

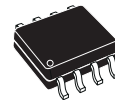


## 2.5A SWITCH STEP DOWN SWITCHING REGULATOR

- 2.5A INTERNAL SWITCH
- OPERATING INPUT VOLTAGE FROM 4.4V TO 36V
- 3.3V / ( $\pm 2\%$ ) REFERENCE VOLTAGE
- 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
- 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: CHARGERS, CAR BATTERY DC-DC CONVERTERS



**HSOP8 - EXPOSED PAD**  
**ORDERING NUMBERS: L5973D (Tube)**  
**L5973D013TR (T & R)**

### DESCRIPTION

The L5973D is a step down monolithic power switching regulator with a minimum switch current limit of 2.5A so it is able to deliver more than 2A DC current to the load depending on the application conditions. The output voltage can be set from 1.235V to 35V.

The high current level is also achieved thanks to an SO8 package with exposed frame, that allows to reduce the  $R_{th(j-amb)}$  down to approximately  $40^{\circ}\text{C/W}$

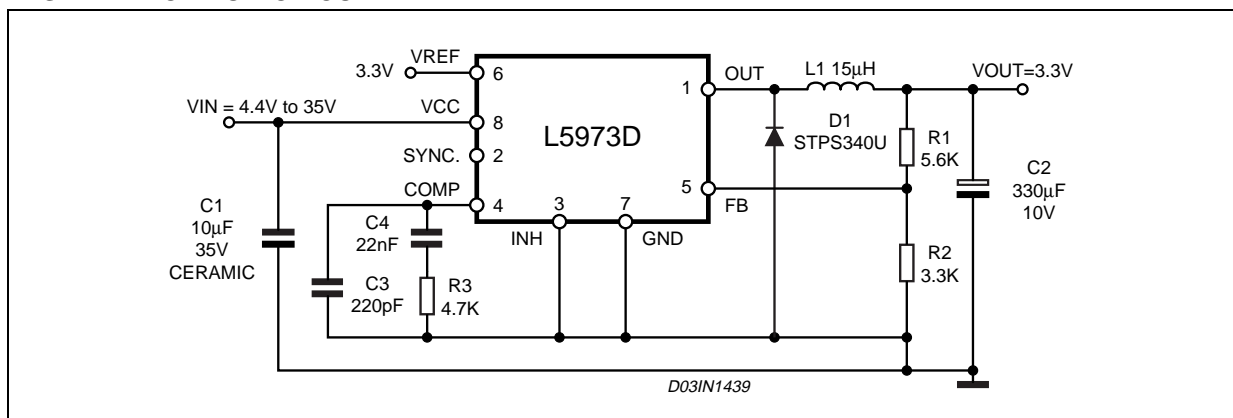
The device uses an internal P-Channel D-MOS transistor (with a typical  $R_{dson}$  of  $250\text{m}\Omega$ ) as switching element to minimize the size of the external components.

An internal oscillator fixes the switching frequency at 250KHz.

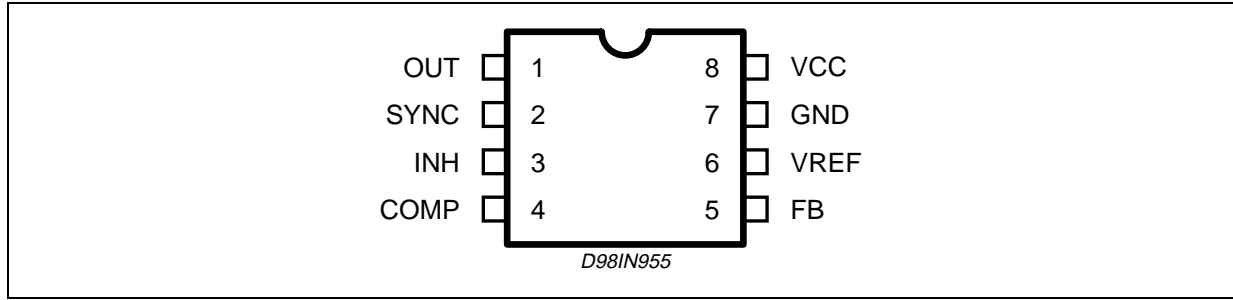
Having a minimum input voltage of 4.4V only, it is particularly suitable for 5V bus, available in all computer related applications.

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

### TEST APPLICATION CIRCUIT



**PIN CONNECTION**



**PIN DESCRIPTION**

N°	Pin	Function
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	3.3V $V_{REF}$ No cap is requested for stability.
7	GND	Ground.
8	VCC	Unregulated DC input voltage.

**THERMAL DATA**

Symbol	Parameter	Value	Unit
$R_{th(j-amb)}$	Thermal Resistance Junction to ambient	Max. 40 (*)	°C/W

(\*) Package mounted on board

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_8$	Input Voltage	40	V
$V_1$	Output DC voltage	-1 to 40	V
	Output peak voltage at $t = 0.1\mu s$	-5 to 40	V
$I_1$	Maximum output current	int. limit.	
$V_4, V_5$	Analog pins	4	V
$V_3$	INH	-0.3V to $V_{CC}$	
$V_2$	SYNC	-0.3 to 4	V
$P_{tot}$	Power dissipation at $T_{amb} \leq 60^\circ C$	2.25	W
$T_j$	Operating junction temperature range	-40 to 150	°C
$T_{stg}$	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  $125^\circ\text{C}$  (1).

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit	
$V_{CC}$	Operating input voltage range	$V_o = 1.235\text{V}; I_o = 2\text{A}$	*	4.4	36	V	
$R_{DSON}$	Mosfet on Resistance		*	0.250	0.5	$\Omega$	
$I_l$	Maximum limiting current	$V_{CC} = 4.4\text{V to } 36\text{V}$		2.5	3	3.5	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	$4.4\text{V} < V_{CC} < 36\text{V},$ $20\text{mA} < I_o < 2\text{A}$		1.220	1.235	1.25	V
			*	1.198	1.235	1.272	V
$\eta$	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
$I_{qst-by}$	Total stand-by quiescent current	$V_{inh} > 2.2\text{V}$	*		50	100	$\mu\text{A}$
		$V_{CC} = 36\text{V}; V_{inh} > 2.2\text{V}$	*		80	150	$\mu\text{A}$
<b>INHIBIT</b>							
	INH Threshold Voltage	Device ON				0.8	V
		Device OFF		2.2			V
<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
$I_{o\ source}$	Source output current	$V_{COMP} = 1.9\text{V}; V_{FB} = 1\text{V}$		200	300		$\mu\text{A}$
$I_{o\ sink}$	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	$\mu\text{A}$
	DC open loop gain	$R_L = \infty$		50	57		dB
$g_m$	Transconductance	$I_{comp} = -0.1\text{mA to } 0.1\text{mA}$ $V_{COMP} = 1.9\text{V}$			2.3		mS
<b>SYNC FUNCTION</b>							
	High Input Voltage	$V_{CC} = 4.4\text{V to } 36\text{V}$		2.5		$V_{REF}$	V
	Low Input Voltage	$V_{CC} = 4.4\text{V to } 36\text{V}$				0.74	V
	Slave Sink Current	$V_{sync} = 0.74\text{V}$ (2) $V_{sync} = 2.33\text{V}$		0.11		0.25	mA
				0.21		0.45	mA
	Master Output Amplitude	$I_{source} = 3\text{mA}$		2.75	3		V
	Output Pulse Width	no load, $V_{sync} = 1.65\text{V}$		0.20	0.35		$\mu\text{s}$
<b>REFERENCE SECTION</b>							
	Reference Voltage			3.234	3.3	3.366	V
		$I_{REF} = 0$ to $5\text{mA}$ $V_{CC} = 4.4\text{V to } 36\text{V}$	*	3.2	3.3	3.399	V
	Line Regulation	$I_{REF} = 0\text{mA}$ $V_{CC} = 4.4\text{V to } 36\text{V}$			5	10	mV
	Load Regulation	$I_{REF} = 0$ to $5\text{mA}$			8	15	mV
	Short Circuit Current			10	18	30	mA

Notes: 1. Specification over the  $-40$  to  $+125$   $T_j$  Temperature range are assured by design, characterization and statistical correlation.

2. Guaranteed by design.

Figure 1. Line Regulation

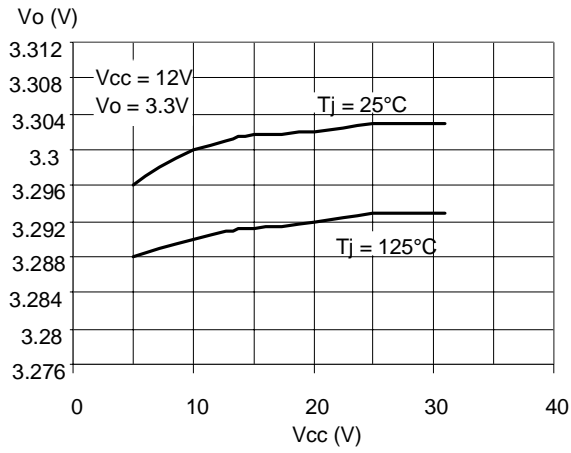


Figure 2. Output Voltage vs. Junction Temperature

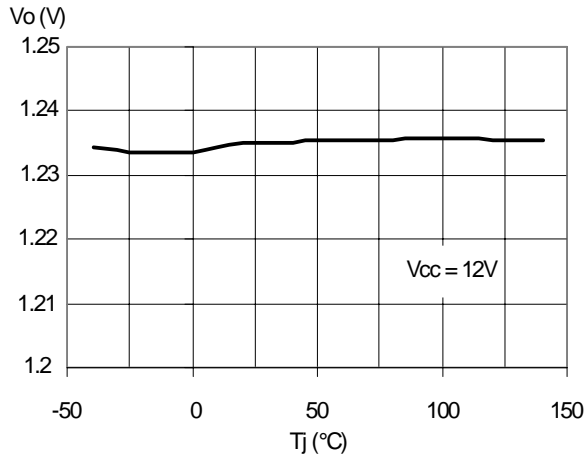


Figure 3. Quiescent Current vs. Junction Temperature

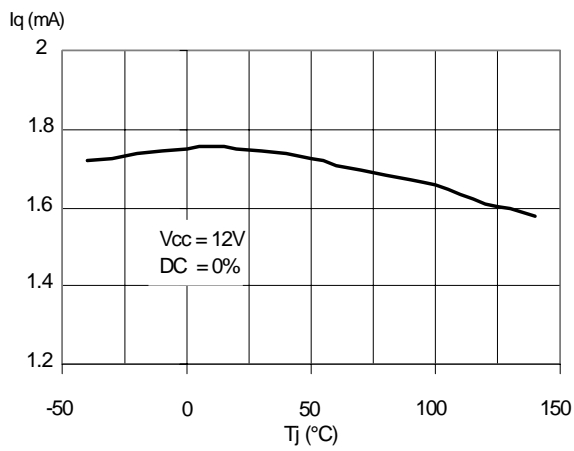


Figure 4. Shutdown Current vs. Junction Temperature

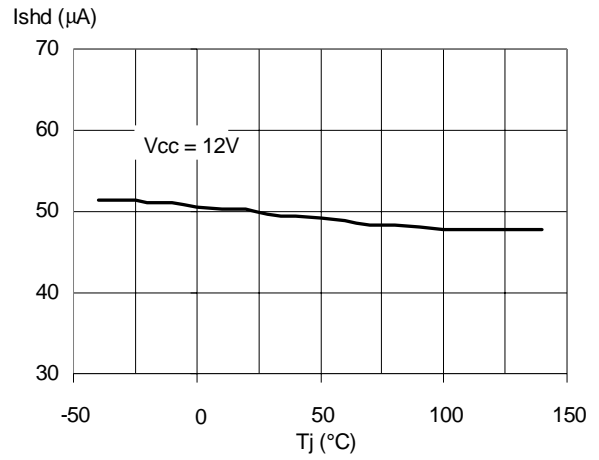
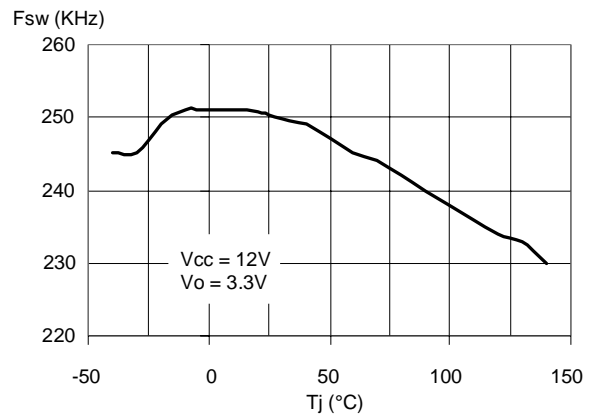


Figure 5. Switching Frequency vs. Junction Temperature



## APPLICATION CIRCUIT

In figure 6 is shown the demo board application circuit, 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 6. Demo board Application Circuit

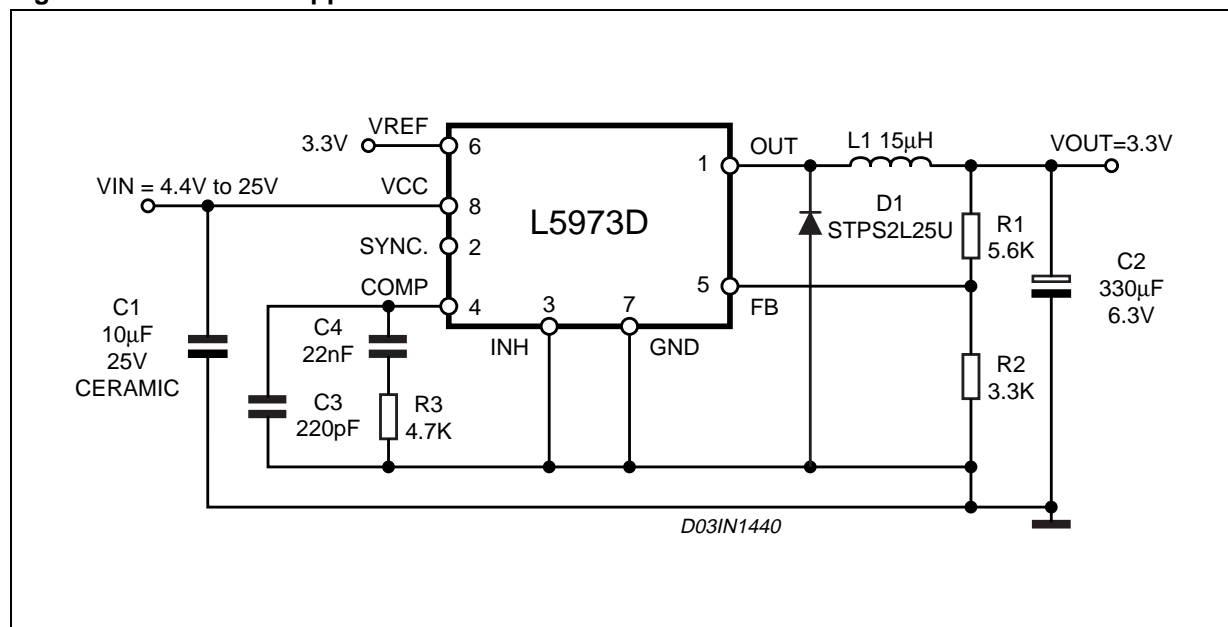


Table 1. Component List

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

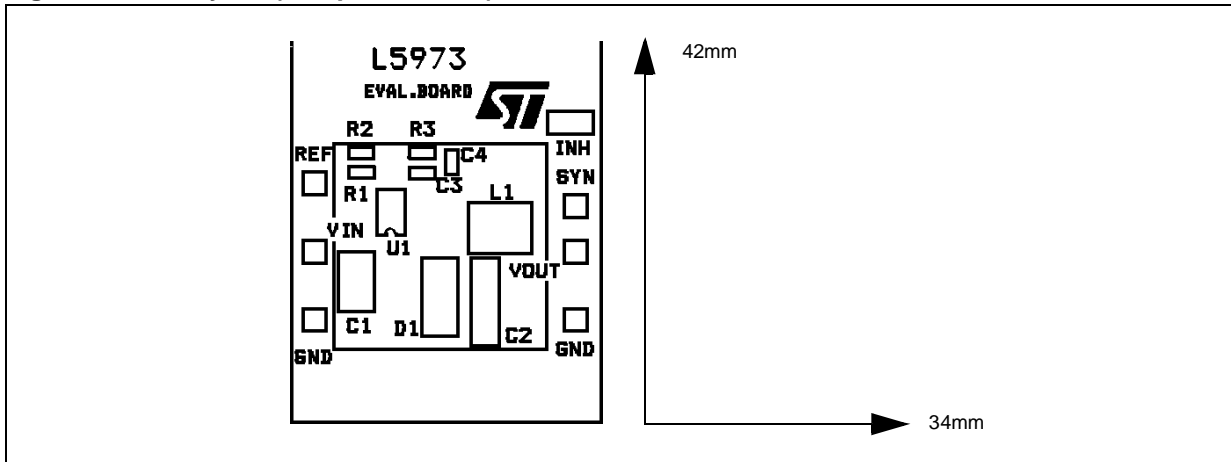


Figure 8. PCB layout (bottom side)

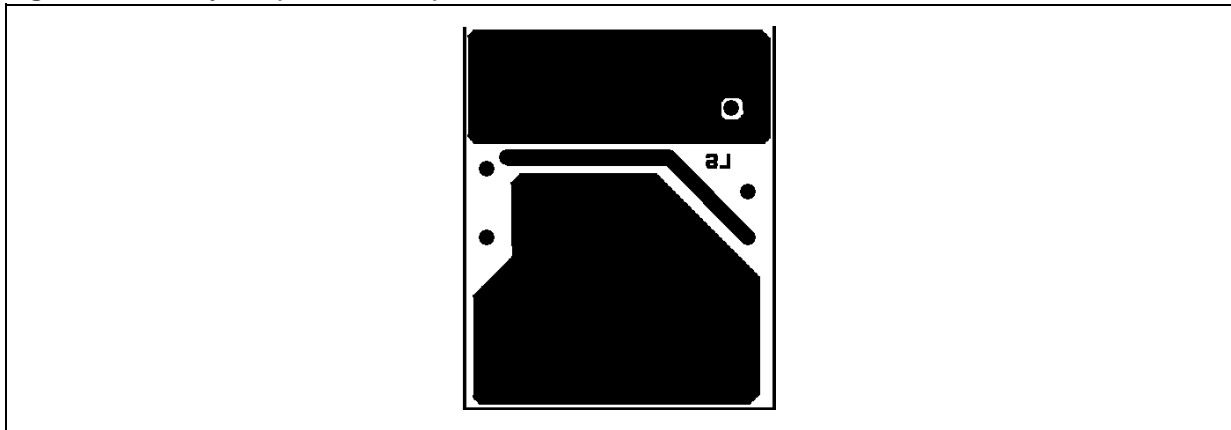
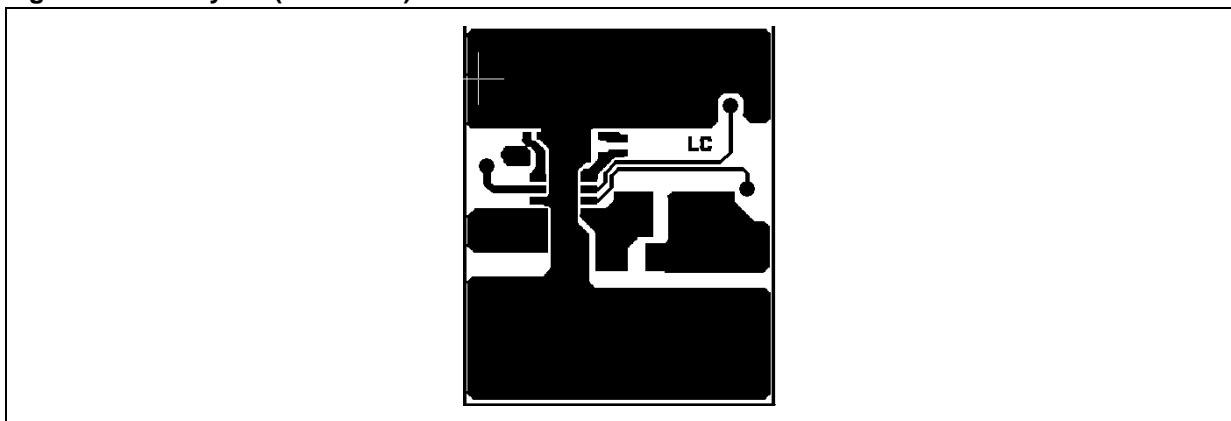
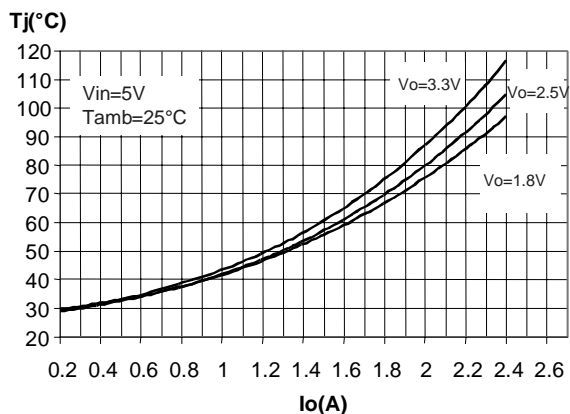


Figure 9. PCB layout (front side)

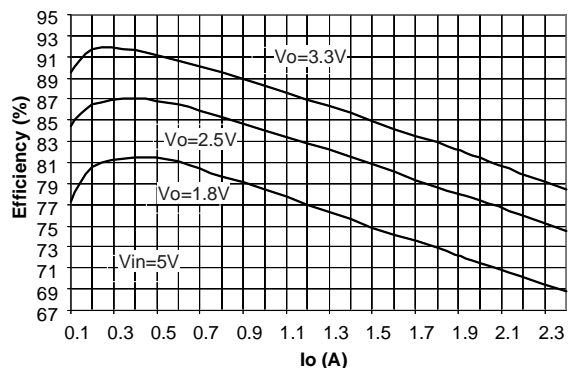


Below some graphs show the  $T_j$  versus output current in different conditions of the input and output voltage and some efficiency measurements.

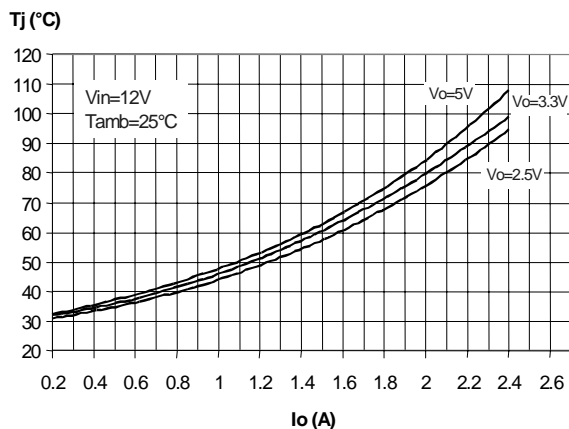
**Figure 10. Junction Temperature vs. Output Current**



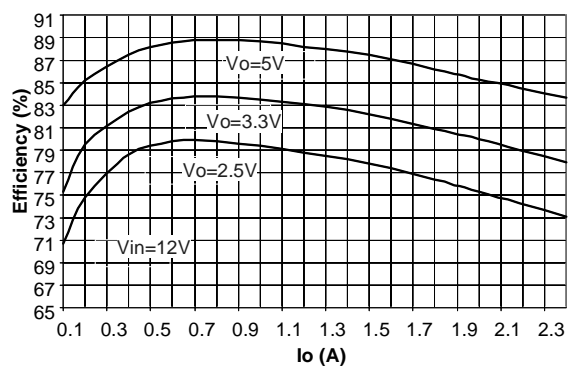
**Figure 12. Efficiency vs. Output Current**



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



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



APPLICATION IDEAS

Figure 14. Positive Buck-Boost regulator

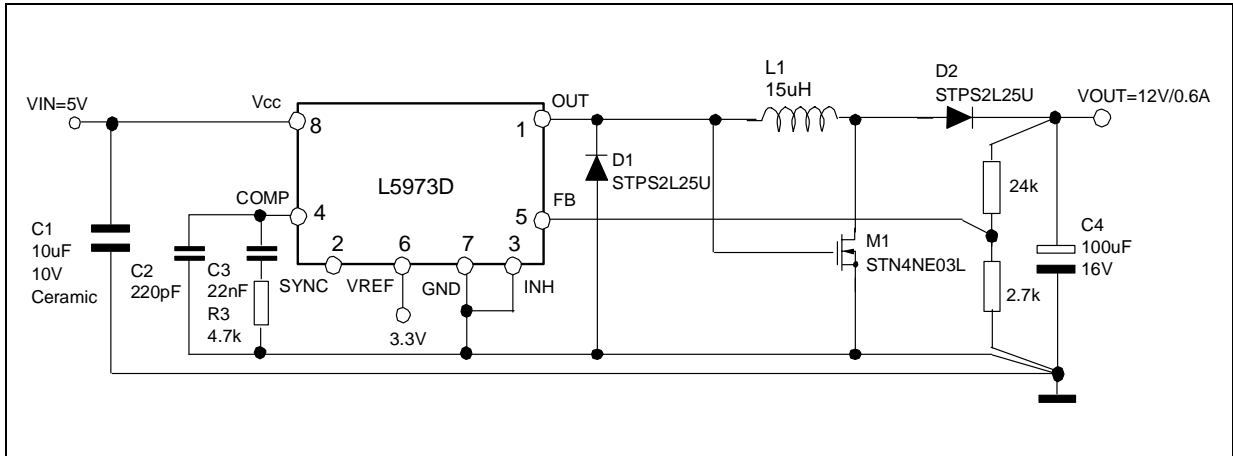


Figure 15. Buck-Boost regulator

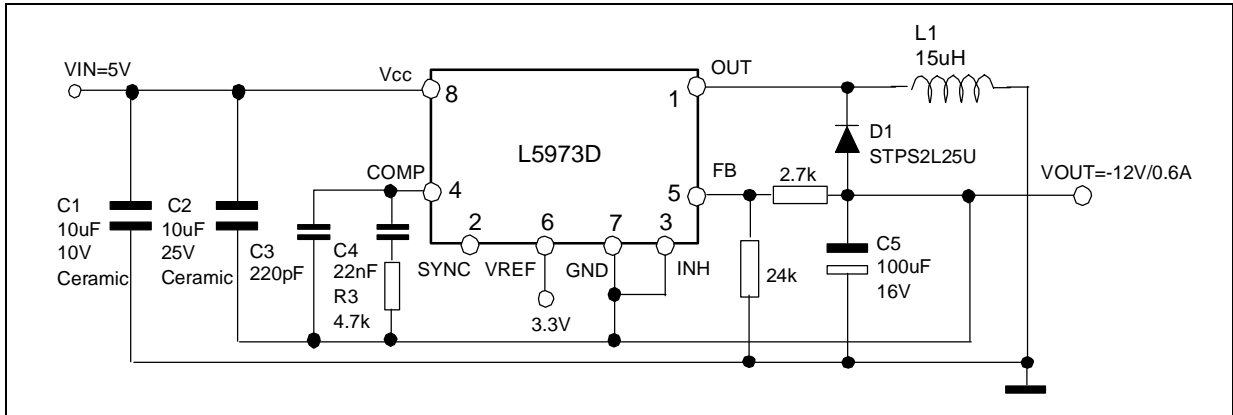
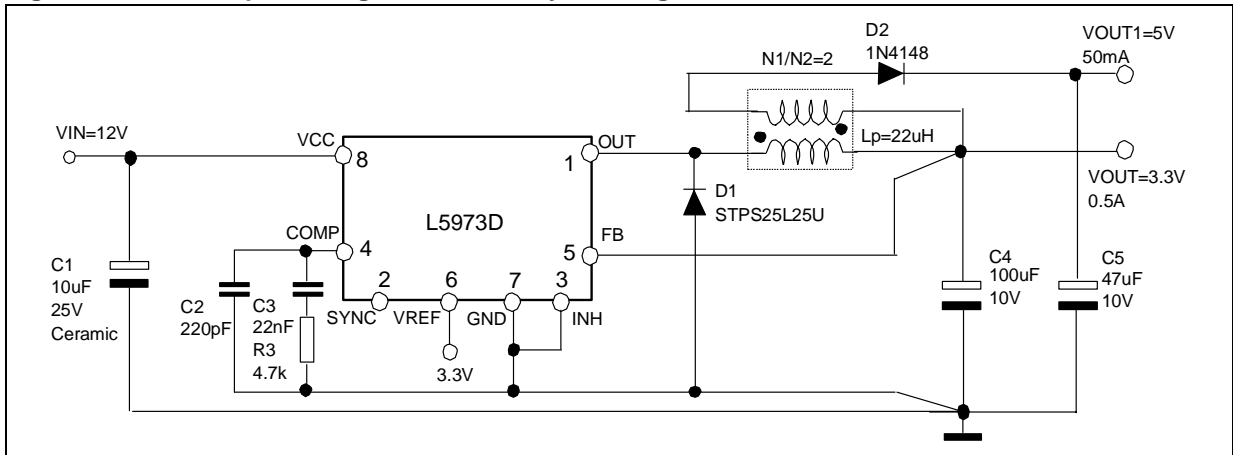


Figure 16. Dual output voltage with auxiliary winding

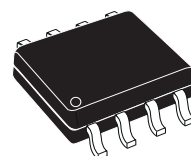




DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	1.350		1.750	0.531		0.069
A1	0.100		0.250	0.004		0.010
A2	1.100		1.650	0.043		0.065
B	0.330		0.510	0.013		0.020
C	0.190		0.250	0.07		0.010
D	4.800		5.000	0.189		0.197
E	3.800		4.000	0.150		0.157
e		1.270			0.05	
H	5.800		6.200	0.228		0.244
h	0.250		0.500	0.010		0.020
L	0.400		1.270	0.016		0.05
k	0° (min), 8° (max)					
ddd			0.100			0.010

(1) Dimension D does not include mold flash, protusions or gate burrs shall not exceed 0.15mm (both side).

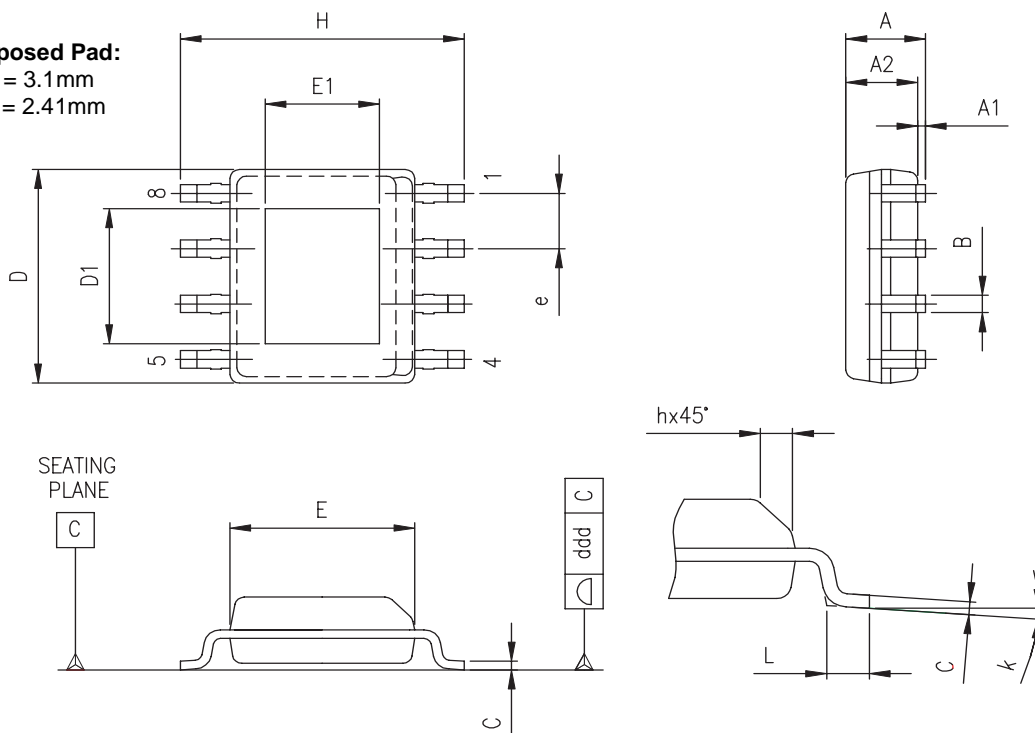
## OUTLINE AND MECHANICAL DATA



## HSOP8 (Exposed Pad)

### Exposed Pad:

D1 = 3.1mm  
E1 = 2.41mm



7195016

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