

## Up to 1 A switching regulator with adjustable current limit

### Features

- Up to 1 A output current
- Operating input voltage from 8 V to 36 V
- Precise 3.3 V ( $\pm 2\%$ ) reference voltage
- 5 % output current accuracy
- Output voltage adjustable from 1.235 V to 34 V
- 250 kHz internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Adjustable current limit
- Protection against feedback Disconnection
- Thermal shutdown

### Applications

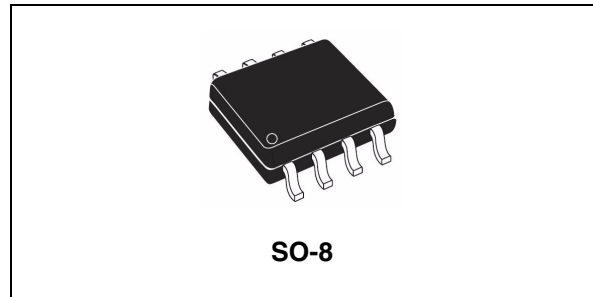
- Chargers for NiCd, NiMH batteries and preregulator for lithium-ion batteries
- Adjustable current generator
- Simple step-down converters with adjustable current limit
- Battery equipped systems
- Distributed power supply
- Mobile PC and subnotebook

### Description

The L6902D is a complete and simple step down switching regulator with adjustable current limit.

Based on a voltage mode structure it integrates a current error amplifier to have a constant voltage and constant current control.

By means of an on board current sense resistor and the availability of the current sense pins (both compatible to Vcc and for Cs- compatible with GND too) a current limit programming is very simple and accurate ( $\pm 5\%$ ). Moreover constant



current control can be used to charge NiMH and NiCd batteries.

The device can be used as a standard DC/DC converter with adjustable current limit (set by using the external sense resistor).

The internal robust P-channel DMOS transistor with a typical of 250 m $\Omega$  assures high efficiency and a minimum dropout even at high output current level. The internal limiting current (latched function) of typical value of 2.5 A protects the device from accidental output short circuit avoiding dangerous loads damage.

If the temperature of the chip goes higher than a fixed internal threshold (150°C with 20°C hysteresis), the power stage is turned off.

Other protections beside thermal shutdown complete the device for a safe and reliable application: overvoltage protection, frequency foldback overcurrent protection and protection vs. feedback disconnection.

The internal fixed switching frequency of 250KHz, and the SO-8 package pin allow to built an ultra compact DC/ DC converter with a minimum board space.

**Table 1. Device summary**

Order codes	Package	Packaging
L6902D	SO-8	Tube
L6902D013TR		Tape and reel

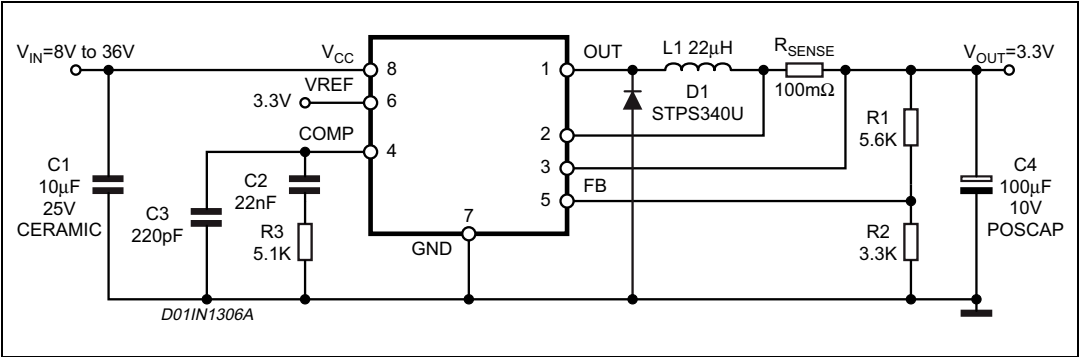
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# 1 Test and application circuit

Figure 1. Test and application circuit



# 2 Pin connection

Figure 2. Pin connection

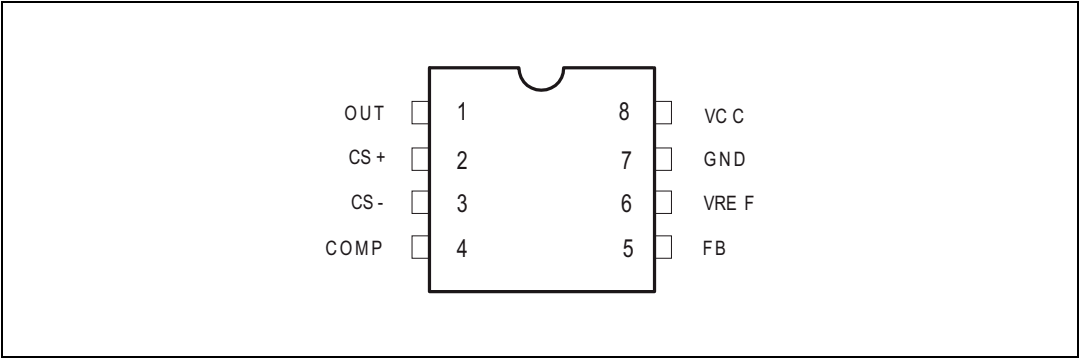


Table 2. Pin description

N°	Pin	Function
1	OUT	Regular output
2	CS+	Current error amplifier input (current sense at higher voltage)
3	CS-	Current error amplifier input (current sense at lower voltage)
4	COMP	E/A output to be used for frequency compensation
5	FB	Stepdown feedback input. Connecting directly to this pin results in an output voltage of 1.235 V. An external resistive divider is required for higher output voltages. In this case: $V_{out} = V_{FB} \cdot \left(1 + \frac{R1}{R2}\right) = 1.235V \left(1 + \frac{R1}{R2}\right)$
6	VREF	3.3 V VREF. No cap is need for stability.
7	GND	Ground
8	VCC	Unregulated DC input voltage.

### 3 Maximum ratings

**Table 3. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_8$	Input voltage	40	V
$V_1$	Output DC voltage output peak voltage at $t = 0.1 \mu s$	-1 to 40 -5 to 40	V V
$I_1$	Maximum output current	Internally limited	
$V_4, V_5$	Analog pins	4	V
$V_2, V_3$	Analog pins	-0.3V to VCC	V
$P_{tot}$	Power dissipation at $T_{amb} \leq 70^\circ C$	0.7	W
$T_j$	Operating junction temperature range	-40 to 150	$^\circ C$
$T_{stg}$	Storage temperature range	-55 to 150	$^\circ C$

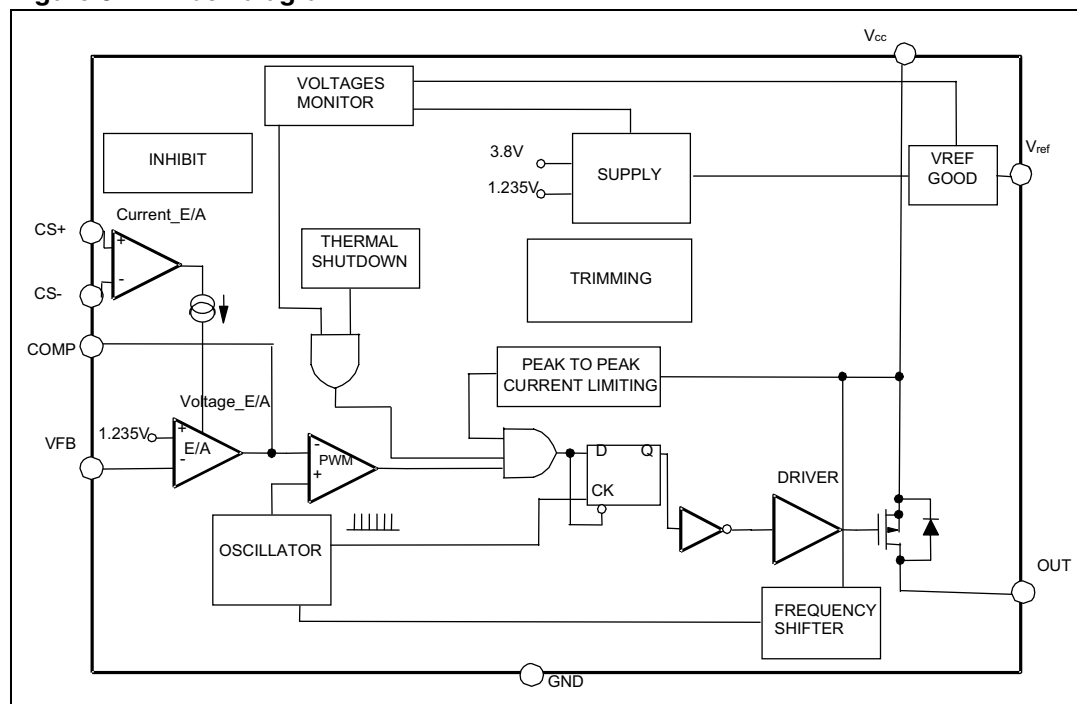
**Table 4. Thermal data**

Symbol	Parameter	Value	Unit
$R_{th j-amb}$	Thermal Resistance Junction to Ambient Max.	110 <sup>(1)</sup>	$^\circ C/W$

1. Package mounted on board.

## 4 Internal block diagram

Figure 3. Block diagram



## 5 Electrical characteristics

$T_j = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$ , unless otherwise specified.

**Table 5. Electrical characteristics**

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{CC}$	Operating input voltage range	$V_O = 1.235\text{V}$ ; $I_O = 1\text{A}$	8		36	V
$V_d$	Dropout voltage	$V_{CC} = 8\text{V}$ ; $I_O = 1\text{A}$		0.25	0.5	V
$I_O$	Operating charging current	$R_{\text{sense}} = 0.1\Omega$	0.95	1	1.05	A
			(1) 0.92		1.08	A
$I_l$	Maximum limiting current	$V_{CC} = 8\text{V to } 36\text{V}$	2	2.5	3.2	A
$f_s$	Switching frequency		(1) 212	250	287	kHz
			225	250	275	kHz
d	Duty cycle		0		100	%
<b>Dynamic characteristics</b>						
$V_5$	Voltage feedback (FB)	$8\text{V} < V_{CC} < 36\text{V}$ , $20\text{mA} < I_O < 1\text{A}$		1.21	1.235	1.259 V
			(1) 1.198	1.235	1.272	V
$\eta$	Efficiency	$V_O = 5\text{V}$ , $V_{CC} = 12\text{V}$		90		%
<b>DC characteristics</b>						
$I_{\text{qop}}$	Total operating quiescent current		(1)	3	5	mA
$I_q$	Quiescent current	Duty cycle = 0; $V_{FB} = 1.5\text{V}$			3	mA
<b>Voltage error amplifier</b>						
$V_{OH}$	High level output voltage	$V_{FB} = 1\text{V}$	3.6			V
$V_{OL}$	Low level output voltage	$V_{FB} = 1.5$			0.4	V
$I_{O \text{ source}}$	Source output current	$V_{\text{comp}} = 1.9\text{V}$ ; $V_{FB} = 1\text{V}$	200	300		$\mu\text{A}$
$I_{O \text{ sink}}$	Sink output current	$V_{\text{comp}} = 1.9\text{V}$ ; $V_{FB} = 1.5\text{V}$	1	1.5		mA
$I_b$	Source bias current			2.5	4	$\mu\text{A}$
	DC open loop gain	$R_L = 0$	50	58		dB
$g_m$	Transconductance	$I_{\text{comp}} = -0.1 \text{ to } 0.1\text{mA}$ , $V_{\text{comp}} = 1.9\text{V}$		2.3		mS
<b>Current error amplifier</b>						
$V_{\text{offs}}$	Input offset voltage	$V_{CS-} = 1.8\text{V}$ ; $V_{CS+} = V_{\text{comp}}$	95	100	105	mV
$I_{CS+}$	CS+ output current	$I_O = 1\text{A}$ , $R_{\text{sense}} = 100\text{m}\Omega$ , $V_{\text{out}} < V_{CC} - 2\text{V}$		1.5	3	$\mu\text{A}$
$I_{CS-}$	CS- output current	$I_O = 1\text{A}$ , $R_{\text{sense}} = 100\text{m}\Omega$ , $V_{\text{out}} < V_{CC} - 2\text{V}$		1.5	3	$\mu\text{A}$

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit	
Reference section							
	Reference voltage			3.234	3.3	3.366	V
		I <sub>REF</sub> = 0 to 5mA V <sub>CC</sub> = 8V to 36V	(1)	3.2	3.3	3.399	V
	Line regulation	I <sub>REF</sub> = 0mA, V <sub>CC</sub> = 8V to 36V			5	10	mV
	Load regulation	I <sub>REF</sub> = 0 to 5 mA			8	15	mV
	Short circuit current			10			mA

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

## 6 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.

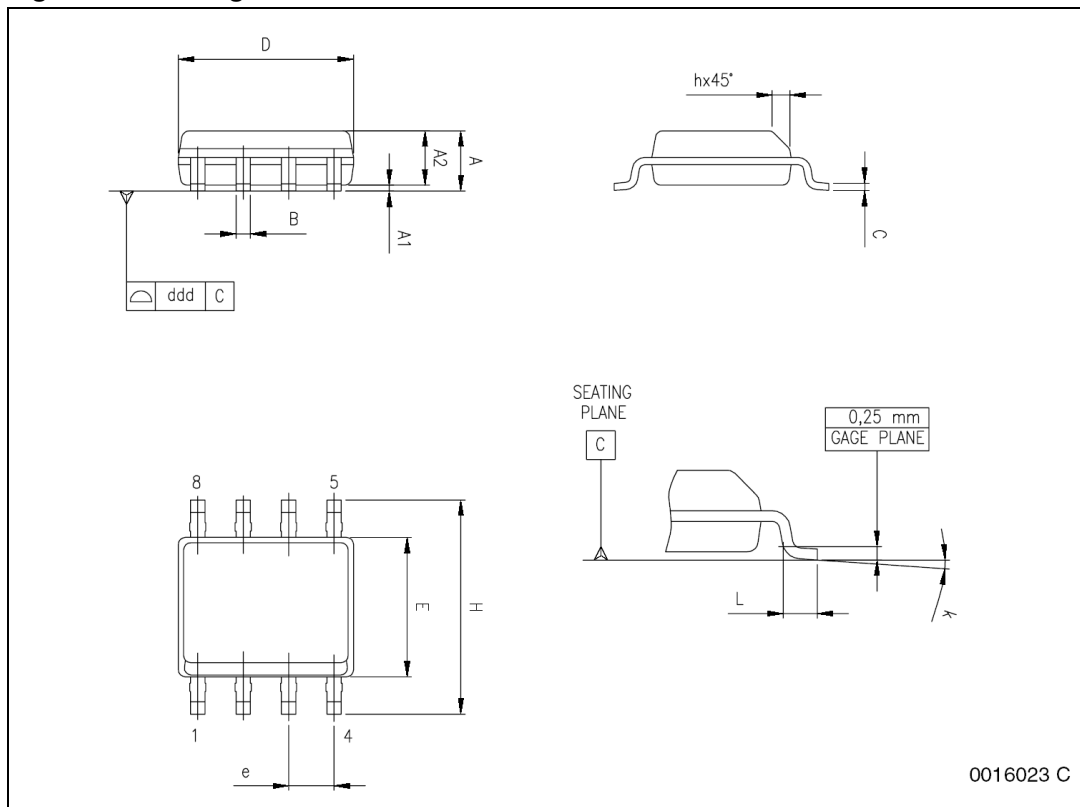
**Table 1. SO-8 mechanical data**

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 4. Package dimensions



## 7 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
January 2004	7	Technical migration from ST-PRESS to EDOCS.
October 2004	8	Changed style look and feel.
26-Nov-2010	9	Updated <a href="#">Note 1 on page 7</a>

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