L5150BN

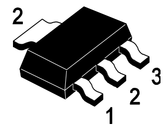
5 V low dropout voltage regulator

Features

Max DC supply voltage	V_S	40 V
Max output voltage tolerance	ΔV_o	±2%
Max dropout voltage	V_{dp}	500 mV
Output current	I_0	150 mA
Quiescent current	I_q	50 μA(1)

1. Typical value.

- Operating DC supply voltage range 5.6 V to 40 V
- Low dropout voltage
- Low quiescent current
- Precison output voltage 5 V ±2%
- Very wide stability range with low value output capacitor
- Thermal shutdown and short-circuit protection
- Wide temperature range (T_j = -40 °C to 150 °C)



SOT-223

Description

L5150BN is a low dropout linear 5 V regulator particularly suitable for automotive applications.

High output voltage accurancy (2%) is kept over wide temperature range line and load variation.

Its sophisticated design allows to have extremely low quiescent current.

The maximum input voltage is 40 V.

The regulator output current is internally limited and the device is protected against short-circuit, overload and overtemperature conditions. In addition, only low-value ceramic capacitor on output is required for stability.

Table 1. Device summary

Package	Order codes	
	Tube	Tape & reel
SOT-223	L5150BN	L5150BNTR

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1 Block diagram and pins description

Figure 1. Block diagram

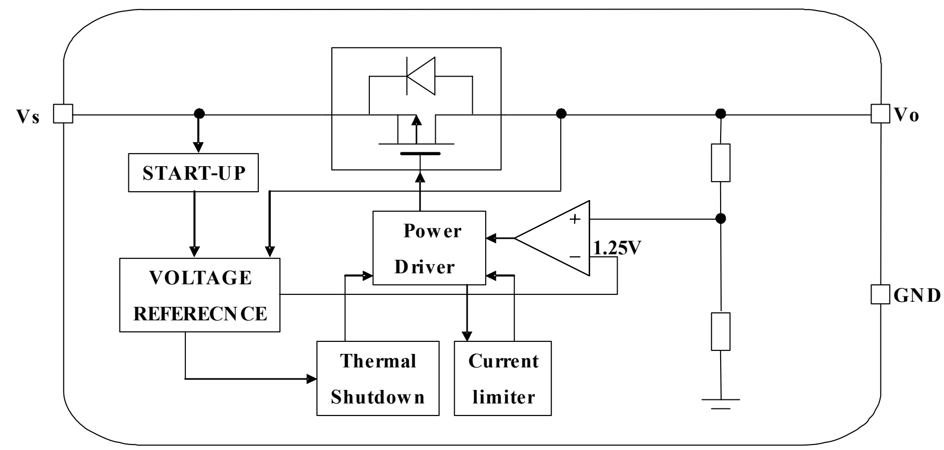


Table 2. Pins description[1]

N°	Pin name	Function
1	V_S	Supply voltage, block directly to GND on the IC with a capacitor.
2	GND	Ground reference
3	V_o	5 V regulated output. Block to GND with a ceramic capacitor ($C_0 \geq 220$ nF for regulator stability)

1. For the pins configuration see outlines at page 1.

2 Electrical specifications

2.1 Absolute maximum ratings

Stressing the device above the rating listed in the *Table 3: Absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE program and other relevant quality documents.

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{sdc}	DC supply voltage	-0.3 to 40	V
I_{sdc}	Input current	internally limited	
V_o	DC output voltage	-0.3 to 6	V
I_o	DC output current	internally limited	
T_j	Junction temperature	-40 to 150	°C
$V_{ESD\ HBM}$	ESD voltage level (HBM-MIL STD 883C)	±2	kV
$V_{ESD\ CDM}$	ESD voltage level (CDM AEC-Q100-011)	±750	V

2.2 Thermal data

Table 4. Thermal data(1)

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction to case: SOT-223	20	°K/W
$R_{thj\text{-}amb}$	Thermal resistance junction to ambient: SOT-223	79	°K/W

1. The values quoted are for PCB 58 mm x 58 mm x 2 mm, FR4, double copper layer with single heatsink layer, copper thickness 35 µm, copper area 2 cm^2.

2.3 Electrical characteristics

Values specified in this section are for V_S = 5.6 V to 31 V, T_j = -40 °C to +150 °C unless otherwise stated.

Table 5. General

Pin	Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_o	V_{o_ref}	Output voltage	V_S = 8 V to 18 V, Io = 8 mA to 150 mA	4.9	5.0	5.1	V
V_o	V_{o_ref}	Output voltage	V_S = 5.6 V to 31 V, I_o = 8 mA to 150 mA	4.85	5.0	5.15	V
V_o	V_{o_ref}	Output voltage	V_S = 5.6 V to 31 V, I_o = 0.1 mA to 8 mA	4.75	5.0	5.25	V
V_o	I_{short}	Short-circuit current	V_S = 13.5 V	0.65	1.10	1.45	A
V_o	I_{lim}	Output current limitation(1)	V_S = 13.5 V	0.28	0.45	0.66	A
V_S, V_o	Vline	Line regulation voltage	V_S = 6 V to 28 V, I_o = 30 mA			40	mV
V_o	V_{load}	Load regulation voltage	V_S = 8 V to 18 V, I_o = 8 mA to 150 mA			55	mV
			V_S = 13.5 V, T_j = 25 °C, I_o = 8 mA to 150 mA			40	
V_S, V_o	V_{dp}	Drop voltage(2)	I_o = 150 mA			500	mV
V_S, V_o	SVR	Ripple rejection	f_r = 100 Hz(3)		60		dB
V_o	I_{oth_H}	Normal consumption mode output current	V_S = 8 V to 18 V	8			mA
V_o	I_{oth_L}	Very low consumption mode output current	V_S = 8 V to 18 V			1.1	mA
V_o	I_{oth_Hyst}	Output current switching threshold hysteresis	V_S = 13.5 V, T_j = 25 °C		0.8		mA
V_S, V_o	I_{qn_1}	Current consumption with regulator enabled Iqn_1 = I_{Vs} – Io	V_S = 13.5 V, I_o = 0.1 mA to 1 mA, Tj = 25 °C		50	80	µA
			V_S = 13.5 V, I_o = 0.1 mA to 1 mA,			95	
V_S, V_o	I_{qn_150}	Current consumption with regulator enabled $I_{qn\_150} = I_{Vs} - I_o$	V_S = 13.5 V, I_o = 150 mA		3.2	4.2	mA
	T_w	Thermal protection temperature		150		190	°C
	T_{w_hy}	Thermal protection temperature hysteresis			10		°C

1. Measured output current when the output voltage has dropped 100 mV from its nominal value obtained at 13.5 V and I_o = 75 mA.

2. V_S - V_o measured dropout when the output voltage has dropped 100 mV from its nominal value obtained at 13.5 V and I_o = 75 mA.
3. Guaranteed by design.

2.4 Electrical characteristics curves

Figure 2. Output voltage vs. T_j

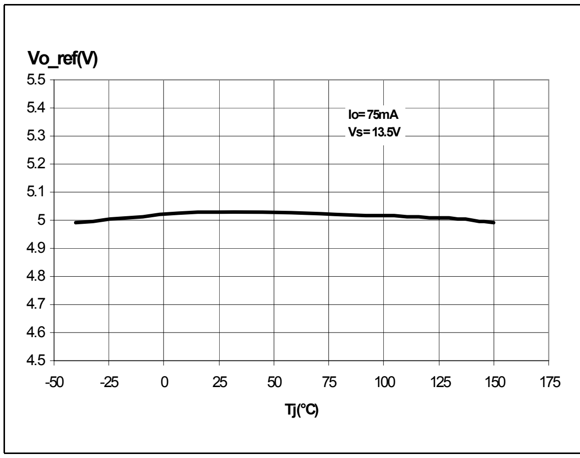


Figure 3. Output voltage vs. V_S

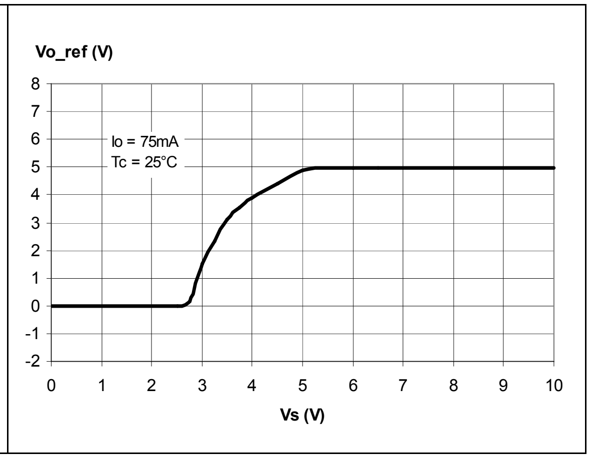


Figure 4. Drop voltage vs. output current

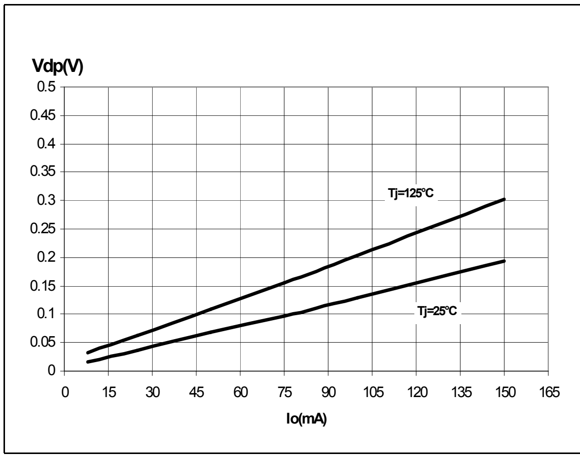


Figure 5. Current consumption vs. output current

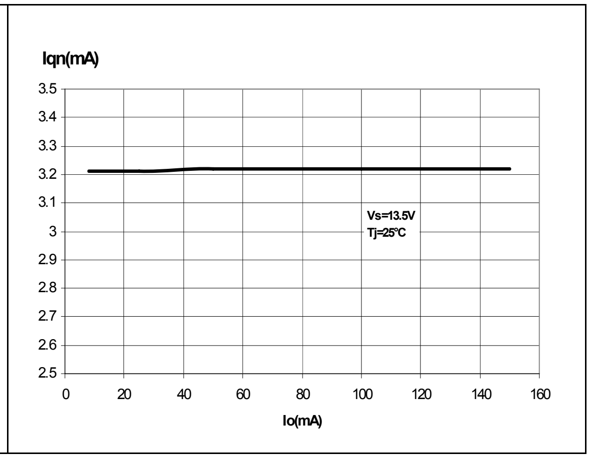


Figure 6. Current consumption vs. output current (at light load condition)

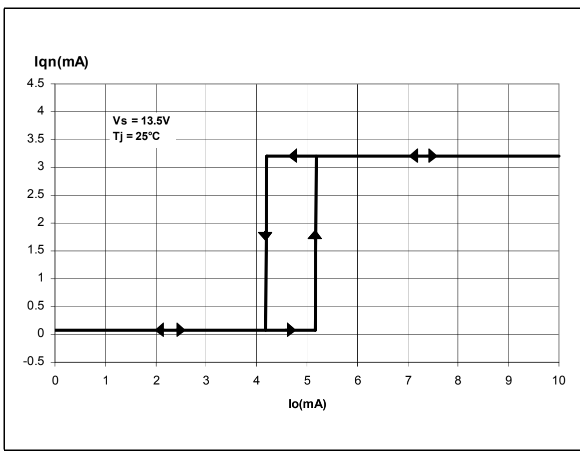


Figure 7. Current consumption vs. input voltage (Io = 0.1 mA)

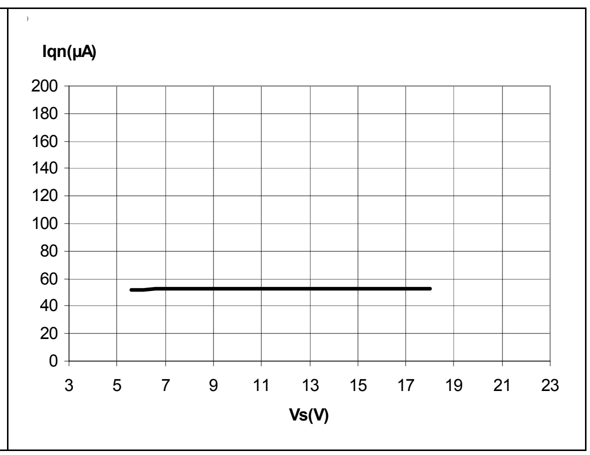


Figure 8. Current consumption vs. input voltage (Io = 75 mA)

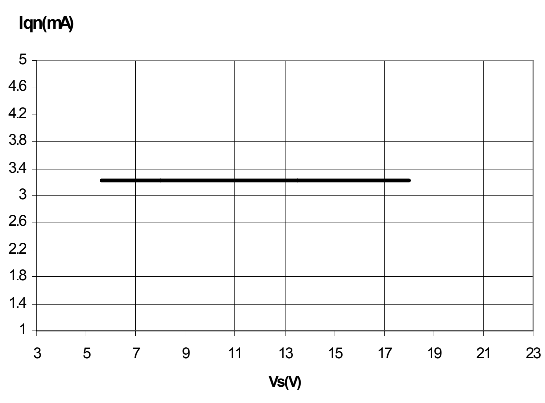


Figure 9. Current limitation vs. T_j

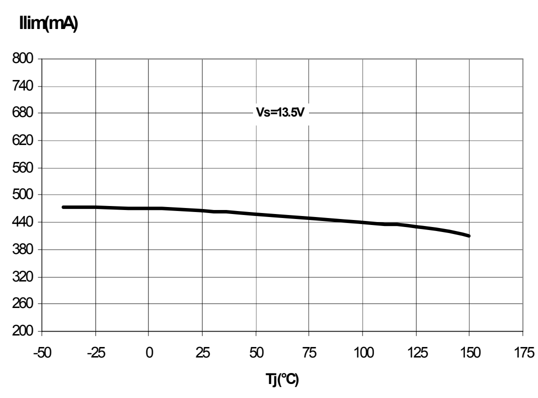


Figure 10. Current limitation vs. input voltage

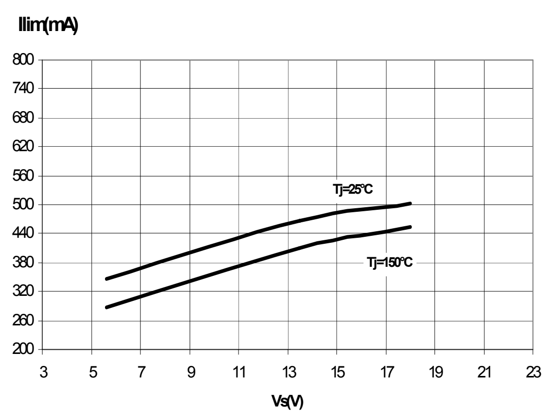


Figure 11. Short-circuit current vs. T_j

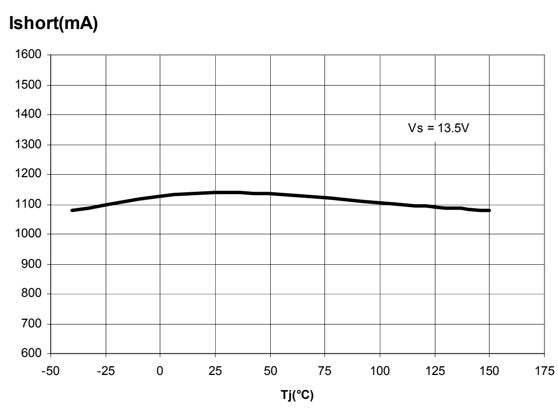


Figure 12. Short-circuit current vs. input voltage

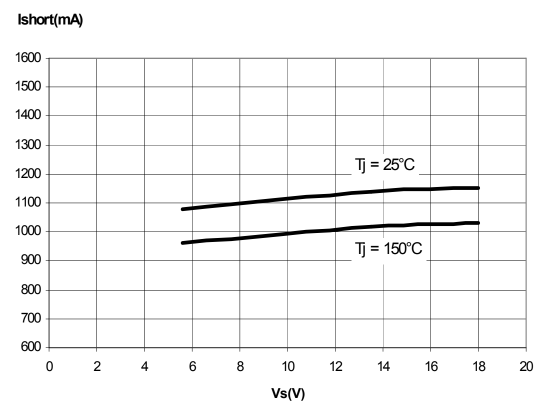
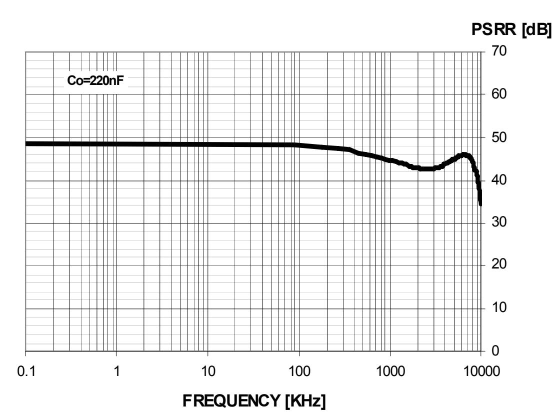


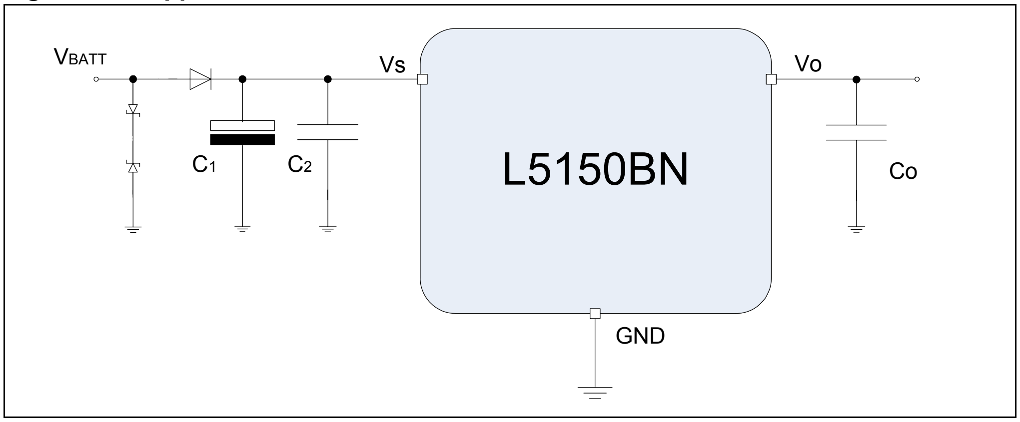
Figure 13. PSRR



2.5 Application information

The voltage regulator uses a p-channel mos transistor as a regulating element. With this structure a very low dropout voltage at current up to 150 mA is obtained. The output voltage is regulated up to input supply voltage of 40 V. The high-precision of the output voltage (2%) is obtained with a pre-trimmed reference voltage. The voltage regulator automatically adapts its own quiescent current to the output current level. In light-load conditions the quiescent current goes to 55 µA only (low consumption mode). This procedure features a certain hysteresis on the output current (see *Figure 6*). Short-circuit protection to GND and a thermal shutdown are provided.

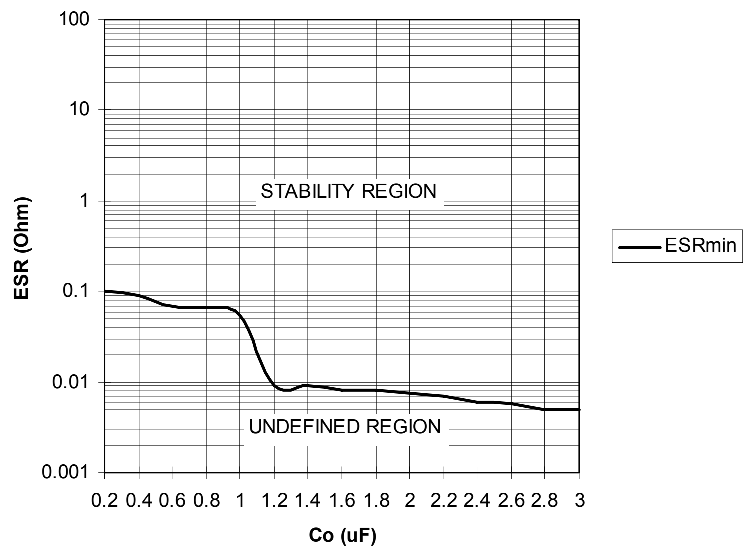
Figure 14. Application schematic



The input capacitor $C_1 \geq 100$ µF is necessary as backup supply for negative pulses which may occur on the line. The second input capacitor $C_2 \geq 220$ nF is needed when the C_1 is too distant from the V_S pin and it compensates smooth line disturbances. The C_0 ceramic capacitor, connected to the output pin, is for bypassing to GND the high-frequency noise and it guarantees stability even during sudden line and load variations. Suggested value is $C_0 = 220$ nF with $ESR \geq 100\ m\Omega$.

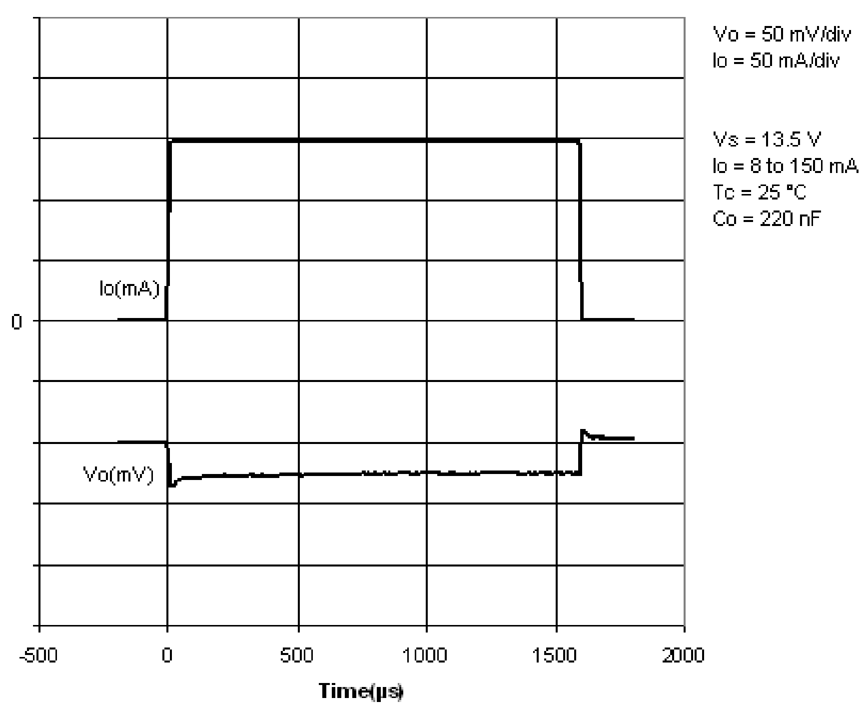
Stability region is reported in *Figure 15*.

Figure 15. Stability region(1)



1. The curve which describes the minimum ESR is derived from characterization data on the regulator with connected ceramic capacitors which feature low ESR values (at 100 kHz). Any capacitor with further lower ESR than the given plot value must be evaluated in each and every case.

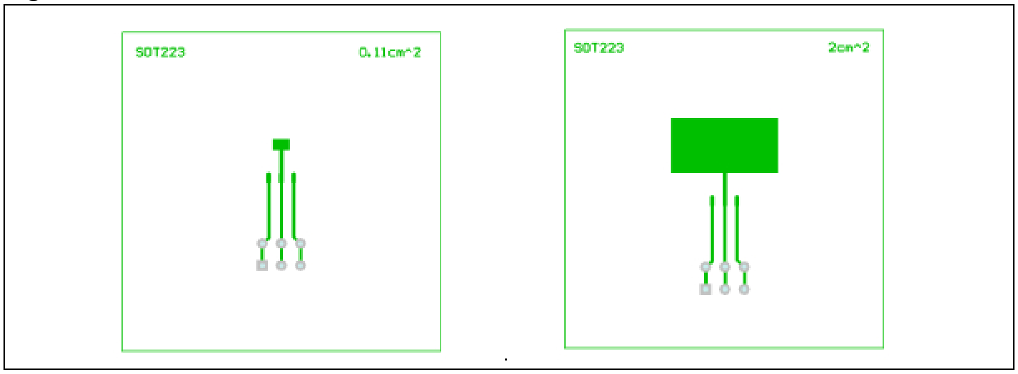
Figure 16. Maximum load variation response



3 Package and PCB thermal data

3.1 SOT-223 thermal data

Figure 17. SOT-223 PC board(1)



1. Layout condition of R_{th} and Z_{th} measurements (PCB: double layer, FR4 area= 58 mm x 58 mm, PCB thickness = 2 mm, Cu thickness = 35 µm (front and back side), footprint dimension 4.1 mm x 6.5 mm).

Figure 18. $R_{thj\text{-}amb}$ vs. PCB copper area in open box free air condition

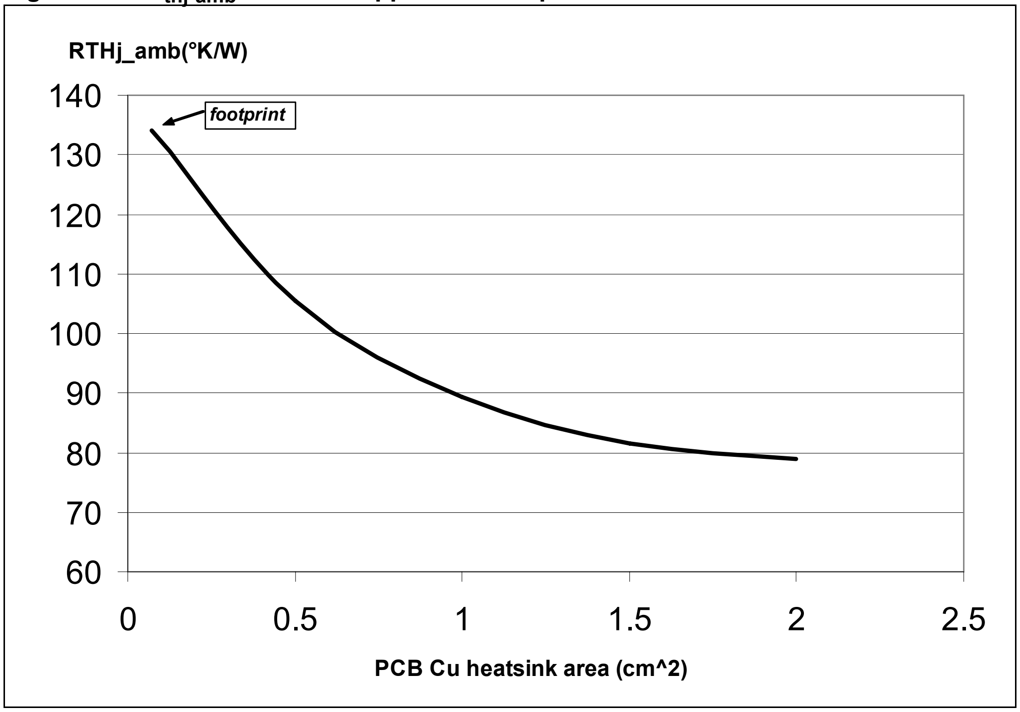
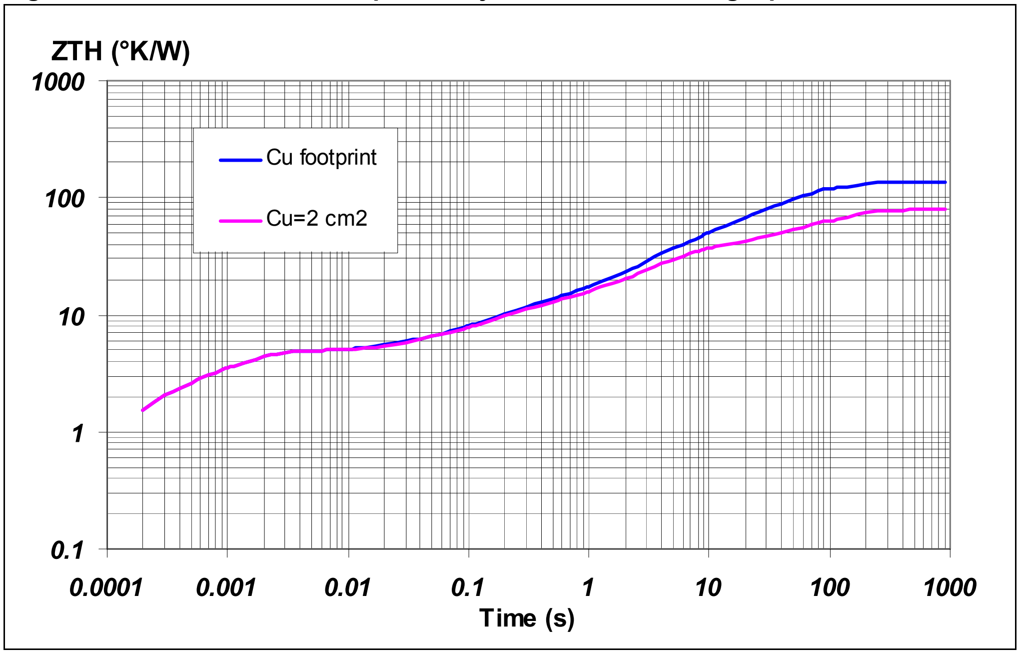


Figure 19. SOT-223 thermal impedance junction ambient single pulse



Equation 1: pulse calculation formula

$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_P/T$

Figure 20. Thermal fitting model of Vreg in SOT-223

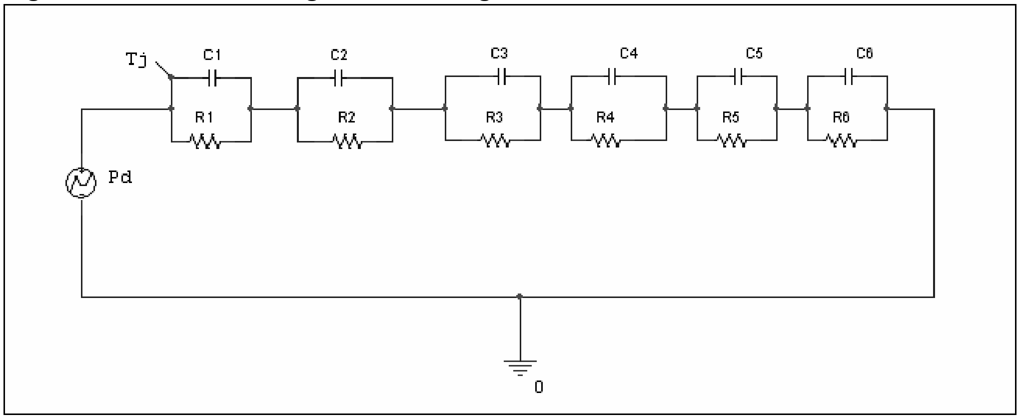


Table 6. SOT-223 thermal parameter

Area (cm^2)	Footprint	2
R1 (°K/W)	1.53	
R2 (°K/W)	3.21	
R3 (°K/W)	5.2	
R4 (°K/W)	24	
R5 (°K/W)	0.1	
R6 (°K/W)	100	45
C1 (W.s/°K)	0.00004	
C2 (W.s/°K)	0.0003	
C3 (W.s/°K)	0.03	
C4 (W.s/°K)	0.16	
C5 (W.s/°K)	1000	
C6 (W.s/°K)	0.5	2

4 Package and packing information

4.1 ECOPACK®

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.

4.2 SOT-223 mechanical data

Figure 21. SOT-223 package dimensions

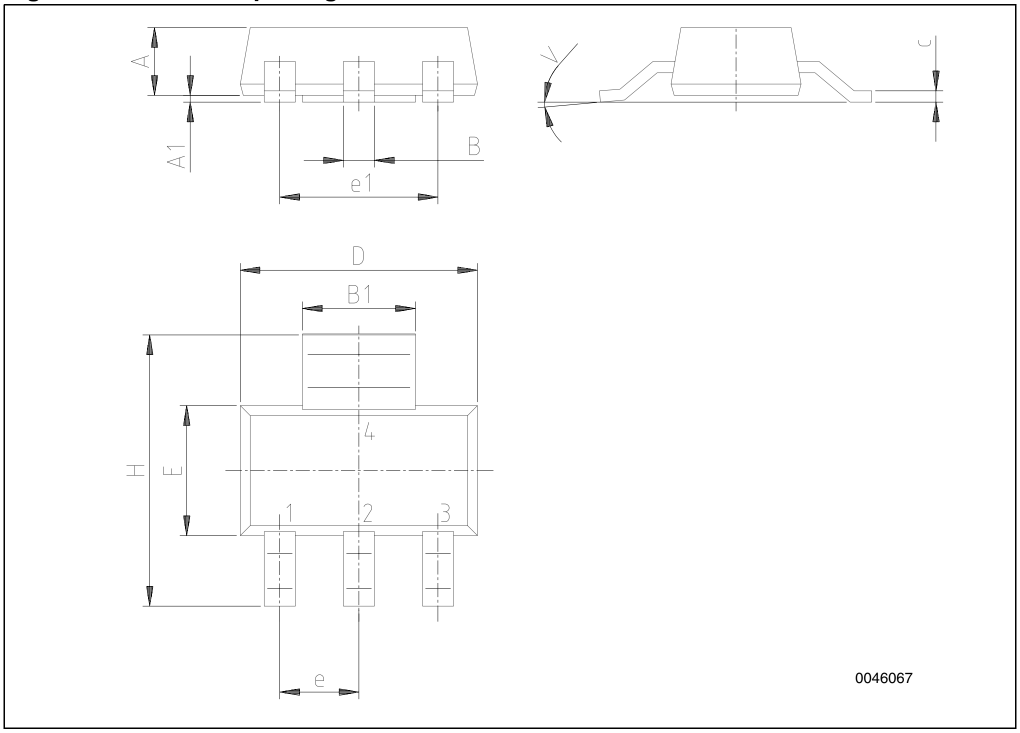
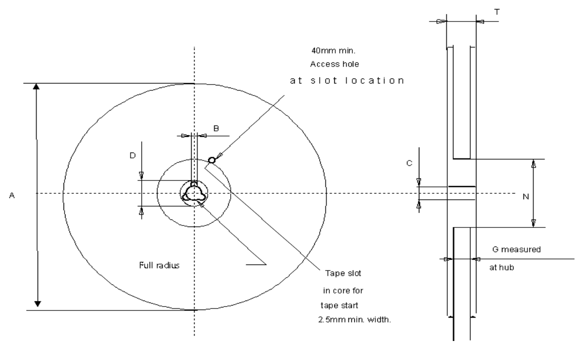


Table 7. SOT-223 mechanical data

DIM.	mm.			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.8			0.071
B	0.6	0.7	0.85	0.024	0.027	0.033
B1	2.9	3	3.15	0.114	0.118	0.124
c	0.24	0.26	0.35	0.009	0.01	0.014
D	6.3	6.5	6.7	0.248	0.256	0.264
e		2.3			0.09	
e1		4.6			0.181	
E	3.3	3.5	3.7	0.13	0.138	0.146
H	6.7	7	7.3	0.264	0.276	0.287
V	10 (max)					
A1	0.02		0.1	0.0008		0.004

4.3 SOT-223 packing information

Figure 22. SOT-223 tape and reel shipment (suffix "TR")



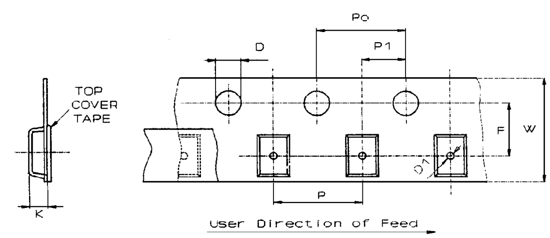
Reel dimensions

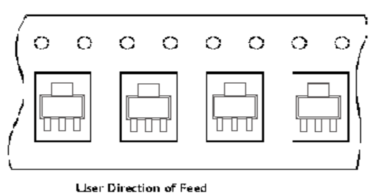
Base q.ty	1000
Bulk q.ty	1000
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	12.4
N (min)	60
T (max)	18.4

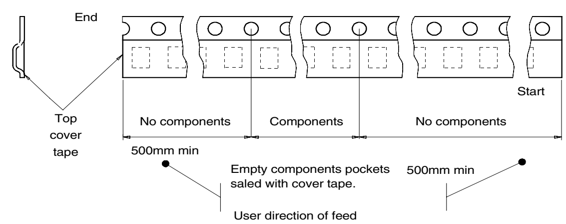
Tape dimensions

According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb. 1986

Tape width	**W**	12
Tape hole spacing	**P0 (± 0.1)**	4
Component spacing	**P**	8
Hole diameter	**D (± 0.1/-0)**	1.5
Hole diameter	**D1 (min)**	1.5
Hole position	**F (± 0.05)**	5.5
Compartment depth	**K (max)**	4.5
Hole spacing	**P1 (± 0.1)**	2







5 Revision history

Table 8. Document revision history

Date	Revision	Changes
18-Jun-2007	1	Initial release.
14-May-2008	2	Corrected *Table 2.: Pins description* : inverted 1 and 3 pins descriptions. Updated *Table 5.: General* : – V_{o_ref} parameter: updated test conditions and values. – V_{line} and V_{short} : updated test condition – Ishort: changed values from 0.65/0.95/1.25 to 0.65/1.10/1.45 (Min/Typ/Max) – I_{lim}: changed values from 0.7/1/1.30 to 0.28/0.45/0.66, added note – V_{dp}: added note – Inserted Io_{th_L}, Io_{th_H}, Io_{th_Hyst} rows – I_{qn_1}: changed values from 38/48 to 48/70 (Typ/Max).
09-Sep-2008	3	Updated *Table 5.: General* : – V_{load} parameter: changed test conditions.

Table 8. Document revision history (continued)

Date	Revision	Changes
16-Jun-2009	4	Updated corporate template (from V2 to V3) Changed document title *Section : Features* on cover page – I_q on table: changed value from 48 µA to 50 µA – Added row in bullet list *Table 2: Pins description* V_o: changed ceramic capacitor expression for Function *Table 3: Absolute maximum ratings* – Updated all symbols *Table 4: Thermal data* – $R_{thj\text{-}amb}$: changed value – Updated TableFootnote *Table 5: General* – V_{load}: changed max value for Vs = 8 V to 18 V, added new row – I_{qn_1}: changed Test condition (added T_j = 25 °C), changed typ/max value for T_j = 25 °C , added new row – I_{qn_150}: changed typ value Added *Figure 2: Output voltage vs. T_j* Added *Figure 3: Output voltage vs. V_S* Added *Figure 4: Drop voltage vs. output current* Added *Figure 5: Current consumption vs. output current* Added *Figure 6: Current consumption vs. output current (at light load condition)* Added *Figure 7: Current consumption vs. input voltage (Io = 0.1 mA)* Added *Figure 8: Current consumption vs. input voltage (Io = 75 mA)* Added *Figure 9: Current limitation vs. T_j* Added *Figure 10: Current limitation vs. input voltage* Added *Figure 11: Short-circuit current vs. T_j* Added *Figure 12: Short-circuit current vs. input voltage* Added *Figure 13: PSRR* *Section 2.5: Application information* – Changed section title from “Voltage regulator“ to “Application information“ – Updated text – Added *Figure 14: Application schematic* – Added *Figure 16: Maximum load variation response* Added *Section 3: Package and PCB thermal data* Changed *Section 4.1: ECOPACK®*
04-Dec-2009	5	Updated features list. Updated *Section 2.5: Application information*.

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