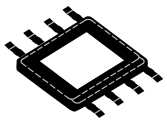
# L5973D

## 2.5 A switch step down switching regulator

**Datasheet - production data**



**HSOP8 exposed pad**

## Features

- 2.5 A internal switch
- Operating input voltage from 4 V to 36 V
- 3.3 V / (±2%) reference voltage
- Output voltage adjustable from 1.235 V to 35 V
- Low dropout operation: 100% duty cycle
- 250 kHz internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Internal current limiting
- Inhibit for zero current consumption
- Synchronization
- Protection against feedback disconnection
- Thermal shutdown

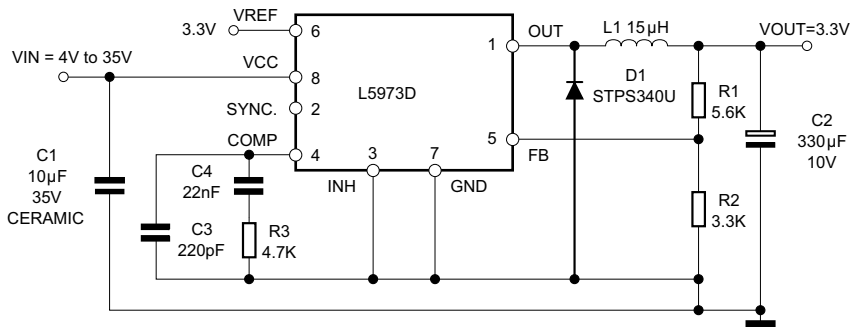
## Applications

- 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 L5973D is a step down monolithic power switching regulator with a minimum switch current limit of 2.5 A so it is able to deliver more than 2 A DC current to the load depending on the application conditions.
The output voltage can be set from 1.235 V to 35 V. The high current level is also achieved thanks to an SO8 package with exposed frame, that allows to reduce the Rth(j-amb) down to approximately 40°C/W.
The device uses an internal P-channel D-MOS transistor (with a typical Rdson of 250 mΩ) as switching element to minimize the size of the external components.
An internal oscillator fixes the switching frequency at 250 kHz.
Having a minimum input voltage of 4 V only, it is particularly suitable for 5 V 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**






This is information on a product in full production. www.st.com

# 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** . . . . . 7

5 **Application circuit** . . . . . 9

6 **Application ideas** . . . . . 11

7 **Package information** . . . . . 13

8 **HSOP8 package mechanical data** . . . . . 14

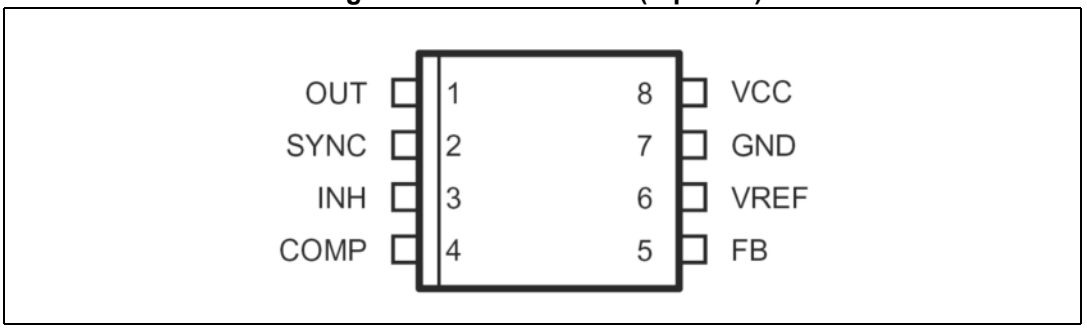
9 **Order code** . . . . . 15

10 **Revision history** . . . . . 16

# 1 Pin settings

## 1.1 Pin connection

**Figure 2. Pin connection (top view)**




## 1.2 Pin description

**Table 1. Pin description**

| N° | Type | Description |
|---|---|---|
| 1 | OUT | Regulator output. |
| 2 | SYNC | Master/slave synchronization. |
| 3 | INH | A logical signal (active high) disables the device. If INH not used the pin must be grounded. When it is open an internal pull-up disable the device. |
| 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. |
| 6 | VREF | 3.3 V $V_{REF}$. No cap is requested for stability. |
| 7 | GND | Ground. |
| 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 |
| $V_1$ | Output DC voltage<br>Output peak voltage at t = 0.1µs | -1 to 40<br>-5 to 40 | V<br>V |
| $I_1$ | Maximum output current | int. limit. | |
| $V_4$, $V_5$ | Analog pins | 4 | V |
| $V_3$ | INH | -0.3 V to $V_{CC}$ | |
| $V_2$ | SYNC | -0.3 to 4 | V |
| $P_{TOT}$ | Power dissipation at $T_A \leq 60°C$ | 2.25 | W |
| $T_J$ | Operating junction temperature range | -40 to 150 | °C |
| $T_{STG}$ | Storage temperature range | -55 to 150 | °C |

## 2.2 Thermal data

**Table 3. Thermal data**

| Symbol | Parameter | HSOP8 Exposed Pad | Unit |
|---|---|---|---|
| $R_{thJA}$ | Maximum thermal resistance junction-ambient | 40 (1) | °C/W |

1. Package mounted on board

# 3 Electrical characteristics

**Table 4. Electrical characteristics ( $T_J$ = 25 °C, $V_{CC}$ = 12 V, unless otherwise specified)**

| Symbol | Parameter | Test condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CC}$ | Operating input voltage range | $V_o$ = 1.235 V; $I_o$ = 2 A | (1) | 4 | | 36 | V |
| $R_{DS(on)}$ | Mosfet on Resistance | | (1) | | 0.250 | 0.5 | Ω |
| $I_l$ | Maximum limiting current | $V_{CC}$ = 4.4 V to 36 V | | 2.5 | 3 | 3.5 | 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 V V < $V_{CC}$ < 36 V, 20 mA < $I_O$ < 2 A | | 1.220 | 1.235 | 1.25 | V |
| | | | (1) | 1.198 | 1.235 | 1.272 | V |
| h | Efficiency | $V_O$ = 5 V, $V_{CC}$ = 12 | | | 90 | | % |
| **DC characteristics** | | | | | | | |
| $I_{qop}$ | Total operating quiescent current | | (1) | | 3 | 5 | mA |
| $I_q$ | Quiescent current | Duty Cycle = 0; $V_{FB}$ = 1.5 V | | | | 2.5 | mA |
| $I_{qst-by}$ | Total stand-by quiescent current | $V_{inh}$ > 2.2 V | (1) | | 50 | 100 | µA |
| | | $V_{CC}$ = 36 V; $V_{inh}$ > 2.2 V | (1) | | 80 | 150 | µA |
| **Inhibit** | | | | | | | |
| | INH threshold voltage | Device ON | | | | 0.8 | V |
| | | Device OFF | | 2.2 | | | V |
| **Error amplfier** | | | | | | | |
| $V_{OH}$ | High level output voltage | VFB = 1 V | | 3.5 | | | V |
| $V_{OL}$ | Low level output voltage | VFB = 1.5 V | | | | 0.4 | V |
| $I_{o\ source}$ | Source output current | $V_{COMP}$ = 1.9 V; $V_{FB}$ = 1 V | | 200 | 300 | | µA |
| $I_{o\ sink}$ | 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 | µA |
| | DC open loop gain | $R_L$ = ∞ | | 50 | 57 | | dB |
| gm | Transconductance | $I_{comp}$ = -0.1 mA to 0.1 mA $V_{COMP}$ = 1.9 V | | | 2.3 | | mS |

**Table 4. Electrical characteristics (continued) ( $T_J$ = 25 °C, $V_{CC}$ = 12 V, unless otherwise specified)**

| Symbol | Parameter | Test condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Sync function** | | | | | | | |
| | High input voltage | $V_{CC}$ = 4.4 V to 36 V | | 2.5 | | $V_{REF}$ | V |
| | Low input voltage | $V_{CC}$ = 4.4 V to 36 V | | | | 0.74 | V |
| | Slave sink current | $V_{sync}$ = 0.74 V (2)<br>$V_{sync}$ = 2.33 V | | 0.11<br>0.21 | | 0.25<br>0.45 | mA<br>mA |
| | Master output amplitude | $I_{source}$ = 3 mA | | 2.75 | 3 | | V |
| | Output pulse width | no load, $V_{sync}$=1.65 V | | 0.20 | 0.35 | | µs |
| **Reference section** | | | | | | | |
| | Reference voltage | | | 3.234 | 3.3 | 3.366 | V |
| | | $I_{REF}$ = 0 mA<br>$V_{CC}$ = 4.4 V to 36 V | (1) | 3.2 | 3.3 | 3.399 | V |
| | Line regulation | $I_{REF}$ = 0 mA<br>$V_{CC}$ = 4.4 V to 36V | | | 5 | 10 | mV |
| | Load regulation | $I_{REF}$ = 0 to 5 mA | | | 8 | 15 | mV |
| | Short circuit current | | | 10 | 18 | 30 | 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.
2. Guaranteed by design.

# 4 Typical characteristics

**Figure 3. Line regulation**

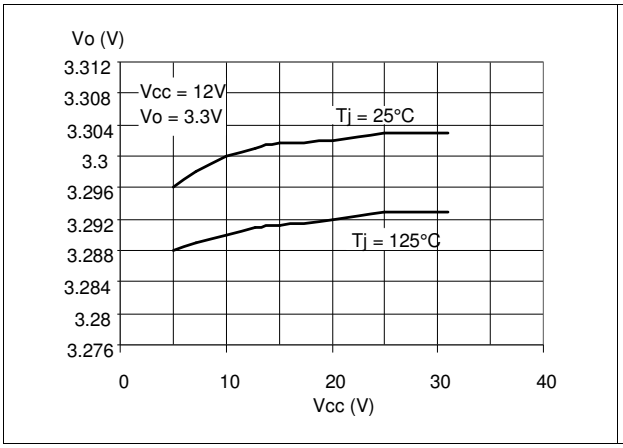



**Figure 4. Shutdown current vs junction temperature**

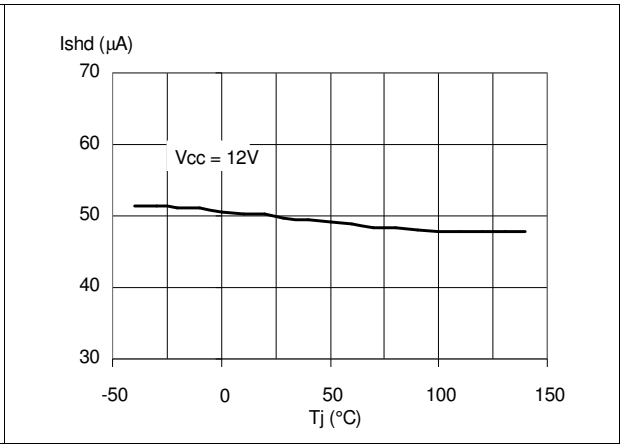



**Figure 5. Output voltage vs junction temperature**

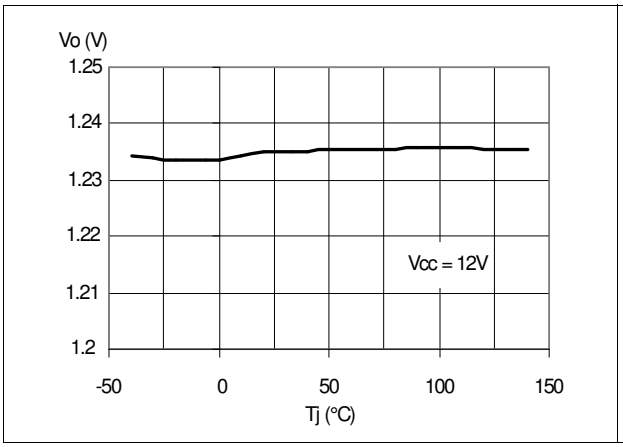



**Figure 6. Switching frequency vs junction temperature**

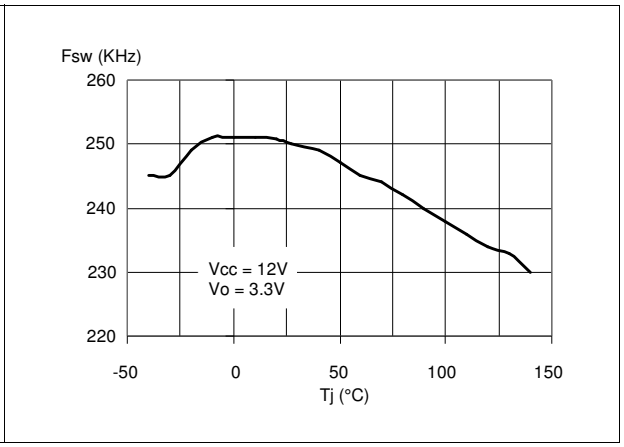



**Figure 7. Quiescent current vs junction temperature**

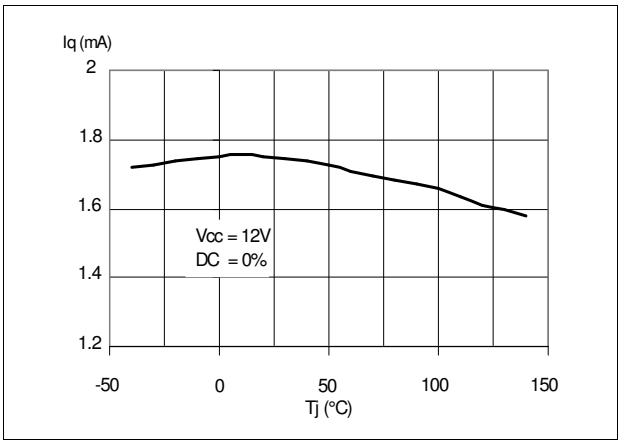


**Figure 8. Junction temperature vs output current**

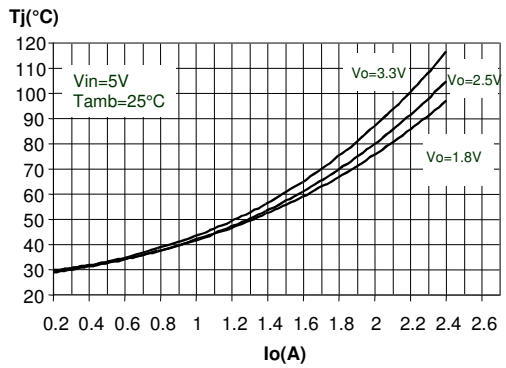



**Figure 9. Junction temperature vs output current**

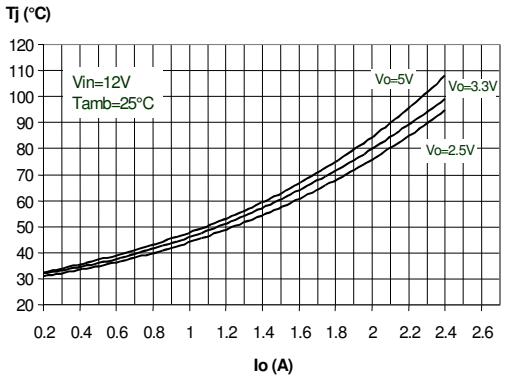



**Figure 10. Efficiency vs output current**

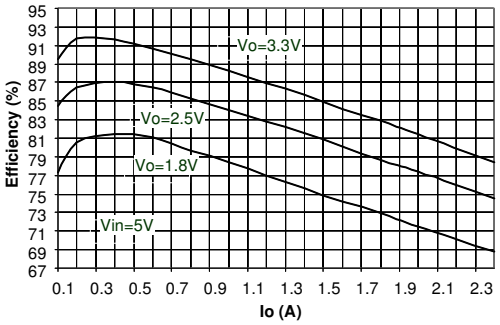
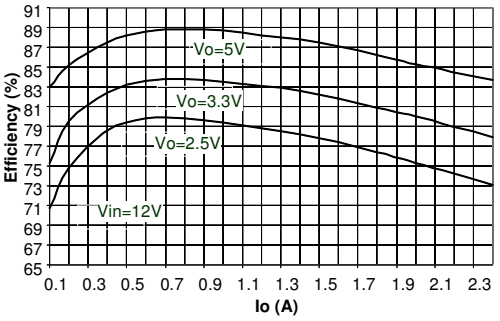



**Figure 11. Efficiency vs output current**



# 5 Application circuit

In figure 6 is shown the demonstration board application circuit, where the input supply voltage, $V_{CC}$, can range from 4 V to 25 V due to the rated voltage of the input capacitor and the output voltage is adjustable from 1.235 V to $V_{CC}$.

**Figure 12. Demonstration board application circuit**

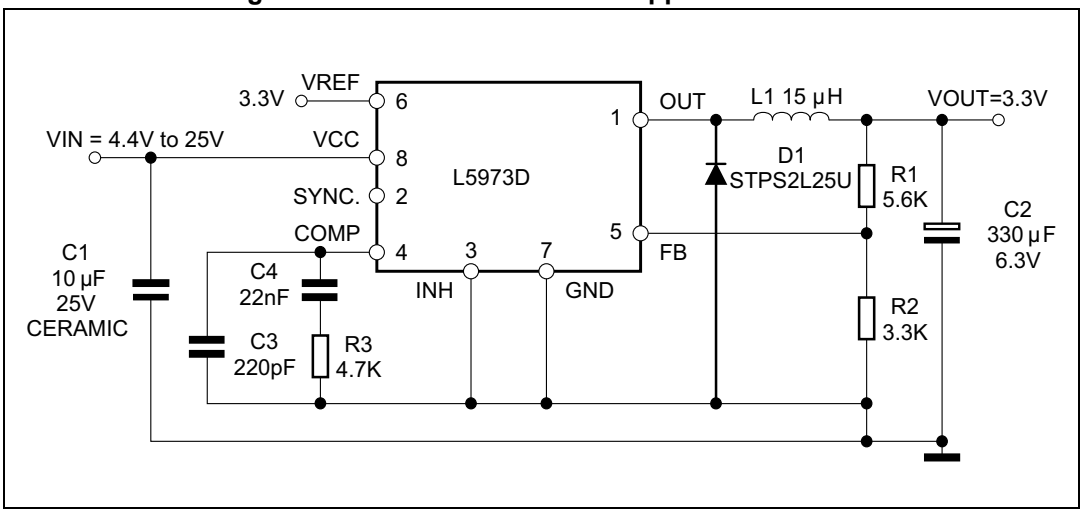



**Table 5. Component list**

| Reference | Part number | Description | Manufacturer |
|---|---|---|---|
| C1 | GRM32DR61E106KA12L | 10µF, 25V | Murata |
| C2 | POSCAP 6TPB330M | 330µF, 6.3V | 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-153 | 15µH, 3A | COILCRAFT |

Figure 13. PCB layout (component side)

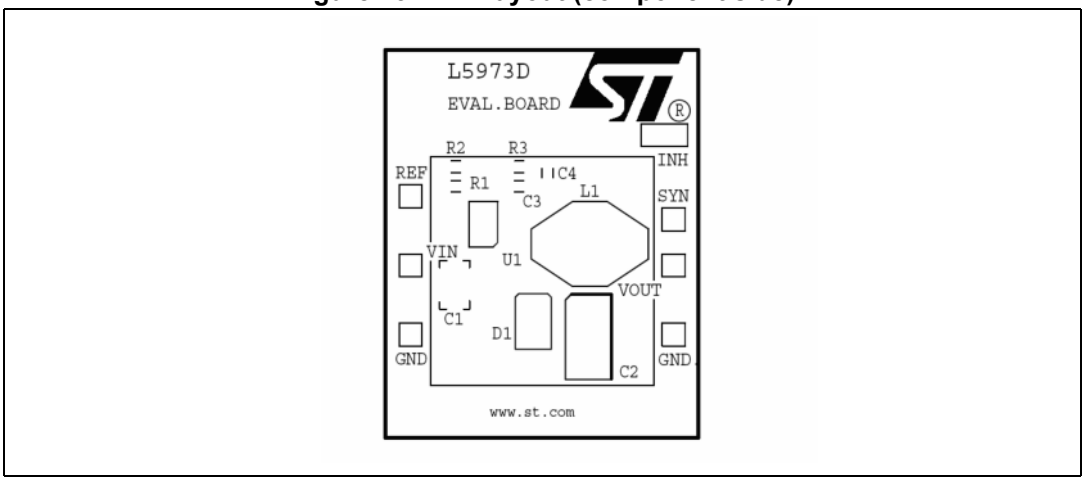



Figure 14. PCB layout (bottom side)

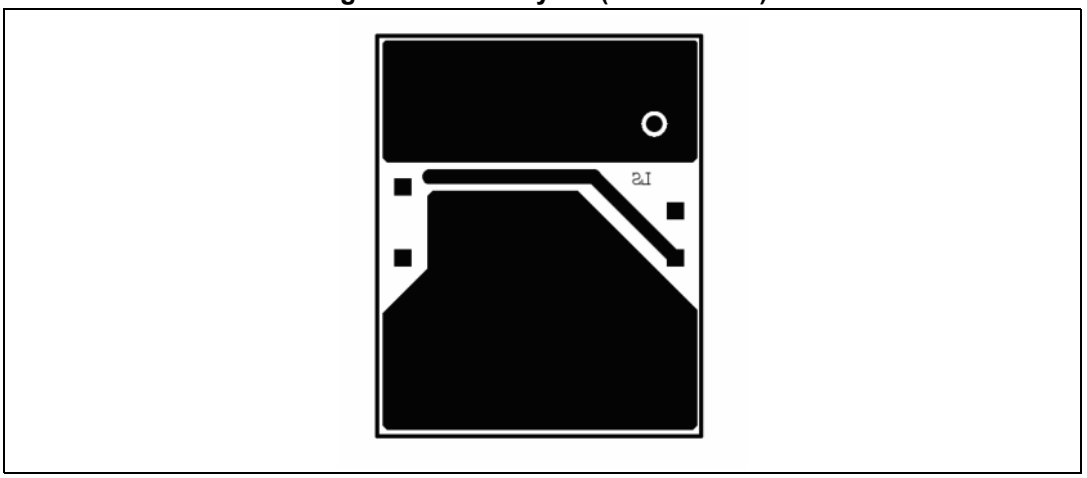
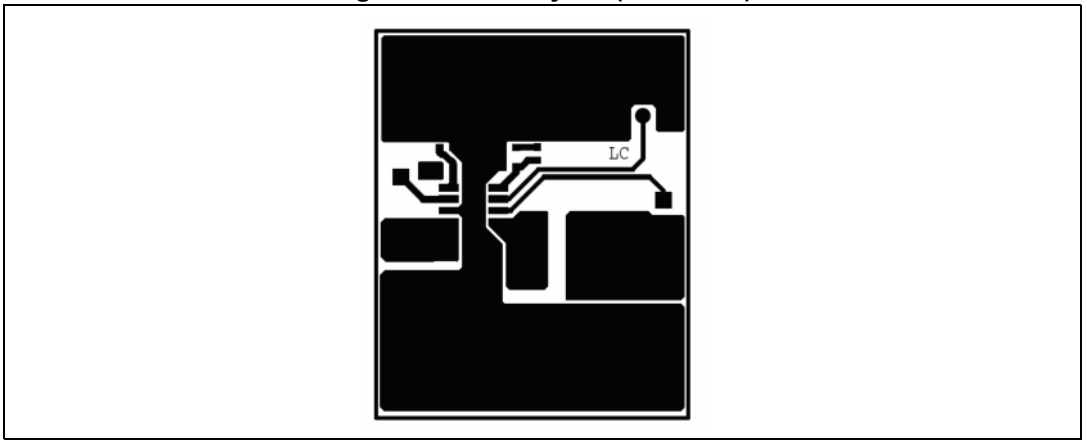


Figure 15. PCB layout (front side)




Below some graphs show the $T_J$ versus output current in different conditions of the input and output voltage and some efficiency measurements.

# 6 Application ideas

Figure 16. Positive buck-boost regulator

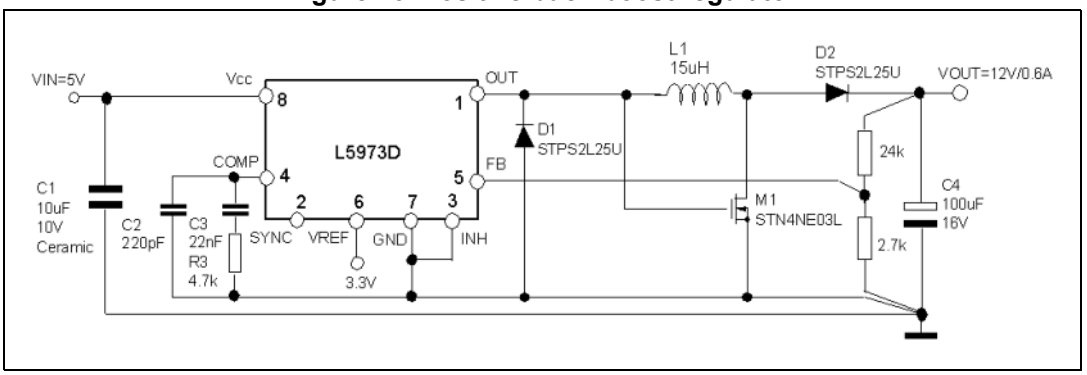



Figure 17. Buck-boost regulator

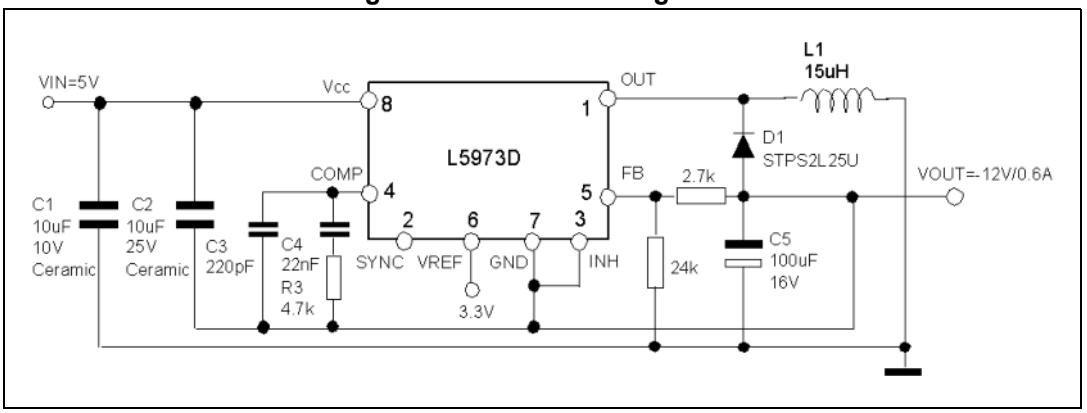
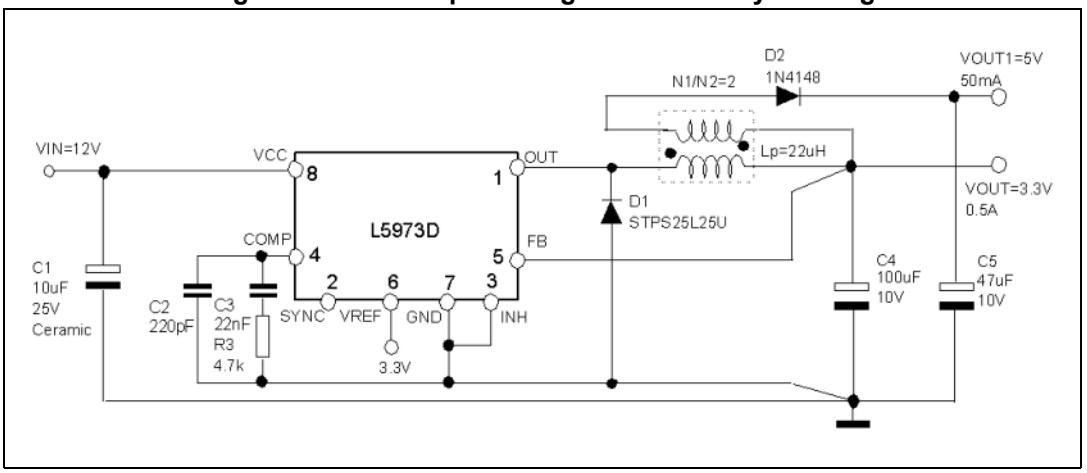



Figure 18. Dual output voltage with auxiliary winding



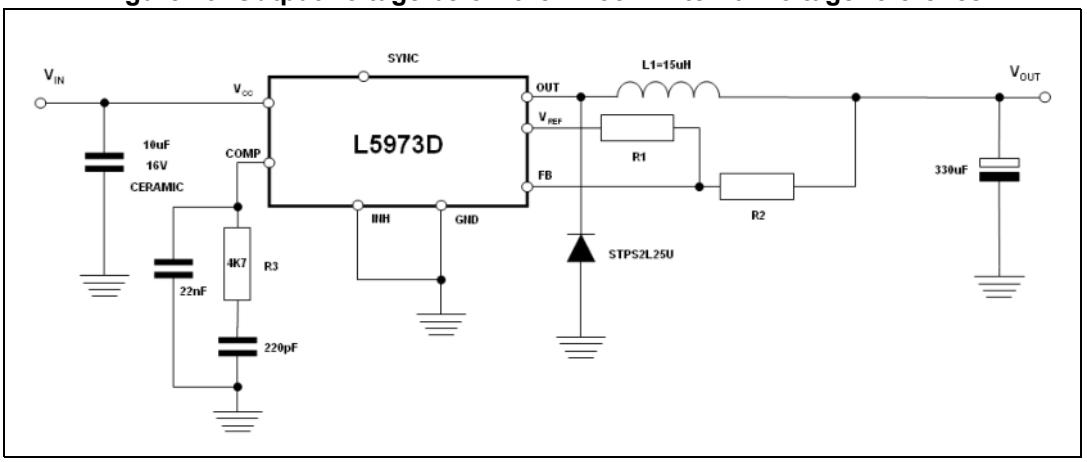
When an output voltage below the internal reference (1.235V) is required, the circuit reported in the *Figure 19* can been used. In this case the minimum voltage reachable is 0.6 V and can be easily calculated with the following formula:

$V_{OUT} = V_{FB} - [(V_{REF} - V_{FB})x(R_2 / R_1)]$

If the load is not present, a resistor connected between $V_{OUT}$ and GND is required in order to avoid that the voltage across $C_{OUT}$ increases.

The value of this resistor has to be calculated taking into account that the current flowing through this resistance has to be higher than the current flowing through $R_2$.

**Figure 19. Output voltage below the 1.235 V internal voltage reference**



# 7 Package information

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.

# 8 HSOP8 package mechanical data

**Figure 20. Package dimensions**

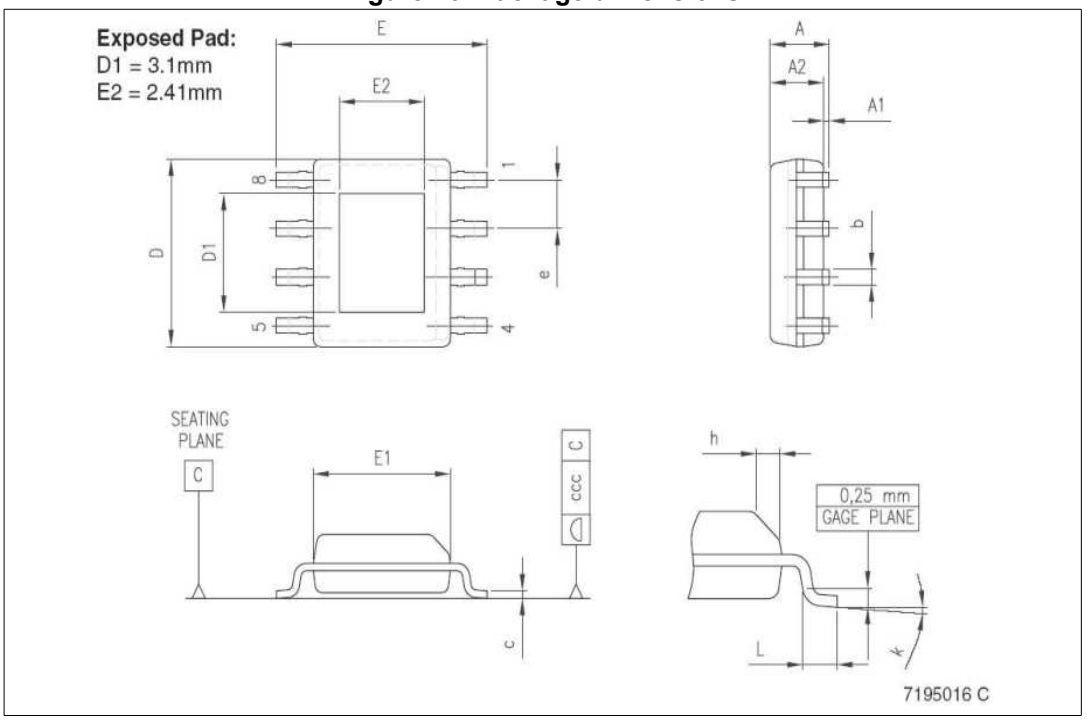



**Table 6. HSOP8 mechanical data**

| Dim | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | Min | Typ | Max | Min | Typ | Max |
| A | | | 1.70 | | | 0.0669 |
| A1 | 0.00 | | 0.10 | | 0.00 | 0.0039 |
| A2 | 1.25 | | | 0.0492 | | |
| b | 0.31 | | 0.51 | 0.0122 | | 0.0201 |
| c | 0.17 | | 0.25 | 0.0067 | | 0.0098 |
| D | 4.80 | 4.90 | 5.00 | 0.1890 | 0.1929 | 0.1969 |
| D1 | 3 | 3.1 | 3.2 | 0.118 | 0.122 | 0.126 |
| E | 5.80 | 6.00 | 6.20 | 0.2283 | | 0.2441 |
| E1 | 3.80 | 3.90 | 4.00 | 0.1496 | | 0.1575 |
| E2 | 2.31 | 2.41 | 2.51 | 0.091 | 0.095 | 0.099 |
| e | | 1.27 | | | | |
| h | 0.25 | | 0.50 | 0.0098 | | 0.0197 |
| L | 0.40 | | 1.27 | 0.0157 | | 0.0500 |
| k | 0° (min), 8° (max) | | | | | |
| ccc | | | 0.10 | | | 0.0039 |

# 9 Order code

Table 7. Order code

| Part number | Package | Packaging |
|---|---|---|
| L5973D | HSOP8 (Exposed pad) | Tube |
| L5973D013TR | HSOP8 (Exposed pad) | Tape and reel |

# 10 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|---|---|---|
| 01-Nov-2005 | 10 | Updated package information |
| 22-May-2006 | 11 | Electrical characteristic Table 4 updated, new application idea Figure 19 added, new template |
| 13-Nov-2006 | 12 | Typo in order codes |
| 26-Jan-2007 | 13 | Updated Table 4 on page 5 |
| 17-Oct-2007 | 14 | Updated Section 5: Application circuit on page 9 |
| 24-Oct-2007 | 15 | Updated Table 6 on page 14 |
| 07-Jan-2008 | 16 | Updated Table 6 on page 14 |
| 17-Sep-2025 | 17 | Updated $I_{REF}$ test condition reference section in *Table 4* |

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST

products and/or to this document at any time without notice.

In the event of any conflict between the provisions of this document and the provisions of any contractual arrangement in force between the purchasers and

ST, the provisions of such contractual arrangement shall prevail.

The purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and

conditions of sale in place at the time of order acknowledgment.

The purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of

the purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

If the purchasers identify an ST product that meets their functional and performance requirements but that is not designated for the purchasers' market

segment, the purchasers shall contact ST for more information..

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, please refer to *www.st.com/trademarks*. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2025 STMicroelectronics – All rights reserved