



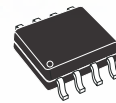
## L5972D

### 2A SWITCH STEP DOWN SWITCHING REGULATOR

- 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: CHARGERS, CAR BATTERY DC-DC CONVERTERS



SO8 (4+2+2)

ORDERING NUMBERS: L5972D (SO8)

L5972D013TR (Tape & Reel)

#### 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.

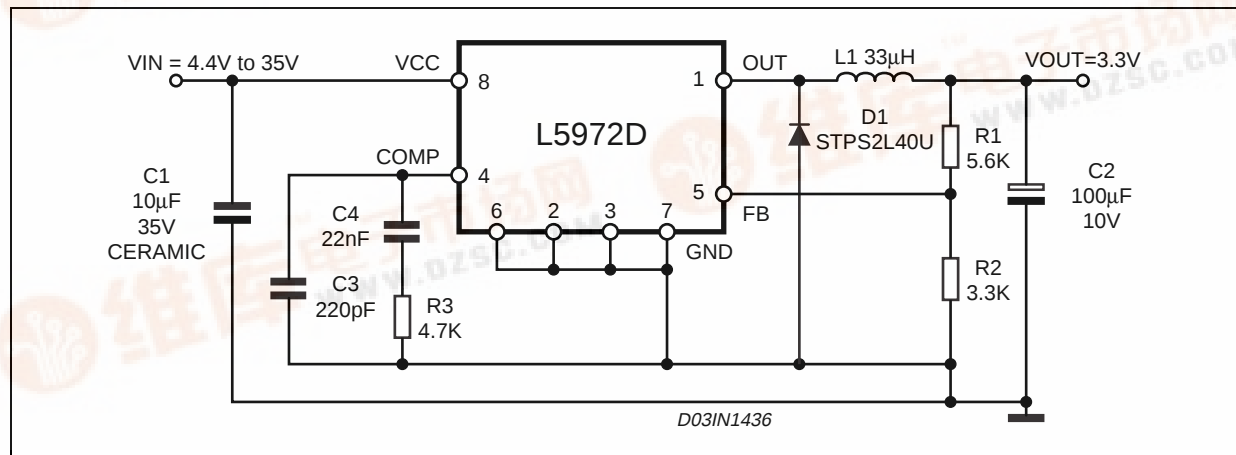
The device uses an internal P-Channel D-MOS transistor (with a typical  $R_{ds(on)}$  of 250m $\Omega$ ) as switching element to minimize the size of the external components.

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.

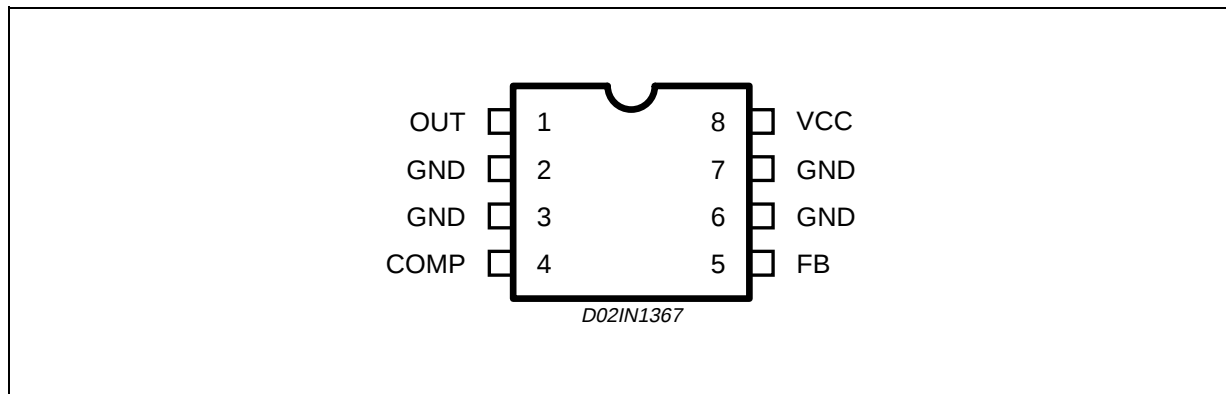
Pulse by pulse current limit with the internal frequency modulation offers an effective constant current short circuit protection.

#### TEST APPLICATION CIRCUIT



## L5972D

### PIN CONNECTION



### PIN DESCRIPTION

| N°      | Pin  | Function                                                                                                                                                     |
|---------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                                                                                                                |

### THERMAL DATA

| Symbol                  | Parameter                                      | Value  | Unit |
|-------------------------|------------------------------------------------|--------|------|
| R <sub>th (j-amb)</sub> | Thermal Resistance Junction to ambient<br>Max. | 65 (*) | °C/W |

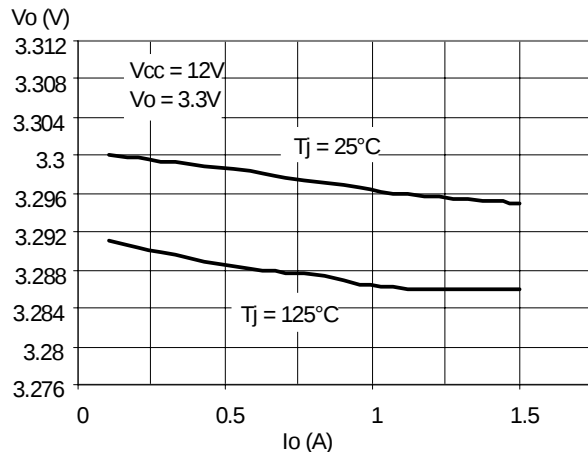
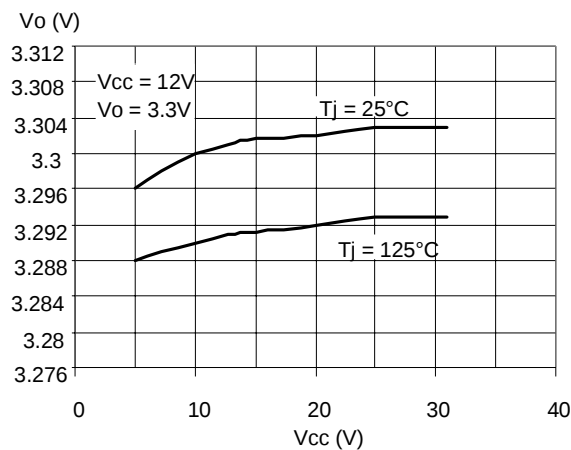
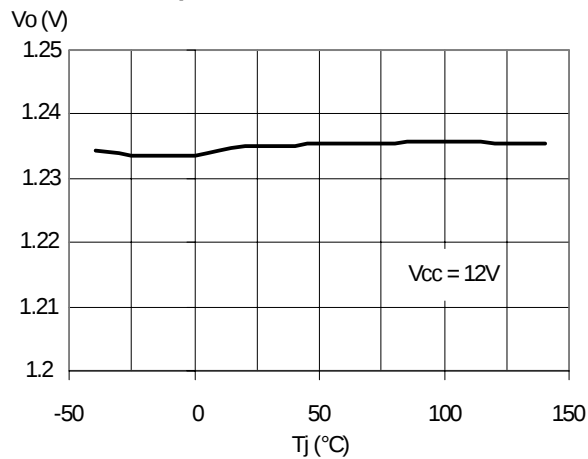
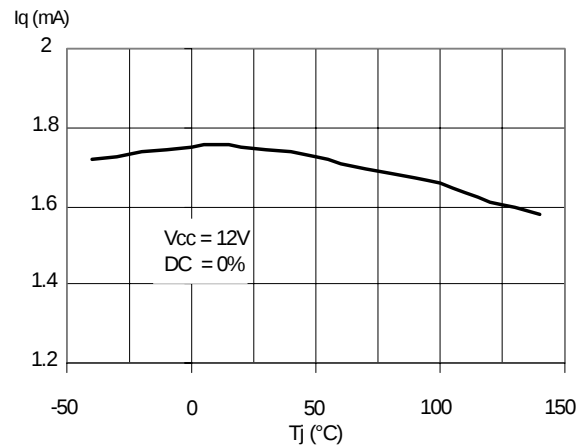
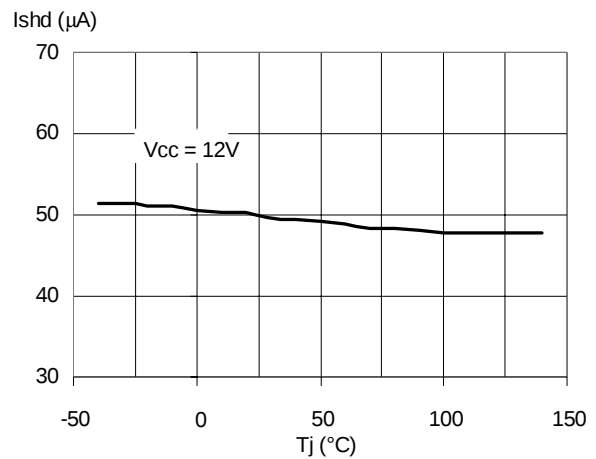
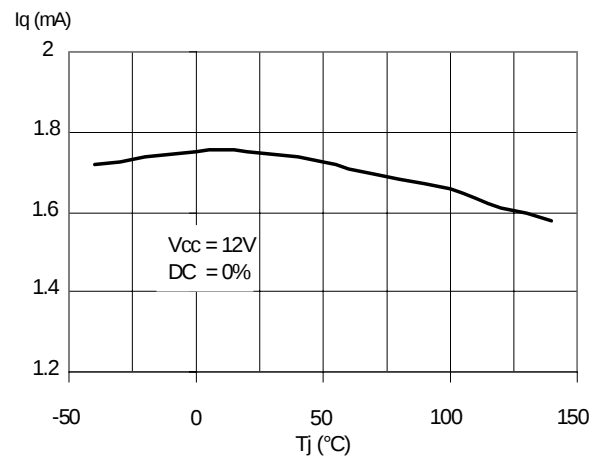
(\*) Package mounted on board (4cm<sup>2</sup> ground-plane)

### ABSOLUTE MAXIMUM RATINGS

| Symbol                          | Parameter                                                           | Value                | Unit   |
|---------------------------------|---------------------------------------------------------------------|----------------------|--------|
| V <sub>8</sub>                  | Input Voltage                                                       | 40                   | V      |
| V <sub>1</sub>                  | Out pin DC voltage<br>Out pin peak voltage at $\Delta t = 0.1\mu s$ | -1 to 40<br>-5 to 40 | V<br>V |
| I <sub>1</sub>                  | Maximum output current                                              | int. limit.          |        |
| V <sub>4</sub> , V <sub>5</sub> | Analog pins                                                         | 4                    | V      |
| P <sub>tot</sub>                | Power dissipation at T <sub>amb</sub> ≤ 70°C                        | 1.2                  | W      |
| T <sub>j</sub>                  | Operating junction temperature range                                | -40 to 150           | °C     |
| T <sub>stg</sub>                | Storage temperature range                                           | -55 to 150           | °C     |

**ELECTRICAL CHARACTERISTICS** ( $T_j = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$ , unless otherwise specified.)(\*) Specification Referred to  $T_j$  from  $-40$  to  $125^\circ\text{C}$ .

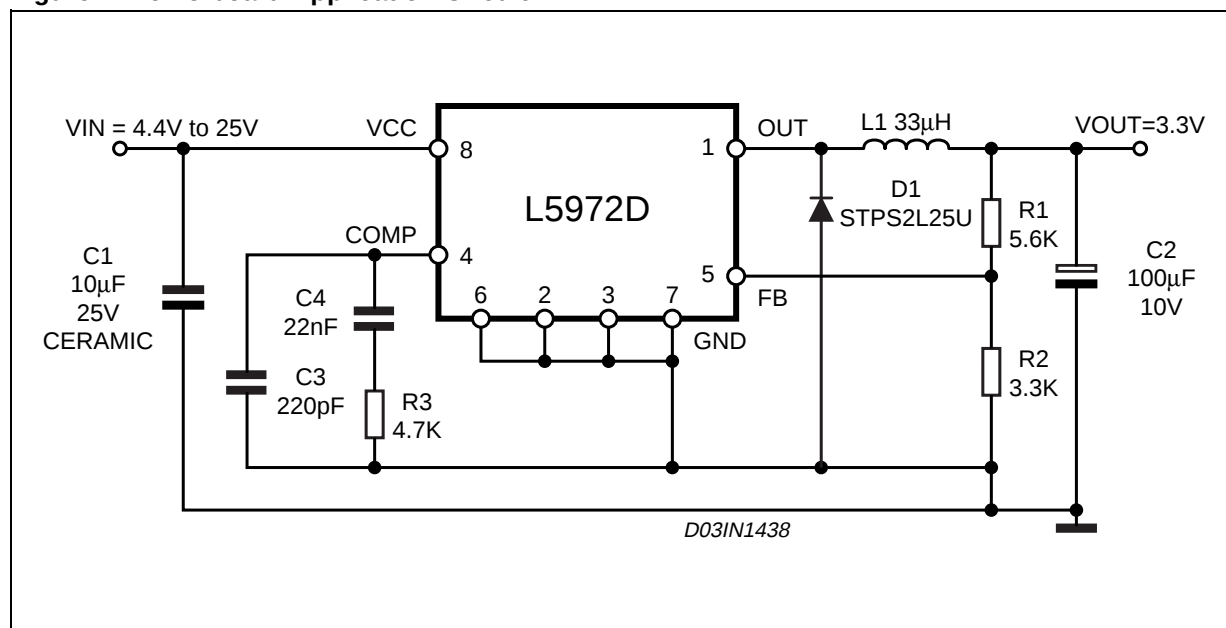
| Symbol                                              | Parameter                         | Test Condition                                                             |   | Min.  | Typ.  | Max.  | Unit          |
|-----------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------|---|-------|-------|-------|---------------|
| $V_{CC}$                                            | Operating input voltage range     | $V_O = 1.235\text{V}$ ; $I_O = 1.5\text{A}$                                | * | 4.4   |       | 36    | V             |
| $V_d$                                               | Dropout voltage                   | $V_{CC} = 4.4\text{V}$ ; $I_O = 1.5\text{A}$                               | * |       | 0.375 | 0.75  | V             |
| $I_l$                                               | Maximum limiting current          | $V_{CC} = 4.4\text{V}$ to $36\text{V}$                                     | * | 2     | 2.5   | 3     | A             |
| $f_s$                                               | Switching frequency               |                                                                            | * | 212   | 250   | 280   | KHz           |
|                                                     |                                   |                                                                            |   | 225   | 250   | 275   | KHz           |
|                                                     | Duty cycle                        |                                                                            |   | 0     |       | 100   | %             |
| <b>DYNAMIC CHARACTERISTICS</b> (see test circuit ). |                                   |                                                                            |   |       |       |       |               |
| $V_5$                                               | Voltage feedback                  | $4.4\text{V} < V_{CC} < 36\text{V}$ ,<br>$20\text{mA} < I_O < 1.5\text{A}$ |   | 1.220 | 1.235 | 1.25  | V             |
|                                                     |                                   |                                                                            | * | 1.198 | 1.235 | 1.272 | V             |
| $h$                                                 | Efficiency                        | $V_O = 5\text{V}$ , $V_{CC} = 12\text{V}$                                  |   |       | 90    |       | %             |
| <b>DC CHARACTERISTICS</b>                           |                                   |                                                                            |   |       |       |       |               |
| $I_{qop}$                                           | Total operating quiescent current |                                                                            | * |       | 3     | 5     | mA            |
| $I_q$                                               | Quiescent current                 | Duty Cycle = 0; $V_{FB} = 1.5\text{V}$                                     |   |       |       | 2.5   | mA            |
| <b>ERROR AMPLIFIER</b>                              |                                   |                                                                            |   |       |       |       |               |
| $V_{OH}$                                            | 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             |
| $I_{O\text{ source}}$                               | Source output current             | $V_{COMP} = 1.9\text{V}$ ; $V_{FB} = 1\text{V}$                            |   | 200   | 300   |       | $\mu\text{A}$ |
| $I_{O\text{ sink}}$                                 | 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     | $\mu\text{A}$ |
|                                                     | DC open loop gain                 | $R_L = \infty$                                                             |   | 50    | 65    |       | dB            |
| $g_m$                                               | Transconductance                  | $I_{comp} = -0.1\text{mA}$ to $0.1\text{mA}$<br>$V_{COMP} = 1.9\text{V}$   |   |       | 2.3   |       | mS            |

**Figure 1. Output Voltage vs. Junction Temperature****Figure 2. Line Regulation****Figure 3. Output Voltage vs. Junction Temperature****Figure 4. Quiescent Current vs. Junction Temperature****Figure 5. Shutdown Current vs. Junction Temperature****Figure 6. Switching Frequency vs. Junction Temperature**

### APPLICATION CIRCUIT

In figure 7 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 7. Demo board Application Circuit**



**Table 1. Component List**

| Reference | Part Number      | Description         | Manufacturer |
|-----------|------------------|---------------------|--------------|
| C1        |                  | 10µF, 25V           | TOKIN        |
| 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 8. PCB layout (component side)

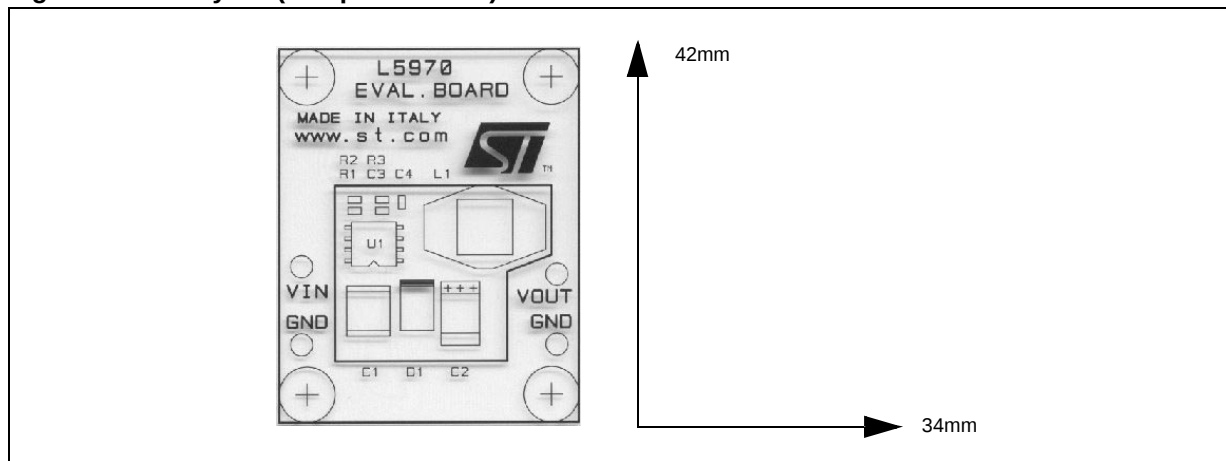


Figure 9. PCB layout (bottom side)

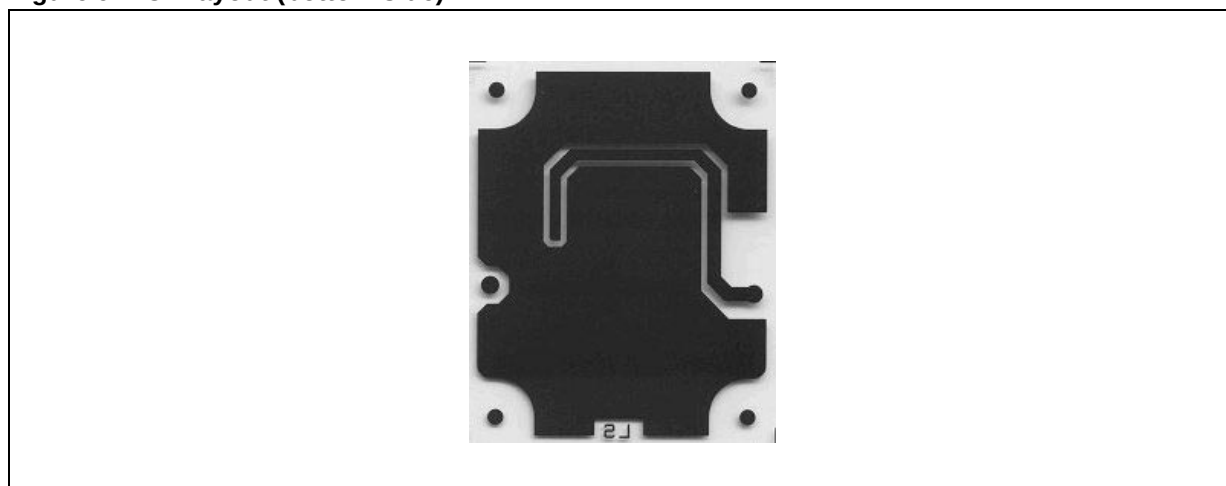
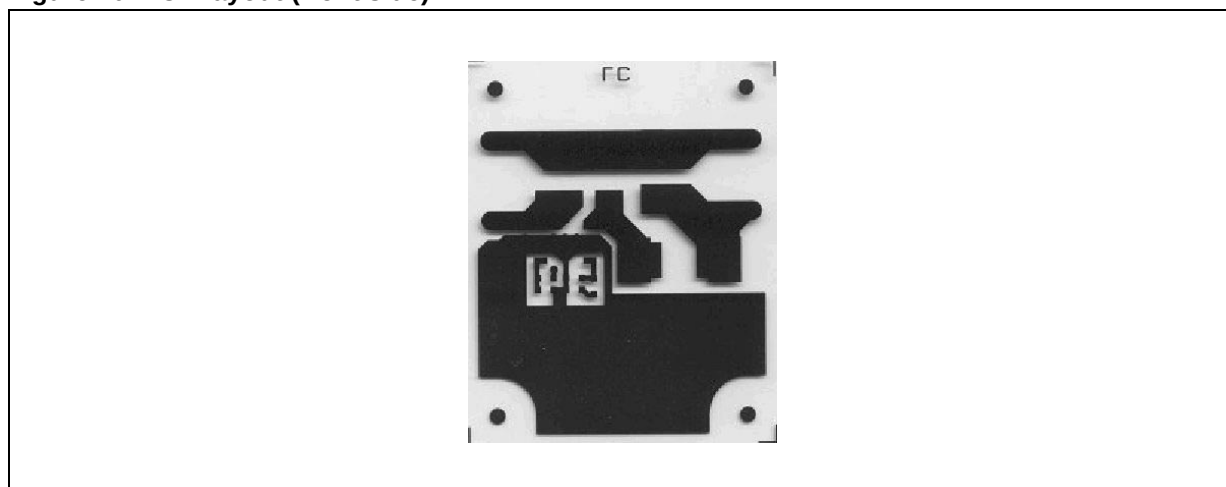
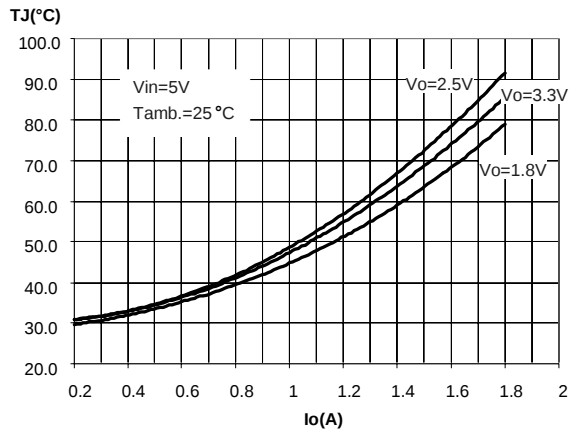


Figure 10. PCB layout (front side)

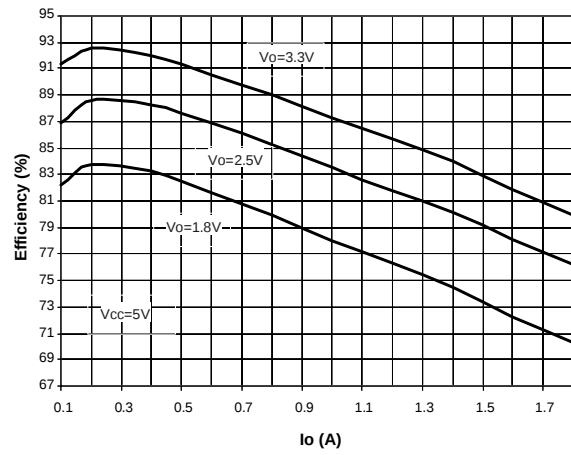


Sideways two graphs show the  $T_j$  versus output current in different conditions of the input and output voltage.

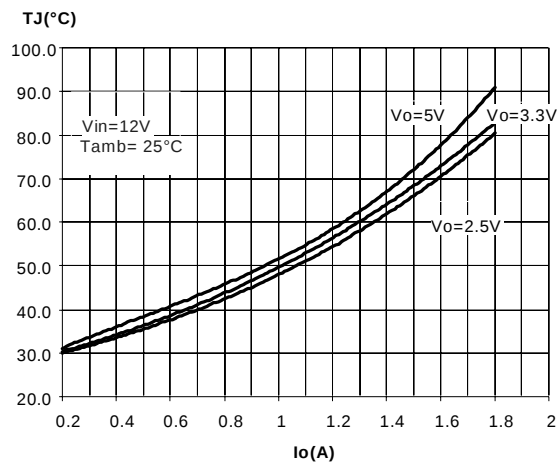
**Figure 11. Junction Temperature vs. Output Current**



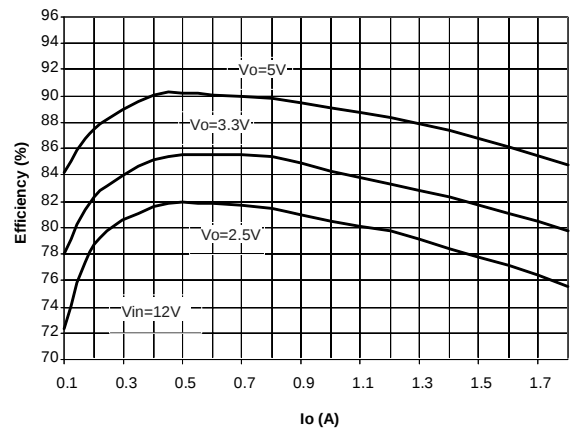
**Figure 13. Efficiency vs. Output Current**



**Figure 12. Junction Temperature vs. Output Current**



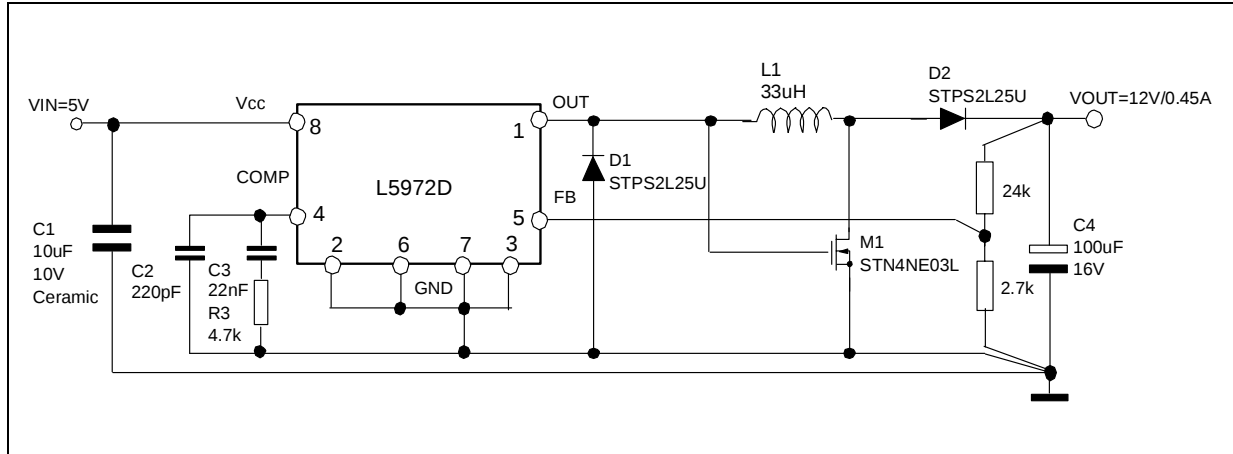
**Figure 14. Efficiency vs. Output Current**



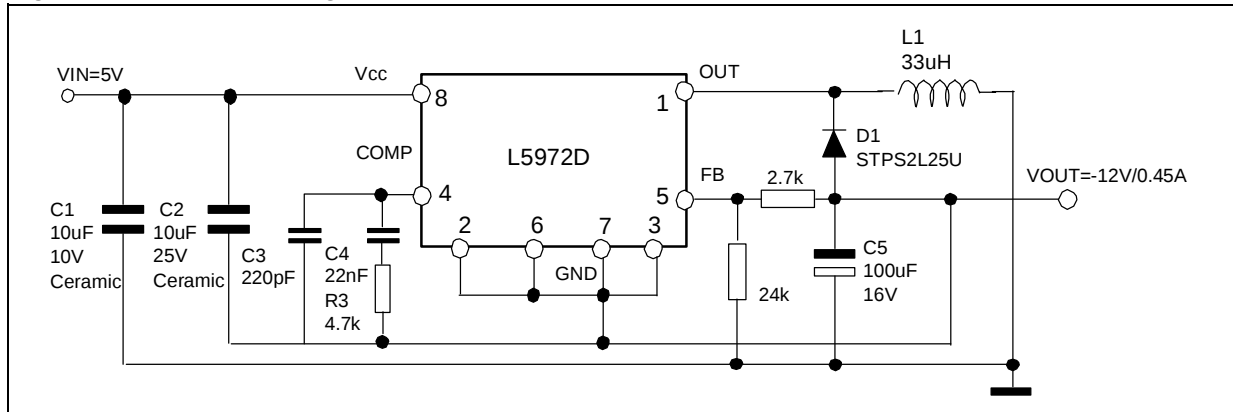
## L5972D

### APPLICATION IDEAS

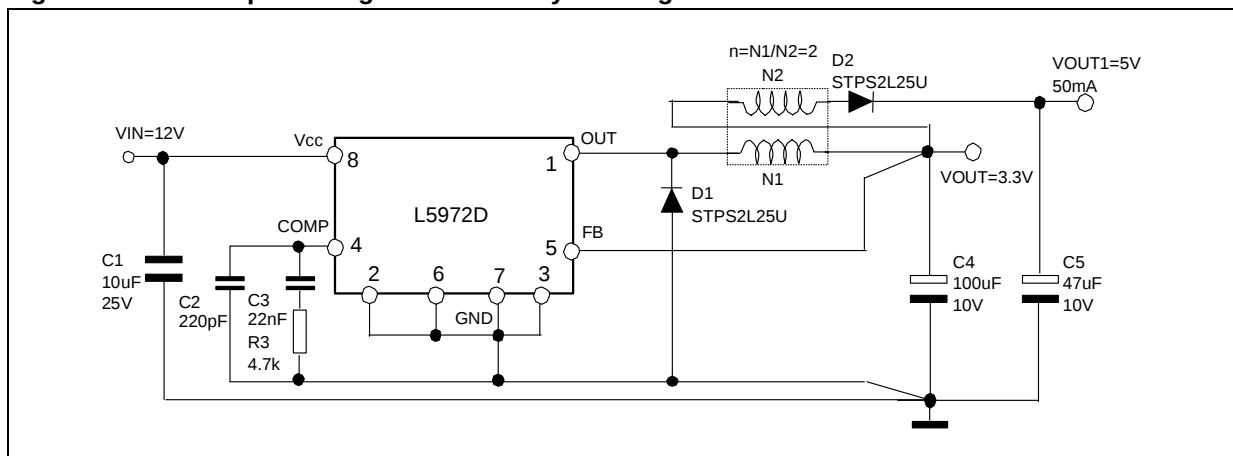
**Figure 15. Positive Buck-Boost regulator**



**Figure 16. Buck-Boost regulator**



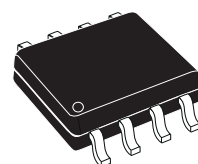
**Figure 17. Dual output voltage with auxiliary winding**



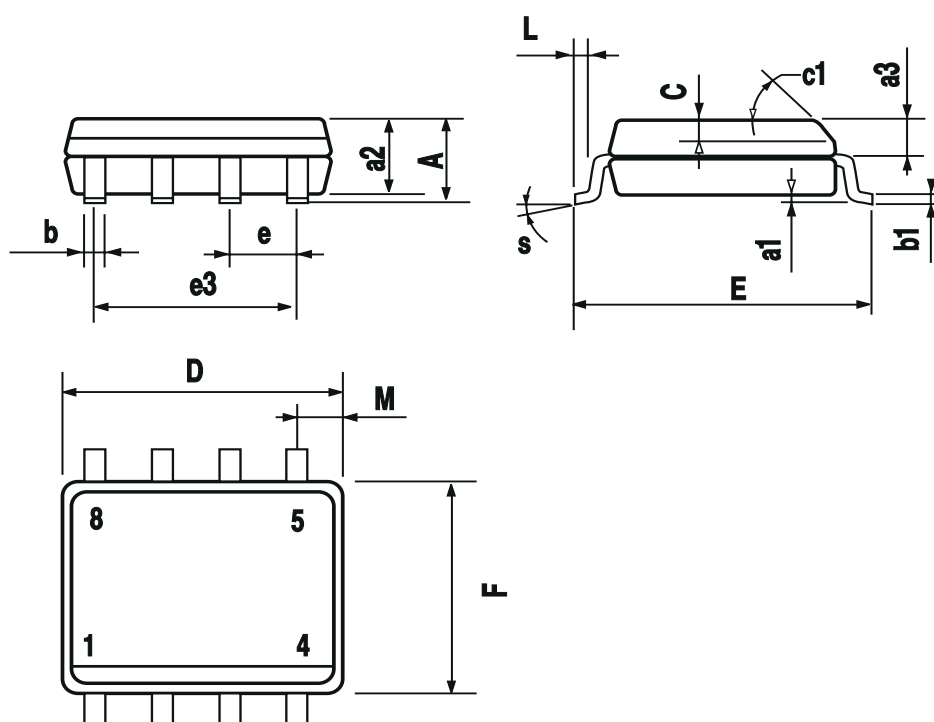
| DIM.  | mm         |      |      | inch  |       |       |
|-------|------------|------|------|-------|-------|-------|
|       | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A     |            |      | 1.75 |       |       | 0.069 |
| a1    | 0.1        |      | 0.25 | 0.004 |       | 0.010 |
| a2    |            |      | 1.65 |       |       | 0.065 |
| a3    | 0.65       |      | 0.85 | 0.026 |       | 0.033 |
| b     | 0.35       |      | 0.48 | 0.014 |       | 0.019 |
| b1    | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C     | 0.25       |      | 0.5  | 0.010 |       | 0.020 |
| c1    | 45° (typ.) |      |      |       |       |       |
| D (1) | 4.8        |      | 5.0  | 0.189 |       | 0.197 |
| E     | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e     |            | 1.27 |      |       | 0.050 |       |
| e3    |            | 3.81 |      |       | 0.150 |       |
| F (1) | 3.8        |      | 4.0  | 0.15  |       | 0.157 |
| L     | 0.4        |      | 1.27 | 0.016 |       | 0.050 |
| M     |            |      | 0.6  |       |       | 0.024 |
| S     | 8° (max.)  |      |      |       |       |       |

(1) D and F do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (.006inch).

## OUTLINE AND MECHANICAL DATA



**SO8**



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