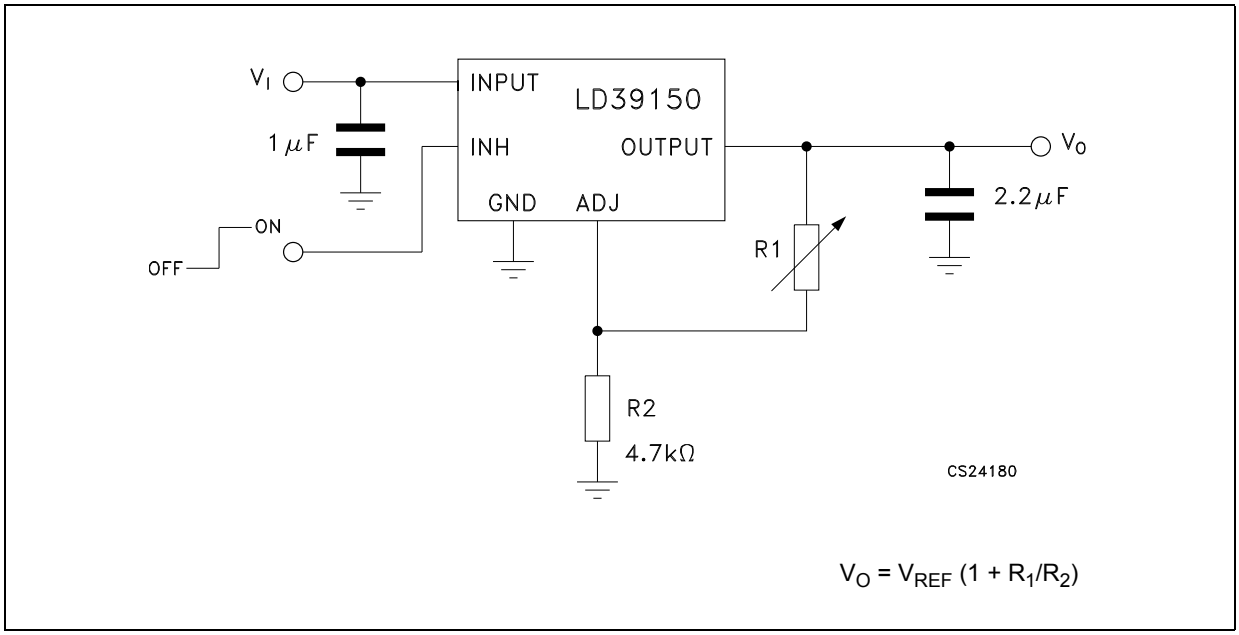
(C_I and C_O capacitors must be placed as close as possible to the IC pins)

Figure 3. LD39150 fixed version with inhibit



Note: 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. LD39150 adjustable version



Note: Set R2 as close as possible to 4.7 kΩ

Figure 5. LD39150 DPAK

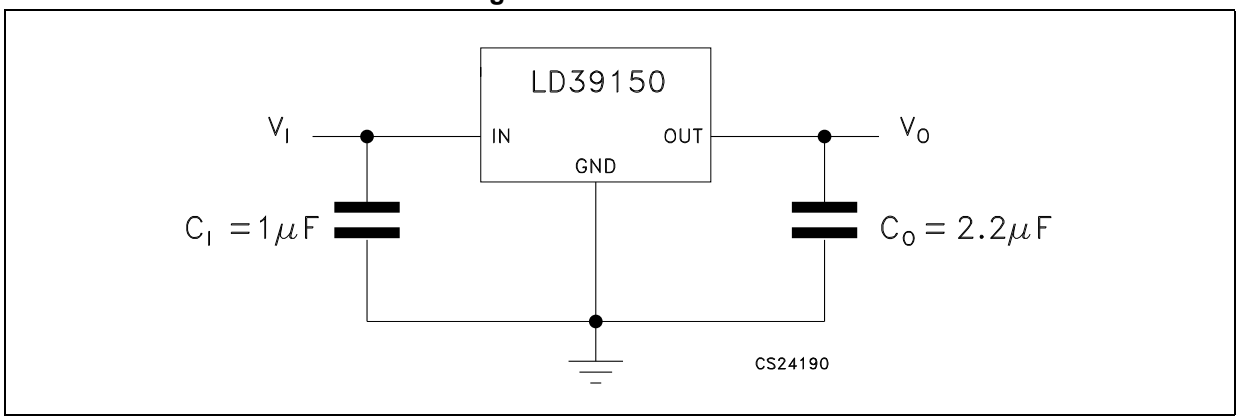
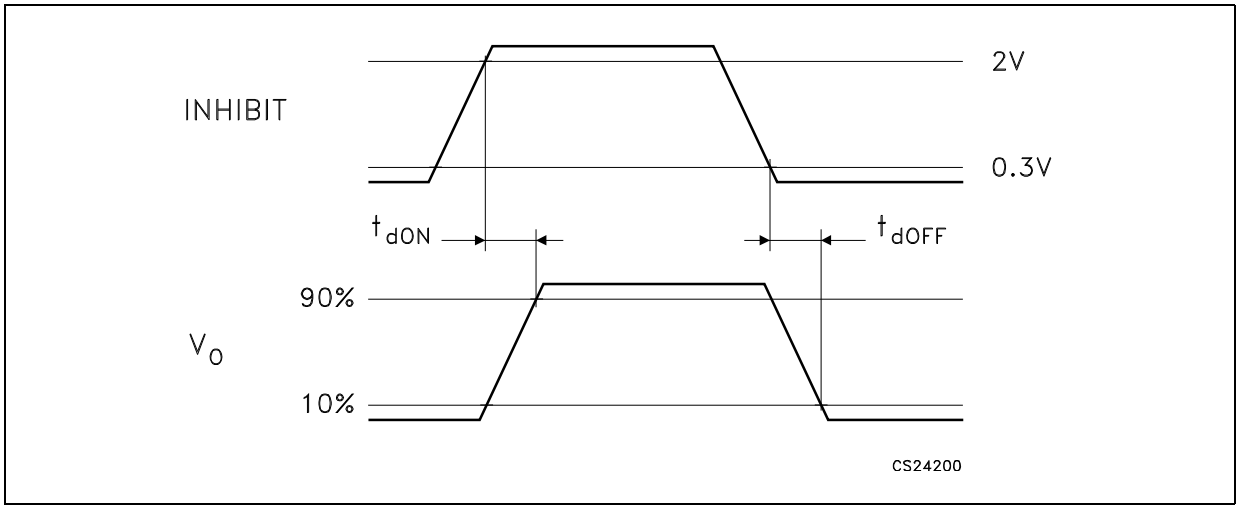


Figure 6. Timing diagram



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 (6.5 V max)	V
V_O	DC output voltage	-0.3 to V_I +0.3 (6.5 V max)	V
V_{ADJ}	ADJ pin voltage	-0.3 to V_I +0.3 (6.5 V 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	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

T_J = 25 °C, V_I = V_O+1 V, C_I = 1 µF, C_O = 2.2 µF, I_{LOAD} = 10 mA, V_{INH} = 2 V, unless otherwise specified.

Table 5. Electrical characteristics

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+1V, I_{LOAD} = 10mA to 1.5A		-1.5		1.5	% of $V_{O(NOM)}$
		V_I = V_O+1V to 6V, T_J = -40 to 125°C I_{LOAD} = 10mA to 1.5A		-3		3	
V_{REF}	Reference voltage				1.22		V
ΔV_O	Output voltage LINE regulation	V_I = V_O+1V to 6V			0.04		%
		V_I = V_O+1V to 6V, T_J = -40 to 125°C			0.1	0.2	%
$\Delta V_O/\Delta I_{LOAD}$	Output voltage LOAD regulation	I_{LOAD} = 10mA to 1.5A			0.06		%/A
		I_{LOAD} = 10mA to 1.5A, T_J = -40 to 125°C			0.2	0.4	
V_{DROP}	Dropout voltage (V_I - V_O)	I_{LOAD} = 300mA, T_J=-40 to 125°C			40	80	mV
		I_{LOAD} = 1.5A, T_J = -40 to 125°C			200	400	
I_Q	Quiescent current: ON MODE	I_{LOAD} = 10mA to 1.5A, V_{INH} = 2V T_J = -40 to 125°C			1	2.5	mA
	Quiescent current: OFF MODE	V_{INH} = 0.3V				1	µA
		V_{INH} = 0.3V, 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_{D-OFF}	Current limit	I_{LOAD} = 1.5A, V_O = 3.3V			15		µs
T_{D-ON}	Current limit	I_{LOAD} = 1.5A, V_O = 3.3V			15		
I_{INH}	Inhibit input current (1)	V_I = 6V, V_{INH} = 0 to 6V			±0.1	±1	µA
AC parameters							
SVR	Supply voltage rejection	V_I = 4.5 ± 1V, V_O = 3.3V, I_{LOAD} = 10mA,	f = 120Hz		65		dB
			f = 1kHz		55		
e_N	Output noise voltage	B_W = 10Hz to 100kHz, C_O = 2.2µF, V_O = 2.5V			100		μV_{RMS}
T_{SHDN}	Thermal shutdown OFF				170		°C
	Hysteresis				10		

1. Guaranteed by design

6 Typical performance characteristics

T_J = 25 °C, $V_I = V_O$ + 1 V, C_I = 1 µF, C_O = 2.2 µF, I_{LOAD} = 10 mA, $V_{INH} = V_I$, unless otherwise specified.

Figure 7. Output voltage vs temperature

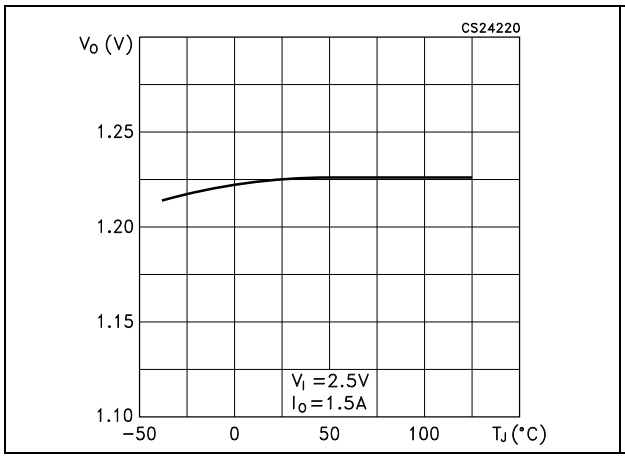


Figure 8. Dropout voltage vs temperature

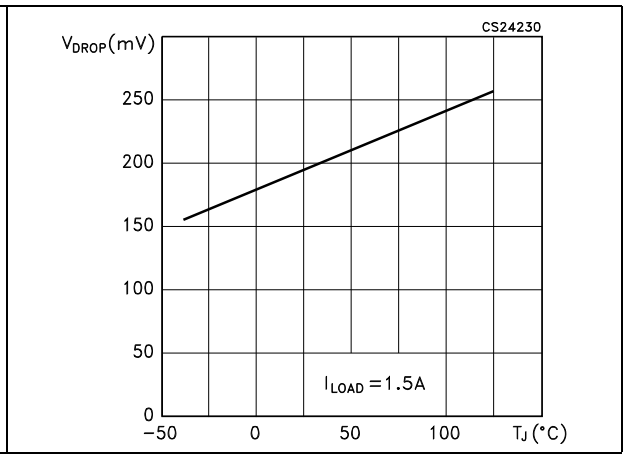


Figure 9. Dropout voltage vs output current

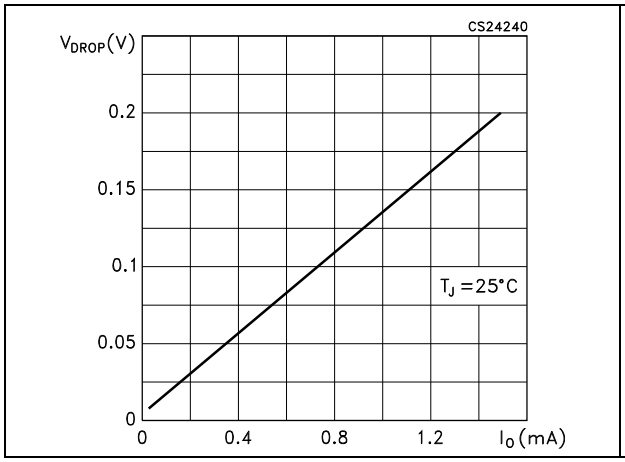


Figure 10. Quiescent current vs supply voltage

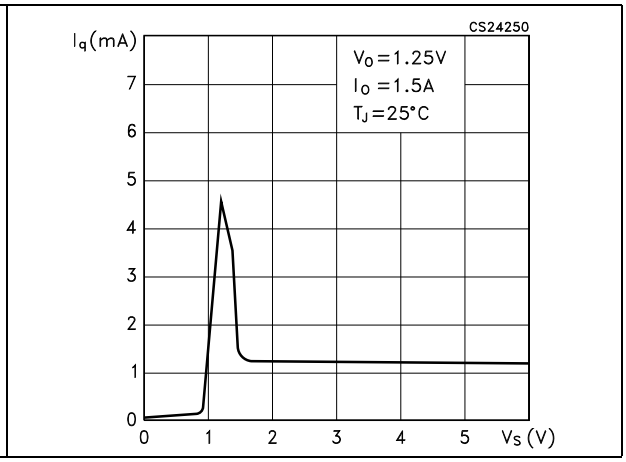


Figure 11. Quiescent current vs temperature

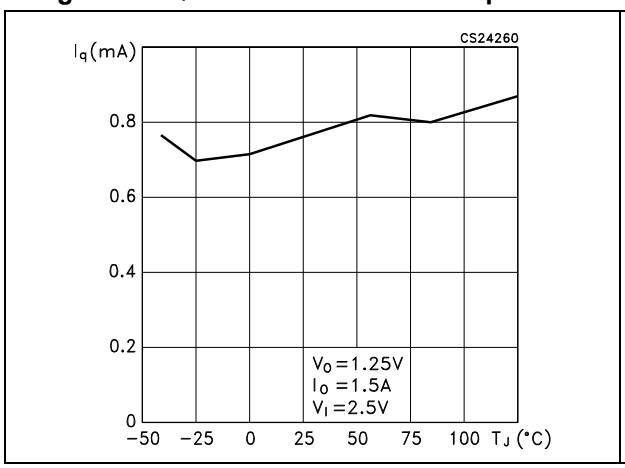


Figure 12. Quiescent current vs temperature

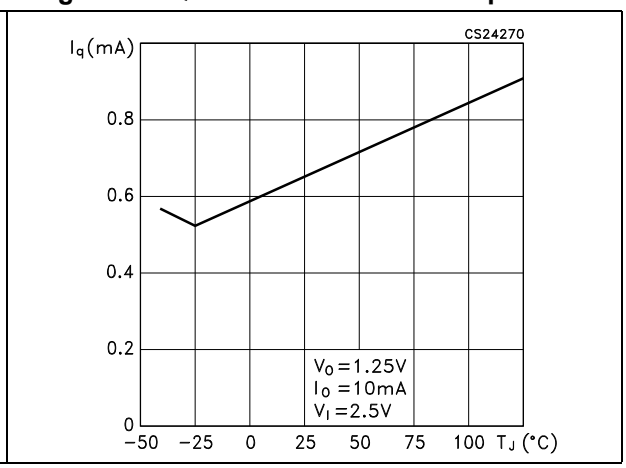


Figure 13. Short circuit current vs temperature

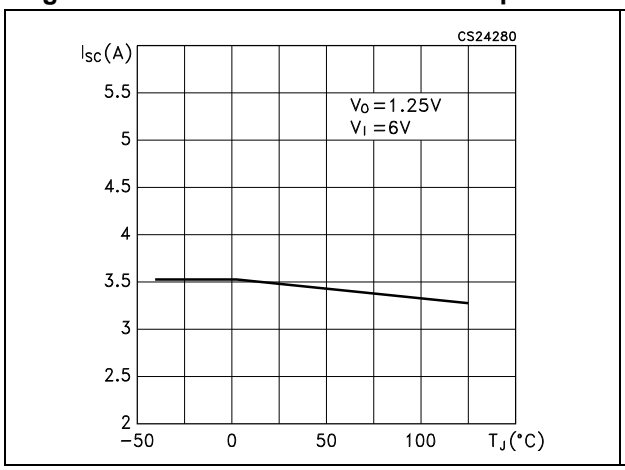


Figure 14. Output voltage vs input voltage

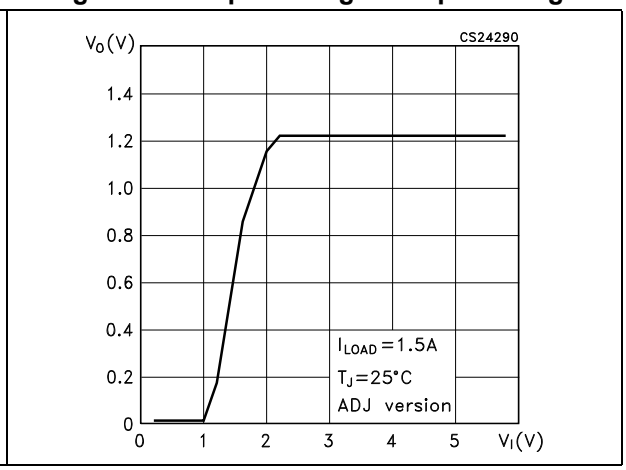


Figure 15. Stability region vs C_O & ESR (at 100 kHz)

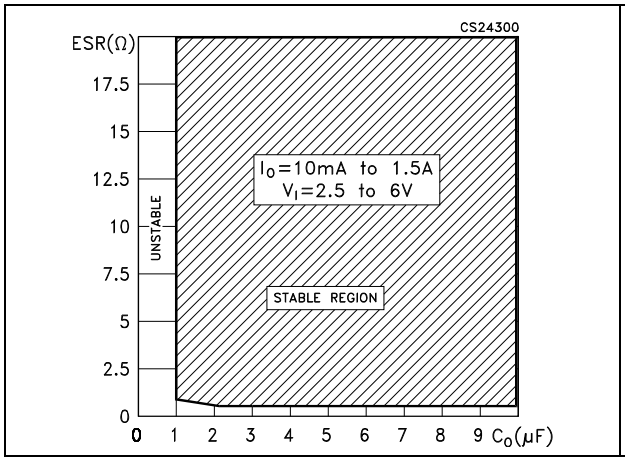


Figure 16. Stability region vs C_O & low ESR (at 100 kHz)

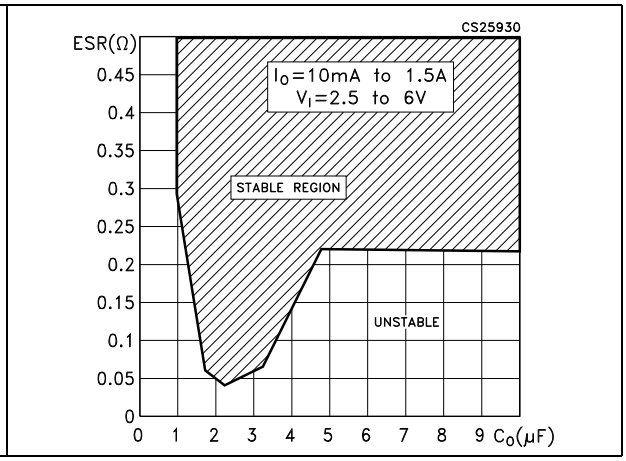
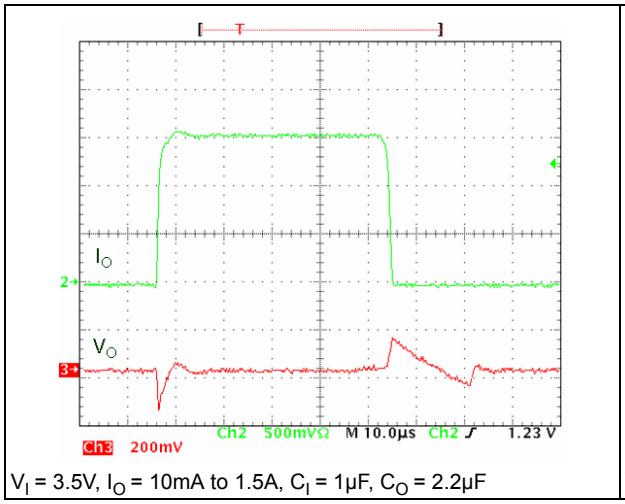
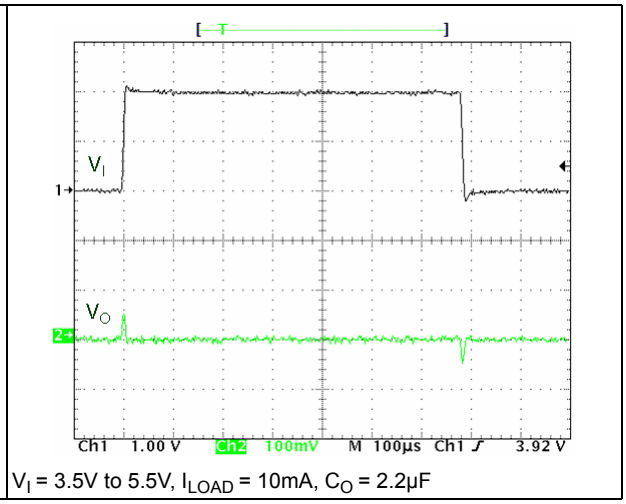


Figure 17. Load transient



V_I = 3.5V, I_O = 10mA to 1.5A, C_I = 1µF, C_O = 2.2µF

Figure 18. Line transient



V_I = 3.5V to 5.5V, I_{LOAD} = 10mA, C_O = 2.2µF

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* and *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.

7.2 Input capacitor

An input capacitor whose minimum value is 1 µF 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 ESR (equivalent series resistance) value. A minimum capacitance of 2.2 µF is a good choice to guarantee the stability of the regulator. Anyway, other C_O values can be used according to the (*Figure 15* and *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 µA. 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 information

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.

8.1 PPAK package information

Figure 19. PPAK outline

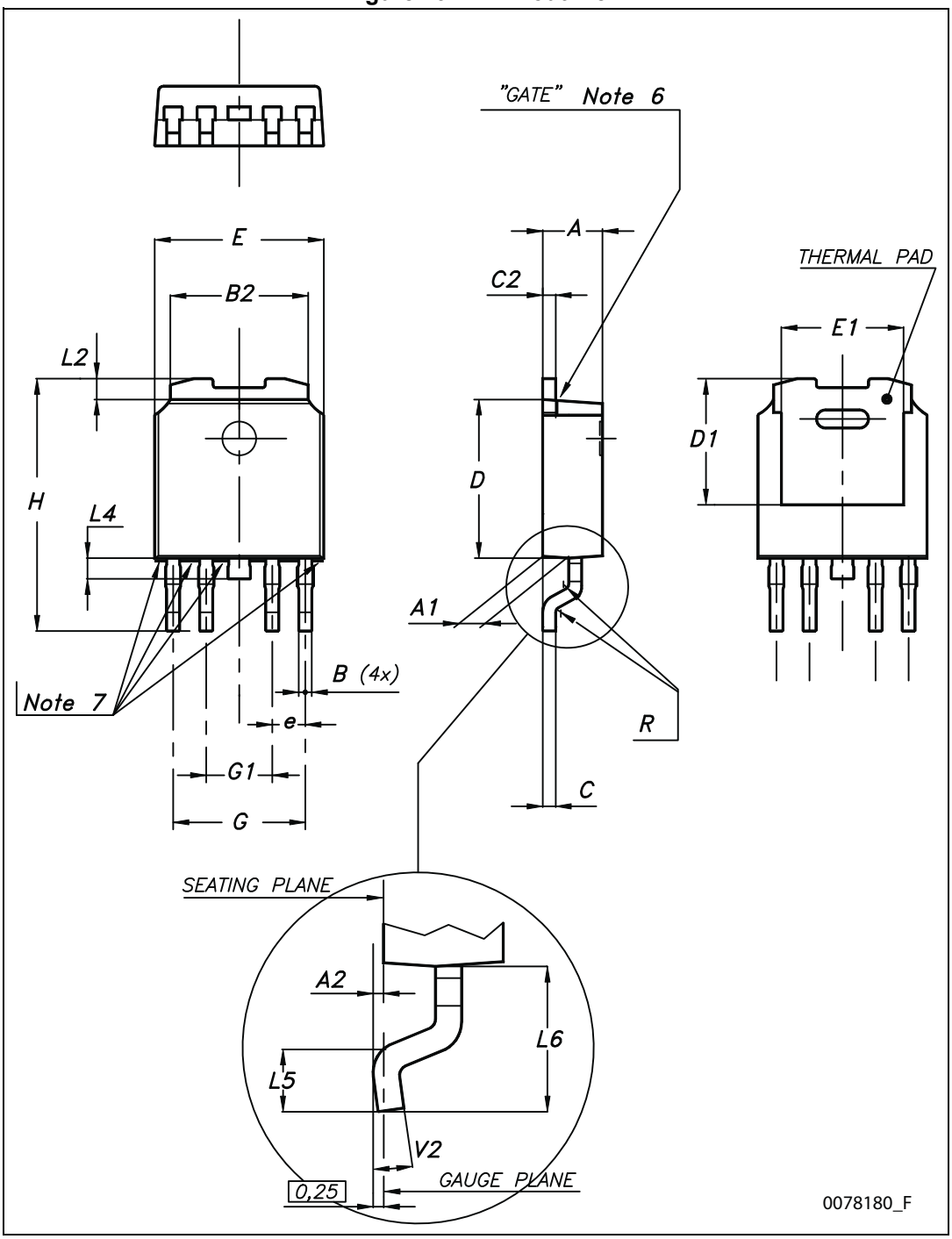


Table 6. PPAK mechanical data

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°

8.2 DPAK package information

Figure 20. DPAK (TO-252) type A outline

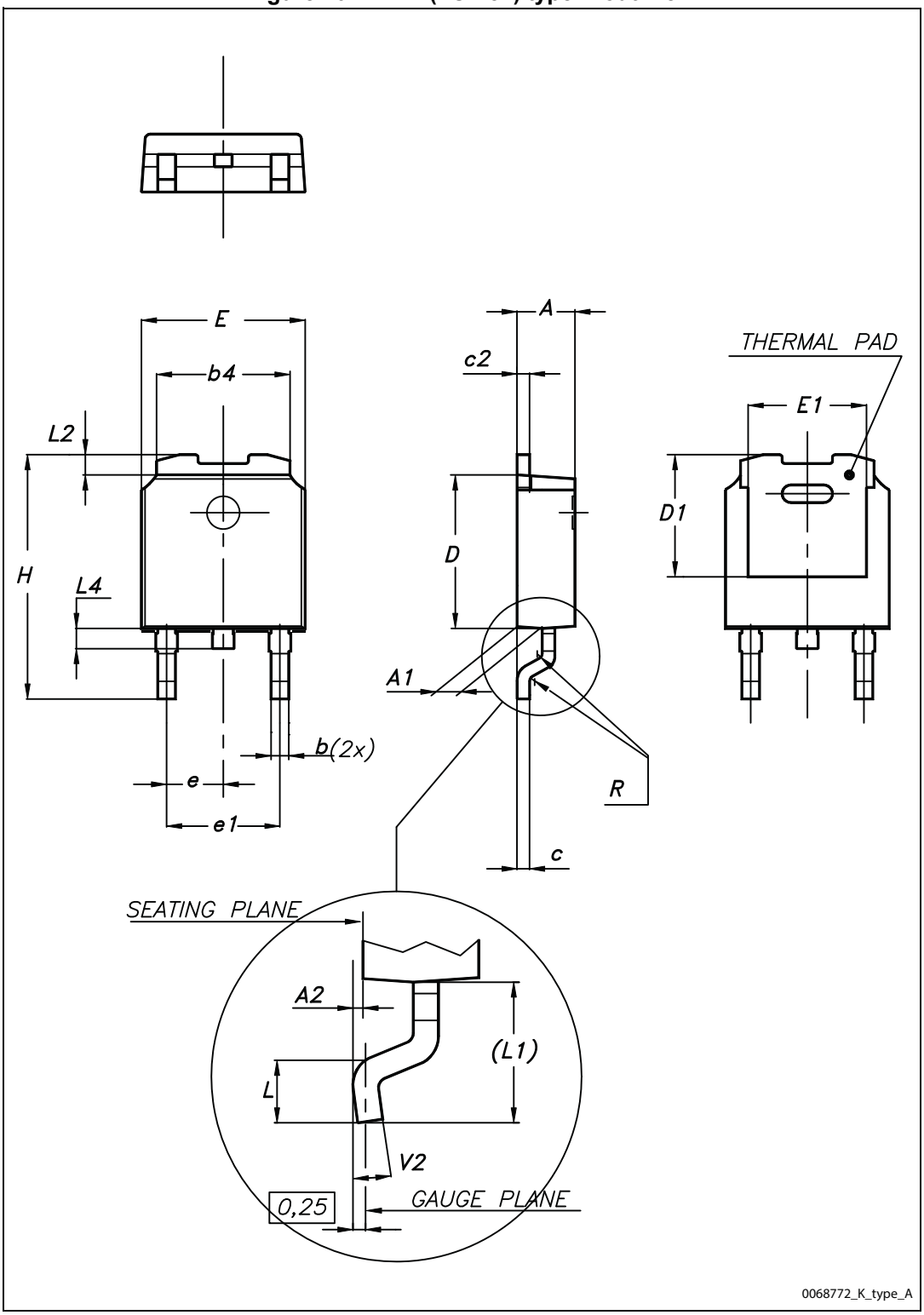
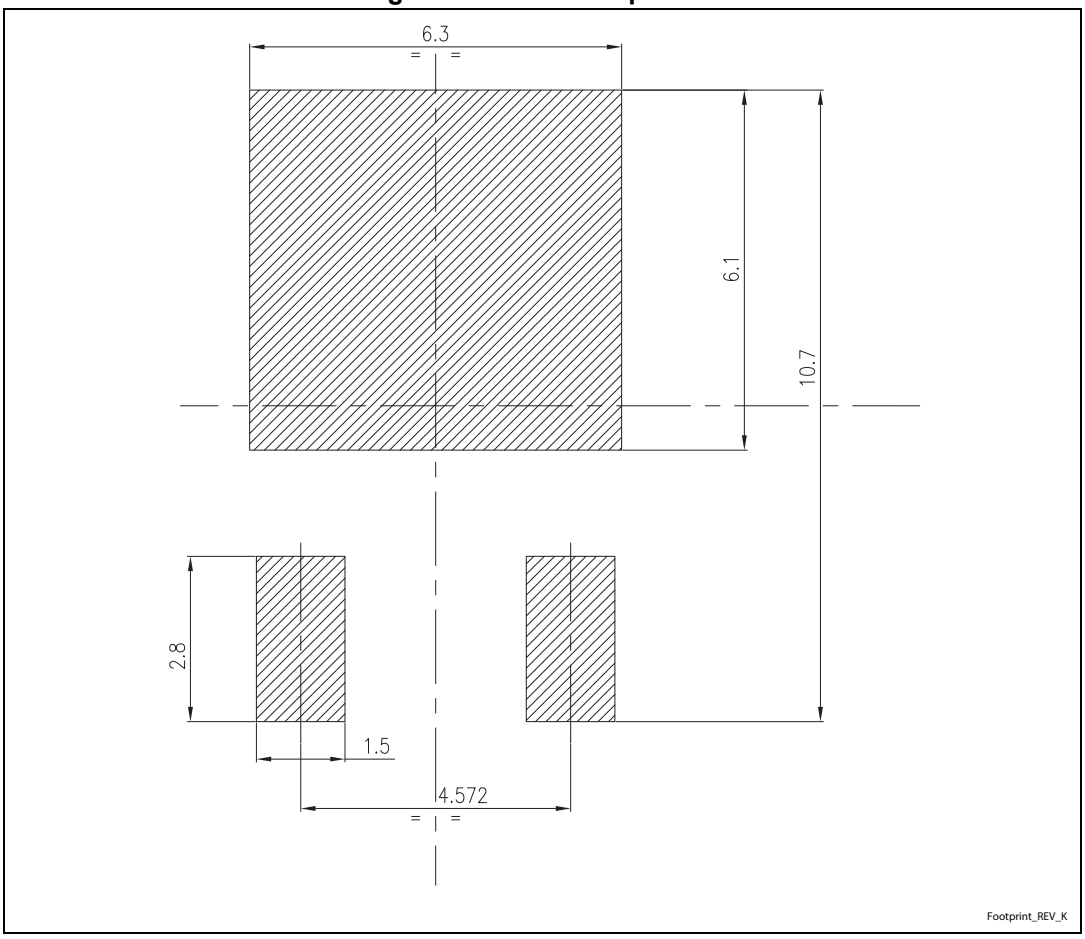


Table 7. DPAK (TO-252) type A mechanical data

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 21. DPAK footprint [(a)]



a. All dimensions are in millimeters

8.3 DFN6 package information

Figure 22. DFN6 (3 x 3 mm) outline

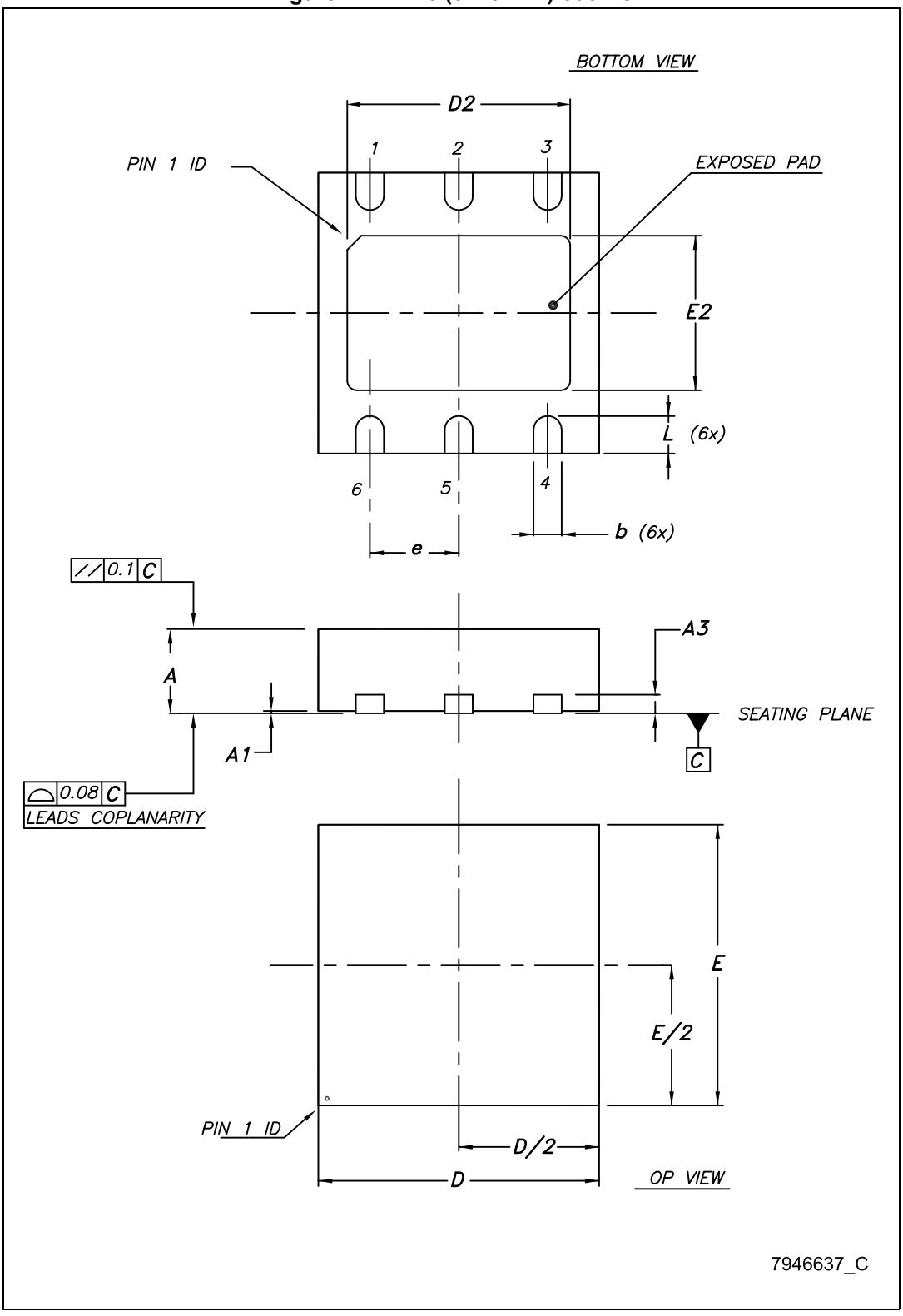
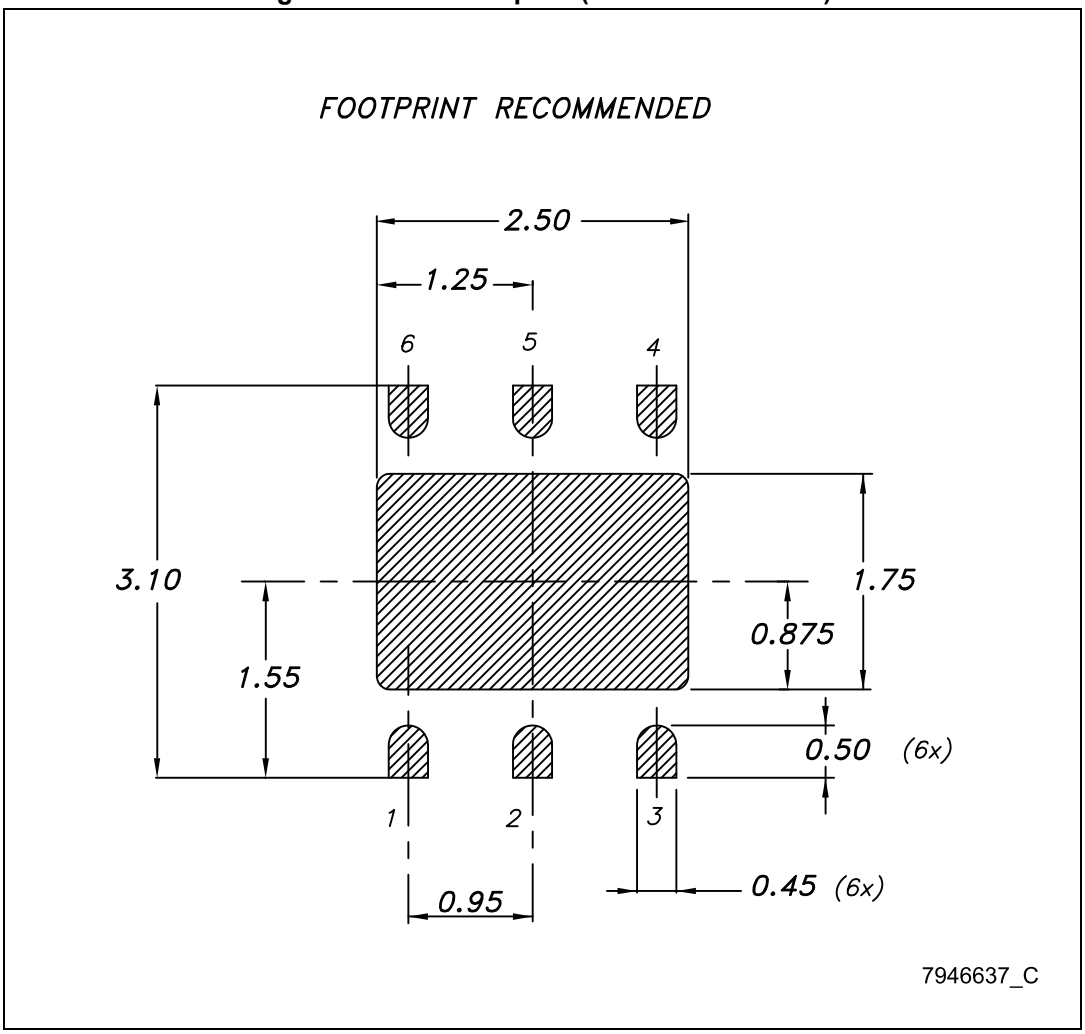


Table 8. DFN6 (3 x 3 mm) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1
A1	0	0.02	0.05
A3		0.20	
b	0.23		0.45
D	2.90	3	3.10
D2	2.23		2.50
E	2.90	3	3.10
E2	1.50		1.75
		0.95	
L	0.30	0.40	0.50

Figure 23. DFN6 footprint (dimensions in mm)



9 Packaging information

9.1 DPAK and PPAK packaging information

Figure 24. Tape for PPAK and DPAK (TO-252)

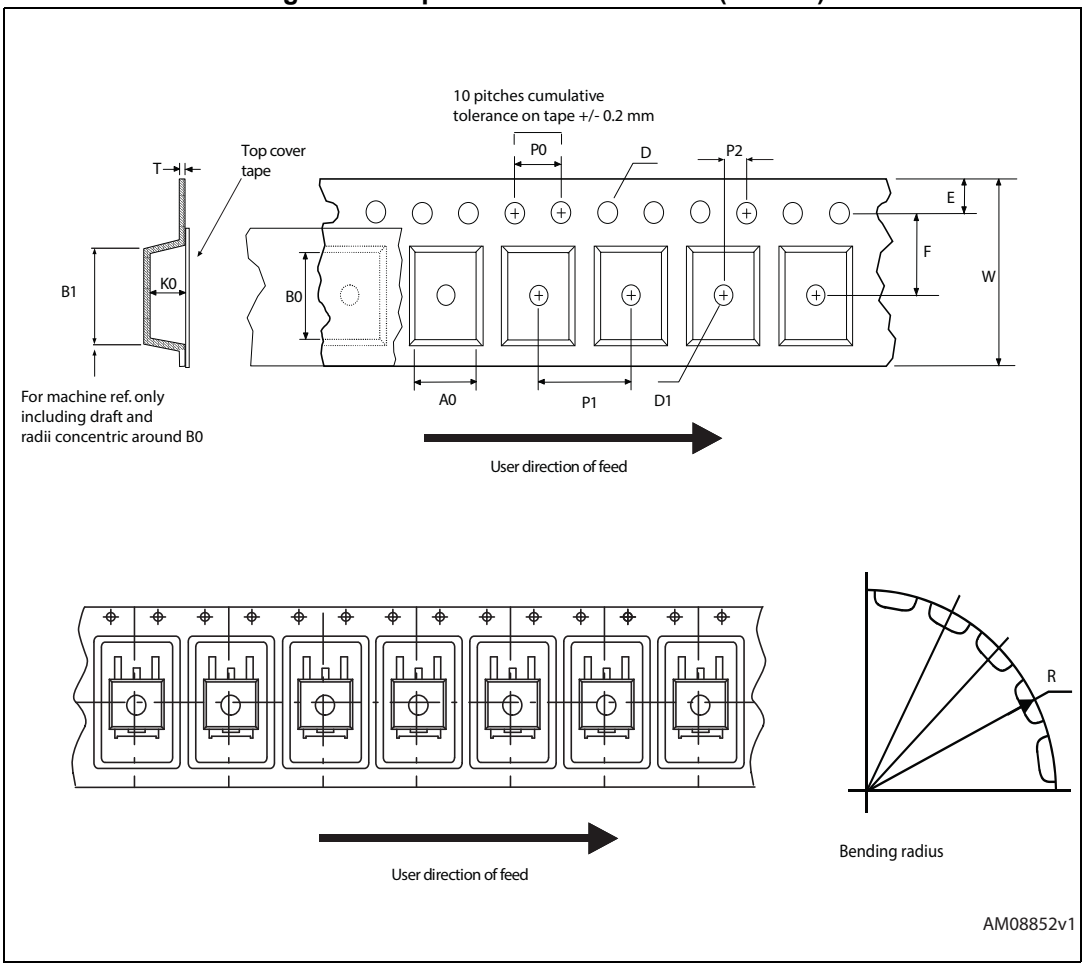


Figure 25. Reel for PPAK and DPAK (TO-252)

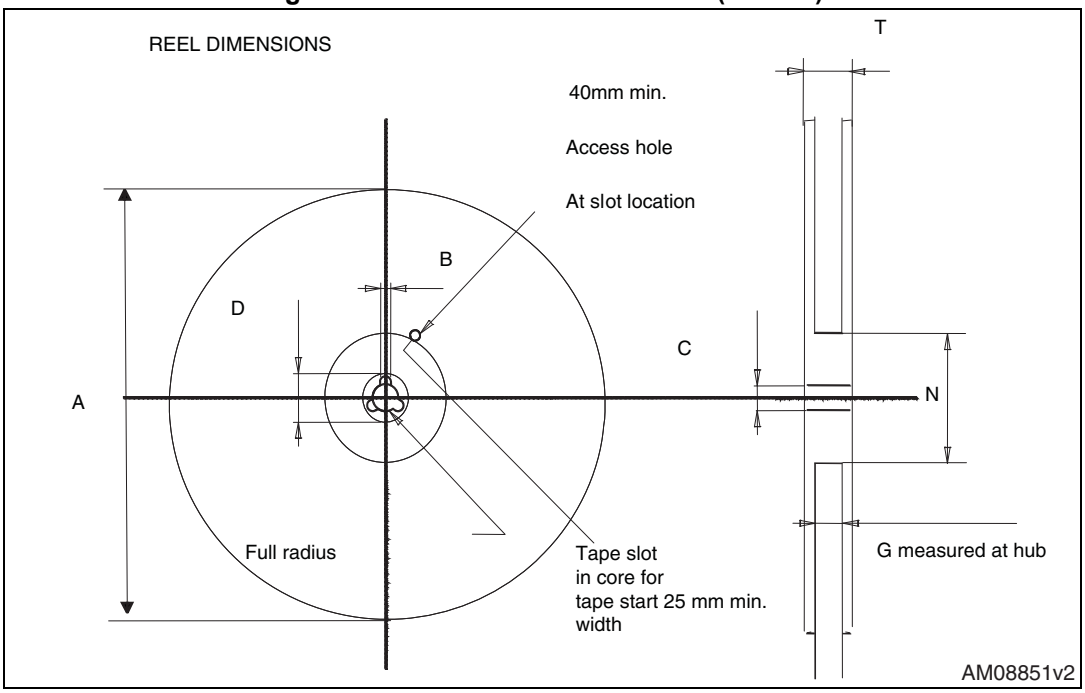


Table 9. PPAK and DPAK (TO-252) tape and reel mechanical data

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			

9.2 DFN6 packaging information

Figure 26. Tape for DFN6

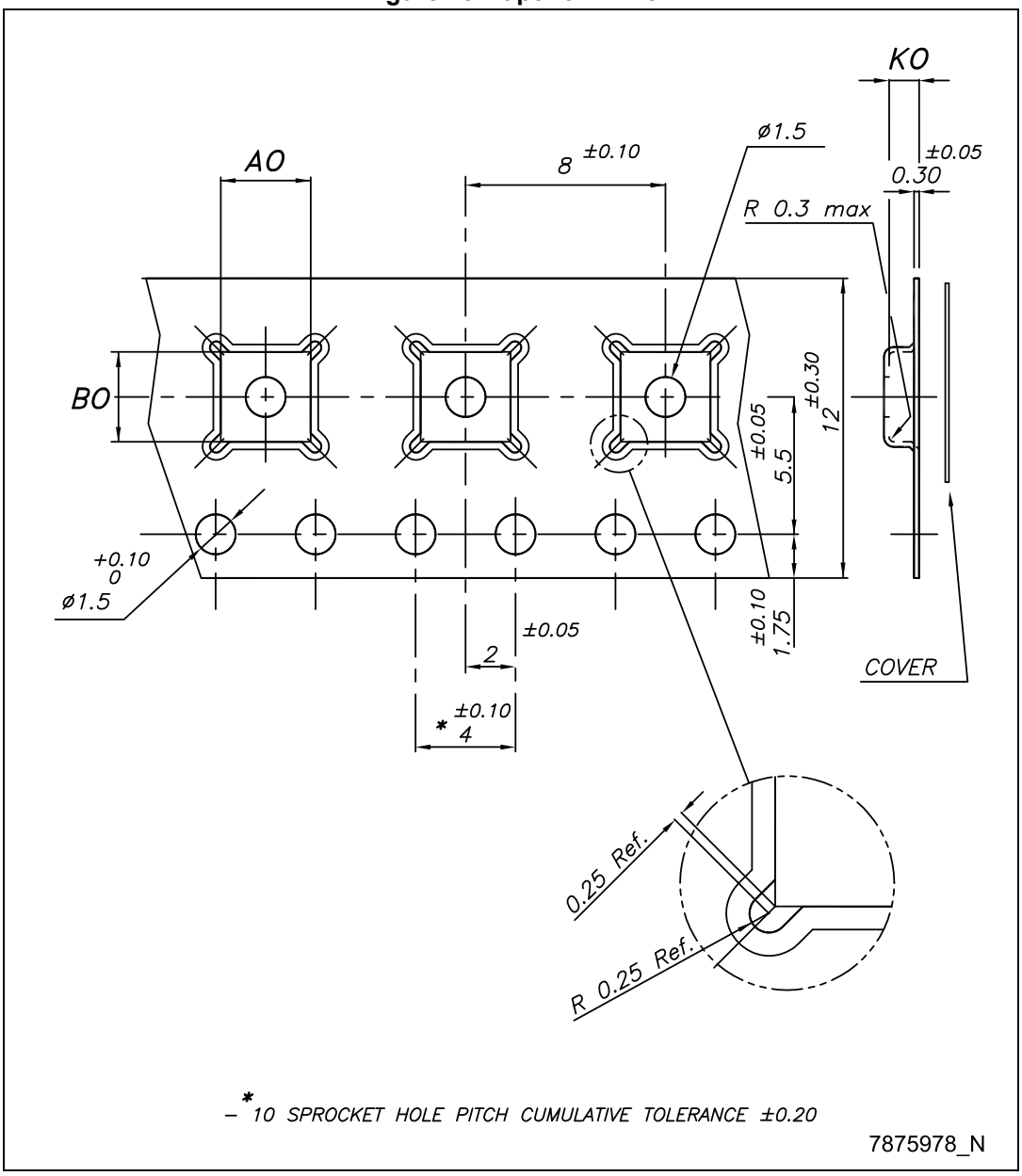


Figure 27. Reel for DFN6

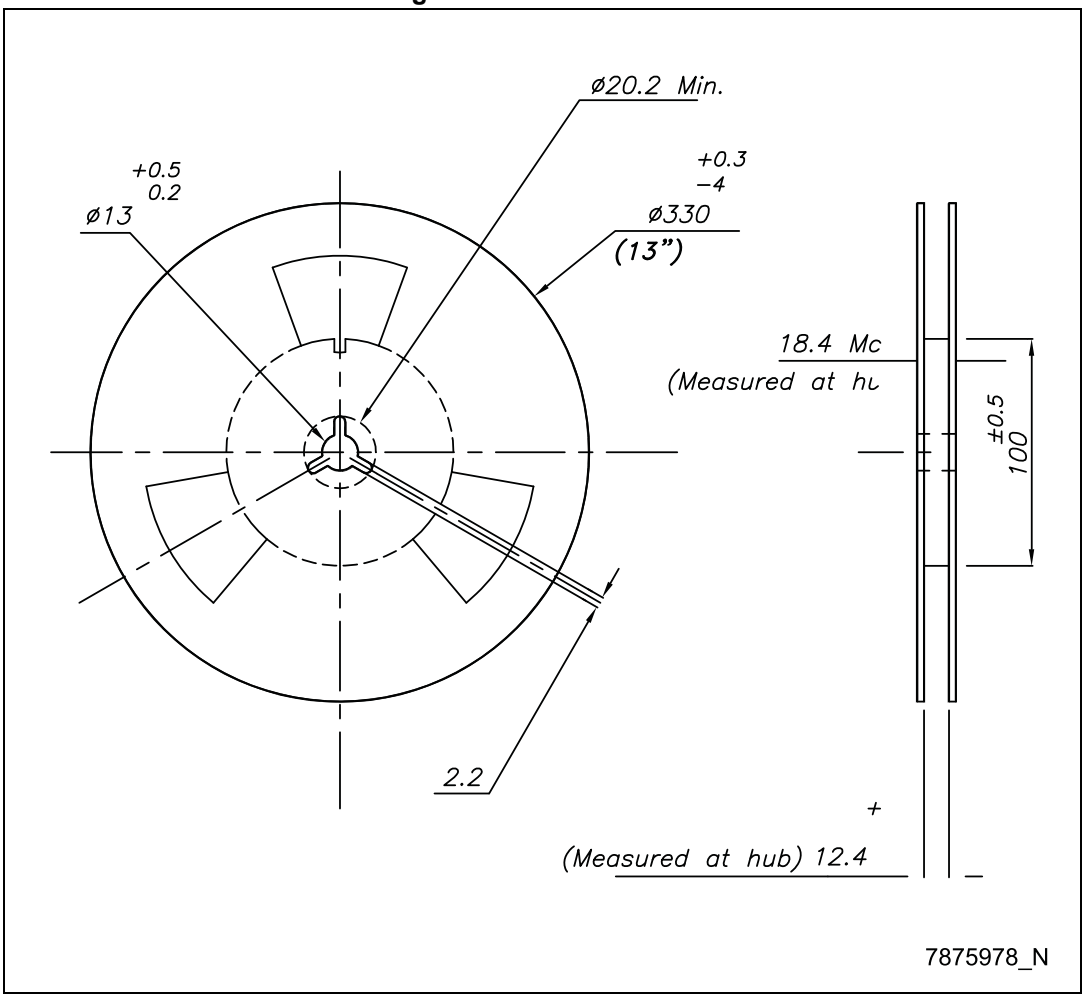


Table 10. DFN6 tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A0	3.20	3.30	3.40
B0	3.20	3.30	3.40
K0	1	1.10	1.20

10 Revision history

Table 11. Document revision history

Date	Revision	Changes
26-Jan-2007	1	Initial release.
12-Jan-2009	2	Removed: package DFN8 (4 x 4 mm) and added package DFN6 (3 x 3 mm).
29-Jan-2013	3	Updated: *Table 1 on page 1*.
14-Jan-2014	4	Document name changed from LD39150XX to LD39150. Updated *Section 8: Package mechanical data*. Added *Section 9: Packaging mechanical data* Minor text changes in title, in features and description in cover page.
30-Aug-2017	5	Removed the following order codes from *Table 1: Device summary*: LD39150PT18-R, LD39150PT25-R, LD39150PT33-R, LD39150PU18R, LD39150PU25R, and LD39150PU33R

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