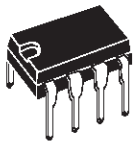
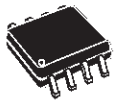
L5970

1A STEP DOWN SWITCHING REGULATOR

- UP TO 1A STEP DOWN CONVERTER
- OPERATING INPUT VOLTAGE FROM 4.4V TO 36V
- PRECISE 3.3V (±2%) REFERENCE VOLTAGE
- OUTPUT VOLTAGE ADJUSTABLE FROM 0 TO 35V
- 250KHz INTERNALLY FIXED FREQUENCY
- VOLTAGE FEEDFORWARD
- ZERO LOAD CURRENT OPERATION
- INTERNAL CURRENT LIMITING
- INHIBIT FOR ZERO CURRENT CONSUMPTION
- SINCHRONIZATION
- PROTECTION AGAINST FEEDBACK DISCONNECTION
- THERMAL SHUTDOWN





Minidip **SO8**

ORDERING NUMBER:

L5970N L5970D

APPLICATIONS:

- SIMPLE, SMALLER & EFFICIENT STEP-DOWN CONVERTERS
- BATTERY EQUIPPED SYSTEMS
- DISTRIBUTED POWER SUPPLY
- MOBILE PC & SUBNOTEBOOK

DESCRIPTION

The L5970 is a step down monolithic power switching regulator capable to deliver up to 1A at output voltages from 0V to 35V.

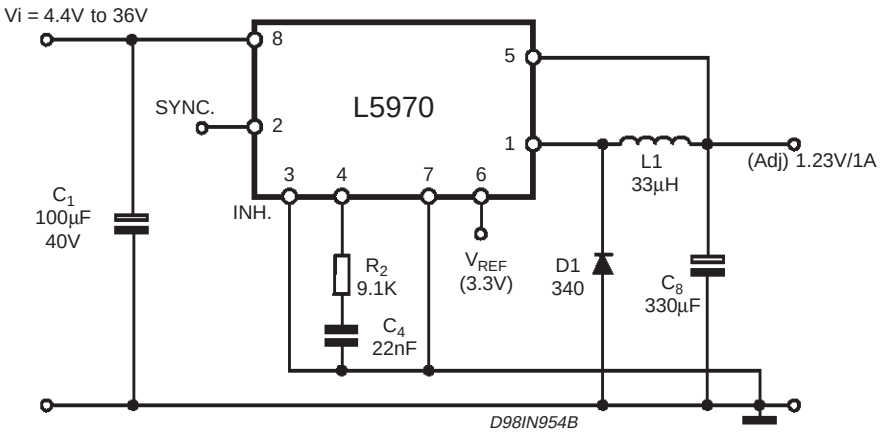
Realised in BCD mixed technology, the device uses an internal P-Chanel D-MOS transistor (with a typical Rdson of only 250mΩ) to obtain high efficiency beside an excellent overall electrical performances.

An internal oscillator fixes the switching frequency at 250KHz (no external component is needed), guarantying a best compromise between high efficiency and passive component size (output LC filter).

Synchronisation pin (master/slave) is available in the case higher frequency up to 500Khz are requested.

Working from input voltage of 4.4V only, it is particular suitable for portable equipment (battery

TEST APPLICATION CIRCUIT



DESCRIPTION (continued)

powered) and distributed power supply (fully compatible with 5V bus).

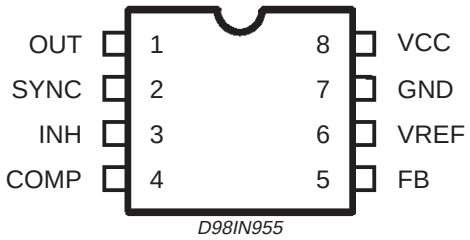
A trimmed bandgap reference voltage assures with an excellent and fast transient response time very high output voltages precision +/- 3% on the nominal value over line, load and temperature.

Pulse by pulse current limit with the internal frequency modulation prevents output overshoot during start-up phase and offers an effective short circuit protection.

Other functions as voltage feed forward, protection against feedback loop disconnection, inhibit with zero current consumption and thermal shutdown complete the added on chip features.

Versatile device and robust design make it an excellent solution for a wide range and noise-sensitive application. The possibility to have the device in smd 8 pin package (with few small surface mount external components) allows to built a ultra compact DC-DC converters with a minimum board space.

PINS CONNECTION (MINIDIP/SO8)



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PINS FUNCTION

N.	Name	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 to be used for frequency compensation.
5	FB	Stepdown 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	V_{REF}	3.3V V_{REF}. No cap is need for stability.
7	GND	Ground.
8	V_{CC}	Unregulated DC input voltage.

THERMAL DATA

Symbol	Parameter		Minidip	SO8	Unit
$R_{th\ (j\text{-}amb)}$	Thermal Resistance Junction to ambient	Max.	90 (*)	120 (*)	°C/W

(*) Package mounted on board

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_8	Input Voltage		40	V
V_1	Output DC voltage Output peak voltage at t = 0.1µs		-1 to 40 -5 to 40	V 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 $T_{amb} \leq 60°C$	**Minidip** **SO8**	1 0.75	W W
T_j	Operating junction temperature range		-40 to 150	°C
T_{stg}	Storage temperature range		-55 to 150	°C

ELECTRICAL CHARACTERISTICS (Tj = 25°C, VCC = 12V, unless otherwise specified.)
(*) Specification Referred to T_j from 0 to 125°C.

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
V_{CC}	Operating input voltage range	V_o = 1.235V; I_o = 1A	*	4.4		36	V
V_d	Dropout voltage	V_{CC} = 4.4V; I_o = 1A	*		0.25	0.5	V
I_l	Maximum limiting current	V_{CC} = 4.4V to 36V	*	1.5	1.87	2.25	A
f_s	Switching frequency		*	212	250	280	KHz
				225	250	275	KHz
	Duty cycle			0		100	%
DYNAMIC CHARACTERISTICS (see test circuit fig. xx note 1).							
V_5	Voltage feedback	4.4V < V_{CC} < 36V, 20mA < I_O < 1A		1.220	1.235	1.25	V
			*	1.198	1.235	1.272	V
η	Efficiency	V_O = 5V, V_{CC} = 12V			90		%
DC CHARACTERISTICS							
I_{qop}	Total operating quiescent current		*		3	5	mA
I_q	Quiescent current	Duty Cycle = 0; VFB = 1.5V				2.5	mA
$I_{qst\text{-}by}$	Total stand-by quiescent current	V_{inh} > 2.2V V_{CC} = 36V; V_{inh} > 2.2V	* *		50 80	100 150	µA µA
INHIBIT							
	INH Threshold voltage	Device ON				0.8	V
		Device OFF		2.2			V

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
ERROR AMPLIFIER							
V_{OH}	High level output voltage	VFB = 1V		3.5			V
V_{OL}	Low level output voltage	VFB = 1.5V				0.4	V
$I_{o\ source}$	Source output current	V_{COMP} = 1.9V; V_{FB} = 1V		200	300		µA
$I_{o\ sink}$	Sink output current	Vcomp = 1.9V; V_{FB} = 1.5V		1	1.5		mA
I_b	Source bias current				2.5	4	µA
	DC open loop gain	$R_L = \infty$		50	57		dB
gm	Transconductance	I_{comp} = -0.1mA to 0.1mA V_{comp} = 1.9V			2.3		mS
SYNC FUNCTION							
	High Input Voltage	V_{CC} = 4.4V to 36V		2.5		V_{REF}	V
	Low Input Voltage	V_{CC} = 4.4V to 36V				0.74	V
	Slave Sink Current	V_{sync} = 0.74V V_{sync} = 2.33V		0.11 0.21		0.25 0.45	mA mA
	Master Output Amplitude	I_{source} = 3mA		2.75	3		V
	Output Pulse Width	no load, V_{sync} = 1.65V		0.20	0.35		µs
REFERENCE SECTION							
	Reference Voltage			3.234	3.3	3.366	V
		I_{REF} = 0 to 5mA V_{CC} = 4.4V to 36V	*	3.2	3.3	3.399	V
	Line Regulation	I_{REF} = 0mA V_{CC} = 4.4V to 36V			5	10	mV
	Load Regulation	I_{REF} = 0 to 5mA			8	15	mV
	Short Circuit Current			10	8	30	mA

Figure 1. Efficiency vs. Output Current

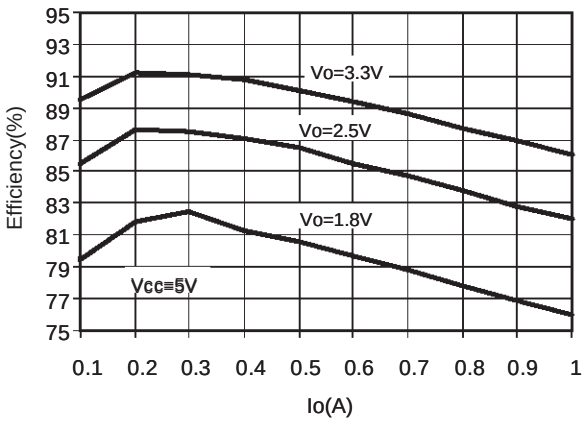


Figure 2. Efficiency vs. Output Current

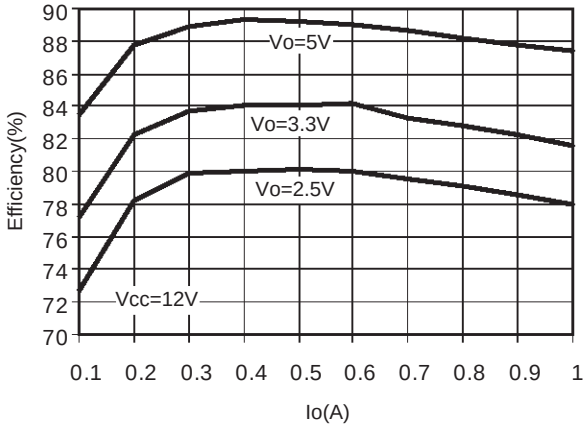


Figure 3. Junction Temperature vs. Output Current (Minidip) *)

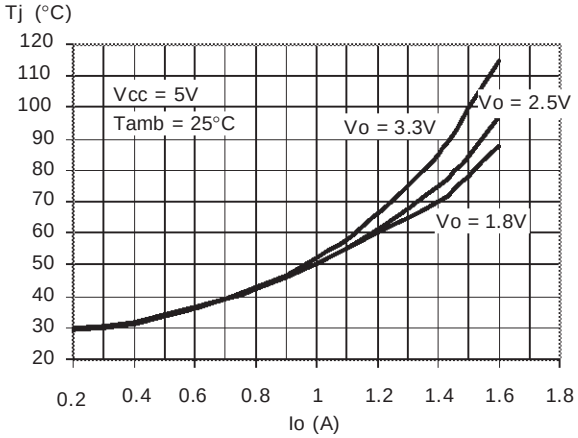


Figure 4. Junction Temperature vs. Output Current (Minidip) *)

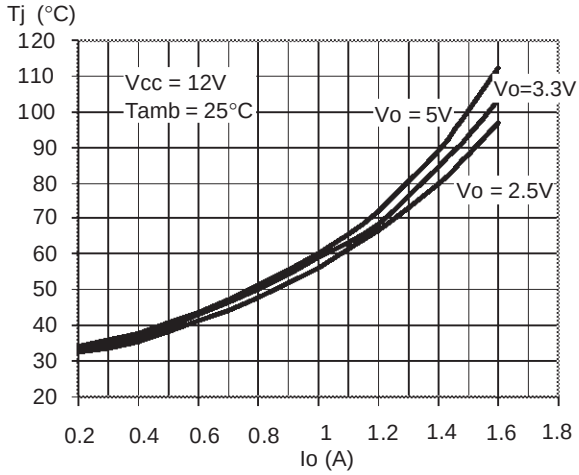


Figure 5. Junction Temperature vs. Output Current (Minidip) *)

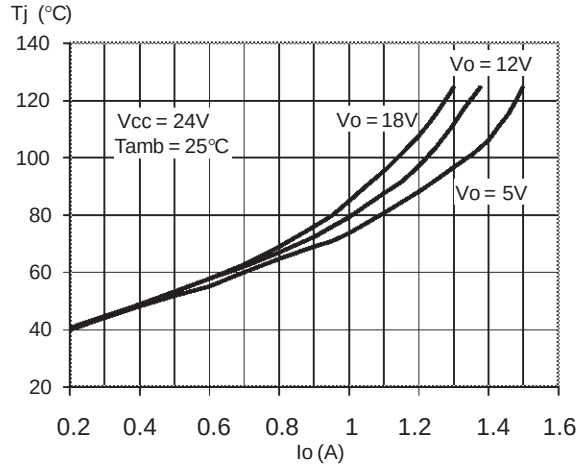


Figure 6. Junction Temperature vs. Output Current (SO8) *)

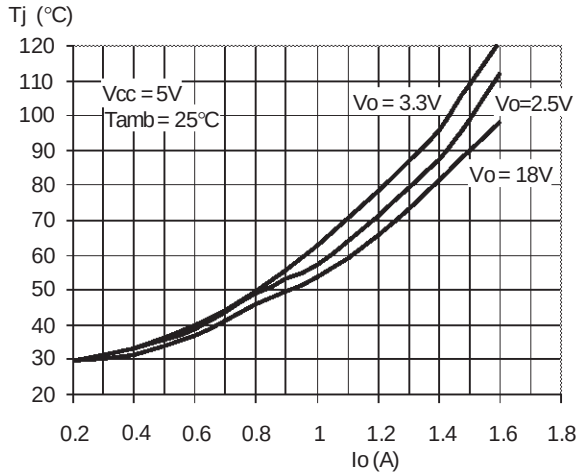


Figure 7. Junction Temperature vs. Output Current (SO8) *)

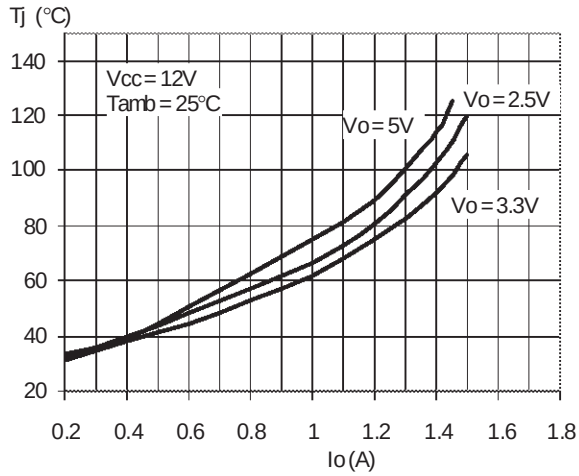
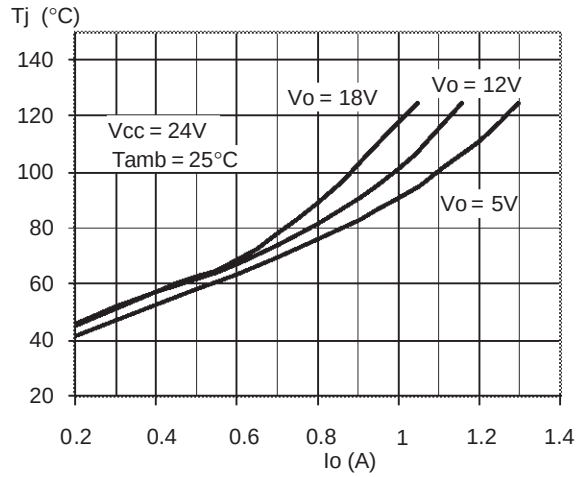


Figure 8. Junction Temperature vs. Output Current (SO8) *)



*) Package mounted on demoboard

Figure 9. Load Regulation

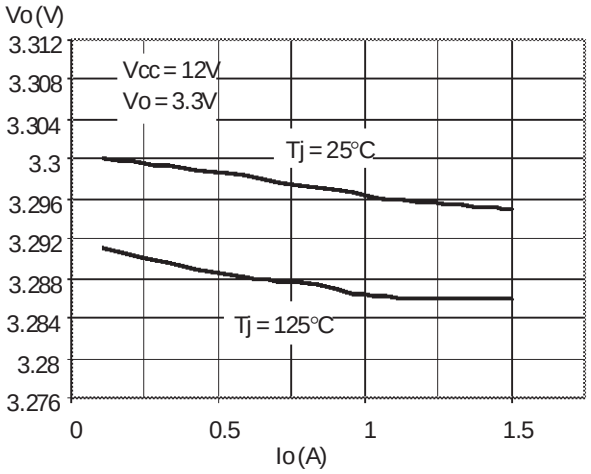


Figure 10. Line Regulation

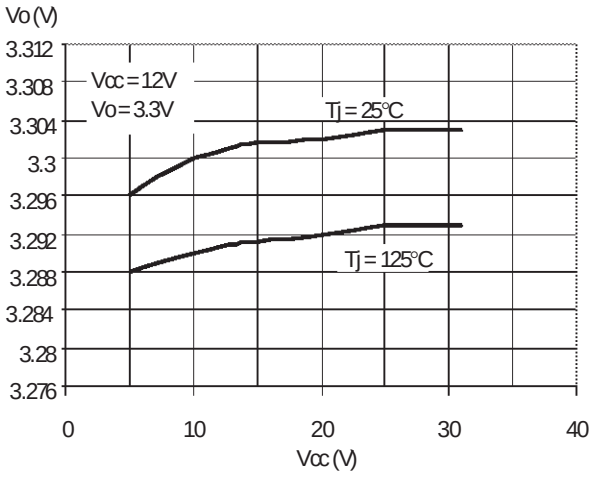


Figure 11. Output Voltage vs. Junction Temperature

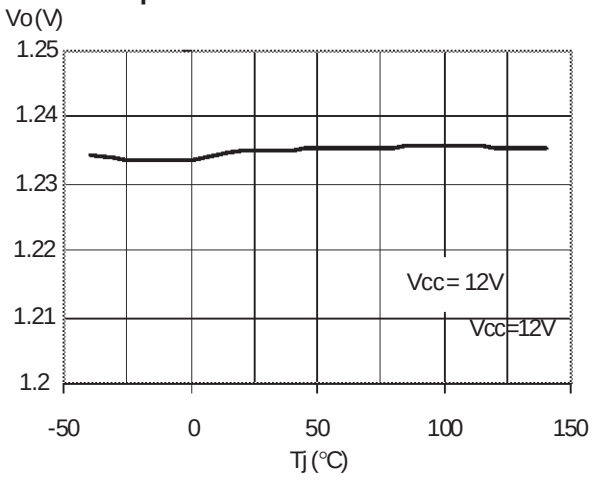


Figure 12. Quiescent Current vs. Junction Temperature

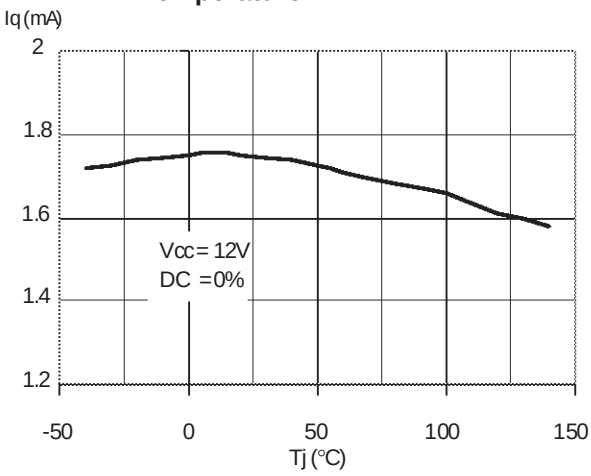


Figure 13. Shutdown Current vs.Junction Temperature

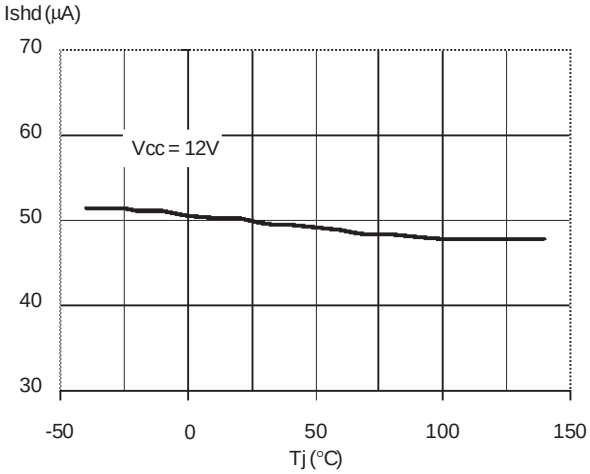
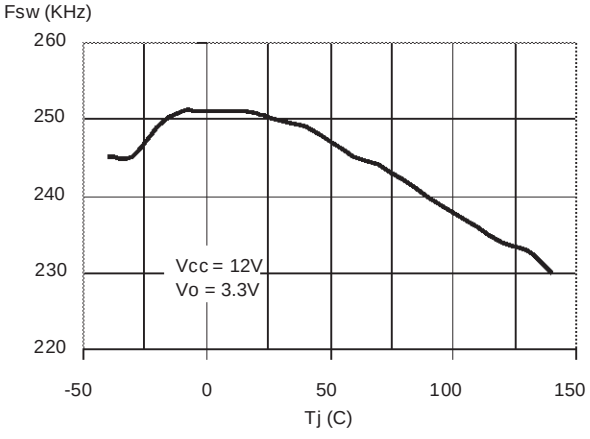


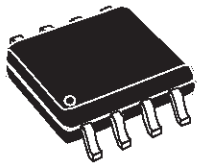
Figure 14. Switching Frequency vs.Junction Temperature



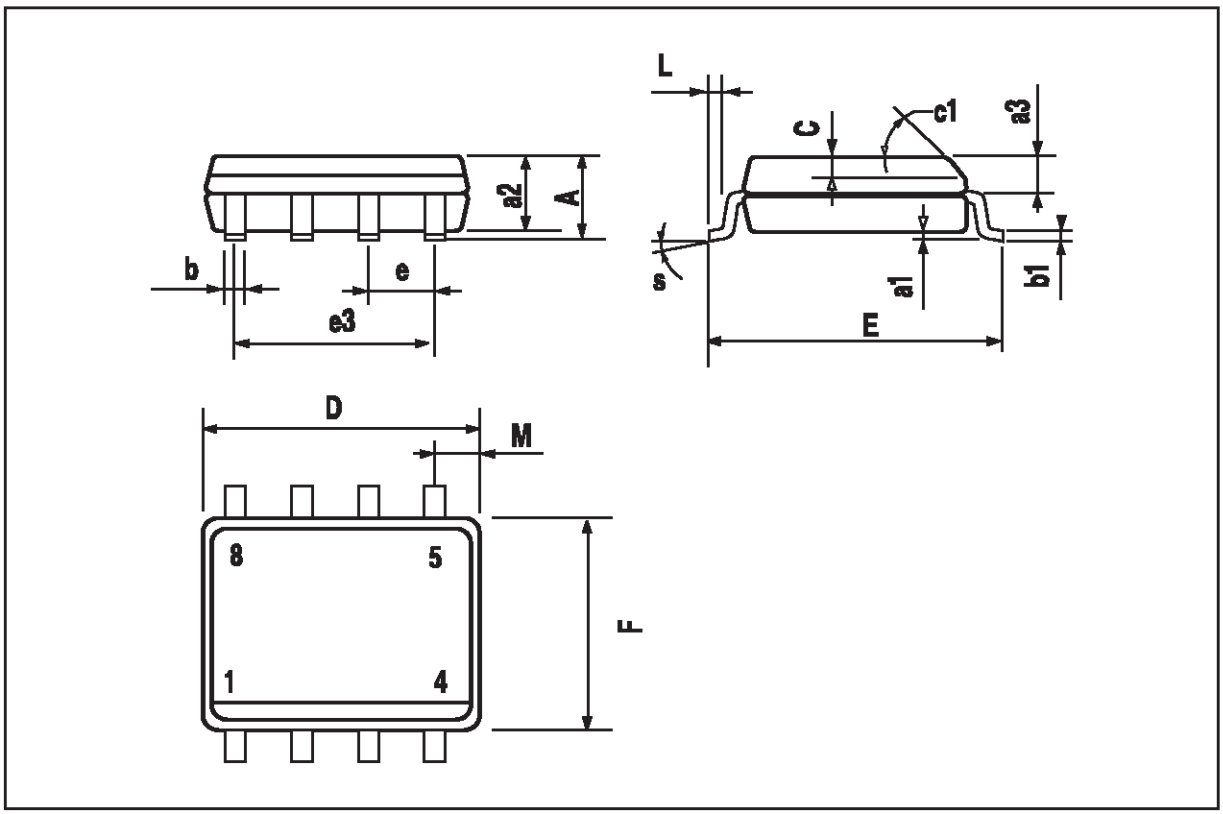
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D (1)	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
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 potrusions shall not exceed 0.15mm (.006inch).

OUTLINE AND MECHANICAL DATA

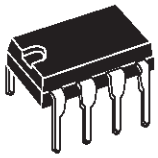


SO8



DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
I			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

OUTLINE AND MECHANICAL DATA



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