

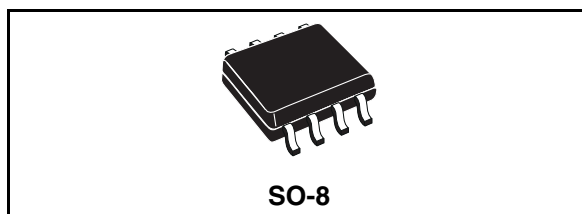


## A6902D

Up to 1 A step down switching regulator with adjustable current limit for automotive applications

### Features

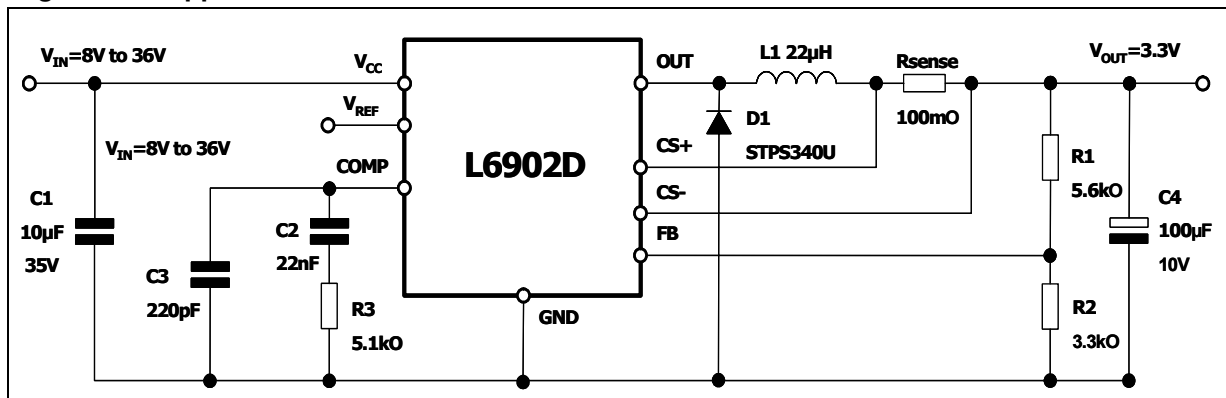
- Qualified following the AEC-Q100 requirements (temperature grade 3), see PPAP for more details.
- Up to 1 A DC output current
- Operating input voltage from 8 V to 36 V
- Output voltage adjustable from 1.235 V to 35 V
- Precise 3.3 V ( $\pm 2\%$ ) reference voltage
- 250 kHz Internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Internal current limiting
- Protection against feedback disconnection
- Thermal shutdown



### Applications

- Automotive applications
- Adjustable current generator
- Simple step-down converters with adjustable current limit

Figure 1. Application schematic



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# 1 Description

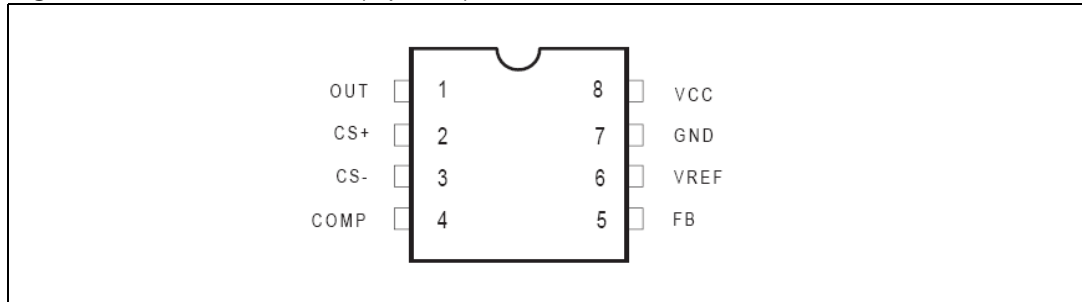
The A6902D is a complete and simple step down switching regulator with adjustable current limit. Based on a voltage mode structure it integrates a current error amplifier to have a constant voltage and constant current control. By means of an on board current sense resistor and the availability of the current sense pins (both compatible to Vcc and for Cs-compatible with GND too) a current limit programming is very simple and accurate. 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 mΩ 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 folback overcurrent protection and protection vs. feedback disconnection. The internal fixed switching frequency of 250 kHz, and the SO-8 package pin allow to built an ultra compact DC/ DC converter with a minimum board space.

## 2 Pin connection

### 2.1 Pin connection

Figure 2. Pin connection (top view)



### 2.2 Pin description

Table 1. Pin description

N	Pin	Description
1	OUT	Regulator 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 for frequency compensation.
5	FB	Feedback input. Connecting directly to this pin results in an output voltage of 1.23 V. An external resistive divider is required for higher output voltages.
6	V <sub>REF</sub>	3.3 V reference voltage. No cap is need for stability.
7	GND	Ground.
8	VCC	Unregulated DC input voltage.

## 3 Electrical data

### 3.1 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
$V_2, V_3$	Analog pins	-0.3 to $V_{CC}$	V
$P_{TOT}$	Power dissipation at $T_A \leq 70 \text{ }^\circ\text{C}$	0.7	W
$T_J$	Operating junction temperature range	-40 to 150	$^\circ\text{C}$
$T_{STG}$	Storage temperature range	-55 to 150	$^\circ\text{C}$

### 3.2 Thermal data

**Table 3. Thermal data**

Symbol	Parameter	SO8	Unit
$R_{thJA}$	Maximum thermal resistance junction-ambient	110 <sup>(1)</sup>	$^\circ\text{C/W}$

1. Package mounted on board

## 4 Electrical characteristics

**Table 4. Electrical characteristics**  
( $T_J = -40$  to  $125$  °C,  $V_{CC} = 12$  V, unless otherwise specified)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{CC}$	Operating input voltage range	$V_0 = 1.235$ V; $I_0 = 2$ A	8		36	V
$R_{DS(on)}$	MOSFET on resistance			0.250	0.5	$\Omega$
$I_L$	Maximum limiting current <sup>(1)</sup>	$V_{CC} = 8.5$ V	1.8	2.5	3.2	A
		$V_{CC} = 8.5$ V, $T_J = 25$ °C	2	2.5	3.2	
$f_{SW}$	Switching frequency		212	250	280	kHz
	Duty cycle		0		100	%
<b>Dynamic characteristics</b> (see test circuit).						
$V_5$	Voltage feedback	$8$ V < $V_{CC} < 36$ V, $20$ mA < $I_0 < 1$ A	1.198	1.235	1.272	V
$\eta$	Efficiency	$V_0 = 5$ V, $V_{CC} = 12$ V		90		%
<b>DC characteristics</b>						
$I_{qop}$	Total operating quiescent current			3	5	mA
$I_q$	Quiescent current	Duty cycle=0; $V_{FB}=1.5$ V			2.7	mA
<b>Error amplifier</b>						
$V_{OH}$	High level output voltage	$V_{FB}=1$ V	3.6			V
$V_{OL}$	Low level output voltage	$V_{FB}=1.5$ V			0.4	V
$I_{o\ source}$	Source output current	$V_{COMP} = 1.9$ V; $V_{FB} = 1$ V	160	300		$\mu$ A
$I_{o\ sink}$	Sink output current	$V_{COMP} = 1.9$ V; $V_{FB} = 1.5$ V	1	1.5		mA
$I_b$	Source bias current			2.5	4	$\mu$ A
	DC open loop gain	$R_L = \infty$	50	58		dB
$g_m$	Transconductance	$I_{COMP} = -0.1$ mA to $0.1$ mA; $V_{COMP} = 1.9$ V		2.3		mS
$V_{OFFS}$	Input offset voltage	$V_{CS-} = 1.8$ V; $V_{CS+} = V_{comp}$	90	100	110	mV
$I_{CS+}$	CS+ output current	$I_0 = 1$ A; $R_{SENSE} = 100$ m $\Omega$ ; $V_{OUT} < V_{CC} - 2$ V		1.5	3	$\mu$ A
$I_{CS-}$	CS- output current	$I_0 = 1$ A; $R_{SENSE} = 100$ m $\Omega$ ; $V_{OUT} < V_{CC} - 2$ V		1.5	3	$\mu$ A

**Table 4. Electrical characteristics (continued)**  
 ( $T_J = -40$  to  $125$  °C,  $V_{CC} = 12$  V, unless otherwise specified)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
<b>Reference section</b>						
	Reference voltage	$I_{REF} = 0$ to $5$ mA $V_{CC} = 8$ V to $36$ V	3.2	3.3	3.399	V
	Line regulation	$I_{REF} = 0$ mA $V_{CC} = 8$ V to $36$ V		5	10	mV
	Load regulation	$I_{REF} = 0$ to $5$ mA		8	15	mV
	Short circuit current		5	18	35	mA

1. With  $T_J = 85$  °C,  $I_{lim\_min} = 2$  A, assured by design, characterization and statistical correlation.

## 5 Package mechanical data

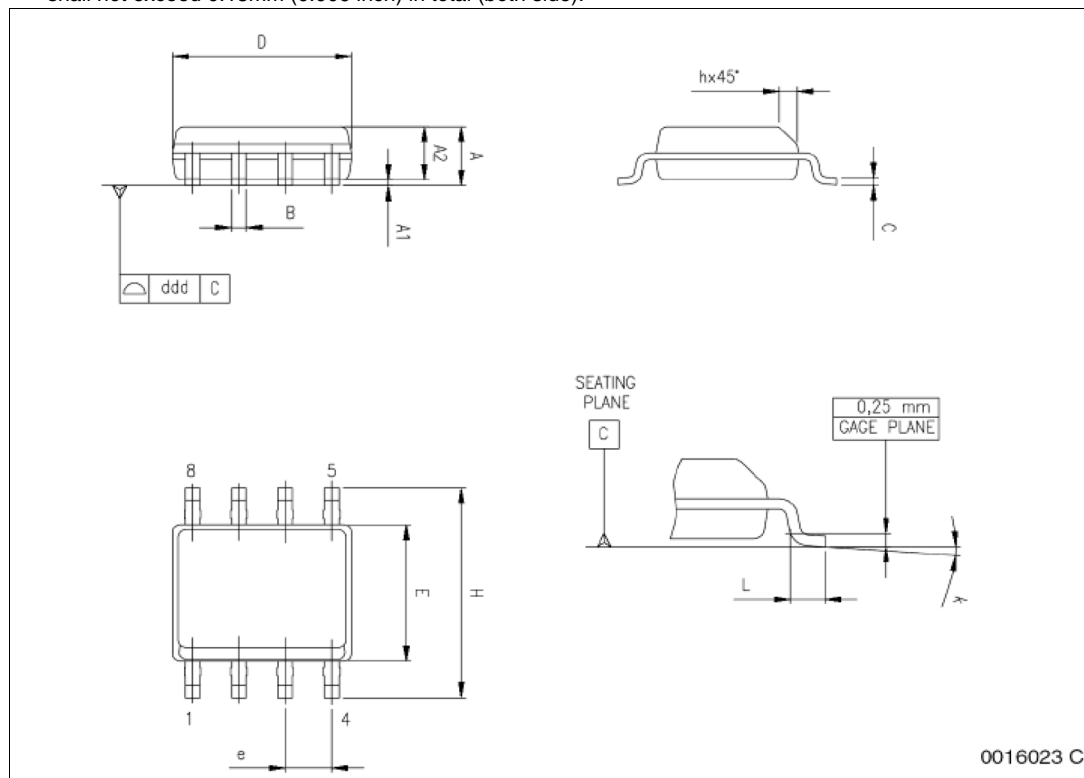
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings 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 5. 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. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm (0.006 inch) in total (both side).



0016023 C

## 6 Order codes

**Table 6. Order codes**

Order codes	Package	Packaging
A6902D	SO-8	Tube
A6902D13TR		Tape and reel

## 7 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
02-Oct-2007	1	Initial release
5-Nov-2007	2	Updated: <a href="#">Table 4 on page 6</a>
2-May-2008	3	Updated: <a href="#">Table 4 on page 6</a>
28-Aug-2008	4	Updated: Coverpage and <a href="#">Table 4 on page 6</a>

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