

L6902D

UP TO 1A SWITCHING REGULATOR WITH ADJUSTABLE CURRENT LIMIT

- UP TO 1A OUTPUT CURRENT
- OPERATING INPUT VOLTAGE FROM 8V TO 36V
- PRECISE 3.3V (±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

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

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-



ORDERING NUMBERS: L6902D

L6902D013TR (Tape & Reel)

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

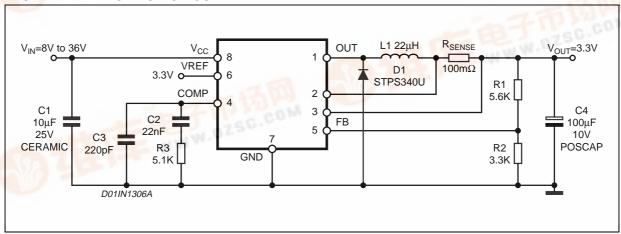
By means of an on board current sense resistor and the availability of the current sense pins (both compatible to Vcc and for Cs- compatible with GND too) a current limit programming is very simple and accurate (±5%). Moreover constant current control can be used to charge NiMH and NiCd batteries.

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.

TEST AND APPLICATION CIRCUIT

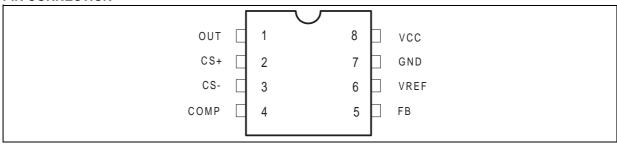


DESCRIPTION (Continued)

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

PIN CONNECTION



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:
		$V_{out} = V_{FB} \cdot \left(1 + \frac{R1}{R2}\right) = 1.235 V \left(1 + \frac{R1}{R2}\right)$
6	V _{REF}	3.3V VREF. No cap is need for stability.
7	GND	Ground
8	VCC	Unregulated DC input voltage.

THERMAL DATA

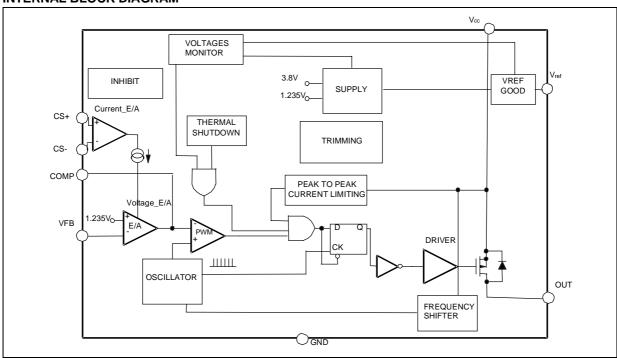
Ī	Symbol	Parameter	Value	Unit
	R _{th j-amb}	Thermal Resistance Junction to Ambient Max.	110 (*)	°C/W

^(*) Package mounted on board.

ABSOLUTE MAXIMUM RATINGS

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

INTERNAL BLOCK DIAGRAM



ELECTRICAL CHARACTERISTCS

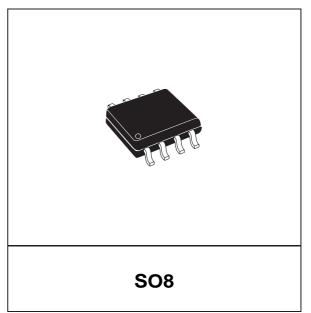
 $(T_j = 25^{\circ}C, V_{CC} = 12V, unless otherwise specified.)$ (•) Specification Referred to Tj from 0 to 125°C.

Symbol Parameter		Test Condition		Min.	Тур.	Max.	Unit
V _{CC}	Operating input voltage range	V _O = 1.235V; I _O = 1A	•	8		36	V
V _d	Dropout voltage	V _{CC} = 8V; I _O = 1A	•		0.25	0.5	V
Io	Operating charging current	$R_{\text{sense}} = 0.1\Omega$		0.95	1	1.05	А
			•	0.92		1.08	Α
II	Maximum limiting current	V _{CC} = 8V to 36V	•	2	2.5	3.2	Α
fs	Switching frequency		•	212	250	287	kHz
				225	250	275	kHz
d	Duty cycle			0		100	%
DYNAMIC	CHARACTERISTICS			!	!		
V ₅	Voltage feedback (FB)	8V < V _{CC} < 36V, 20mA < I _O < 1A		1.21	1.235	1.259	V
			•	1.198	1.235	1.272	V
η	Efficiency	V _O = 5V, V _{CC} = 12V			90		%
DC CHAF	RACTERISTICS	-		1	I	I	
I _{qop}	Total operating quiescent current		•		3	5	mA
Iq	Quiescent current	Duty cycle = 0; VFB = 1.5V				2.7	mA

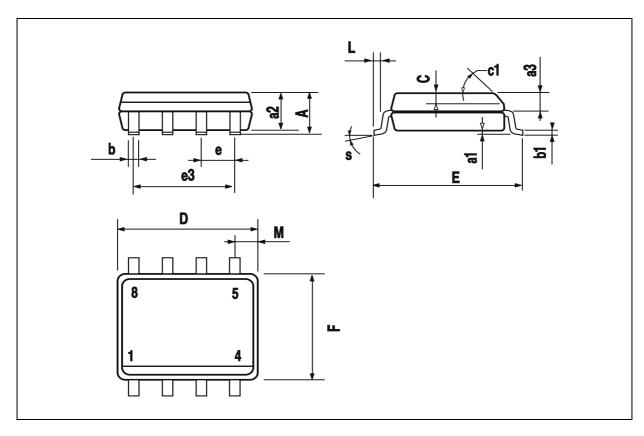
Parameter	Test Condition		Min.	Тур.	Max.	Unit
ERROR AMPLIFIER	'					
High level output voltage	V _{FB} = 1V		3.6			V
Low level output voltage	V _{FB} = 1.5				0.4	V
Source output current	V _{comp} = 1.9V; V _{FB} = 1V	V _{comp} = 1.9V; V _{FB} = 1V		300		μΑ
Sink output current	$V_{comp} = 1.9V; V_{FB} = 1.5V$	FB = 1.5V		1.5		mA
Source bias current				2.5	4	μΑ
DC open loop gain	R _L = 0		50	58		dB
Transconductance	I _{comp} = -0.1 to 0.1mA V _{comp} = 1.9V			2.3		mS
T ERROR AMPLIFIER						
Input offset voltage	$V_{CS-} = 1.8V; V_{CS+} = V_{comp}$		90	100	110	mV
CS+ Output Current	$I_O = 1A$, $R_{sense} = 100 m\Omega$ $V_{out} < V_{CC} - 2V$			1.5	3	μΑ
CS- Output Current	$I_O = 1A$, $R_{sense} = 100 m\Omega$ $V_{out} < V_{CC} - 2V$			1.5	3	μΑ
NCE SECTION						
Reference Voltage			3.234	3.3	3.366	V
	I _{REF} = 0 to 5mA V _{CC} = 8V to 36V	•	3.2	3.3	3.399	V
Line Regulation	I _{REF} = 0mA V _{CC} = 8V to 36V			5	10	mV
Load Regulation	I _{REF} = 0 to 5mA			8	15	mV
Short Circuit Current			10			mA
	ERROR AMPLIFIER High level output voltage Low level output voltage Source output current Sink output current Source bias current DC open loop gain Transconductance TERROR AMPLIFIER Input offset voltage CS+ Output Current CS- Output Current NCE SECTION Reference Voltage Line Regulation Load Regulation	ERROR AMPLIFIERHigh level output voltage $V_{FB} = 1V$ Low level output voltage $V_{FB} = 1.5$ Source output current $V_{comp} = 1.9V$; $V_{FB} = 1V$ Sink output current $V_{comp} = 1.9V$; $V_{FB} = 1.5V$ Source bias current $V_{comp} = 1.9V$; $V_{FB} = 1.5V$ DC open loop gain $V_{comp} = -0.1$ to 0.1 mA $V_{comp} = 1.9V$ TERROR AMPLIFIER $V_{CS-} = 1.8V$; $V_{CS+} = V_{comp}$ Input offset voltage $V_{CS-} = 1.8V$; $V_{CS+} = V_{comp}$ CS+ Output Current $V_{CS-} = 1.8V$; $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$; $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ CS- Output Current $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS-} = 1.8V$ $V_{CS+} = 1.8V$ $V_{CS-} = 1.8V$ <td>ERROR AMPLIFIER High level output voltage $V_{FB} = 1.5$ Low level output voltage $V_{FB} = 1.5$ Source output current $V_{comp} = 1.9V$; 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$V_{CS+} = 1.8V$; $V_{CS+} = 1.8V$; $V_{CS+} = 1.8V$; $V_{CS-} = 1.8V$;</td> <td>ERROR AMPLIFIER High level output voltage V_{FB} = 1V 3.6 Low level output voltage V_{FB} = 1.5 200 300 Source output current V_{comp} = 1.9V; V_{FB} = 1.5V 1 1.5 Source bias current 2.5 50 58 DC open loop gain R_L = 0 50 58 Transconductance $I_{comp} = -0.1 \text{ to } 0.1 \text{ mA}$ V_{comp} = 1.9V 2.3 T ERROR AMPLIFIER Input offset voltage V_{CS} = 1.8V; V_{CS+} = V_{comp} 90 100 CS+ Output Current $I_{O} = 1A$, R_{sense} = 100mΩ V_{out} < V_{CC} -2V 1.5 CS- Output Current $I_{O} = 1A$, R_{sense} = 100mΩ V_{out} < V_{CC} -2V 1.5 NCE SECTION $I_{O} = 1A$, R_{sense} = 100mΩ V_{out} < V_{CC} -2V 1.5 NCE SECTION $I_{REF} = 0$ to 5mA V_{CC} = 8V to 36V • 3.2 3.3 Line Regulation $I_{REF} = 0$ to 5mA • 3.2 3.3 Load Regulation $I_{REF} = 0$ to 5mA 8</td> <td>ERROR AMPLIFIER High level output voltage VFB = 1V 3.6 0.4 Low level output voltage VFB = 1.5 0.4 0.4 Source output current Vcomp = 1.9V; VFB = 1V 200 300 Sink output current Vcomp = 1.9V; VFB = 1.5V 1 1.5 Source bias current 2.5 4 DC open loop gain RL = 0 50 58 Transconductance Icomp = -0.1 to 0.1mA Vcomp = 1.9V 2.3 TERROR AMPLIFIER Input offset voltage VCS- = 1.8V; VCS+ = Vcomp Vcomp 90 100 110 CS+ Output Current Io = 1A, Rsense = 100mΩ Vcot < vcc -2V</td> 1.5 3 CS- Output Current Io = 1A, Rsense = 100mΩ Vcot < vcc -2V	ERROR AMPLIFIER High level output voltage $V_{FB} = 1.5$ Low level output voltage $V_{FB} = 1.5$ Source output current $V_{comp} = 1.9V$; $V_{FB} = 1V$ Sink output current $V_{comp} = 1.9V$; $V_{FB} = 1.5V$ Source bias current $V_{comp} = 1.9V$; $V_{FB} = 1.5V$ DC open loop gain $R_L = 0$ Transconductance $I_{comp} = -0.1$ to 0.1 mA $V_{comp} = 1.9V$ TERROR AMPLIFIER Input offset voltage $V_{CS} = 1.8V$; $V_{CS} = V_{comp}$ $V_{CS} = 1.8V$; $V_{CS} = V_{comp}$ $V_{CS} = 1.8V$; $V_{CS} = 1.8V$; $V_{CS} = V_{comp}$ $V_{CS} = 1.8V$; $V_{CS} = 1.8V$	ERROR AMPLIFIER High level output voltage $V_{FB} = 1V$ 3.6 Low level output voltage $V_{FB} = 1.5$ 200 Source output current $V_{comp} = 1.9V$; 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DIM.		mm			inch		
Dilvi.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Α			1.75			0.069	
a1	0.1		0.25	0.004		0.010	
a2			1.65			0.065	
аЗ	0.65		0.85	0.026		0.033	
b	0.35		0.48	0.014		0.019	
b1	0.19		0.25	0.007		0.010	
С	0.25		0.5	0.010		0.020	
c1			45° ((typ.)			
D (1)	4.8		5.0	0.189		0.197	
Е	5.8		6.2	0.228		0.244	
е		1.27			0.050		
еЗ		3.81			0.150		
F (1)	3.8		4.0	0.15		0.157	
L	0.4		1.27	0.016		0.050	
М			0.6			0.024	
S	8° (max.)						

OUTLINE AND MECHANICAL DATA



(1) D and F do not include mold flash or protrusions. Mold flash or potrusions shall not exceed 0.15mm (.006inch).



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47