L5300EPT

5 V low dropout voltage regulator

Datasheet – production data

Features

Max DC supply voltage	V_S	40 V
Max output voltage tolerance	ΔV_0	+/-2 %
Max dropout voltage	V_{dp}	500 mV
Output current	I_0	300 mA
Quiescent current	I_{qn}	5 µA(1) 55 µA(2)

1. Typical value with regulator disabled
2. Typical value with regulator enabled

- Operating DC supply voltage range 5.6 V to 40 V
- Low dropout voltage
- 300 mA current capability
- Low quiescent current
- Very low consumption mode
- Precision output voltage 5 V +/- 2 %
- Thermal shutdown and short-circuit protection
- Wide temperature range (T_j = -40 °C to 150 °C)
- Enable input for enabling / disabling the voltage regulator

PPAK

Description

L5300EPT is a low dropout linear regulator with ON/OFF control. In addition, only low value ceramic capacitor is required for stability (above or equal 220 nF).

Typical quiescent current is 55 µA in light load conditions. It drops to 5 µA in “not enabled” mode.

On-chip trimming results in high output voltage accuracy (2 %). Accuracy is kept over wide temperature range, line and load variations.

The maximum input voltage is 40 V. The max output current is internally limited. Internal temperature protection disables the voltage regulator output.

Table 1. Device summary

Package	Order codes	
	Tube	Tape and reel
PPAK	L5300EPT	L5300EPTTR

Contents

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1 Block diagram and pins description

Figure 1. Block diagram

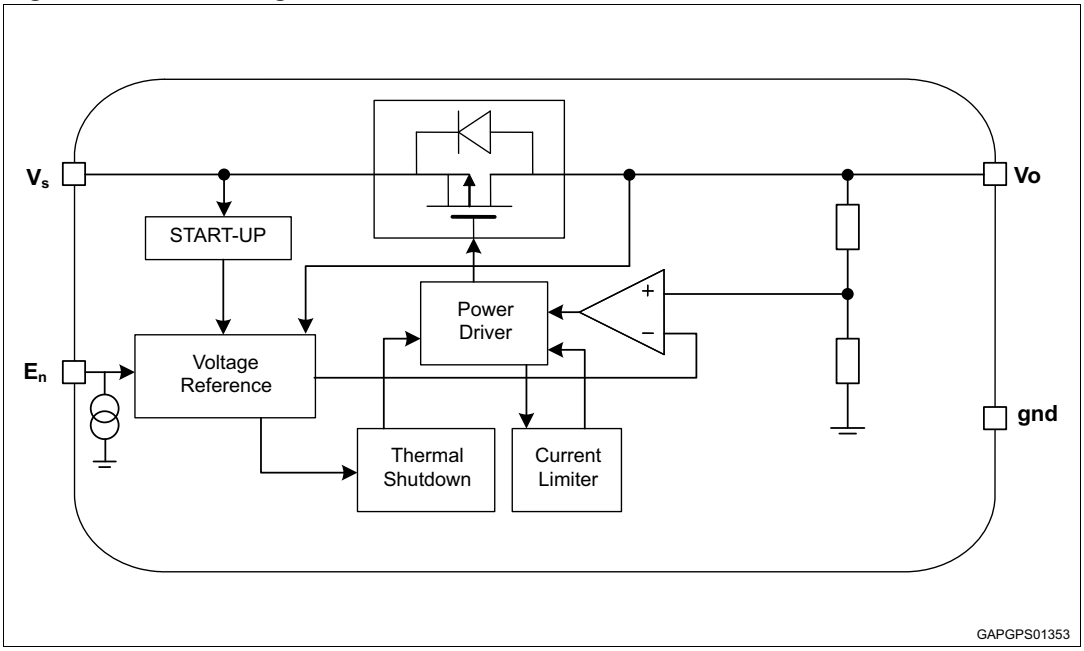


Figure 2. Configuration diagram (top view)

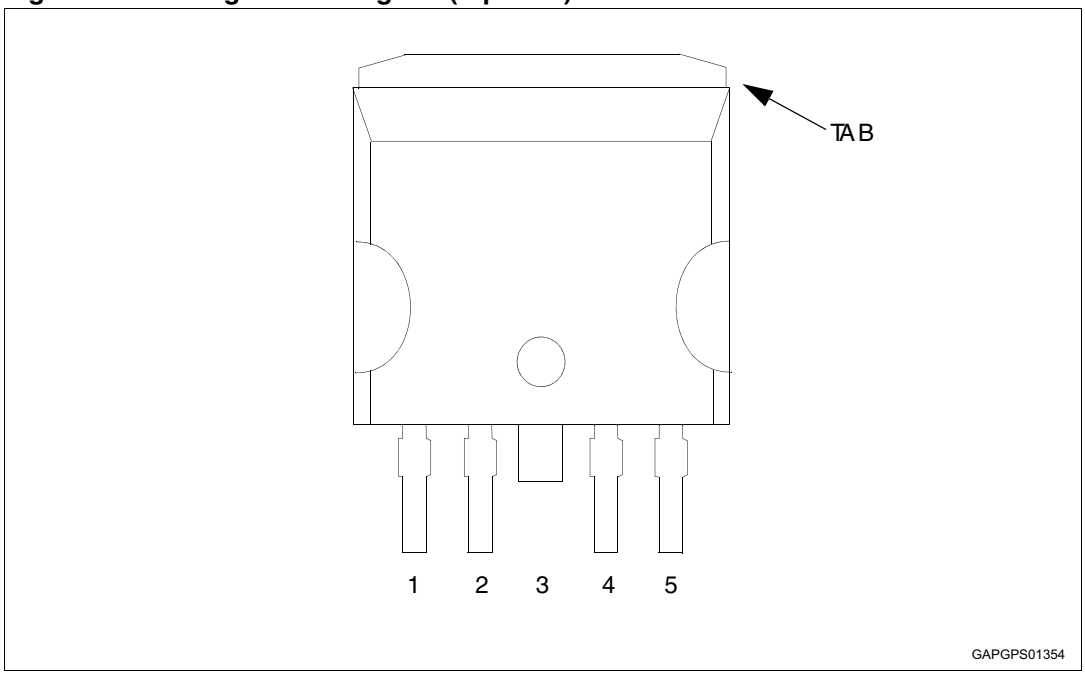


Table 2. Pins description

N°	Name	Function
1	V_S	Supply voltage, block directly to GND on the IC with a capacitor.
2	E_n	Enable input. A high signal switches the regulator on. Connect to V_S if not needed.
3	GND	Ground is internally electrically connected to TAB.
4	N_c	Not connected
5	V_o	5 V regulated output. Block to GND with a ceramic capacitor ($\geq$ 220 nF for regulator stability).

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_{odc}	DC output voltage	-0.3 to 6	V
I_{odc}	DC output current	Internally limited	
V_{En}	Enable input	-0.3 to 40	V
T_j	Junction temperature	-40 to 150	°C
$V_{ESD\ HBM}$	ESD HBM voltage level (HBM-MIL STD 883C)	+/- 2	kV
$V_{ESD\ CDM}$	ESD CDM voltage level (CDM- AEC-Q100-011)	+/- 750	V

2.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction to case	5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction to ambient	45.5	°C/W

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 I_o = 8 mA to 300 mA	4.9	5.0	5.1	V
V_o	V_{o_ref}	Output voltage	V_S = 5.6 V to 31V I_o = 8 mA to 300 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	0.8	1.8	2.6	A
V_o	I_{lim}	Output current capability (1)	V_S = 13.5 V	0.6	1.6	2.5	A
V_S, V_o	V_{line}	Line regulation voltage	V_S = 6 V to 28 V I_o = 50 mA			40	mV
V_o	V_{load}	Load regulation voltage	V_S = 13.5 V I_o = 8 mA to 300 mA T_j = 25 °C			40	mV
			V_S = 8 V to 18 V I_o = 8 mA to 300 mA			55	
V_S, V_o	V_{dp}	Drop voltage (2)	I_o = 300 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_{qs}	Current consumption with regulator disabled $I_{qs} = I_{Vs} - I_o$	V_S = 13.5 V; E_n = low		5	10	µA
V_S, V_o	I_{qn_1}	Current consumption with regulator enabled $I_{qn\_1} = I_{Vs} - I_o$	V_S = 13.5 V, I_o = 0.1 mA to 1mA, E_n = high		55	80	µA
V_S, V_o	I_{qn_300}	Current consumption with regulator enabled $I_{qn\_300} = I_{Vs} - I_o$	V_S = 13.5 V, I_o = 300 mA, E_n = high		3	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 13.5V and I_o = 75 mA.
3. Guaranteed by design.

Table 6. Enable

Pin	Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
E_n	V_{En_low}	E_n input low voltage				1	V
E_n	V_{En_high}	E_n input high voltage		3			V
E_n	V_{En_hyst}	E_n input hysteresis			500		mV
E_n	$I_{\_leak}$	Pull down current	V_{En} = 5 V		3	10	µA

2.4 Electrical characteristics curves

Figure 3. Output voltage vs T_j

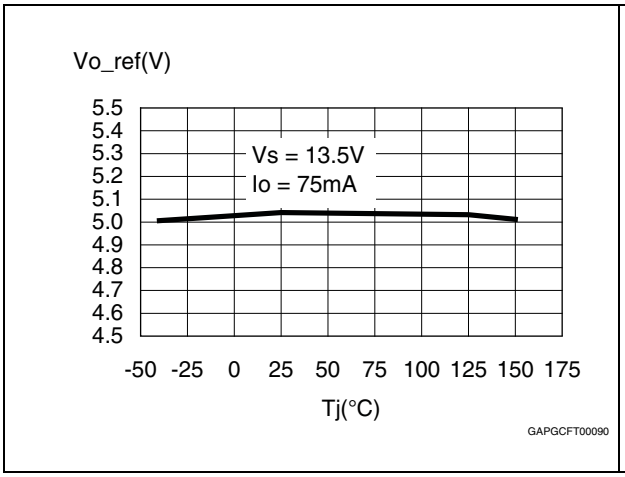


Figure 4. Output voltage vs V_S

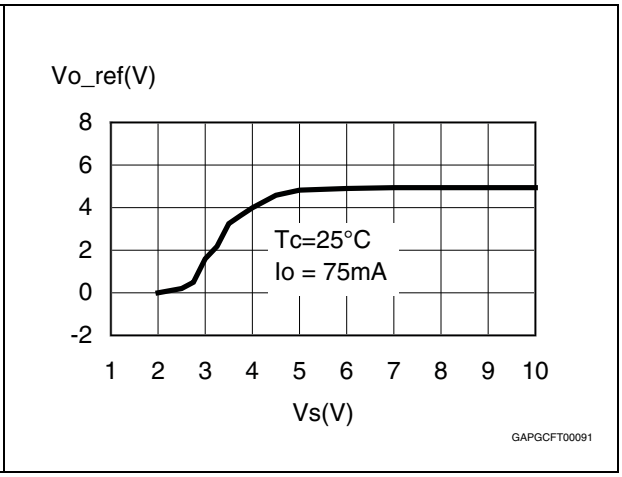


Figure 5. Output voltage vs V_{En}

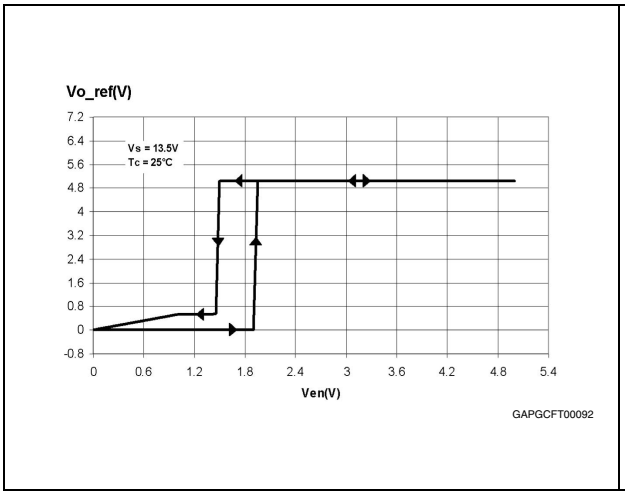


Figure 6. Drop voltage vs output current

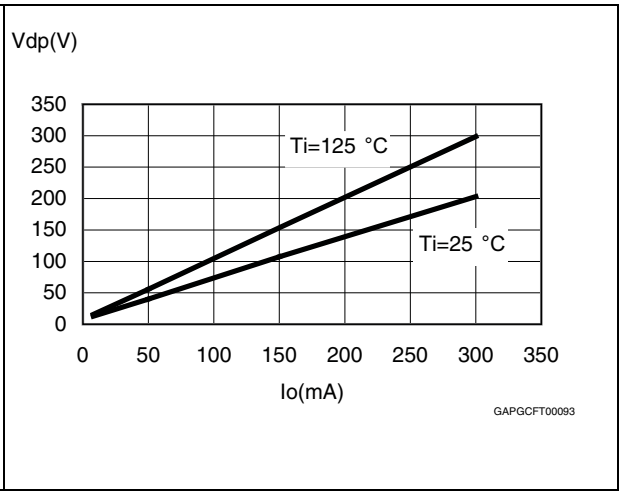


Figure 7. Current consumption vs output current

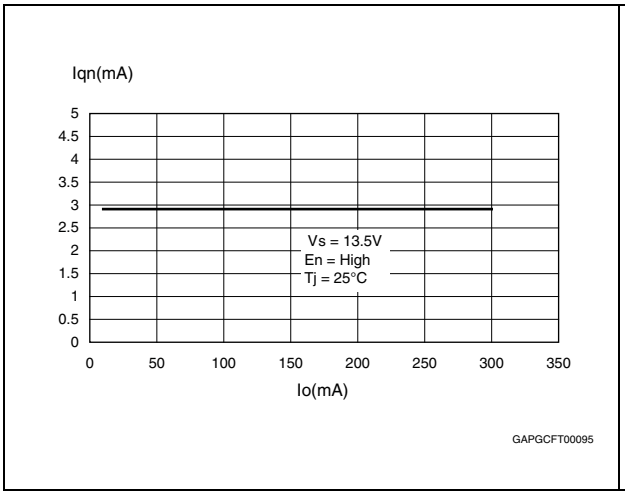


Figure 8. Current consumption vs output current (at light load condition)

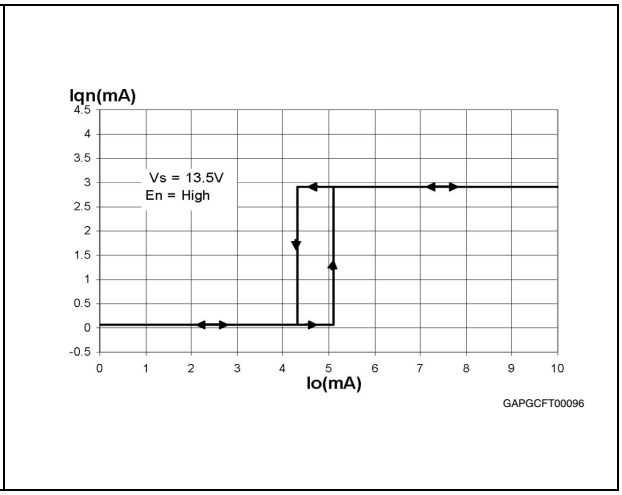


Figure 9. Current consumption vs input voltage (I_o = 0.1 mA)

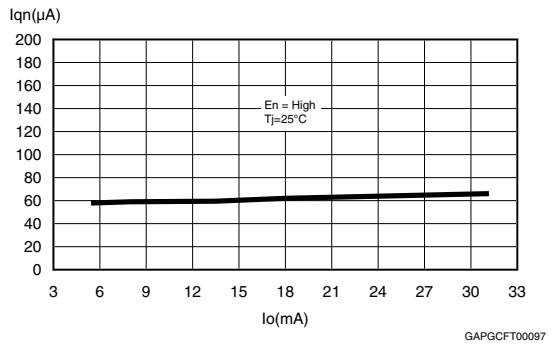


Figure 10. Current consumption vs input voltage (I_o = 100 mA)

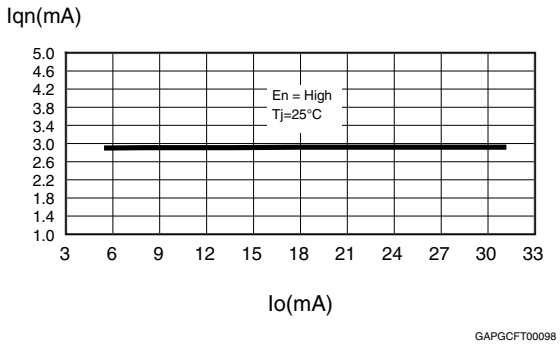


Figure 11. Current limitation vs T_j

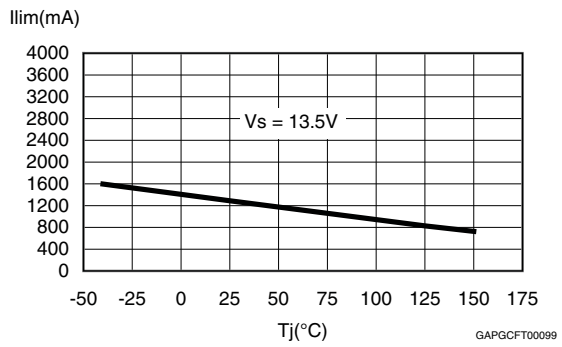


Figure 12. Current limitation vs input voltage

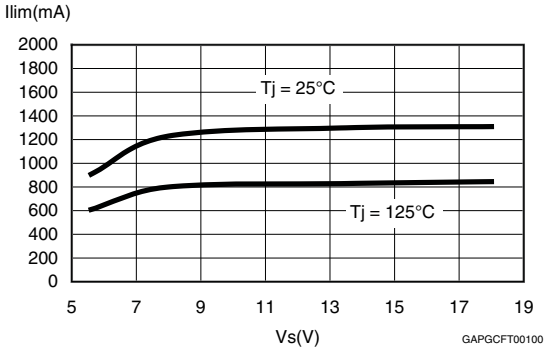


Figure 13. Short-circuit current vs T_j

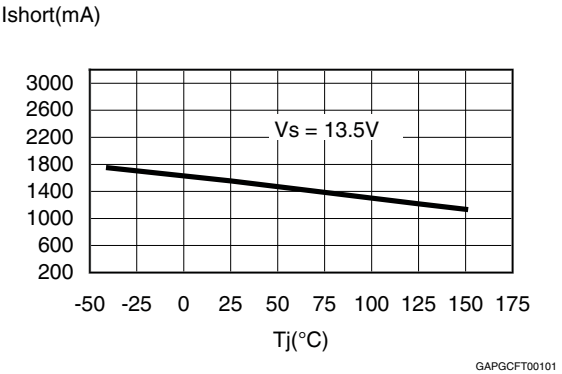


Figure 14. Short-circuit current vs input voltage

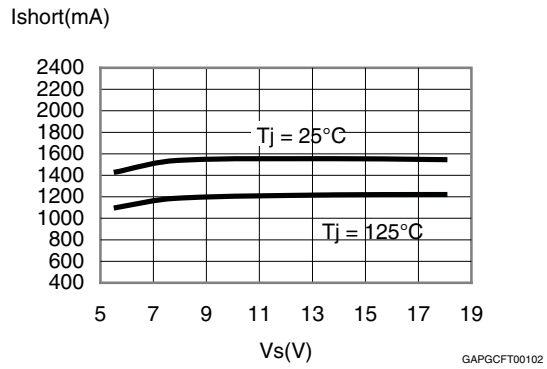


Figure 15. V_{En_high} vs T_j

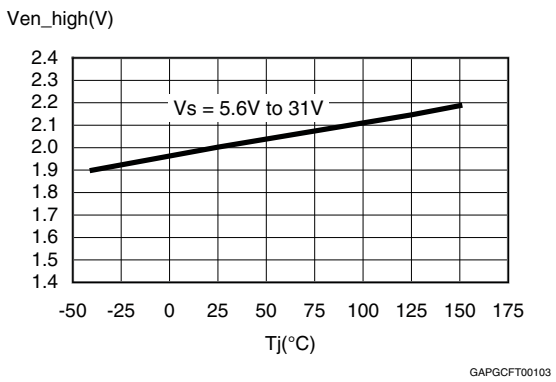
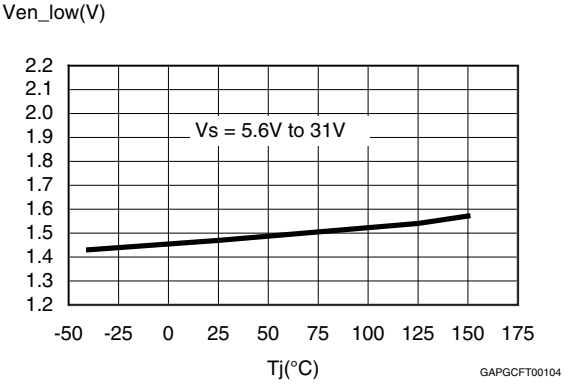


Figure 16. V_{En_low} vs T_j

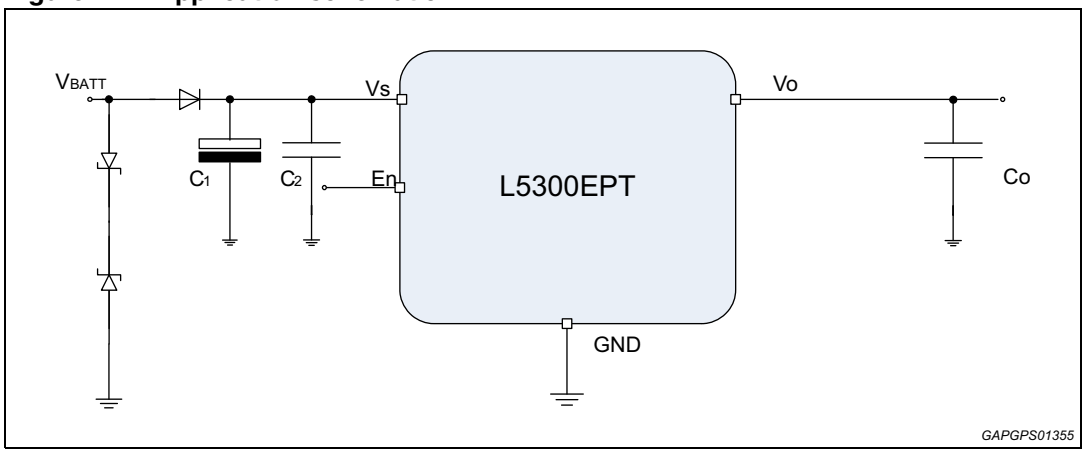


3 Application information

3.1 Voltage regulator

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 300 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 down to 55 µA only (low consumption mode). This procedure features a certain hysteresis on the output current (see *Figure 8*). Short-circuit protection to GND and a thermal shutdown are provided.

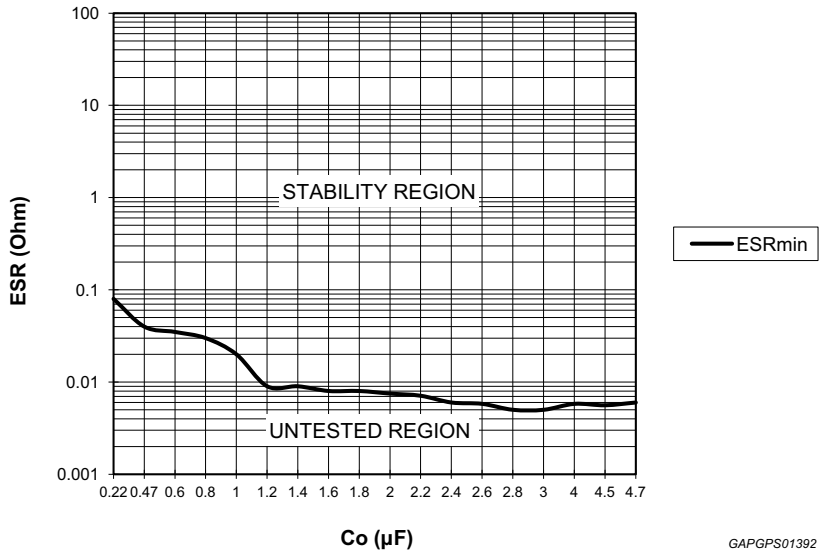
Figure 17. Application schematic



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 $ESR \geq 100$ mΩ.

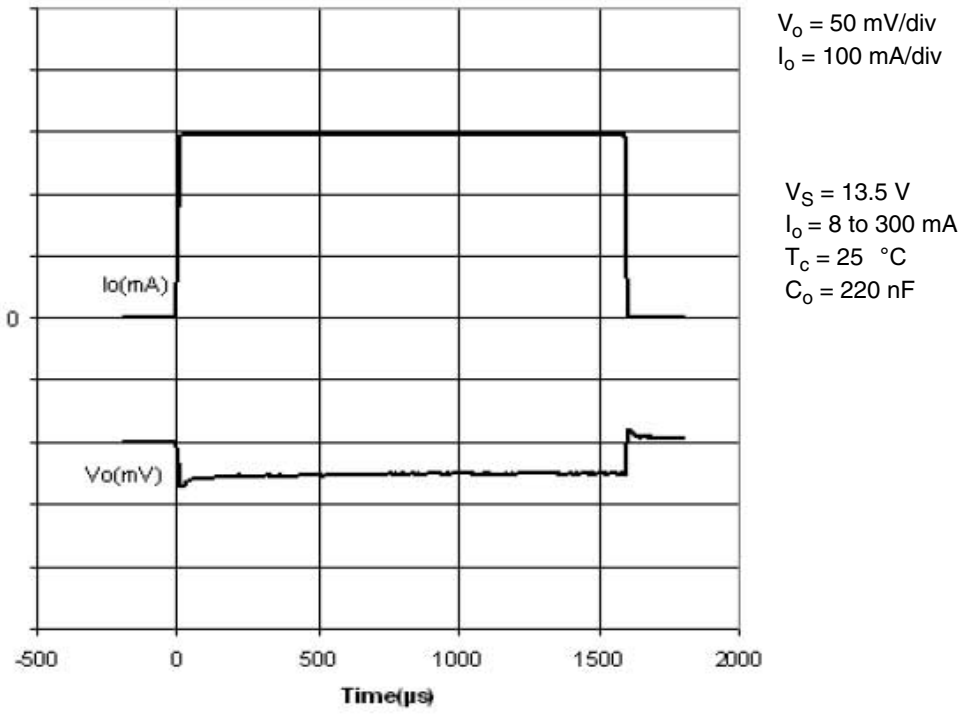
Stability region is reported in *Figure 18*.

Figure 18. Stability region



Note:
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 19. Maximum load variation response

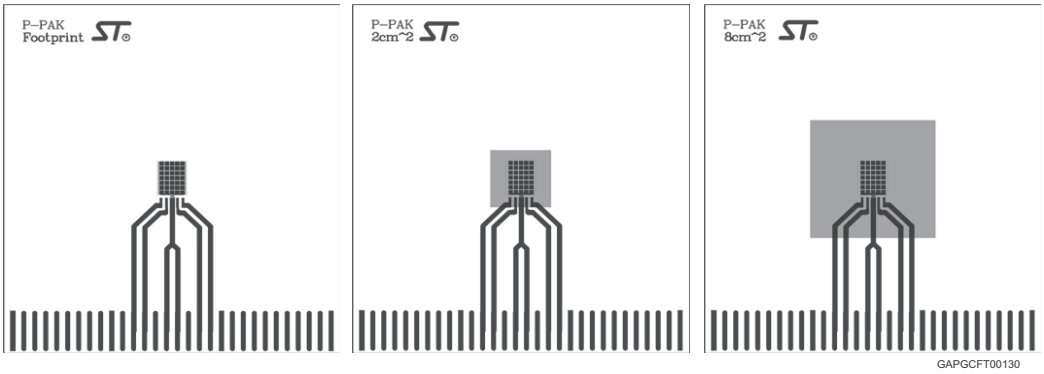


3.2 Enable

L5300EPT is also provided by an enable input, a high signal switches the regulator on. In stand by mode the output is disabled and the current consumption of the device (quiescent current) is less than 10 µA.

4 Package and PCB thermal data

Figure 20. PPAK PC board



Note:
Layout condition of R_{th} and Z_{th} measurements (Board finish thickness 1.6 mm +/- 10%; Board double layer; Board dimension 78x86; Board Material FR4; Cu thickness 0.070mm (front and back side); Thermal vias separation 1.2 mm; Thermal via diameter 0.3 mm +/- 0.08 mm; Cu thickness on vias 0.025 mm).

Figure 21. $R_{thj\text{-}amb}$ vs PCB copper area in open box free air condition

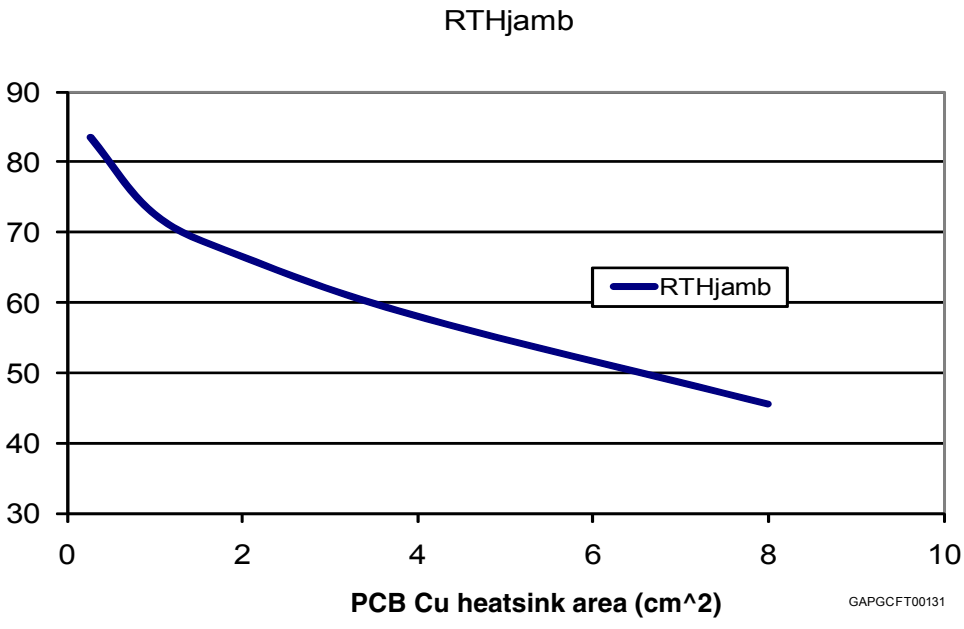
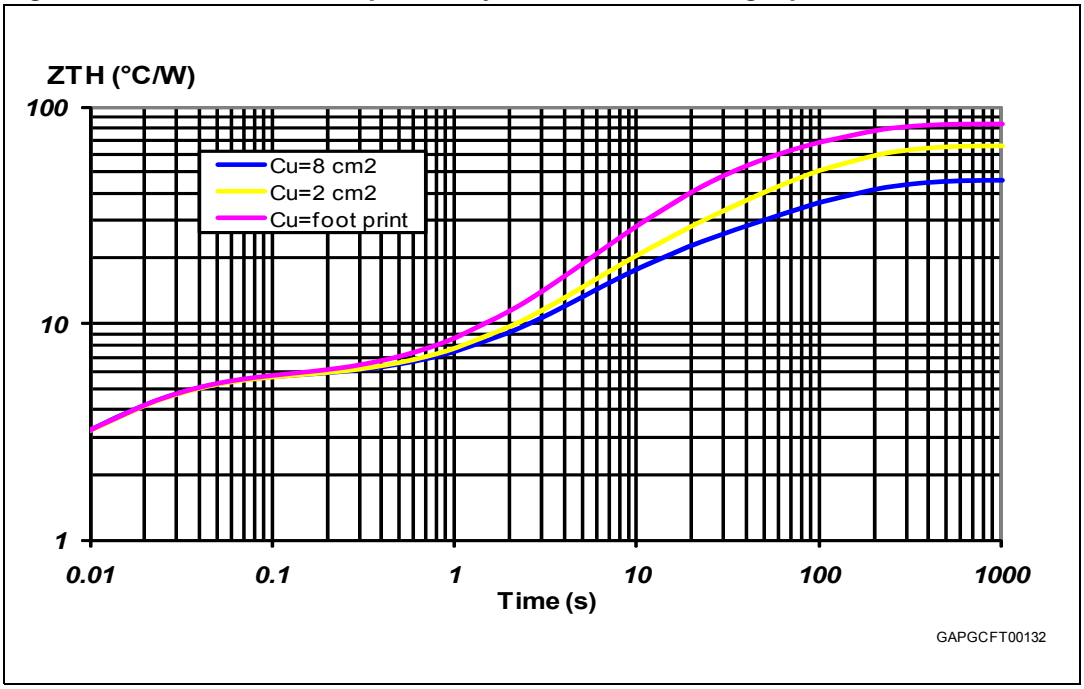


Figure 22. PPAK thermal impedance junction ambient single pulse



Equation 1: pulse calculation formula

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

where $\delta = t_P/T$

Figure 23. Thermal fitting model of a Vreg in PPAK

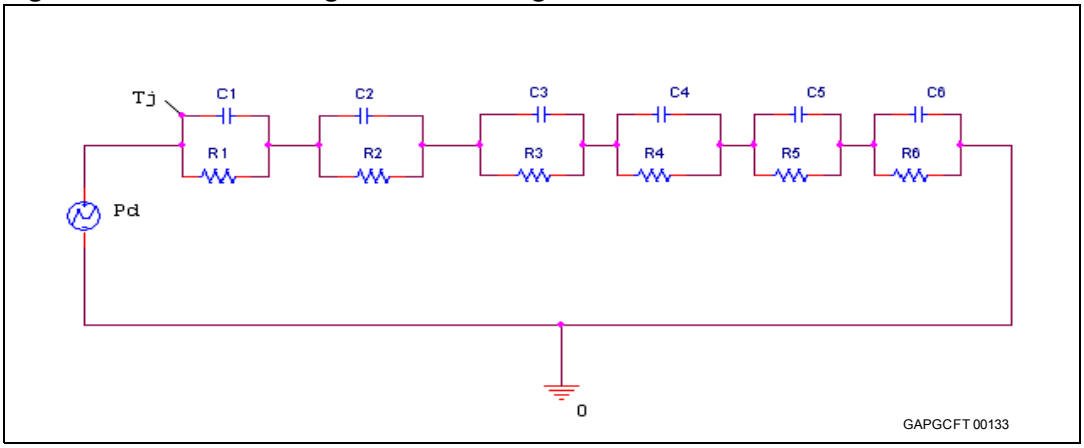


Table 7. PPAK thermal parameter

Area (cm^2)	Footprint	2	8
R1 (°C/W)	1.2		
R2 (°C/W)	6		
R3 (°C/W)	7		
R4 (°C/W)	10	10	9
R5 (°C/W)	22	15	10
R6 (°C/W)	26	20	15
C1 (W.s/°C)	0.0008		
C2 (W.s/°C)	0.0016		
C3 (W.s/°C)	0.05		
C4 (W.s/°C)	0.2	0.1	0.1
C5 (W.s/°C)	0.27	0.8	1
C6 (W.s/°C)	3	6	9

5 Package and packing information

5.1 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.

5.2 PPAK mechanical data

Figure 24. PPAK dimension

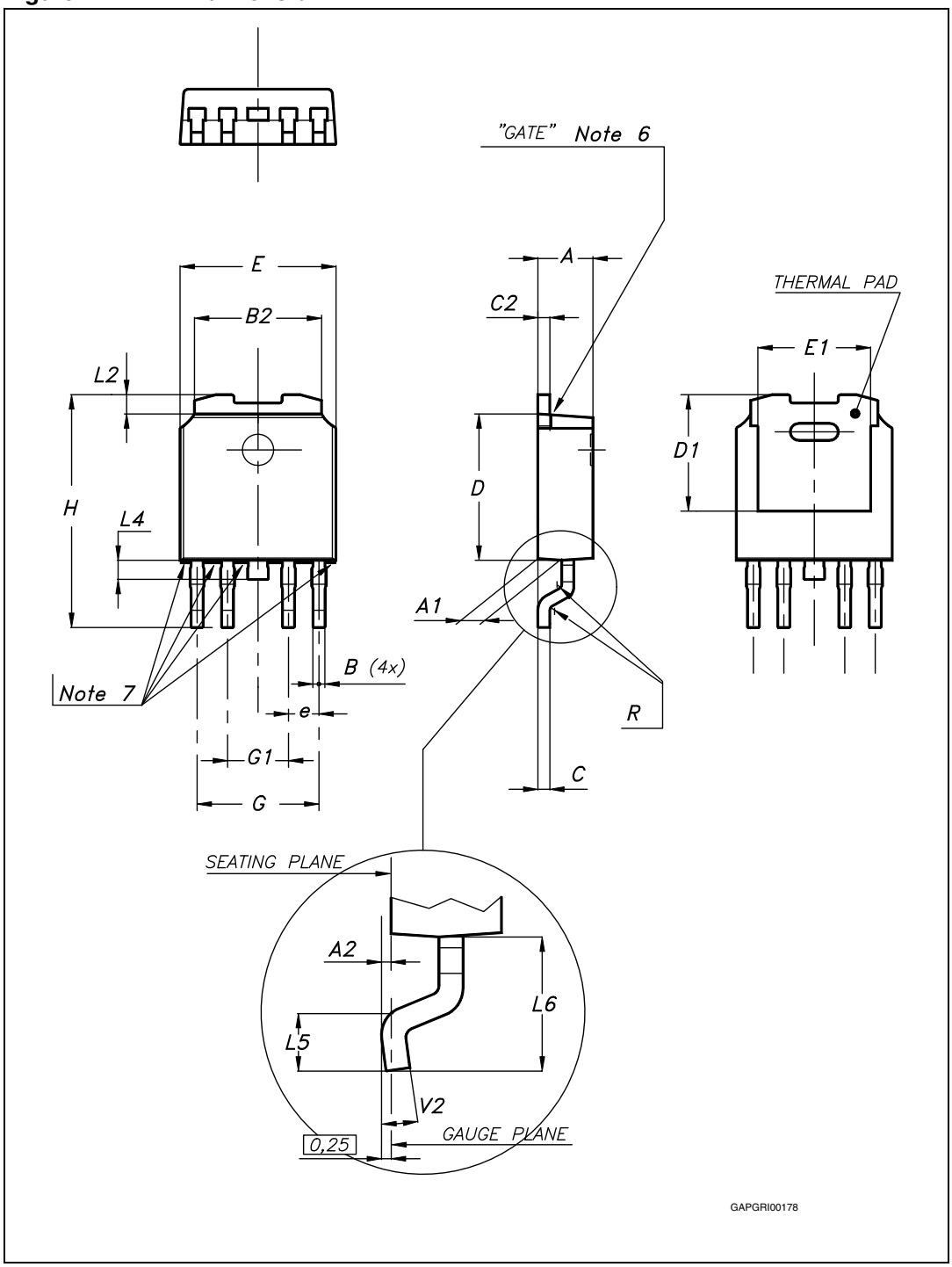
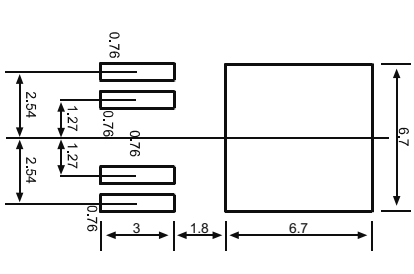


Table 8. PPAK mechanical data

Symbol	Millimeters		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
B	0.40		0.60
B2	5.20		5.40
C	0.45		0.60
C2	0.48		0.60
D1		5.1	
D	6.00		6.20
E	6.40		6.60
E1		4.7	
e		1.27	
G	4.90		5.25
G1	2.38		2.70
H	9.35		10.10
L2		0.8	1.00
L4	0.60		1.00
L5	1.00		
L6		2.80	
R		0.2	
V2	0°		8°
Package weight	Gr. 0.3		

5.3 PPAK packing information

Figure 25. PPAK suggested pad layout and tube shipment (no suffix)



Base q.ty	75
Bulk q.ty	3000
Tube length (± 0.5)	532
A	6
B	21.3
C (± 0.1)	0.6

All dimensions are in mm.

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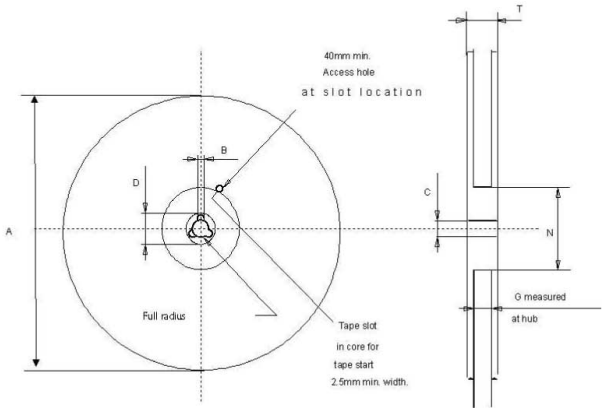
Figure 26. PPAK tape and reel shipment (suffix "TR")



Reel dimensions

Base q.ty	2500
Bulk q.ty	2500
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	16.4
N (min)	60
T (max)	22.4

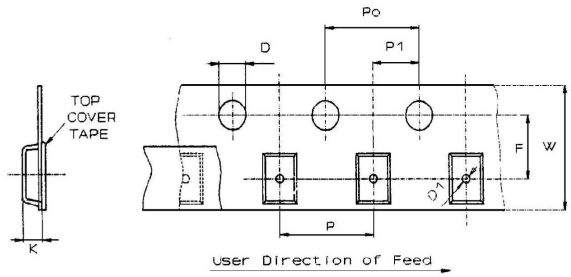
All dimensions are in mm.

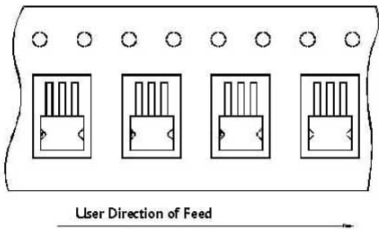
Tape dimensions

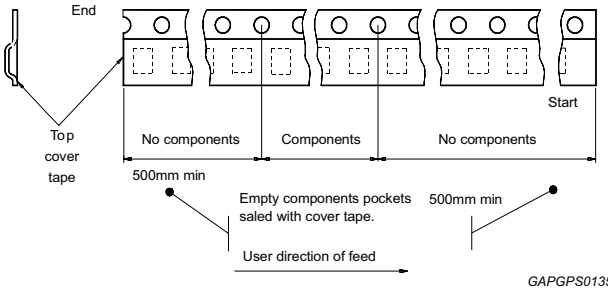
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	16
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)**	7.5
Compartment depth	**K (max)**	2.75
Hole spacing	**P1 (± 0.1)**	2

All dimensions are in mm.







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6 Revision history

Table 9. Document revision history

Date	Revision	Changes
12-Jul-2007	1	Initial release.
13-Mar-2009	2	Changed features table on the cover page *Table 5: General* – V_{o_ref}: deleted row and added 3 new rows Updated *Table 6: Enable*
20-Sep-2010	3	Updated corporate template from V2 to V3 Changed the title of the document *Features* in cover page Changed typical quiescent current value from 60 µA to 55 µA *Description* in cover page – Changed typical quiescent current value from 60 µA to 55 µA – Changed dropped current value from 10 µA to 5 µA *Table 2: Pins description* – Updated pins sequence *Table 3: Absolute maximum ratings* – I_{SDC}: changed symbol from I_{VSDC} – I_{ODC}: changed symbol from I_{VODC} – $V_{ESD\ CDM}$: added standard for parameter Updated *Table 4: Thermal data* *Table 5: General* – I_{short}: changed min/typ/max value – I_{lim}: changed min/typ/max value, changed parameter – V_{line}: changed test condition – V_{load}: changed test condition, added new spec. – SVR: deleted min value, added typ value – I_{qn_300}: changed typ/max value – I_{oth_H}, I_{oth_L}, I_{oth_Hyst}: added new rows – Updated all tablefootnote *Table 6: Enable* – I_{leak}: changed typ value Deleted Figure 3: Behavior of output current versus regulated voltage V_o Added *Section 2.4: Electrical characteristics curves* Added *Chapter 4: Package and PCB thermal data*
12-Oct-2010	4	Updated *Section 3.1: Voltage regulator*
27-Jan-2012	5	Updated *Figure 18: Stability region on page 14*.
07-Feb-2012	6	Modified *Figure 18: Stability region on page 14*
04-May-2012	7	Updated *Figure 24: PPAK dimension on page 20* and *Table 8: PPAK mechanical data*
19-Sep-2013	8	Updated disclaimer.

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