

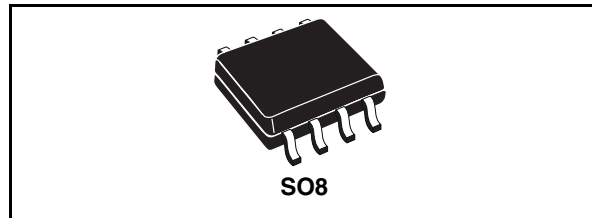
## 2A switch step down switching regulator

### Features

- 2A internal switch
- Operating input voltage from 4.4V to 36V
- Output voltage adjustable from 1.235V to 35V
- Low dropout operation: 100% duty cycle
- 250kHz Internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Internal current limiting
- Protection against feedback disconnection
- Thermal shutdown

### Applications

- Consumer: STB, DVD, TV, VCR, car radio, LCD monitors
- Networking: XDSL, modems, DC-DC modules
- Computer: printers, audio/graphic cards, optical storage, hard disk drive
- Industrial: changers, car battery, DC-DC converters



### Description

The L5972D is a step down monolithic power switching regulator with a minimum switch current limit of 2A so it is able to deliver more than 1.5A DC current to the load depending on the application conditions.

The output voltage can be set from 1.235V to 35V.

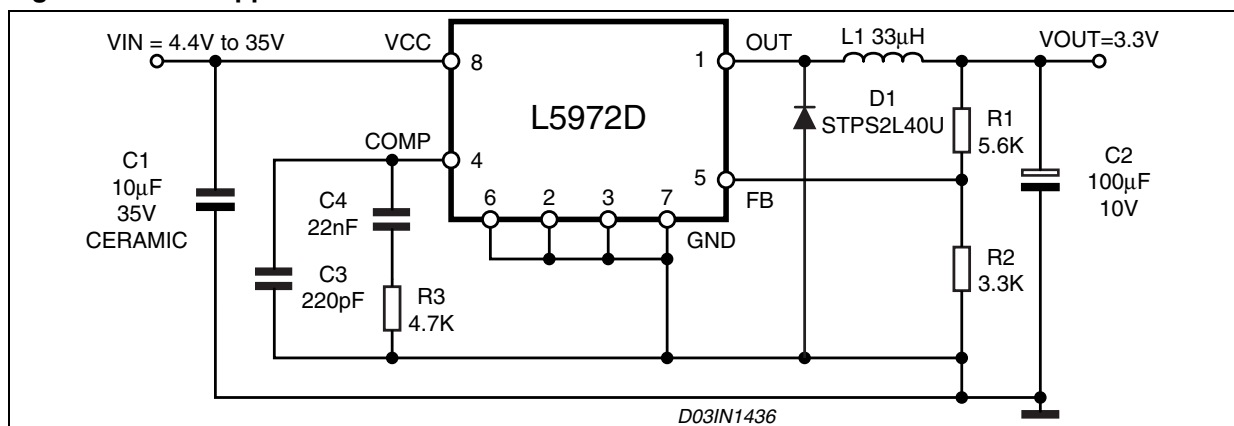
The device uses an internal P-Channel D-MOS transistor (with a typical  $R_{dson}$  of 250m $\Omega$ ) as switching element to minimize the size of the external components.

An internal oscillator fixes the switching frequency at 250kHz.

Having a minimum input voltage of 4.4V only, it is particularly suitable for 5V bus, available in all computer related applications.

Pulse by pulse current limit with the internal frequency modulation offers an effective constant current short circuit protection.

**Figure 1. Test application circuit**



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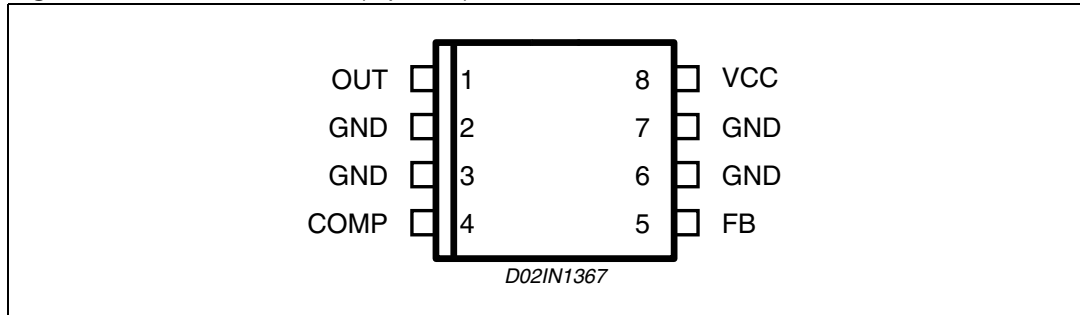
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# 1 Pin settings

## 1.1 Pin connection

Figure 2. Pin connection (top view)



## 1.2 Pin description

Table 1. Pin description

N°	Pin	Description
1	OUT	Regulator output.
2,3,6,7	GND	Ground.
4	COMP	E/A output for frequency compensation.
5	FB	Feedback input. Connecting directly to this pin results in an output voltage of 1.23V. An external resistive divider is required for higher output voltages.
8	VCC	Unregulated DC input voltage.

## 2 Electrical data

### 2.1 Maximum ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_8$	Input voltage	40	V
$V_1$	Out pin DC voltage	-1 to 40	V
	Out pin peak voltage at $\Delta t = 0.1\mu\text{s}$	-5 to 40	V
$I_1$	Maximum output current	int. limit.	
$V_4, V_5$	Analog pins	4	V
$P_{\text{tot}}$	Power dissipation at $T_A \leq 70^\circ\text{C}$	1.2	W
$T_j$	Operating junction temperature range	-40 to 150	$^\circ\text{C}$
$T_{\text{stg}}$	Storage temperature range	-55 to 150	$^\circ\text{C}$

### 2.2 Thermal data

**Table 3. Thermal data**

Symbol	Parameter	SO8	Unit
$R_{\text{thJA}}$	Maximum thermal resistance junction-ambient	65 <sup>(1)</sup>	$^\circ\text{C/W}$

1. Package mounted on board

### 3 Electrical characteristics

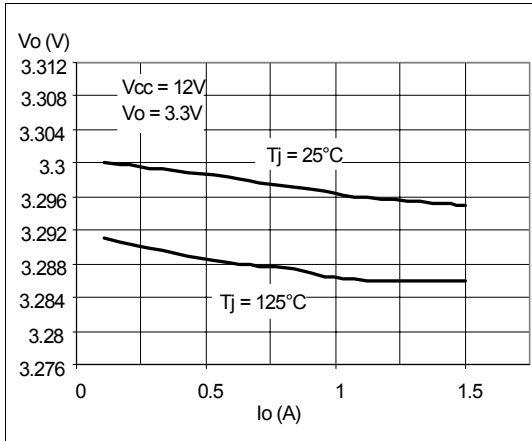
**Table 4. Electrical characteristics** ( $T_J = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$ , unless otherwise specified)

Symbol	Parameter	Test condition		Min	Typ	Max	Unit
$V_{CC}$	Operating input voltage range	$V_o = 1.235\text{V}$ ; $I_o = 2\text{A}$	(1)	4.4		36	V
$R_{DS(on)}$	Mosfet on Resistance		(1)		0.250	0.5	$\Omega$
$I_l$	Maximum limiting current	$V_{CC} = 4.4\text{V to } 36\text{V}$		2	2.5	3	A
$f_s$	Switching frequency		(1)	212	250	280	kHz
				225	250	275	kHz
	Duty cycle			0		100	%
<b>Dynamic characteristics</b> (see test circuit ).							
$V_5$	Voltage feedback	$4.4\text{V} < V_{CC} < 36\text{V}$ , $20\text{mA} < I_o < 2\text{A}$		1.220	1.235	1.25	V
			(1)	1.198	1.235	1.272	V
$h$	Efficiency	$V_o = 5\text{V}$ , $V_{CC} = 12\text{V}$			90		%
<b>DC characteristics</b>							
$I_{qop}$	Total operating quiescent current		(1)		3	5	mA
$I_q$	Quiescent current	Duty cycle = 0; $V_{FB} = 1.5\text{V}$				2.5	mA
<b>Error amplifier</b>							
$V_{OH}$	High level output voltage	$V_{FB} = 1\text{V}$		3.5			V
$V_{OL}$	Low level output voltage	$V_{FB} = 1.5\text{V}$				0.4	V
$I_{o\ source}$	Source output current	$V_{COMP} = 1.9\text{V}$ ; $V_{FB} = 1\text{V}$		200	300		$\mu\text{A}$
$I_{o\ sink}$	Sink output current	$V_{COMP} = 1.9\text{V}$ ; $V_{FB} = 1.5\text{V}$		1	1.5		mA
$I_b$	Source bias current				2.5	4	$\mu\text{A}$
	DC open loop gain	$R_L = \infty$		50	65		dB
$g_m$	Transconductance	$I_{comp} = -0.1\text{mA to } 0.1\text{mA}$ $V_{COMP} = 1.9\text{V}$			2.3		mS

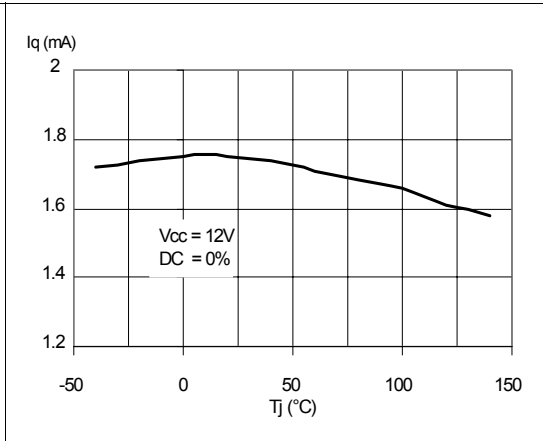
1. Specification Referred to  $T_J$  from  $-40$  to  $125^\circ\text{C}$ . Specification over the  $-40$  to  $+125$   $T_J$  Temperature range are assured by design, characterization and statistical correlation.

# 4 Typical characteristics

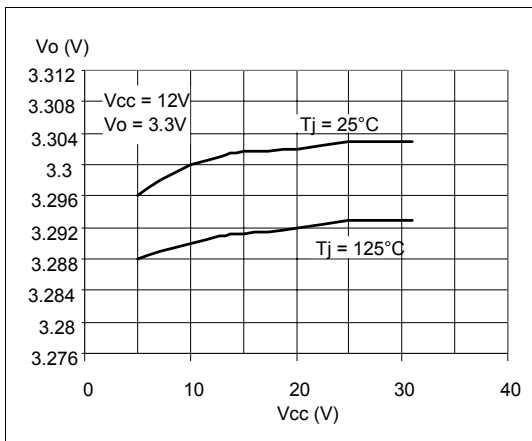
**Figure 3. Output voltage vs. junction temperature**



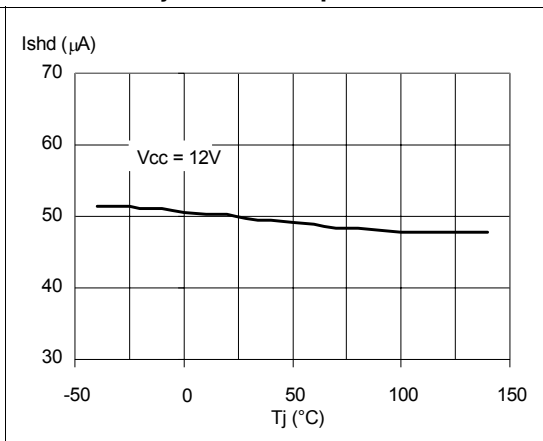
**Figure 4. Quiescent current vs. junction temperature**



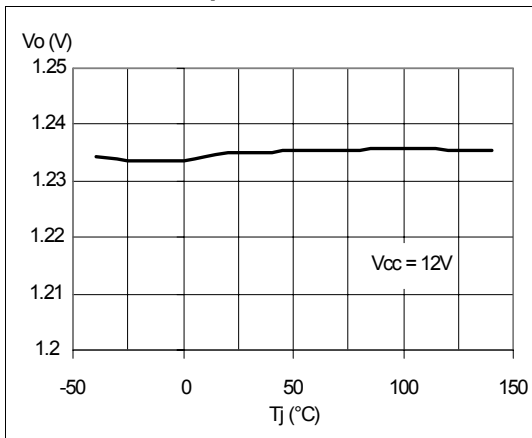
**Figure 5. Line regulator**



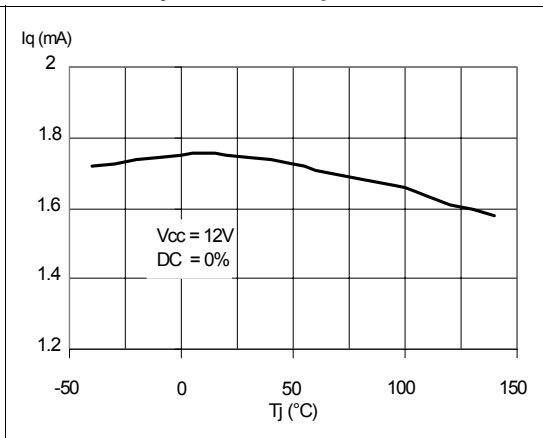
**Figure 6. Shutdown current vs. junction temperature**



**Figure 7. Output voltage vs. junction temperature**



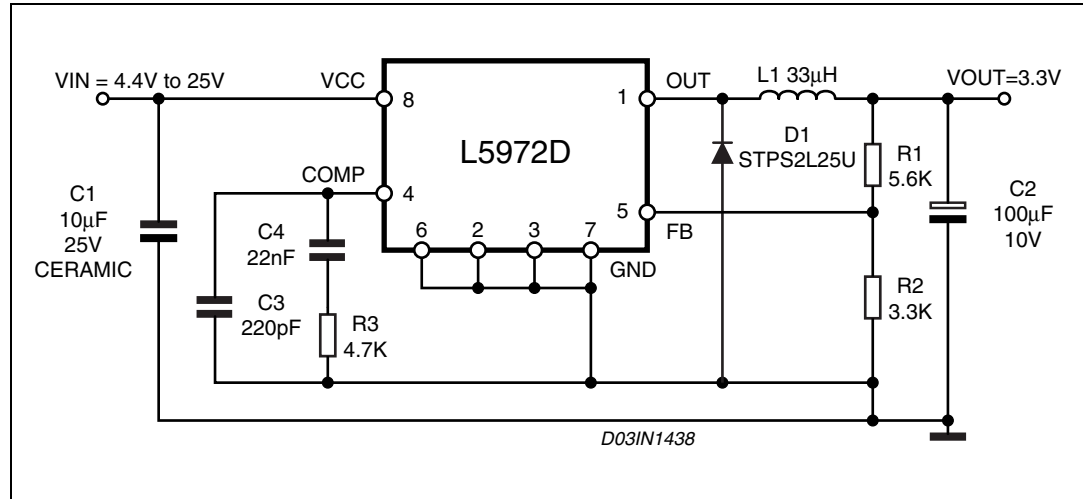
**Figure 8. Switching frequency vs. junction temperature**



## 5 Application circuit

In figure 8 is shown the demo board application circuit for the device in SMD version, where the input supply voltage,  $V_{CC}$ , can range from 4.4V to 25V due to the rated voltage of the input capacitor and the output voltage is adjustable from 1.235V to  $V_{CC}$ .

**Figure 9. Demo board application circuit**



**Table 5. Component list**

Reference	Part number	Description	Manufacturer
C1	GRM32DR61E106KA12L	10µF, 25V	MURATA
C2	POSCAP 10TPB100M	100µF, 10V	Sanyo
C3	C1206C221J5GAC	220pF, 5%, 50V	KEMET
C4	C1206C223K5RAC	22nF, 10%, 50V	KEMET
R1		5.6K, 1%, 0.1W 0603	Neohm
R2		3.3K, 1%, 0.1W 0603	Neohm
R3		4.7K, 1%, 0.1W 0603	Neohm
D1	STPS2L25U	2A, 25V	ST
L1	DO3316P-333	33µH, 2.1A	COILCRAFT

Figure 10. PCB layout (component side)

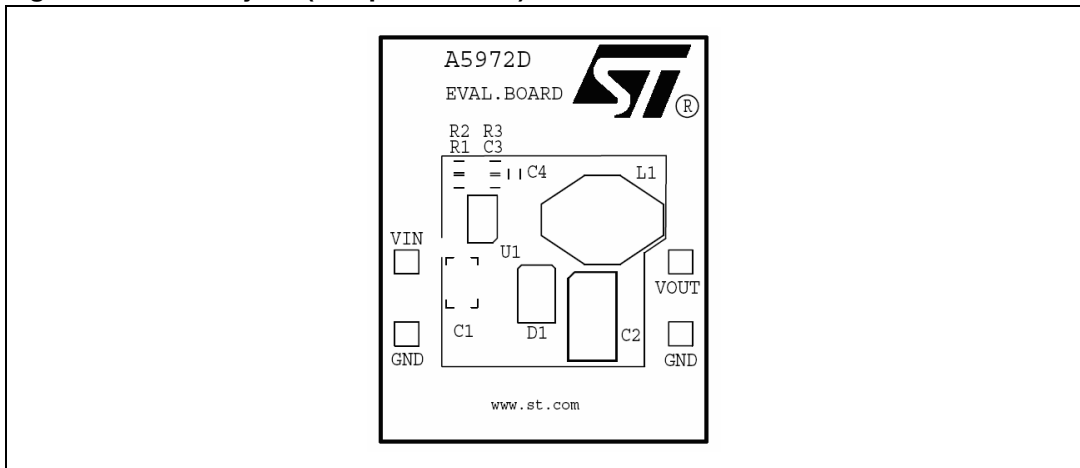


Figure 11. PCB layout (bottom side)

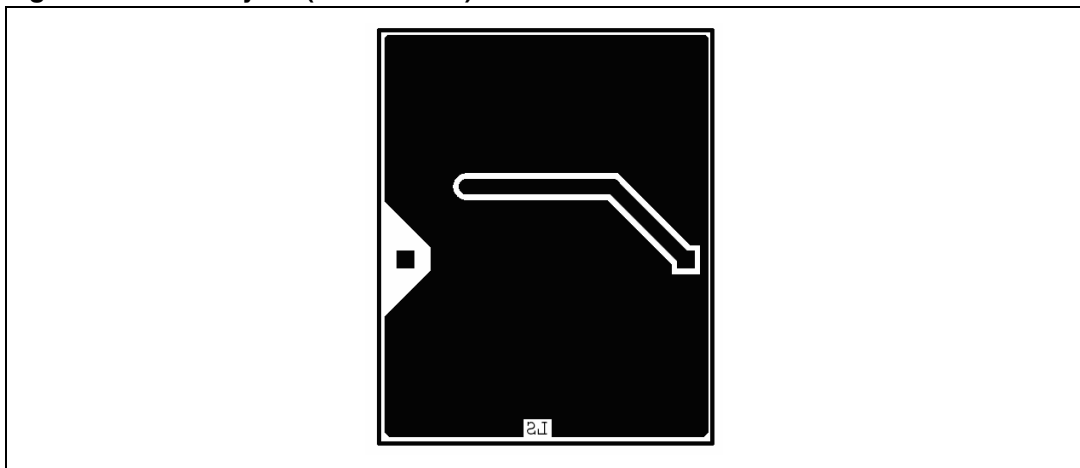
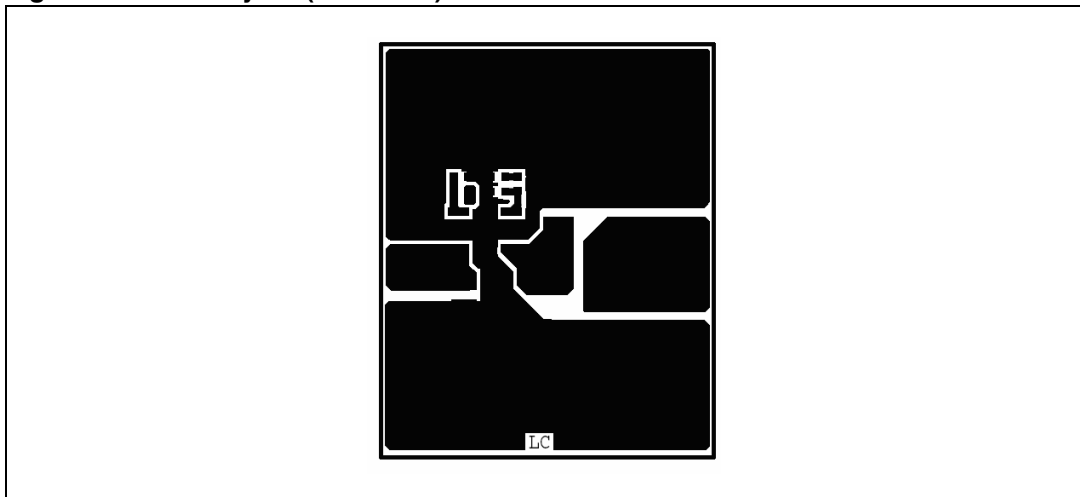


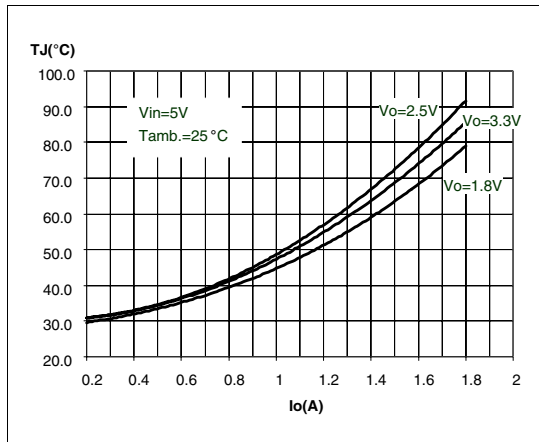
Figure 12. PCB layout (front side)



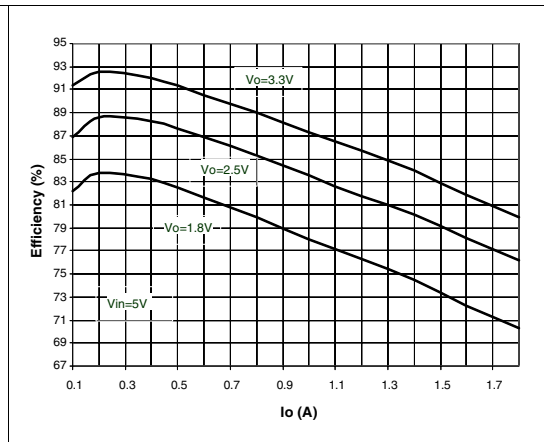
Sideways two graphs show the  $T_J$  versus output current in different conditions of the input and output voltage.



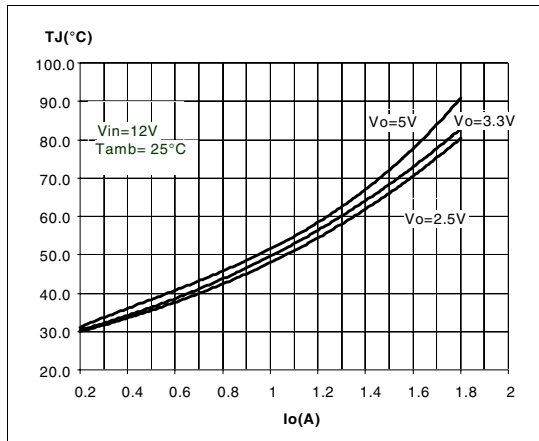
**Figure 13. Junction temperature vs output current**



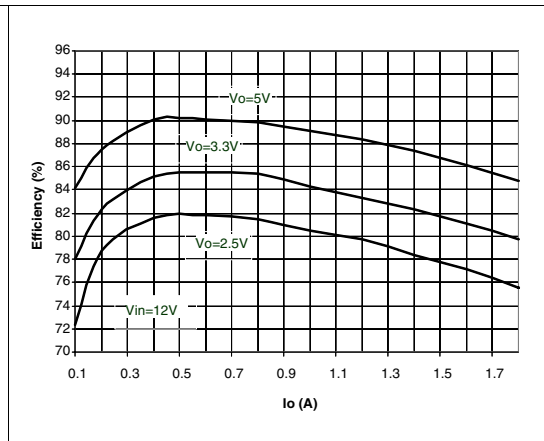
**Figure 14. Efficiency vs output current**



**Figure 15. Junction temperature vs output current**

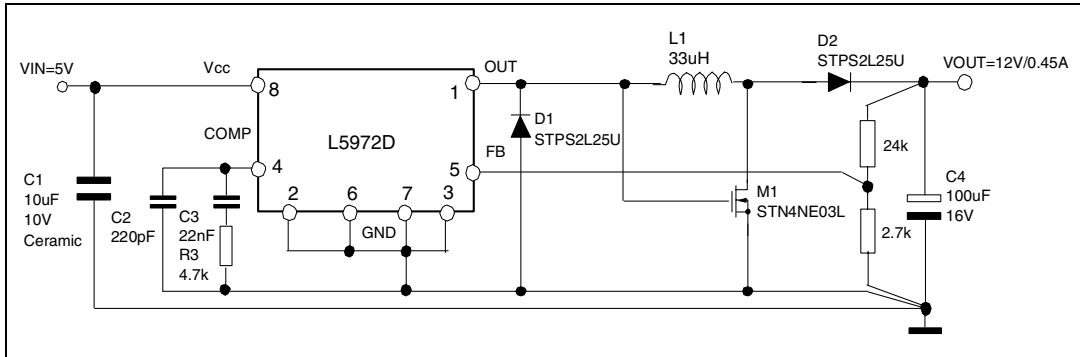


**Figure 16. Efficiency vs output current**

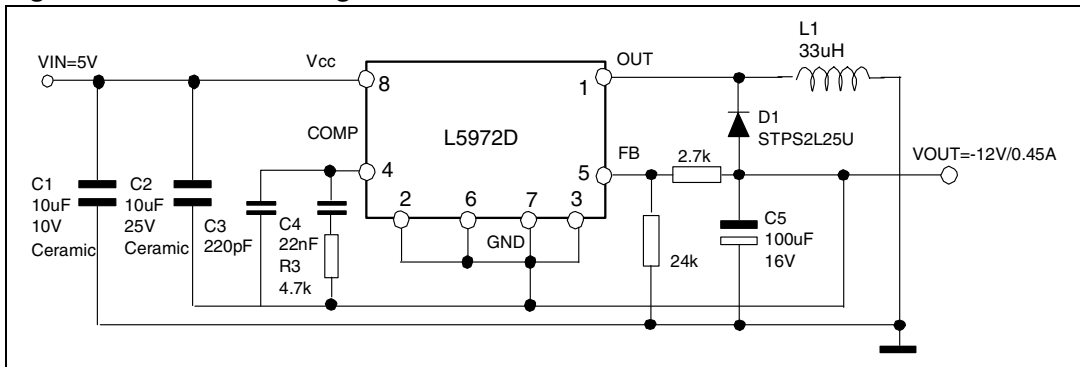


# 6 Application ideas

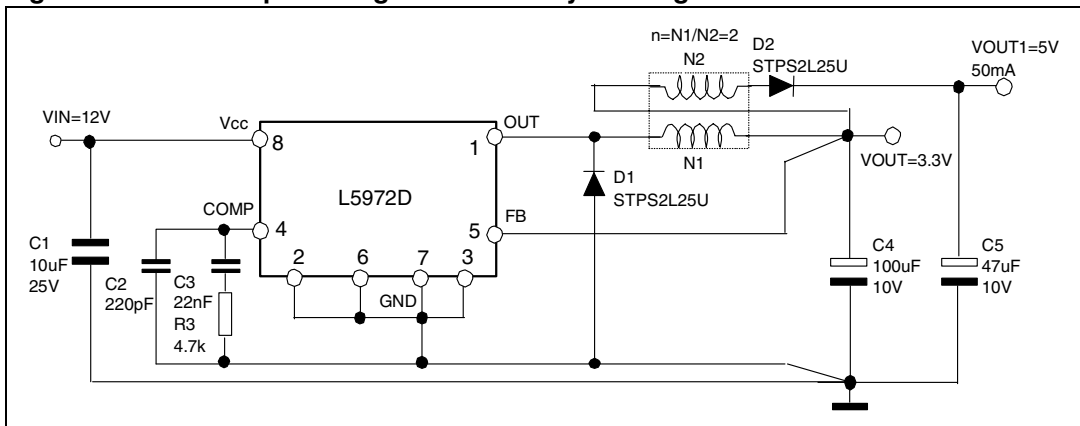
**Figure 17. Positive buck-boost regulator**



**Figure 18. Buck-boost regulator**



**Figure 19. Dual output voltage with auxiliary winding**



## 7 Package mechanical data

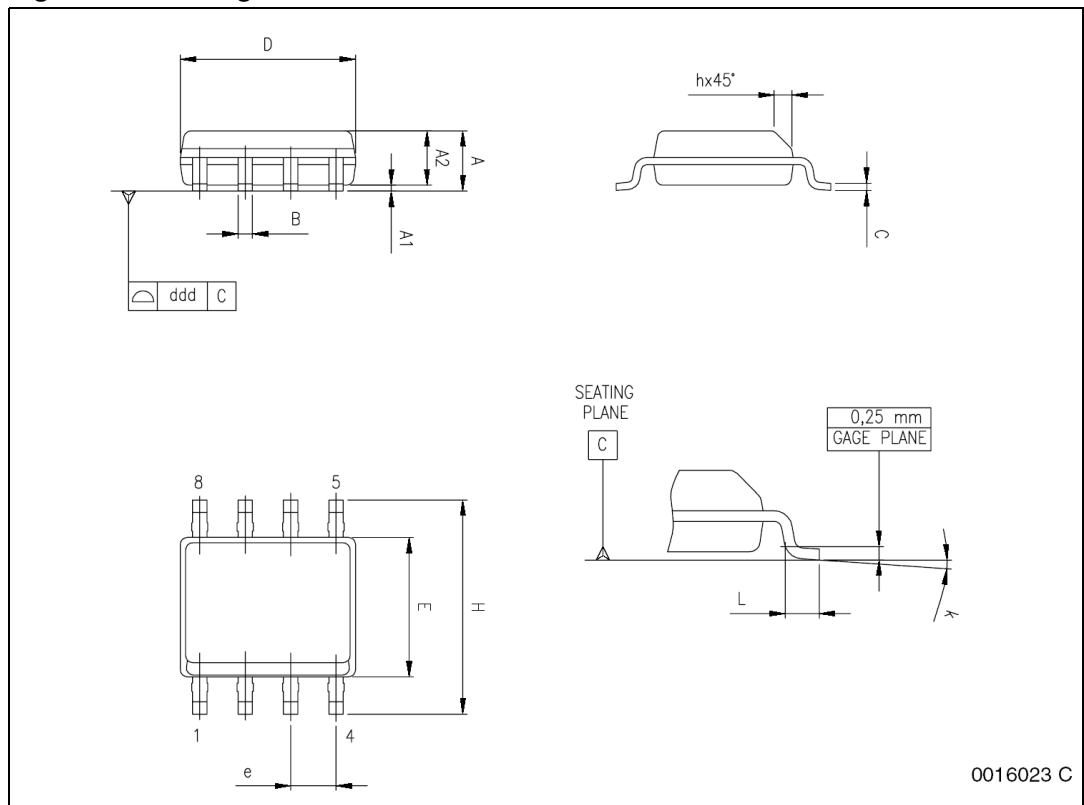
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings 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](http://www.st.com)

Table 6. SO-8 Mechanical data

Dim.	mm.			inch		
	Min	Typ	Max	Min	Typ	Max
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D <sup>(1)</sup>	4.80		5.00	0.189		0.197
E	3.80		4.00	0.15		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

1. Dimensions D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm (.006inch) in total (both side).

Figure 20. Package dimensions



## 8 Order codes

Table 7. Order codes

Part number	Package	Packaging
L5972D	SO8	Tube
L5972D013TR	SO8	Tape and reel

## 9 Revision history

**Table 8. Revision history**

Date	Revision	Changes
02-Feb-2007	8	Updated <a href="#">Table 5 on page 7</a>
10-Apr-2007	9	Mechanical data typo
16-Oct-2007	10	Updated <a href="#">Section 5: Application circuit on page 7</a>

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