

Up to 1 A switching regulator with adjustable current limit

Features

- Up to 1 A output current
- Operating input voltage from 8 V to 36 V
- Precise 3.3 V ($\pm 2\%$) reference voltage
- 5 % output current accuracy
- Output voltage adjustable from 1.235 V to 34 V
- 250 kHz internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Adjustable current limit
- Protection against feedback Disconnection
- Thermal shutdown

Applications

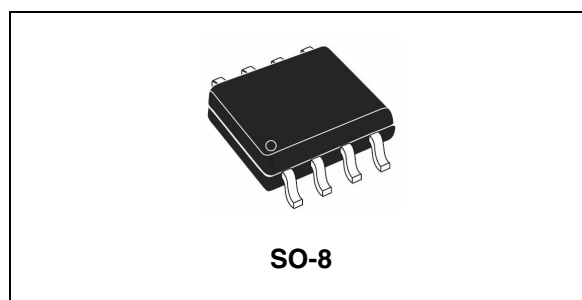
- Chargers for NiCd, NiMH batteries and preregulator for lithium-ion batteries
- Adjustable current generator
- Simple step-down converters with adjustable current limit
- Battery equipped systems
- Distributed power supply
- Mobile PC and subnotebook

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 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 ($\pm 5\%$). 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 250 m Ω 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 250KHz, and the SO-8 package pin allow to built an ultra compact DC/ DC converter with a minimum board space.

Table 1. Device summary

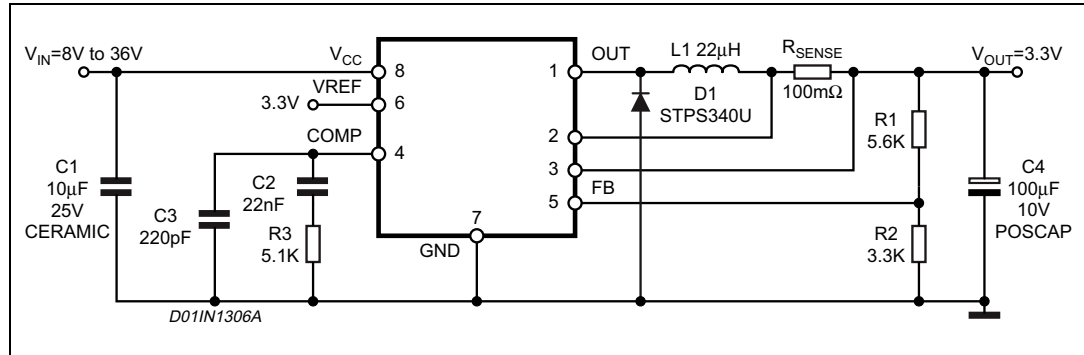
| Order codes | Package | Packaging |
|-------------|---------|---------------|
| L6902D | SO-8 | Tube |
| L6902D013TR | | Tape and reel |

Content

| | | |
|---|------------------------------------|----|
| 1 | Test and application circuit | 3 |
| 2 | Pin connection | 3 |
| 3 | Maximum ratings | 4 |
| 4 | Internal block diagram | 5 |
| 5 | Electrical characteristics | 6 |
| 6 | Package mechanical data | 8 |
| 7 | Revision history | 10 |

1 Test and application circuit

Figure 1. Test and application circuit



2 Pin connection

Figure 2. Pin connection

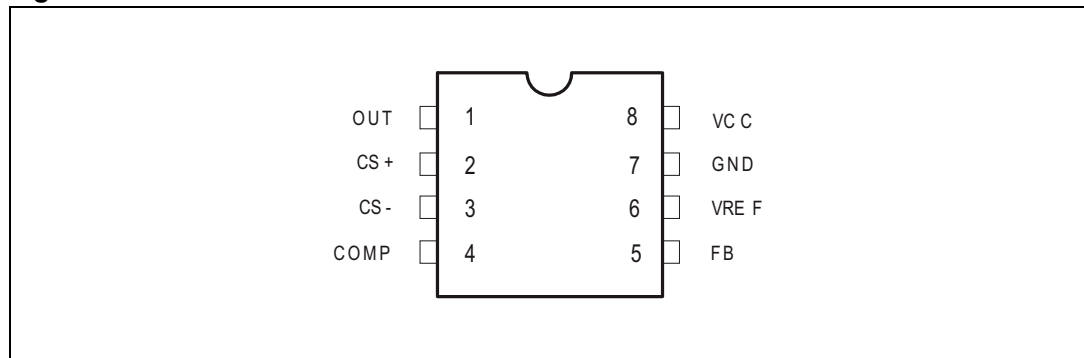


Table 2. Pin description

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

3 Maximum ratings

Table 3. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|------------------|--|--------------------|------------------|
| V_8 | Input voltage | 40 | V |
| V_1 | Output DC voltage output peak voltage at $t = 0.1 \mu\text{s}$ | -1 to 40 -5 to 40 | V V |
| I_1 | Maximum output current | Internally limited | |
| V_4, V_5 | Analog pins | 4 | V |
| V_2, V_3 | Analog pins | -0.3V to VCC | V |
| P_{tot} | Power dissipation at $T_{\text{amb}} \leq 70 \text{ }^\circ\text{C}$ | 0.7 | W |
| T_j | Operating junction temperature range | -40 to 150 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature range | -55 to 150 | $^\circ\text{C}$ |

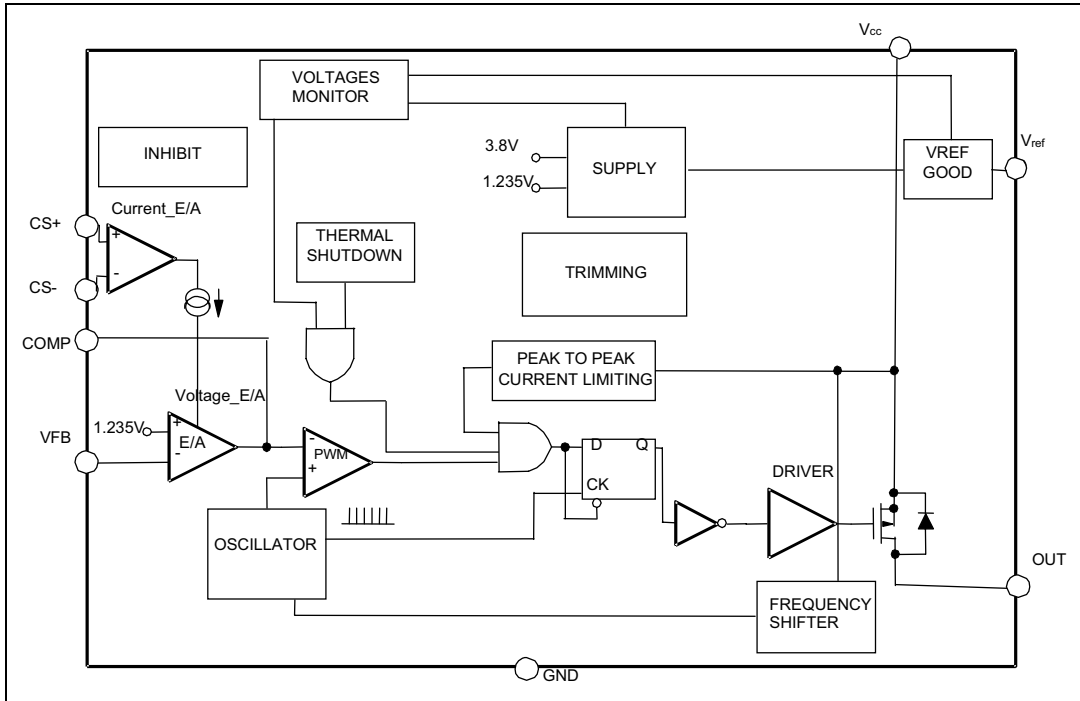
Table 4. Thermal data

| Symbol | Parameter | Value | Unit |
|-----------------------|---|--------------------|--------------------|
| $R_{\text{th-j-amb}}$ | Thermal Resistance Junction to Ambient Max. | 110 ⁽¹⁾ | $^\circ\text{C/W}$ |

1. Package mounted on board.

4 Internal block diagram

Figure 3. Block diagram



5 Electrical characteristics

$T_j = 25^\circ\text{C}$, $V_{CC} = 12\text{V}$, unless otherwise specified.

Table 5. Electrical characteristics

| 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 |
| | | | (1) | 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 | | (1) | 212 | 250 | 287 | kHz |
| | | | | 225 | 250 | 275 | kHz |
| d | Duty cycle | | 0 | | 100 | % | |
| Dynamic characteristics | | | | | | | |
| 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) | 1.198 | 1.235 | 1.272 | V |
| η | Efficiency | $V_O = 5\text{V}$, $V_{CC} = 12\text{V}$ | | 90 | | % | |
| DC characteristics | | | | | | | |
| I_{qop} | Total operating quiescent current | | (1) | | 3 | 5 | mA |
| I_q | Quiescent current | Duty cycle = 0; VFB = 1.5V | | | 3 | | mA |
| Voltage error amplifier | | | | | | | |
| V_{OH} | High level output voltage | $V_{FB} = 1\text{V}$ | | 3.6 | | | V |
| V_{OL} | Low level output voltage | $V_{FB} = 1.5$ | | | 0.4 | | V |
| $I_{O \text{ source}}$ | Source output current | $V_{\text{comp}} = 1.9\text{V}$; $V_{FB} = 1\text{V}$ | | 200 | 300 | | μA |
| $I_{O \text{ sink}}$ | Sink output current | $V_{\text{comp}} = 1.9\text{V}$; $V_{FB} = 1.5\text{V}$ | | 1 | 1.5 | | mA |
| I_b | Source bias current | | | 2.5 | 4 | | μA |
| | DC open loop gain | $R_L = 0$ | | 50 | 58 | | dB |
| g_m | Transconductance | $I_{\text{comp}} = -0.1 \text{ to } 0.1\text{mA}$, $V_{\text{comp}} = 1.9\text{V}$ | | | 2.3 | | mS |
| Current error amplifier | | | | | | | |
| V_{offs} | Input offset voltage | $V_{CS-} = 1.8\text{V}$; $V_{CS+} = V_{\text{comp}}$ | | 95 | 100 | 105 | mV |
| I_{CS+} | CS+ output current | $I_O = 1\text{A}$, $R_{\text{sense}} = 100\text{m}\Omega$, $V_{\text{out}} < V_{CC} - 2\text{V}$ | | | 1.5 | 3 | μA |
| I_{CS-} | CS- output current | $I_O = 1\text{A}$, $R_{\text{sense}} = 100\text{m}\Omega$, $V_{\text{out}} < V_{CC} - 2\text{V}$ | | | 1.5 | 3 | μA |

Table 5. Electrical characteristics (continued)

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|--------------------------|-----------------------|--|--------------------|------|-------|------|
| Reference section | | | | | | |
| | Reference voltage | | 3.234 | 3.3 | 3.366 | V |
| | | $I_{REF} = 0 \text{ to } 5\text{mA}$ $V_{CC} = 8\text{V to } 36\text{V}$ | ⁽¹⁾ 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 | | 10 | | | mA |

1. Specification Referred to T_J from -40 to 125°C. Specification over the -40 to +125 T_J Temperature range are assured by design, characterization and statistical correlation

6 Package mechanical data

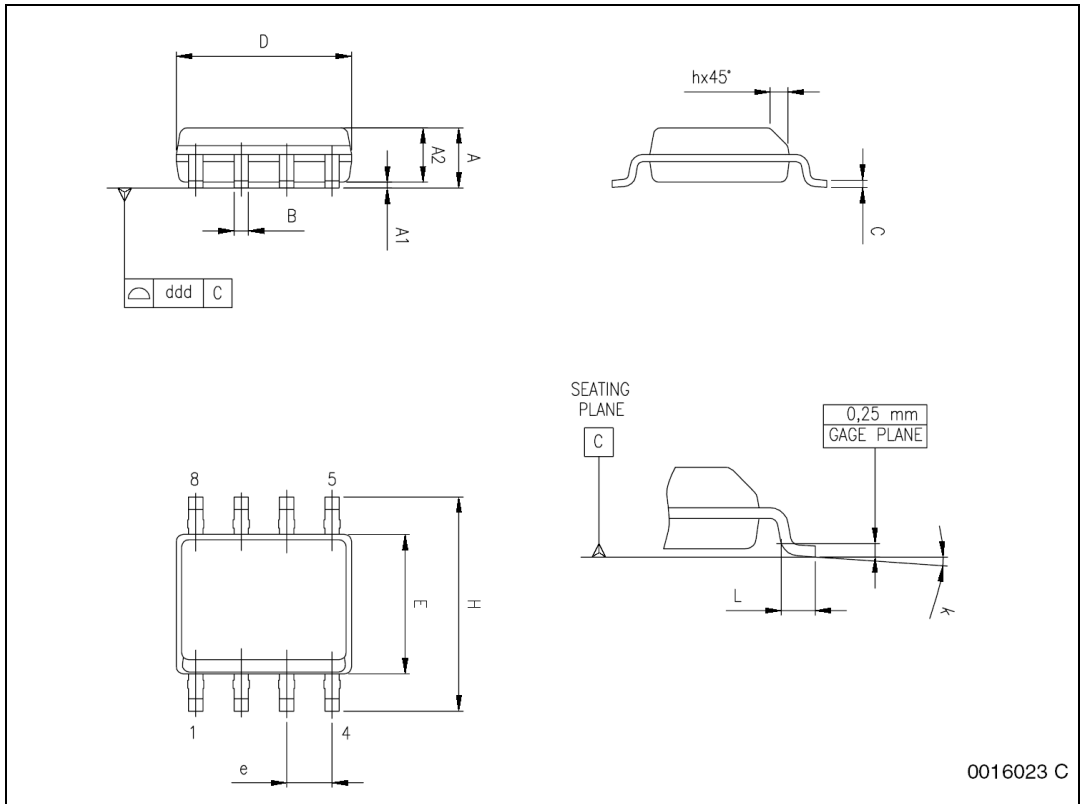
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

Table 1. 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. 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).

Figure 4. Package dimensions



7 Revision history

Table 6. Document revision history

| Date | Revision | Changes |
|--------------|----------|---|
| January 2004 | 7 | Technical migration from ST-PRESS to EDOCS. |
| October 2004 | 8 | Changed style look and feel. |
| 26-Nov-2010 | 9 | Updated Note 1 on page 7 |