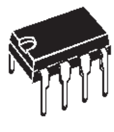
L5971

1.5A STEP DOWN SWITCHING REGULATOR

- UP TO 1.5A STEP DOWN CONVERTER
- OPERATING INPUT VOLTAGE FROM 6.5V TO 28V
- PRECISE 1.26V (±1%) INTERNAL REFERENCE VOLTAGE
- OUTPUT VOLTAGE ADJUSTABLE FROM 1.26V TO 20V
- SWITCHING FREQUENCY ADJUSTABLE UP TO 300KHz
- VOLTAGE FEEDFORWARD
- ZERO LOAD CURRENT OPERATION
- INTERNAL CURRENT LIMITING (PULSE-BY-PULSE AND HICCUP MODE)
- INHIBIT FOR ZERO CURRENT CONSUMPTION
- PROTECTION AGAINST FEEDBACK DISCONNECTION
- THERMAL SHUTDOWN
- SOFT START FUNCTION



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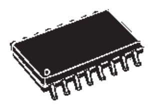


SO16W

ORDERING NUMBERS: L5971 (Minidip)
L5971D (SO16)

DESCRIPTION

The L5971 is a step down monolithic power switching regulator delivering 1.5A at a voltage between 1.26V and 20V (selected by a simple external divider). Realized in BCD mixed technology, the device uses an internal power D-MOS transistor (with a typical Rdson of 0.25Ω) to obtain very high efficency and high switching speed.

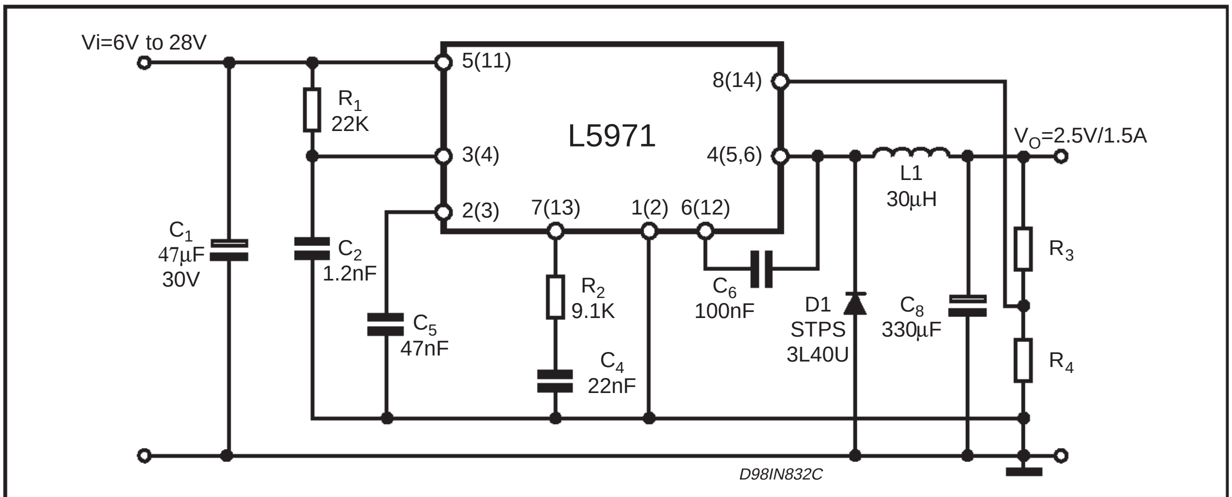
A switching frequency up to 300KHz is achievable (the maximum power dissipation of the packages must be observed).

Features of this new generations of DC-DC converter include pulse-by-pulse current limit, hiccup mode for short circuit protection, voltage feedforward regulation, soft-start, protection against feedback loop disconnection, inhibit for zero current consumption and thermal shutdown.

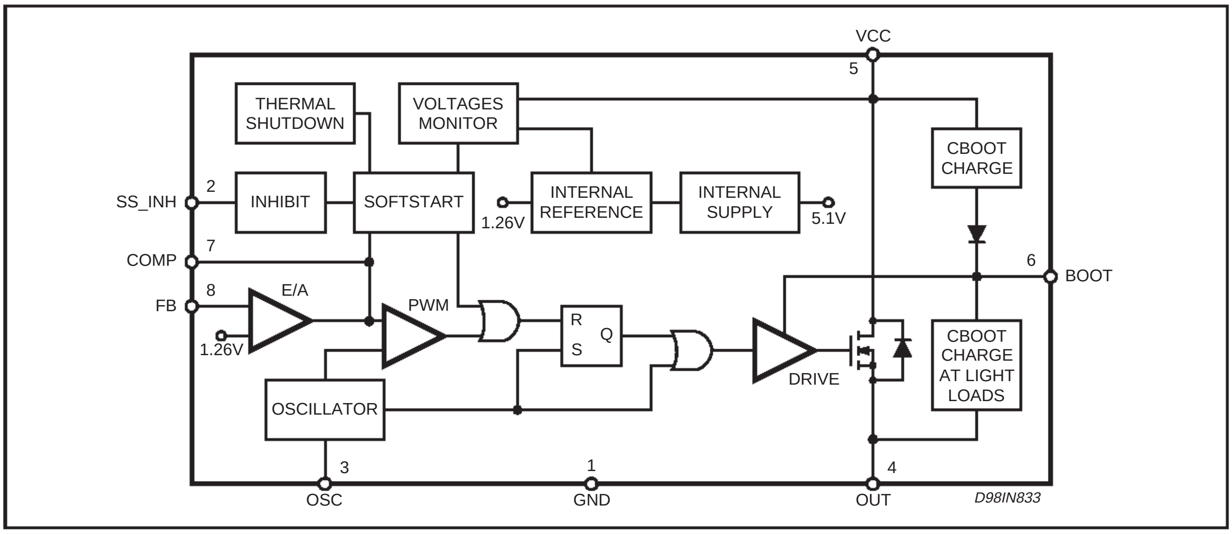
The device is available in plastic dual in line, MINIDIP 8 for standard assembly, and SO16 for SMD assembly.

Typical Applications:
- High efficiency step-down converter
- Portable computers
- Battery charger
- Distributed power
- PDAs and Mobile Comminicators

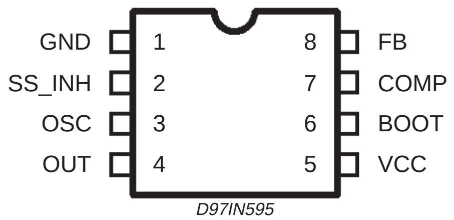
TYPICAL APPLICATION CIRCUIT



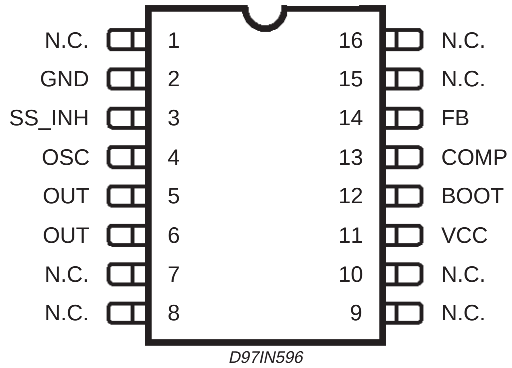
BLOCK DIAGRAM



PIN CONNECTIONS



Minidip



SO16W

PIN FUNCTIONS

DIP	SO (*)	Name	Function
1	2	GND	Ground
2	3	SS_INH	A logic signal (active low) disables the device (sleep mode operation). A capacitor connected between this pin and ground determines the soft start time. When this pin is grounded disables the device (driven by open collector/drain).
3	4	OSC	An external resistor connected between the unregulated input voltage and this pin and a capacitor connected from this pin to ground fix the switching frequency. (Line feed forward is automatically obtained)
4	5, 6	OUT	Stepdown regulator output
5	11	V_{CC}	Not regulated DC input voltage
6	12	BOOT	A capacitor connected between this pin and OUT allows to drive the internal VDMOS
7	13	COMP	E/A output to be used for frequency compensation
8	14	FB	Stepdown feedback input. Connecting directly this pin to the output 1.26V is obtained; a voltage divider is requested for higher output voltages

(*) Pins 1, 7, 8, 9, 10, 15 and 16 are not internally, electrically connected to the die.

THERMAL DATA

Symbol	Parameter		Minidip	SO16	Unit
$R_{th(j-amb)}$	Thermal Resistance Junction to ambient	Max.	90 (*)	110 (*)	°C/W

(*) Package mounted on board.

ABSOLUTE MAXIMUM RATINGS

Symbol		Parameter		Value	Unit
Minidip	S016				
V_5, V_3	V_{11}, V_4	Input voltage		30	V
V_4	V_5,V_6	Output DC voltage Output peak voltage at t = 0.1µs f=200KHz		-1 -5	V V
I_4	I_5,I_6	Maximum output current		int. limit.	
V_6-V_5	V12-V_{11}			14	V
V_6	V_{12}	Bootstrap voltage		45	V
V_7,V_2	V_{13},V_3	Analogs input voltage (V_{CC} = 12V)		10	V
V_8	V_{14}	(V_{CC} = 20V)		6 -0.3	V V
P_{tot}		Power dissipation a T_{amb} ≤ 60°C	**Minidip**	1	W
			SO16	0.8	W
T_j,T_{stg}		Junction and storage temperature		-40 to 150	°C

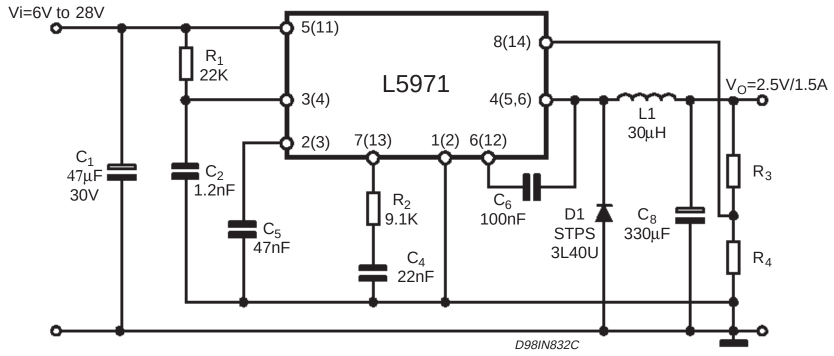
ELECTRICAL CHARACTERISTICS (Tj = 25°C, Cosc = 2.7nF, Rosc = 20kΩ, V_{CC} = 12V, unless otherwise specified.) * Specification Refered to Tj from 0 to 125°C

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
DYNAMIC CHARACTERISTIC							
V_I	Operating input voltage range		*	6.5		28	V
V_o	Output voltage	I_o = 0.5A		1.247	1.26	1.273	V
		I_o = 0.2 to 1.5A		1.235	1.26	1.285	V
		V_{cc} = 6.5 to 25V	*	1.21	1.26	1.31	V
V_d	Dropout voltage	V_{cc} = 10V; I_o = 1.5A			0.44	0.55	V
			*			0.88	V
I_l	Maximum limiting current	V_{cc} = 6.5 to 25V	*	2	2.5	3	A
	Efficiency	V_o = 3.3V; I_o = 1.5A			85		%
f_S	Switching frequency		*	90	100	110	KHz
SVRR	Supply voltage ripple rejection	V_i = V_{cc}+2V_{RMS}; V_o = V_{ref}; I_o = 1.5A; f_{ripple} = 100Hz		60			dB
	Voltage stability of switching frequency	Vcc = 6.5 to 25V			3	6	%
	Temp. stability of switching frequency	T_j = 0 to 125°C			4		%
Soft Start							
	Soft start charge current			30	40	50	µA
	Soft start discharge current			6	10	14	µA
Inhibit							
V_{LL}	Low level voltage		*			0.9	V
I_{sLL}	Isource Low level		*		5	15	µA

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
DC Characteristics							
I_{qop}	Total operating quiescent current	Pin 5 (Pin 11)			3	4.5	mA
I_q	Quiescent current	Duty Cycle = 0; V_{FB} = 1.7V			2.8	3.5	mA
$I_{qst\text{-}by}$	Total stand-by quiescent current	V_{inh} <0.9V			100	200	µA
		Vcc = 25V; V_{inh} <0.9V			150	300	µA
Error Amplifier							
V_{FB}	Voltage Feedback Input			1.247	1.26	1.273	V
R_L	Line regulation	Vcc = 6.5 to 25V			5	10	mV
	Ref. voltage stability vs temperature		*		0.4		mV/°C
V_{oH}	High level output voltage	V_{FB} = 0.8V		8.7			V
V_{oL}	Low level output voltage	V_{FB} = 1.7V				0.65	V
$I_{o\ source}$	Source output current	V_{comp} = 3V; V_{FB} = 0.8V		180	250		µA
$I_{o\ sink}$	Sink output current	V_{comp} = 3V; V_{FB} = 1.7V		200	300		µA
I_b	Source bias current				2	3	µA
SVRR E/A	Supply voltage ripple rejection	V_{comp} = V_{fb}; Vcc = 6.5 to 25V		60	80		dB
	DC open loop gain	$R_L = \infty$		50	57		dB
gm	Transconductance	I_{comp} = -0.1 to 0.1mA V_{comp} = 6V			4.3		mS
Oscillator Section							
	Ramp Valley			0.74	0.81	0.88	V
	Ramp peak	Vcc = 6.5V		1.80	1.87	1.94	V
		Vcc = 25V		4.72	4.79	4.86	V
	Maximum duty cycle			95	97		%
	Maximum Frequency	Duty Cycle = 0% R_{osc} = 13kΩ, C_{osc} = 820pF				300	kHz

Figure 1. Test and valutation board circuit.



V_O (V)	R3 (KΩ)	R4 (KΩ)
1.8	1	2
1.5	0.5	2
2.5	2	2
3.3	8.2	4.7
5.1	12	3.6
12	27	3
15	23	2

Figure 2. PCB and component layout of the figure 1.

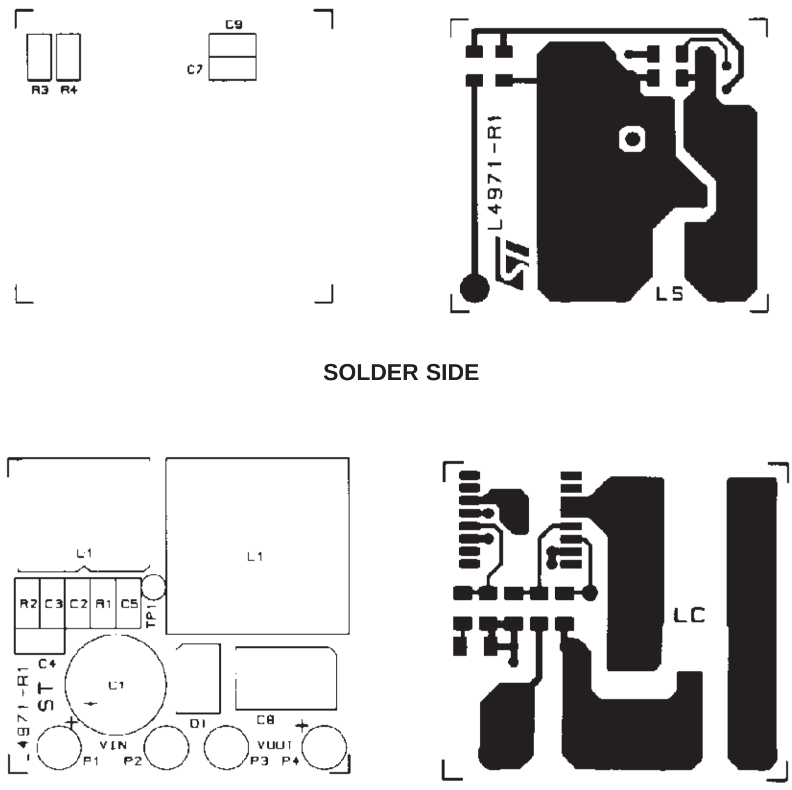


Figure 3. Quiescent drain current vs. input voltage.

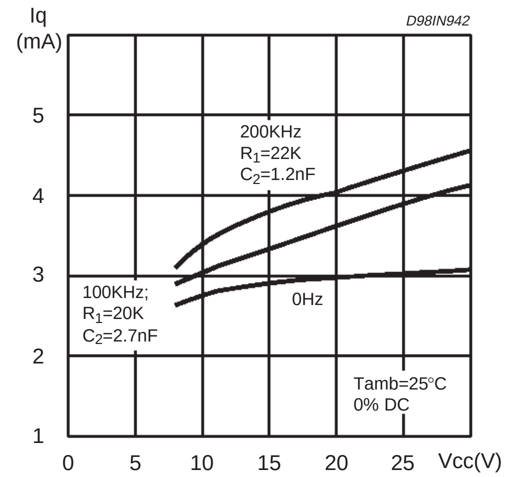


Figure 4. Quiescent current vs. junction temperature

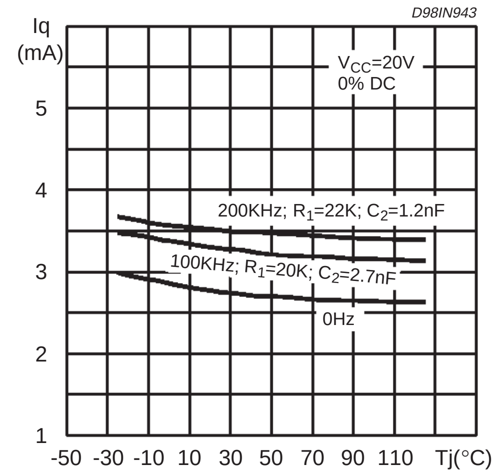


Figure 5. Stand-by drain current vs. input voltage

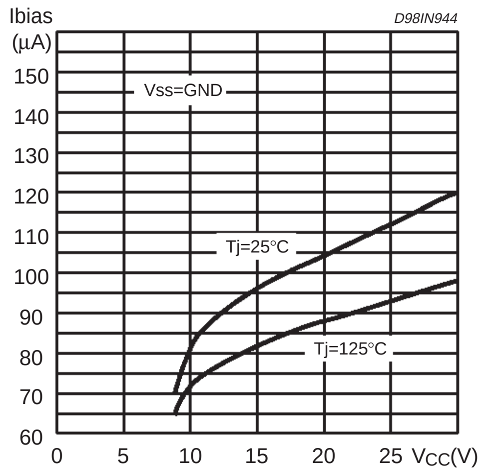


Figure 6. Line Regulation

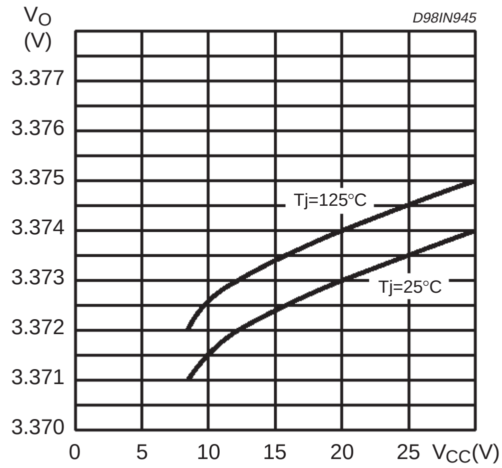


Figure 7. Switching frquency vs. R1 and C2

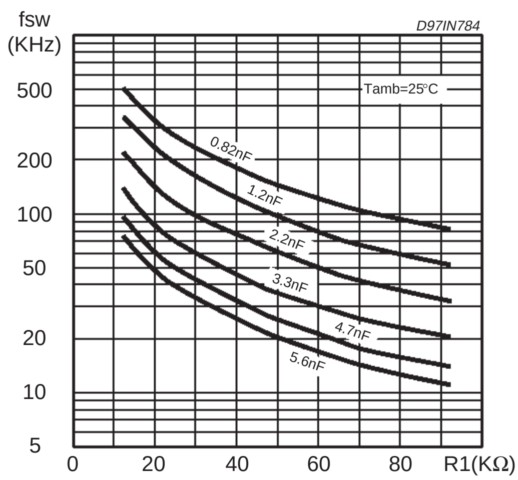


Figure 8. Switching Frequency vs. input voltage.

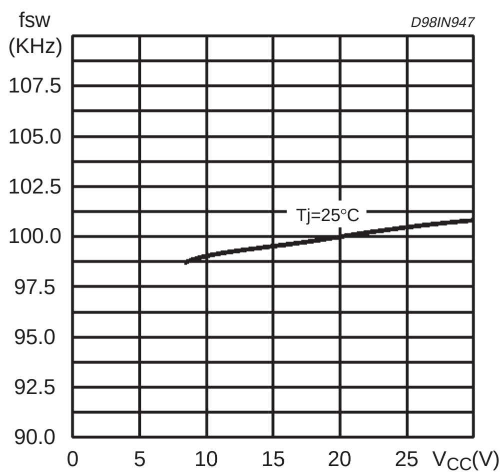


Figure 9. Switching frequency vs. junction temperature.

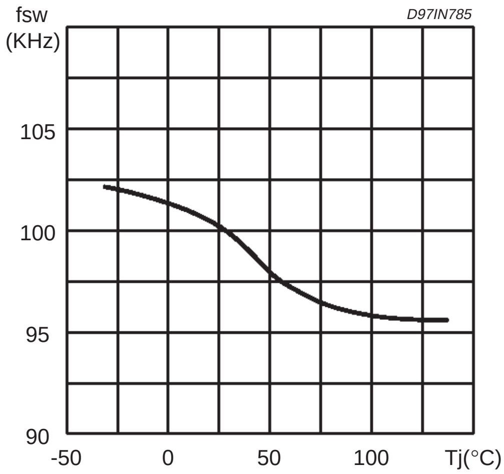


Figure 10. Dropout voltage between pin 5 and 4.

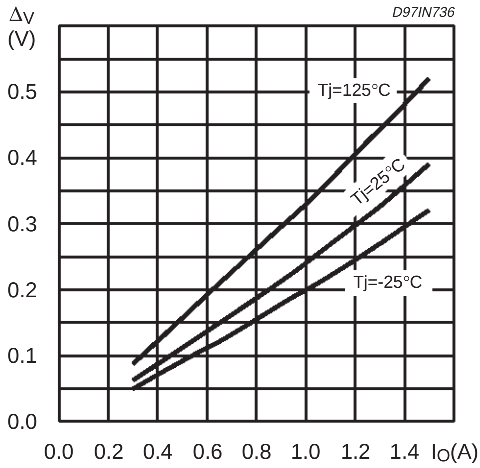


Figure 11. Efficiency vs output voltage.

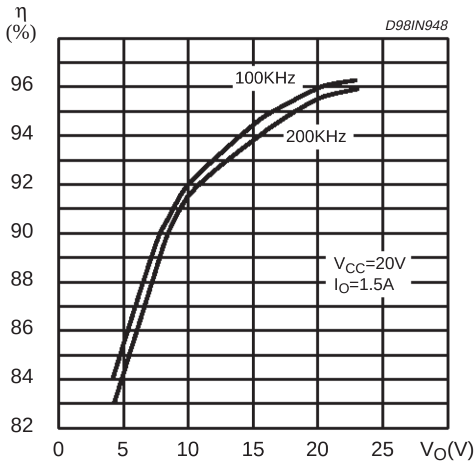


Figure 12. Efficiency vs. output current.

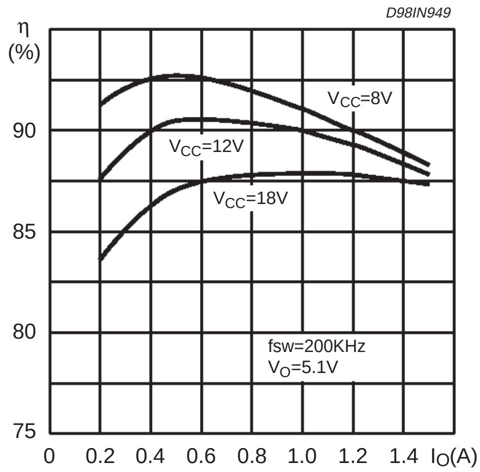


Figure 13. Efficiency vs output current.

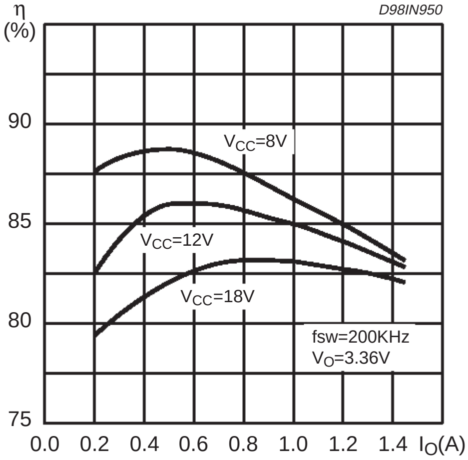


Figure 14. Efficiency vs. output current.

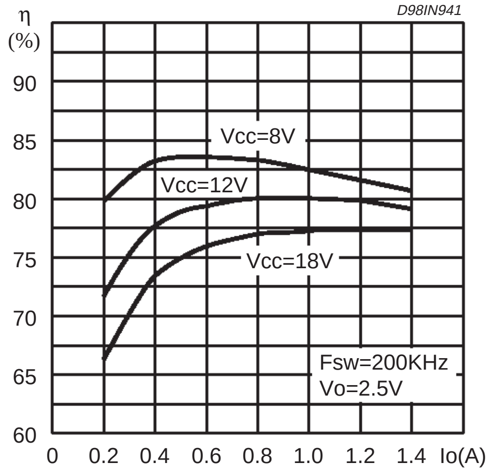


Figure 15. Load transient.

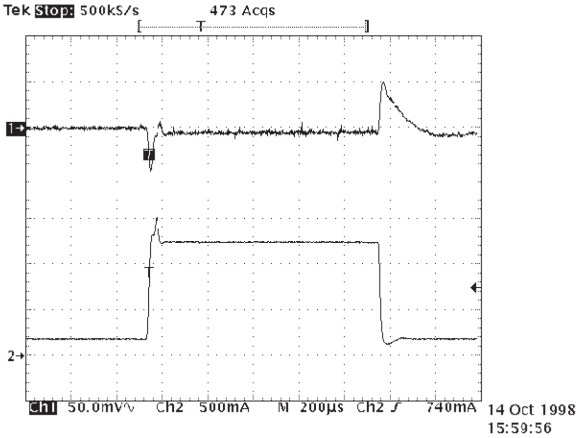


Figure 16. Soft start capacitor selection vs. Inductor and V_{ccmax}

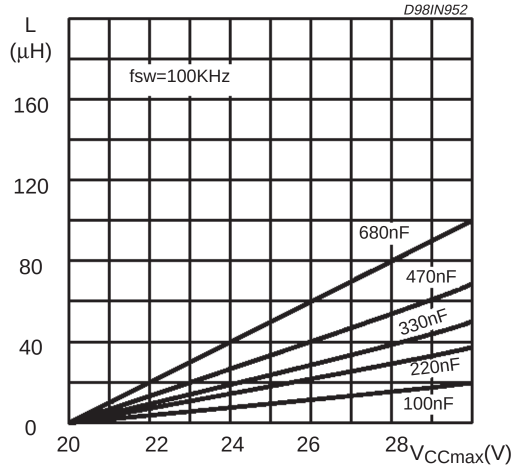


Figure 17. Soft start capacitor selection vs. Inductor and V_{ccmax}

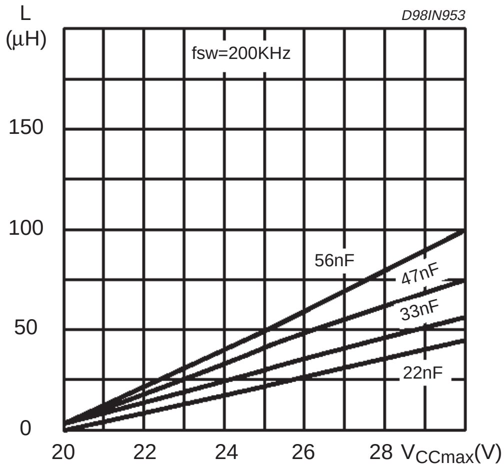
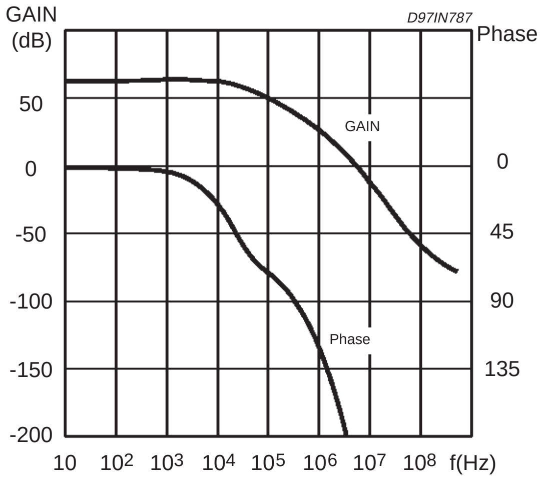
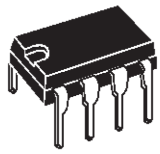


Figure 18. Open loop frequency and phase of error amplifier.



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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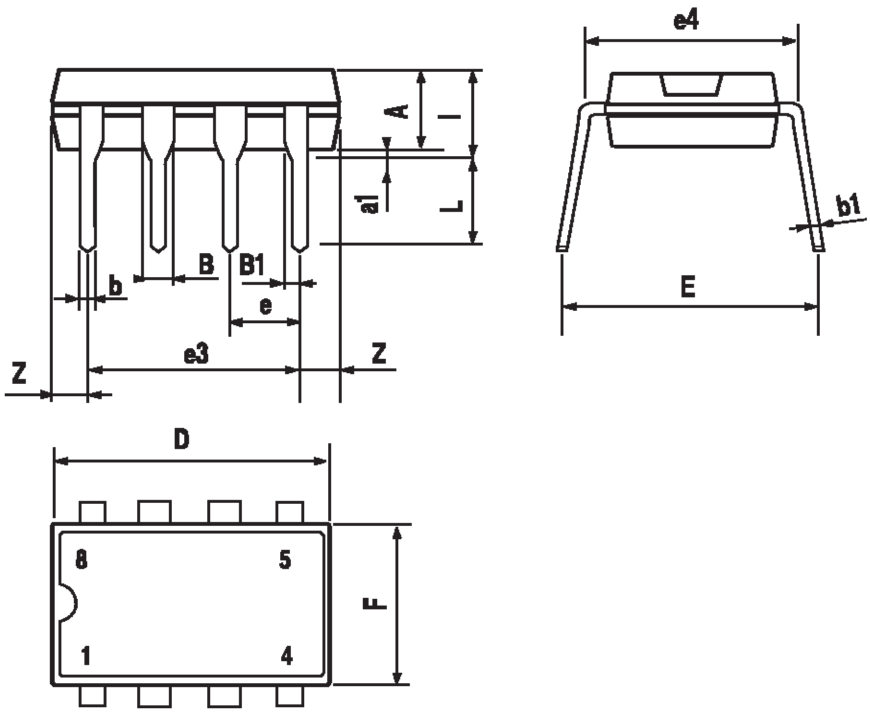
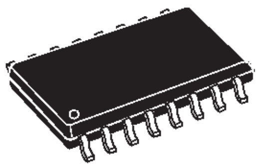


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	10.1		10.5	0.398		0.413
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0° (min.)8° (max.)					

OUTLINE AND MECHANICAL DATA



SO16 Wide