

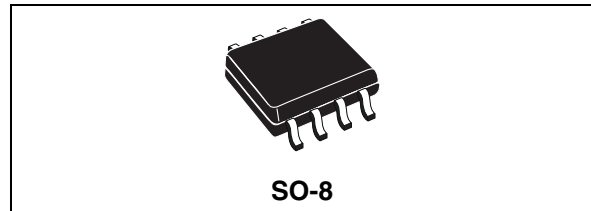


## A6902D

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

### Features

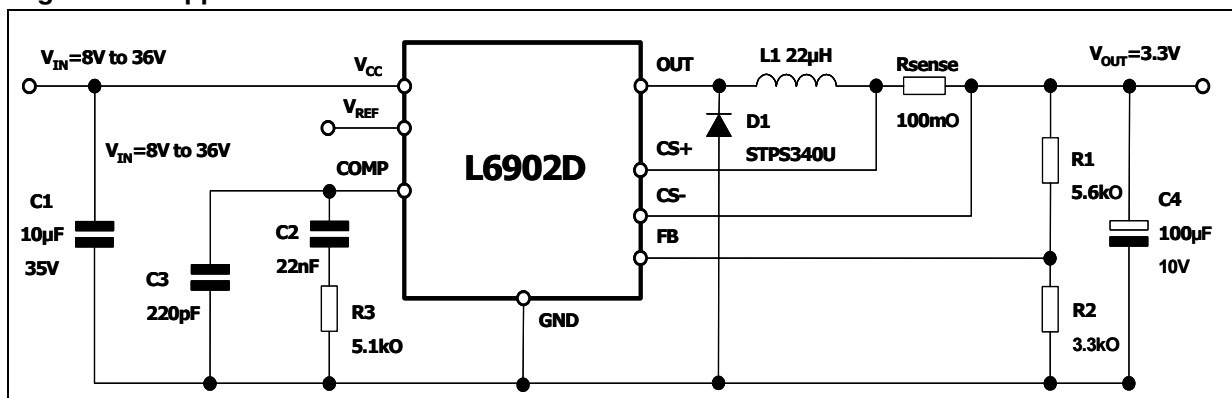
- Qualified following the AEC-Q100 requirements (see PPAP for more details)
- Up to 1 A DC output current
- Operating input voltage from 8 V to 36 V
- Output voltage adjustable from 1.235 V to 35 V
- Precise 3.3 V ( $\pm 2\%$ ) reference voltage
- 250 kHz Internally fixed frequency
- Voltage feedforward
- 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

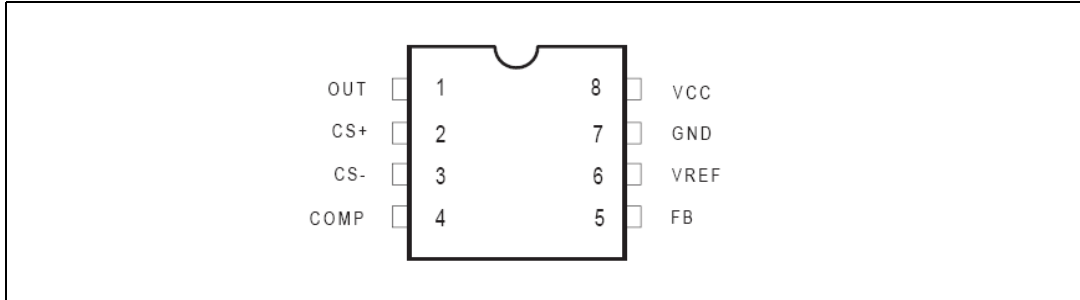
The A6902D is a complete and simple step down switching regulator with adjustable current limit. Based on a voltage mode structure it integrates a current error amplifier to have a constant voltage and constant current control. By means of an on board current sense resistor and the availability of the 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>	$^\circ\text{C}/\text{W}$

1. Package mounted on board

## 4 Electrical characteristics

$T_J = -40$  to  $125$  °C,  $V_{CC} = 12$  V, unless otherwise specified

**Table 4. Electrical characteristics**

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 (1)	$V_{CC} = 8.5$ 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 (see test circuit)</b>						
$V_5$	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)

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 different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

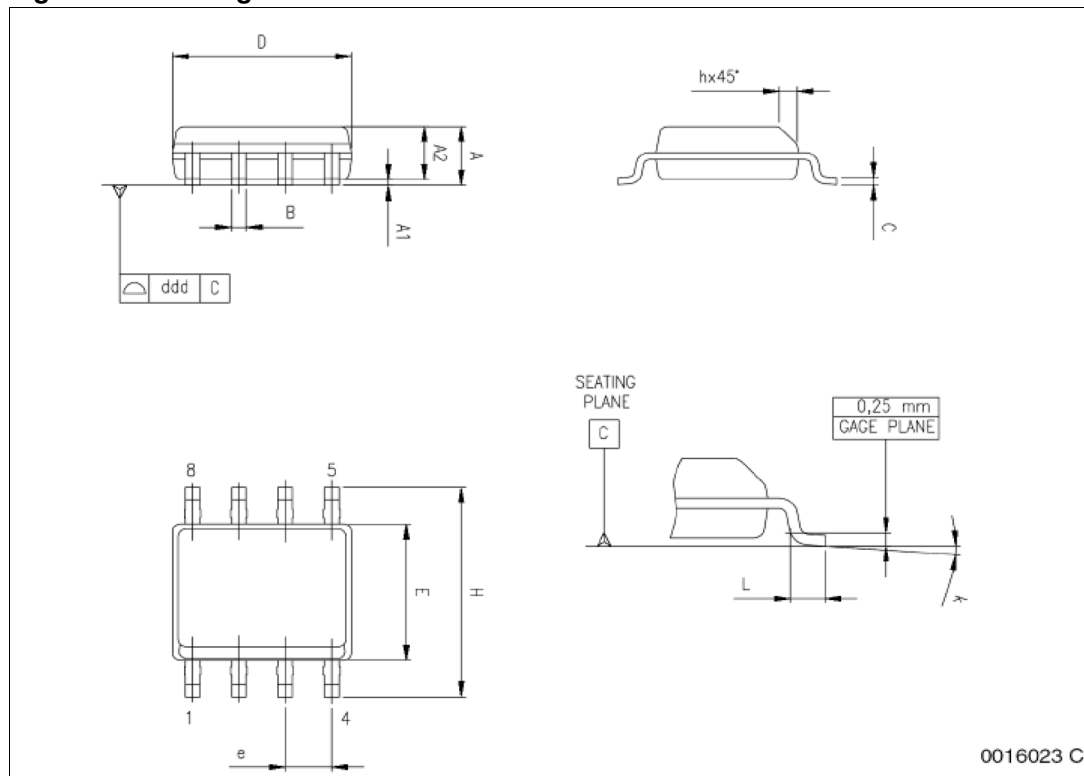


Table 5. SO-8 mechanical data

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 0.15 mm (0.006 inch) in total (both side).

Figure 3. Package dimensions



## 6 Order codes

**Table 6. Ordering information**

<b>Order codes</b>	<b>Package</b>	<b>Packaging</b>
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>
23-Apr-2009	5	Updated first feature in coverpage

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