

## UP TO 1A SWITCHING REGULATOR WITH ADJUSTABLE CURRENT LIMIT

### 1 FEATURES

- UP TO 1A OUTPUT CURRENT
- OPERATING INPUT VOLTAGE FROM 8V TO 36V
- PRECISE 3.3V ( $\pm 2\%$ ) REFERENCE VOLTAGE
- 5% OUTPUT CURRENT ACCURACY
- OUTPUT VOLTAGE ADJUSTABLE FROM 1.235V TO 34V
- 250KHz INTERNALLY FIXED FREQUENCY
- VOLTAGE FEEDFORWARD
- ZERO LOAD CURRENT OPERATION
- ADJUSTABLE CURRENT LIMIT
- PROTECTION AGAINST FEEDBACK DISCONNECTION
- THERMAL SHUTDOWN

### 2 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 & SUBNOTEBOOK

### 3 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 cur-

Figure 1. Package

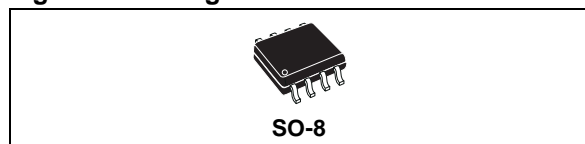


Table 1. Order Codes

Part Number	Package
L6902D	SO-8
L6902D013TR	SO-8 in Tape & Reel

rent error amplifier to have a constant voltage and constant current control.

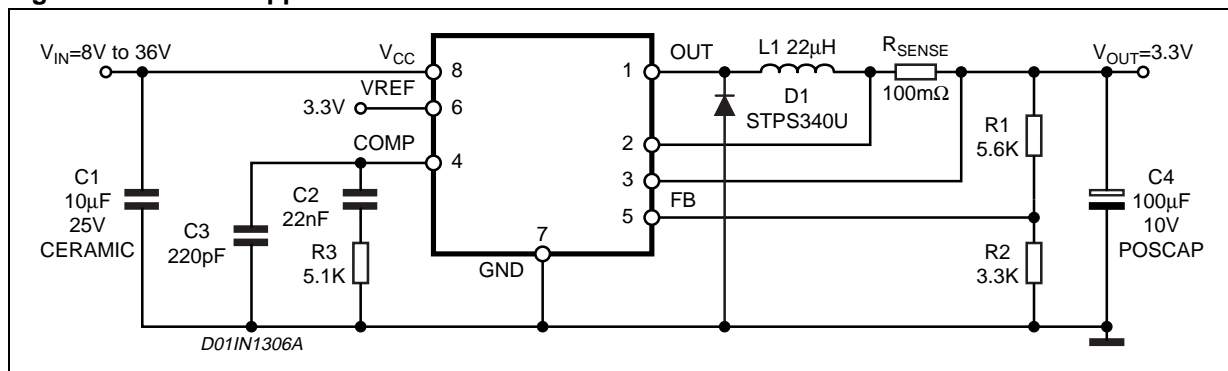
By means of an on board current sense resistor and the availability of the current sense pins (both compatible to Vcc and for Cs- compatible with GND too) a current limit programming is very simple and accurate ( $\pm 5\%$ ). Moreover constant current control can be used to charge NiMH and NiCd batteries.

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 250m $\Omega$  assures high efficiency and a minimum dropout even at high output current level. The internal limiting current (latched function) of typical value of 2.5A 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.

Figure 2. Test And Application Circuit

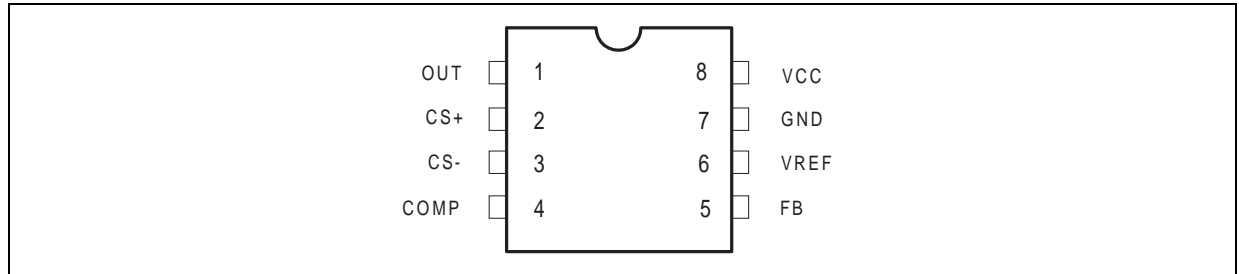


### 3 DESCRIPTION (continued)

Other protections beside thermal shutdown complete the device for a safe and reliable application: overvoltage protection, frequency fallback 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.

**Figure 3. 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 1.235V. 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	3.3V VREF. No cap is need for stability.
7	GND	Ground
8	VCC	Unregulated DC input voltage.

**Table 3. Thermal Data**

Symbol	Parameter	Value	Unit
R <sub>th j-amb</sub>	Thermal Resistance Junction to Ambient Max.	110 (*)	°C/W

(\*) Package mounted on board.

**Table 4. Absolute Maximum Ratings**

Symbol	Parameter	Value	Unit
V <sub>8</sub>	Input Voltage	40	V
V <sub>1</sub>	Output DC voltage Output peak voltage at t = 0.1μs	-1 to 40 -5 to 40	V V
I <sub>1</sub>	Maximum output current	Internally limited	
V <sub>4</sub> , V <sub>5</sub>	Analog pins	4	V
V <sub>2</sub> , V <sub>3</sub>	Analog pins	-0.3V to V <sub>CC</sub>	V
P <sub>tot</sub>	Power dissipation at T <sub>amb</sub> ≤ 70 °C	0.7	W
T <sub>j</sub>	Operating junction temperature range	-40 to 150	°C
T <sub>stg</sub>	Storage temperature range	-55 to 150	°C

Figure 4. Internal Block Diagram

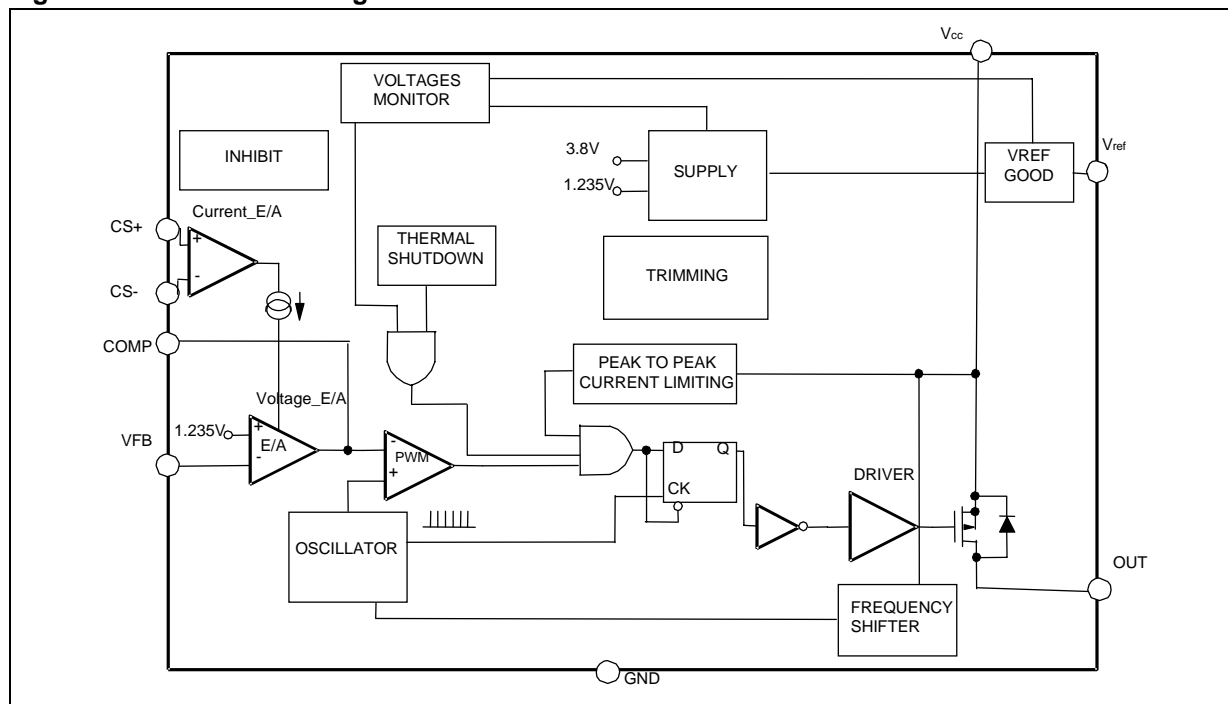


Table 5. Electrical Characteristics

( $T_j = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$ , unless otherwise specified.) (•) Specification Referred to  $T_j$  from 0 to  $125^\circ\text{C}$ .

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	
			• 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		• 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
			•	1.198	1.235	1.272	V
$\eta$	Efficiency	$V_O = 5\text{V}$ , $V_{CC} = 12\text{V}$		90		%	
<b>DC CHARACTERISTICS</b>							
$I_{qop}$	Total operating quiescent current		•	3	5	mA	
$I_q$	Quiescent current	Duty cycle = 0; $V_{FB} = 1.5\text{V}$			3	mA	

**Table 5. Electrical Characteristics** (continued)(T<sub>j</sub> = 25°C, V<sub>CC</sub> = 12V, unless otherwise specified.) (•) Specification Referred to T<sub>j</sub> from 0 to 125°C.

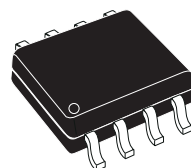
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>VOLTAGE ERROR AMPLIFIER</b>						
V <sub>OH</sub>	High level output voltage	V <sub>FB</sub> = 1V		3.6		V
V <sub>OL</sub>	Low level output voltage	V <sub>FB</sub> = 1.5			0.4	V
I <sub>o source</sub>	Source output current	V <sub>comp</sub> = 1.9V; V <sub>FB</sub> = 1V	200	300		μA
I <sub>o sink</sub>	Sink output current	V <sub>comp</sub> = 1.9V; V <sub>FB</sub> = 1.5V	1	1.5		mA
I <sub>b</sub>	Source bias current			2.5	4	μA
	DC open loop gain	R <sub>L</sub> = 0	50	58		dB
g <sub>m</sub>	Transconductance	I <sub>comp</sub> = -0.1 to 0.1mA V <sub>comp</sub> = 1.9V		2.3		mS
<b>CURRENT ERROR AMPLIFIER</b>						
V <sub>offs</sub>	Input offset voltage	V <sub>CS-</sub> = 1.8V; V <sub>CS+</sub> = V <sub>comp</sub>	95	100	105	mV
I <sub>CS+</sub>	CS+ Output Current	I <sub>O</sub> = 1A, R <sub>sense</sub> = 100mΩ V <sub>out</sub> < V <sub>CC</sub> -2V		1.5	3	μA
I <sub>CS-</sub>	CS- Output Current	I <sub>O</sub> = 1A, R <sub>sense</sub> = 100mΩ V <sub>out</sub> < V <sub>CC</sub> -2V		1.5	3	μA
<b>REFERENCE SECTION</b>						
	Reference Voltage		3.234	3.3	3.366	V
		I <sub>REF</sub> = 0 to 5mA V <sub>CC</sub> = 8V to 36V	• 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 5mA		8	15	mV
	Short Circuit Current		10			mA

Figure 5. SO-8 Mechanical Data &amp; Package Dimensions

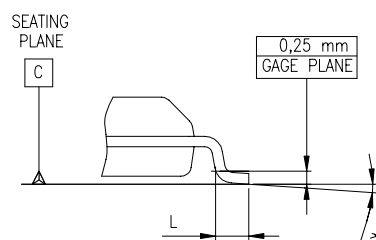
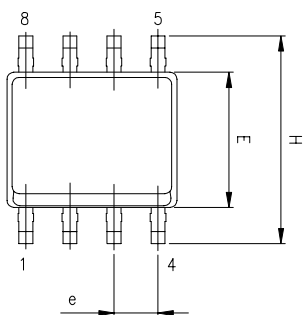
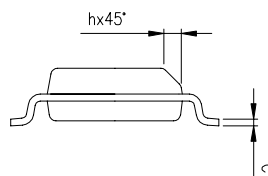
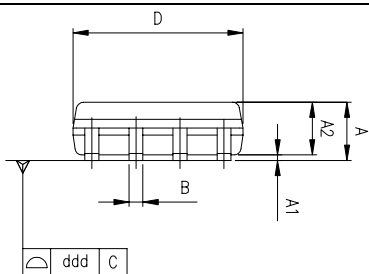
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D (1)	4.80		5.00	0.189		0.197
E	3.80		4.00	0.15		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020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

Note: (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).

## OUTLINE AND MECHANICAL DATA



## SO-8



0016023 C

**Table 6. Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
January 2004	7	Technical Migration from ST-PRESS to EDOCS.
October 2004	8	Changed Style Look & Feel. Changed Iq value in Table 5 page 3/7 from 2.7mA max. to 3.0mA max.

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