

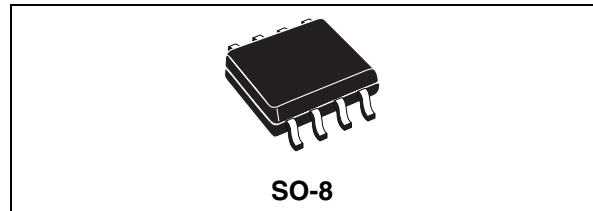


A6902D

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

Features

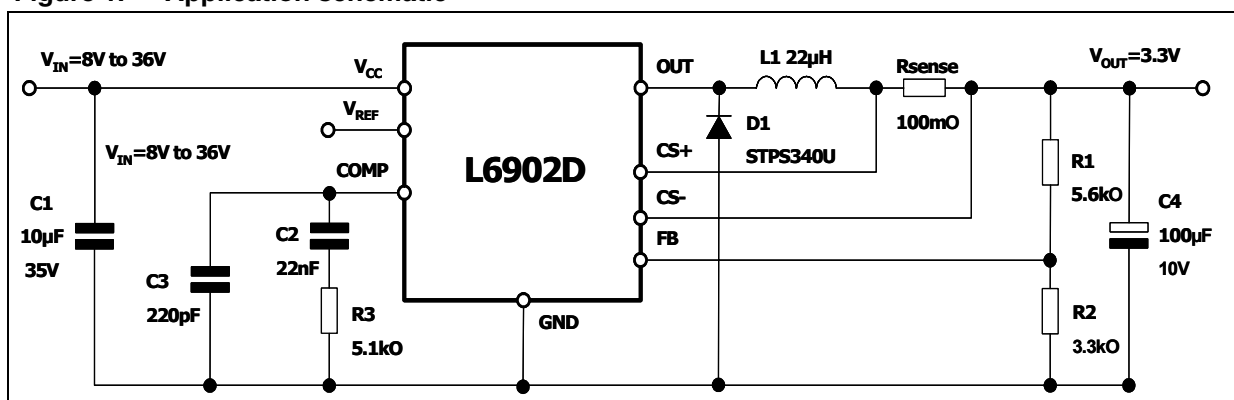
- Qualified following the AEC-Q100 requirements (see PPAP for more details)
- Up to 1 A DC output current
- Operating input voltage from 8 V to 36 V
- Output voltage adjustable from 1.235 V to 35 V
- Precise 3.3 V ($\pm 2\%$) reference voltage
- 250 kHz Internally fixed frequency
- Voltage feedforward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



Contents

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1 Description

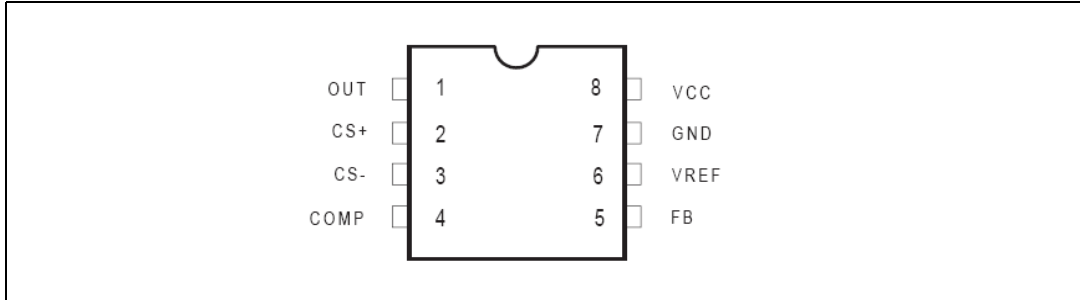
The A6902D is a complete and simple step down switching regulator with adjustable current limit. Based on a voltage mode structure it integrates a current error amplifier to have a constant voltage and constant current control. By means of an on board current sense resistor and the availability of the 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 _{REF} | 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 ⁽¹⁾ | $^\circ\text{C/W}$ |

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 | Ω |
| 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 | % |
| Dynamic characteristics (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 |
| η | Efficiency | $V_0 = 5$ V, $V_{CC} = 12$ V | | 90 | | % |
| DC characteristics | | | | | | |
| I_{qop} | Total operating quiescent current | | | 3 | 5 | mA |
| I_q | Quiescent current | Duty cycle = 0; $V_{FB} = 1.5$ V | | | 2.7 | mA |
| Error amplifier | | | | | | |
| 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 | | μ 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 | μ A |
| | DC open loop gain | $R_L = \infty$ | 50 | 58 | | dB |
| gm | 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 Ω ; $V_{OUT} < V_{CC} - 2$ V | | 1.5 | 3 | μ A |
| I_{CS-} | CS- output current | $I_0 = 1$ A; $R_{SENSE} = 100$ m Ω ; $V_{OUT} < V_{CC} - 2$ V | | 1.5 | 3 | μ A |

Table 4. Electrical characteristics (continued)

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

1. With $T_J = 85 \text{ }^\circ\text{C}$, $I_{lim_min} = 2 \text{ A}$, assured by design, characterization and statistical correlation.

5 Package mechanical data

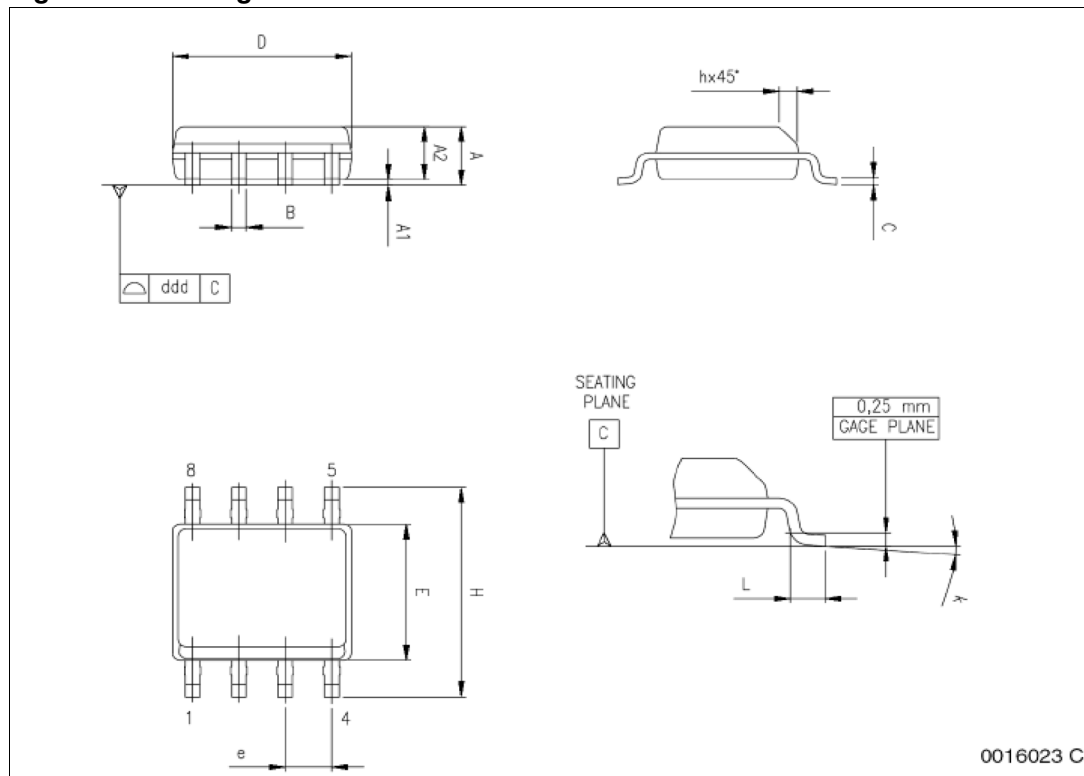
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Table 5. SO-8 mechanical data

| 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 ⁽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 |

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



0016023 C

6 Order codes

Table 6. Ordering information

| 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: Table 4 on page 6 |
| 2-May-2008 | 3 | Updated: Table 4 on page 6 |
| 28-Aug-2008 | 4 | Updated: Coverpage and Table 4 on page 6 |
| 23-Apr-2009 | 5 | Updated first feature in coverpage |

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