

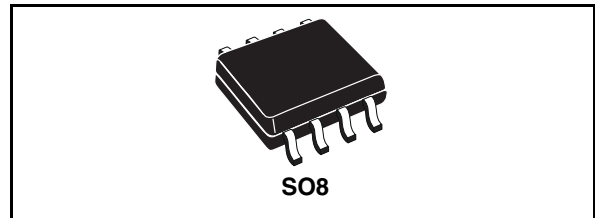
2A switch step down switching regulator

Features

- 2A internal switch
- Operating input voltage from 4.4V to 36V
- Output voltage adjustable from 1.235V to 35V
- Low dropout operation: 100% duty cycle
- 250kHz Internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Internal current limiting
- Protection against feedback disconnection
- Thermal shutdown

Applications

- Consumer: STB, DVD, TV, VCR, car radio, LCD monitors
- Networking: XDSL, modems, DC-DC modules
- Computer: printers, audio/graphic cards, optical storage, hard disk drive
- Industrial: changers, car battery, DC-DC converters



Description

The L5972D is a step down monolithic power switching regulator with a minimum switch current limit of 2A so it is able to deliver more than 1.5A DC current to the load depending on the application conditions.

The output voltage can be set from 1.235V to 35V.

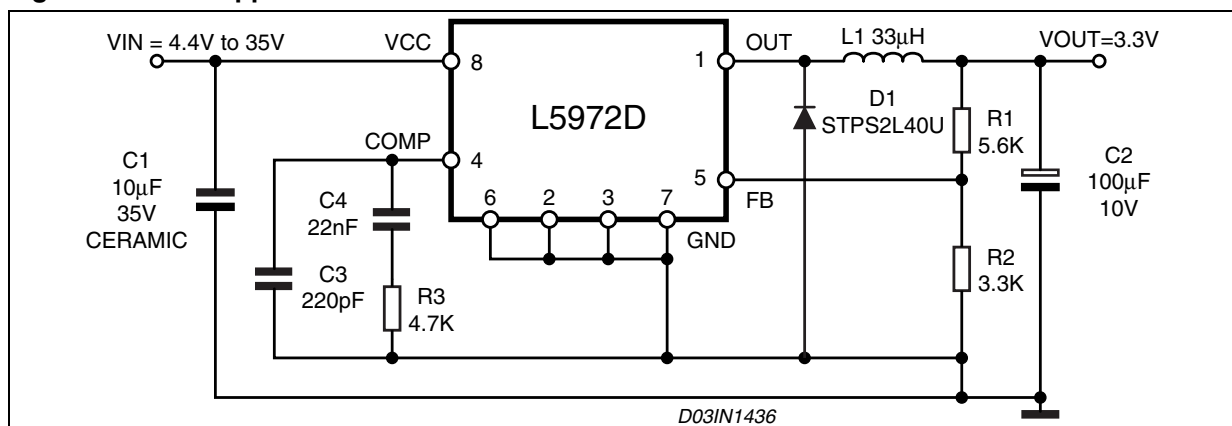
The device uses an internal P-Channel D-MOS transistor (with a typical R_{dson} of 250m Ω) as switching element to minimize the size of the external components.

An internal oscillator fixes the switching frequency at 250kHz.

Having a minimum input voltage of 4.4V only, it is particularly suitable for 5V bus, available in all computer related applications.

Pulse by pulse current limit with the internal frequency modulation offers an effective constant current short circuit protection.

Figure 1. Test application circuit



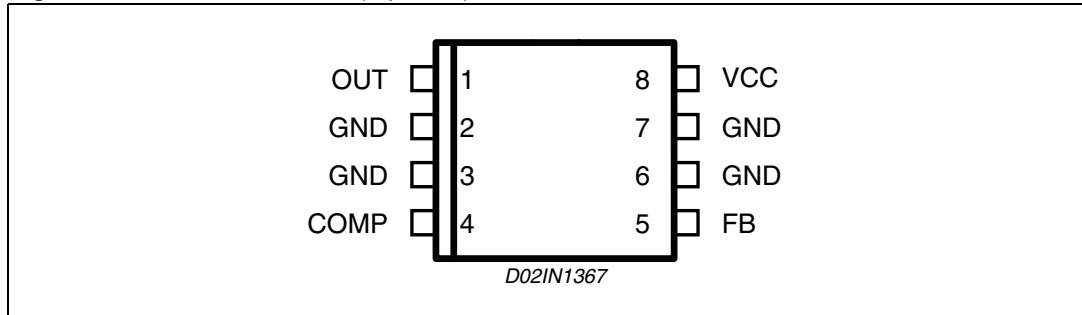
Contents

| | | |
|----------|---|-----------|
| 1 | Pin settings | 3 |
| 1.1 | Pin connection | 3 |
| 1.2 | Pin description | 3 |
| 2 | Electrical data | 4 |
| 2.1 | Maximum ratings | 4 |
| 2.2 | Thermal data | 4 |
| 3 | Electrical characteristics | 5 |
| 4 | Typical characteristics | 6 |
| 5 | Application circuit | 7 |
| 6 | Application ideas | 10 |
| 7 | Package mechanical data | 11 |
| 8 | Order code | 13 |
| 9 | Revision history | 14 |

1 Pin settings

1.1 Pin connection

Figure 2. Pin connection (top view)



1.2 Pin description

Table 1. Pin description

| N° | Pin | Description |
|---------|------|--|
| 1 | OUT | Regulator output. |
| 2,3,6,7 | GND | Ground. |
| 4 | COMP | E/A output for frequency compensation. |
| 5 | FB | Feedback input. Connecting directly to this pin results in an output voltage of 1.23V. An external resistive divider is required for higher output voltages. |
| 8 | VCC | Unregulated DC input voltage. |

2 Electrical data

2.1 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 |
| P_{tot} | Power dissipation at $T_A \leq 70^\circ\text{C}$ | 1.2 | W |
| T_j | Operating junction temperature range | -40 to 150 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature range | -55 to 150 | $^\circ\text{C}$ |

2.2 Thermal data

Table 3. Thermal data

| Symbol | Parameter | SO8 | Unit |
|-------------------|---|-------------------|--------------------|
| R_{thJA} | Maximum thermal resistance junction-ambient | 65 ⁽¹⁾ | $^\circ\text{C/W}$ |

1. Package mounted on board

3 Electrical characteristics

Table 4. Electrical characteristics ($T_J = 25^\circ\text{C}$, $V_{CC} = 12\text{V}$, unless otherwise specified)

| Symbol | Parameter | Test condition | | Min | Typ | Max | Unit |
|---|-----------------------------------|--|-----|-------|-------|-------|---------------|
| V_{CC} | Operating input voltage range | $V_o = 1.235\text{V}$; $I_o = 2\text{A}$ | (1) | 4.4 | | 36 | V |
| $R_{DS(on)}$ | Mosfet on Resistance | | (1) | | 0.250 | 0.5 | Ω |
| I_l | Maximum limiting current | $V_{CC} = 4.4\text{V to } 36\text{V}$ | | 2 | 2.5 | 3 | A |
| f_s | Switching frequency | | (1) | 212 | 250 | 280 | kHz |
| | | | | 225 | 250 | 275 | kHz |
| | Duty cycle | | | 0 | | 100 | % |
| Dynamic characteristics (see test circuit). | | | | | | | |
| V_5 | Voltage feedback | $4.4\text{V} < V_{CC} < 36\text{V}$, $20\text{mA} < I_o < 2\text{A}$ | | 1.220 | 1.235 | 1.25 | V |
| | | | (1) | 1.198 | 1.235 | 1.272 | V |
| h | 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; $V_{FB} = 1.5\text{V}$ | | | | 2.5 | mA |
| Error amplifier | | | | | | | |
| V_{OH} | High level output voltage | $V_{FB} = 1\text{V}$ | | 3.5 | | | V |
| V_{OL} | Low level output voltage | $V_{FB} = 1.5\text{V}$ | | | | 0.4 | V |
| $I_{o\ source}$ | Source output current | $V_{COMP} = 1.9\text{V}$; $V_{FB} = 1\text{V}$ | | 200 | 300 | | μA |
| $I_{o\ sink}$ | Sink output current | $V_{COMP} = 1.9\text{V}$; $V_{FB} = 1.5\text{V}$ | | 1 | 1.5 | | mA |
| I_b | Source bias current | | | | 2.5 | 4 | μA |
| | DC open loop gain | $R_L = \infty$ | | 50 | 65 | | dB |
| g_m | Transconductance | $I_{comp} = -0.1\text{mA to } 0.1\text{mA}$ $V_{COMP} = 1.9\text{V}$ | | | 2.3 | | mS |

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.

4 Typical characteristics

Figure 3. Output voltage vs. junction temperature

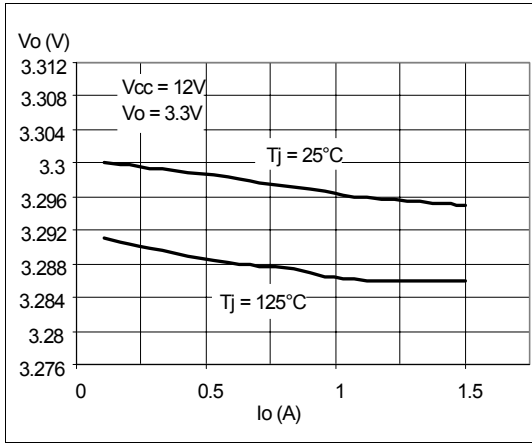


Figure 4. Quiescent current vs. junction temperature

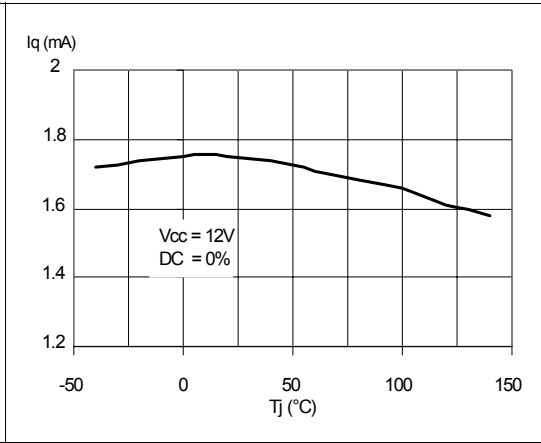


Figure 5. Line regulator

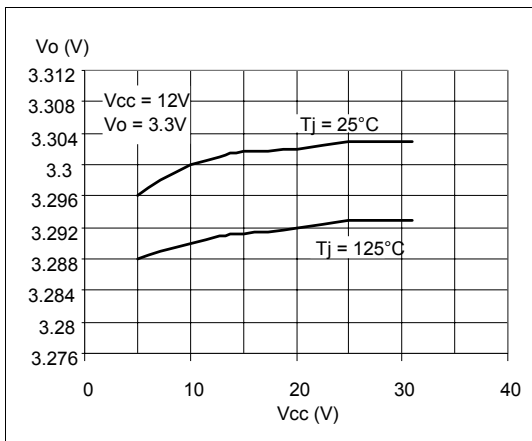


Figure 6. Shutdown current vs. junction temperature

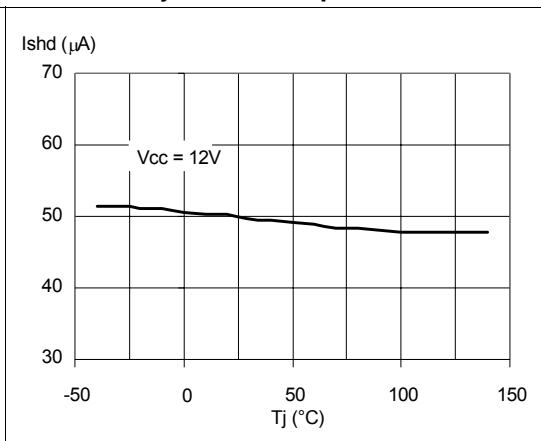


Figure 7. Output voltage vs. junction temperature

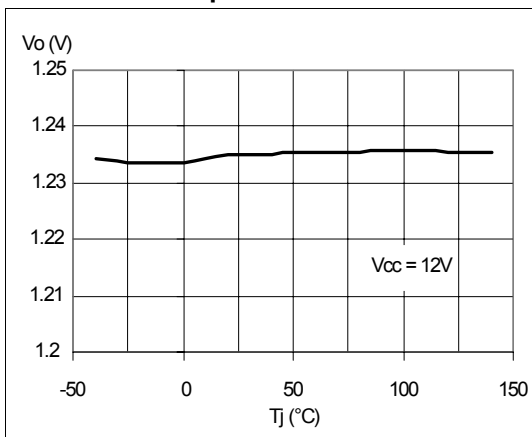
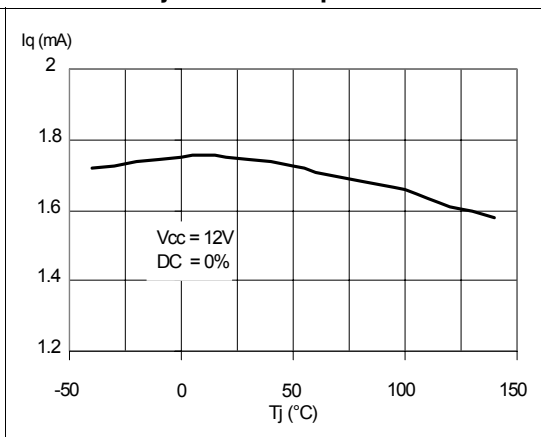


Figure 8. Switching frequency vs. junction temperature



5 Application circuit

In figure 8 is shown the demo board application circuit for the device in SMD version, where the input supply voltage, V_{CC} , can range from 4.4V to 25V due to the rated voltage of the input capacitor and the output voltage is adjustable from 1.235V to V_{CC} .

Figure 9. Demo board application circuit

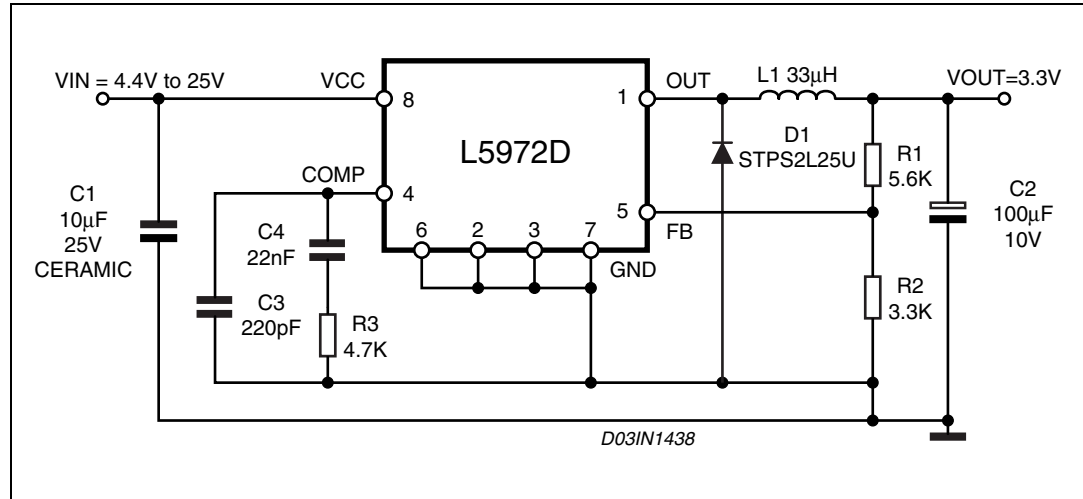


Table 5. Component list

| Reference | Part number | Description | Manufacturer |
|-----------|--------------------|---------------------|--------------|
| C1 | GRM32DR61E106KA12L | 10µF, 25V | MURATA |
| C2 | POSCAP 10TPB100M | 100µF, 10V | Sanyo |
| C3 | C1206C221J5GAC | 220pF, 5%, 50V | KEMET |
| C4 | C1206C223K5RAC | 22nF, 10%, 50V | KEMET |
| R1 | | 5.6K, 1%, 0.1W 0603 | Neohm |
| R2 | | 3.3K, 1%, 0.1W 0603 | Neohm |
| R3 | | 4.7K, 1%, 0.1W 0603 | Neohm |
| D1 | STPS2L25U | 2A, 25V | ST |
| L1 | DO3316P-333 | 33µH, 2.1A | COILCRAFT |

Figure 10. PCB layout (component side)

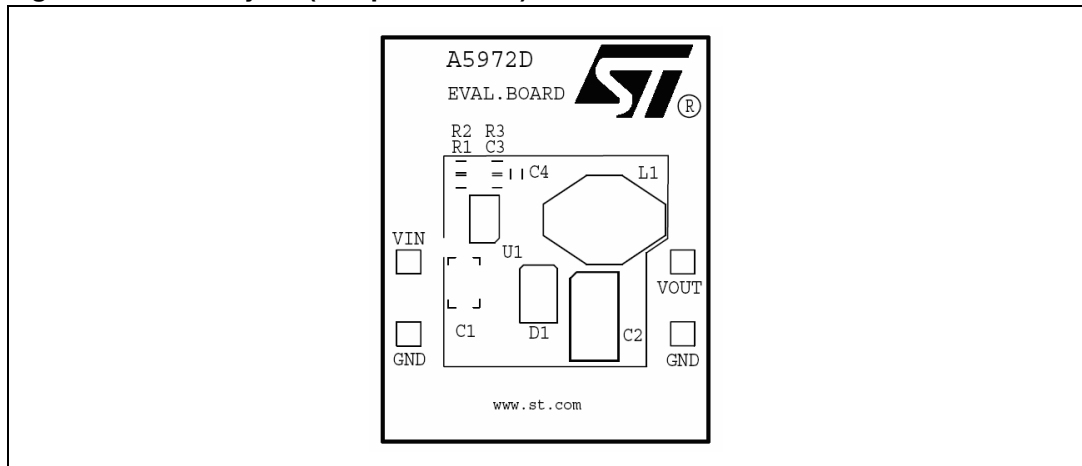


Figure 11. PCB layout (bottom side)

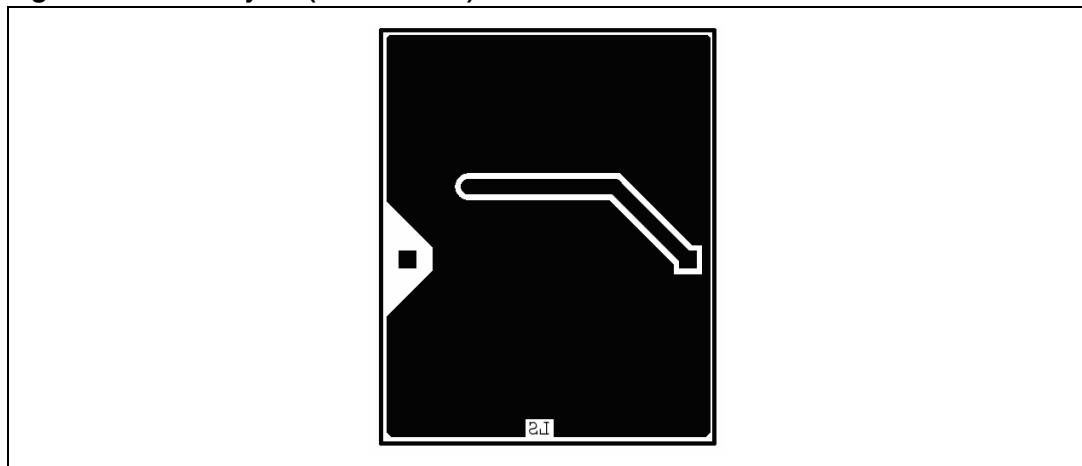
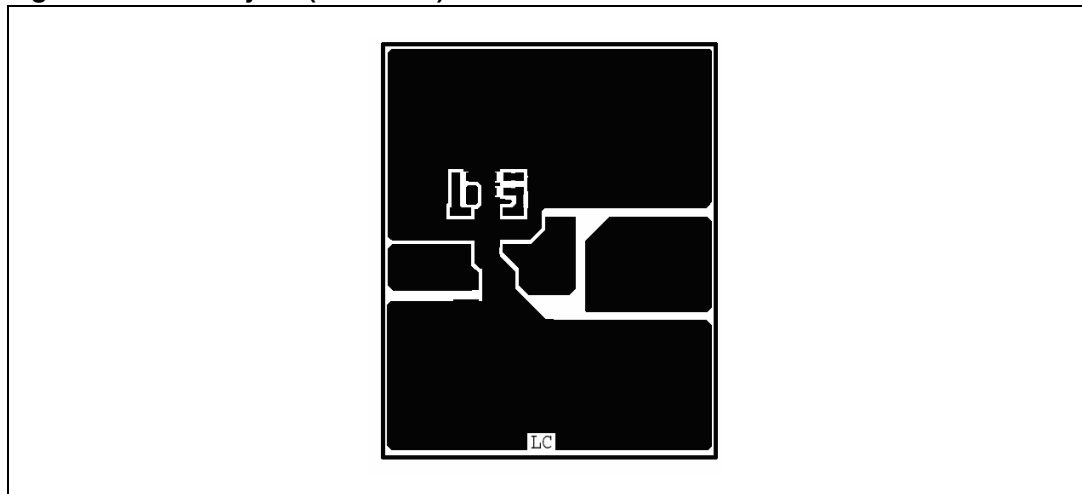


Figure 12. PCB layout (front side)



Sideways two graphs show the T_J versus output current in different conditions of the input and output voltage.

Figure 13. Junction temperature vs output current

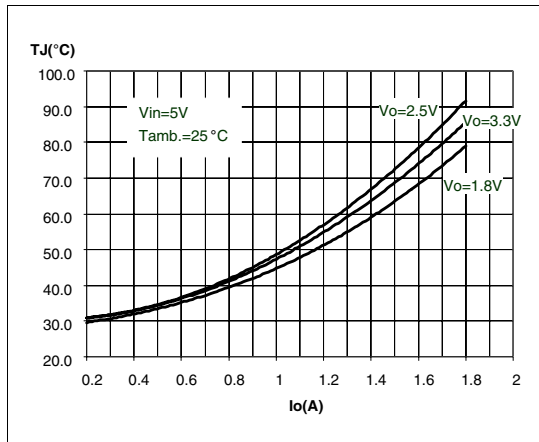


Figure 14. Efficiency vs output current

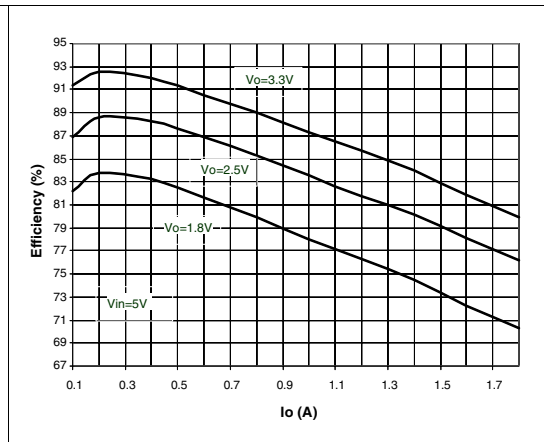


Figure 15. Junction temperature vs output current

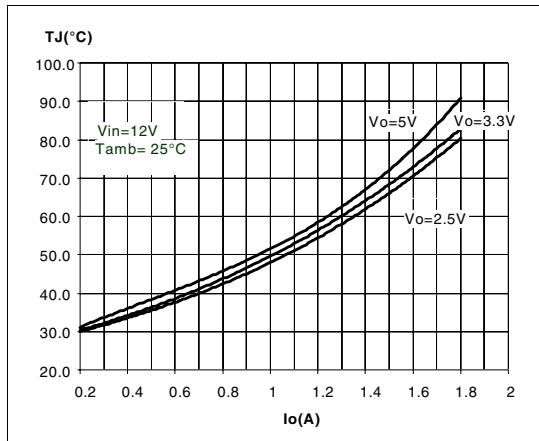
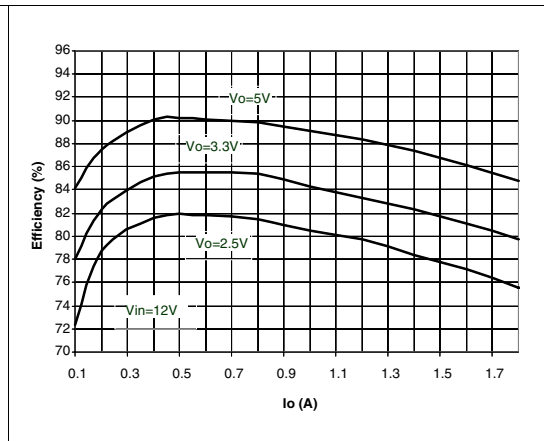


Figure 16. Efficiency vs output current



6 Application ideas

Figure 17. Positive buck-boost regulator

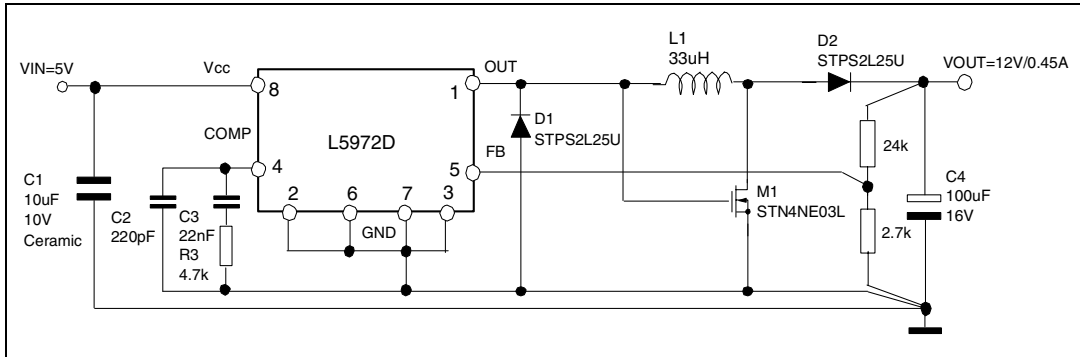


Figure 18. Buck-boost regulator

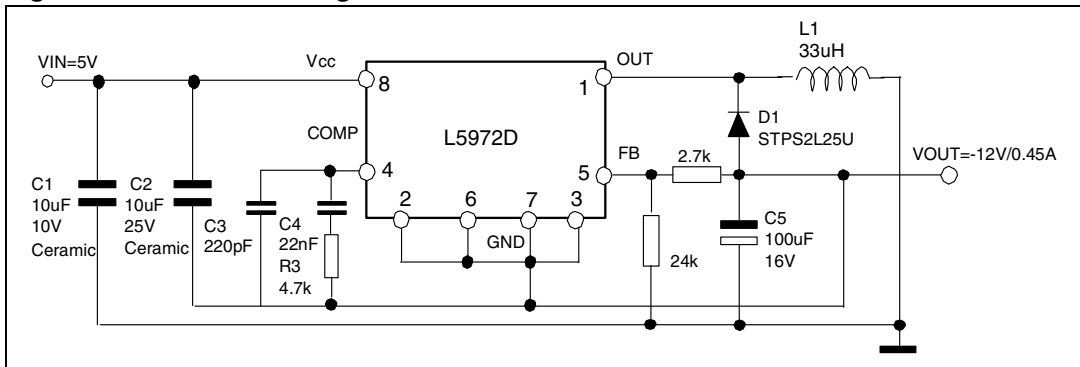
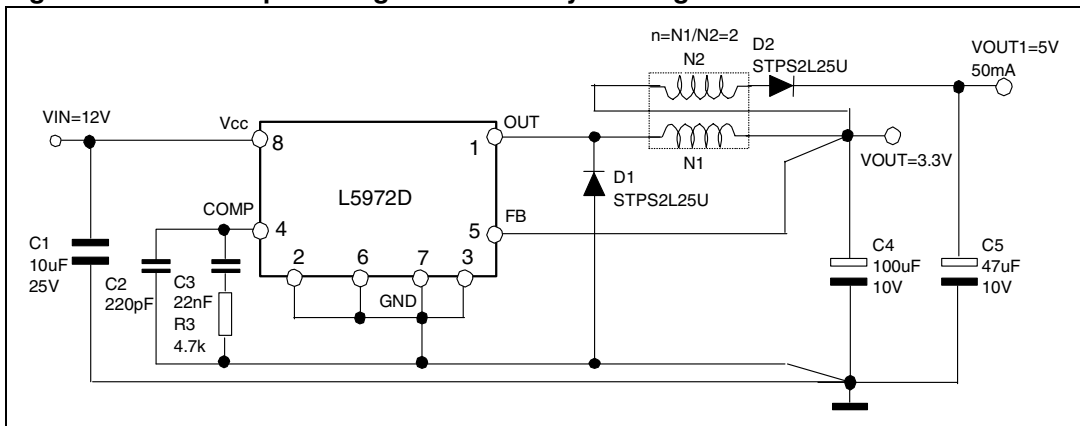


Figure 19. Dual output voltage with auxiliary winding



7 Package mechanical data

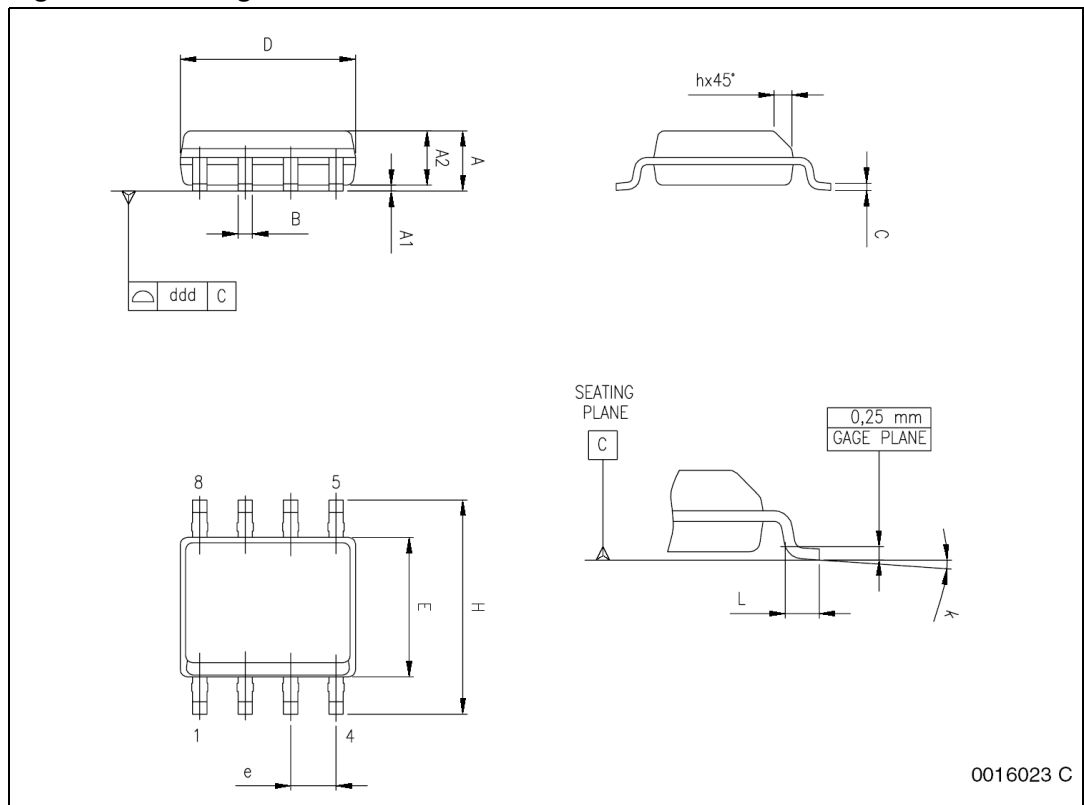
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Table 6. SO-8 Mechanical data

| 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 20. Package dimensions



8 Order codes

Table 7. Order codes

| Part number | Package | Packaging |
|--------------------|----------------|------------------|
| L5972D | SO8 | Tube |
| L5972D013TR | SO8 | Tape and reel |

9 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 02-Feb-2007 | 8 | Updated Table 5 on page 7 |
| 10-Apr-2007 | 9 | Mechanical data typo |
| 16-Oct-2007 | 10 | Updated Section 5: Application circuit on page 7 |

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